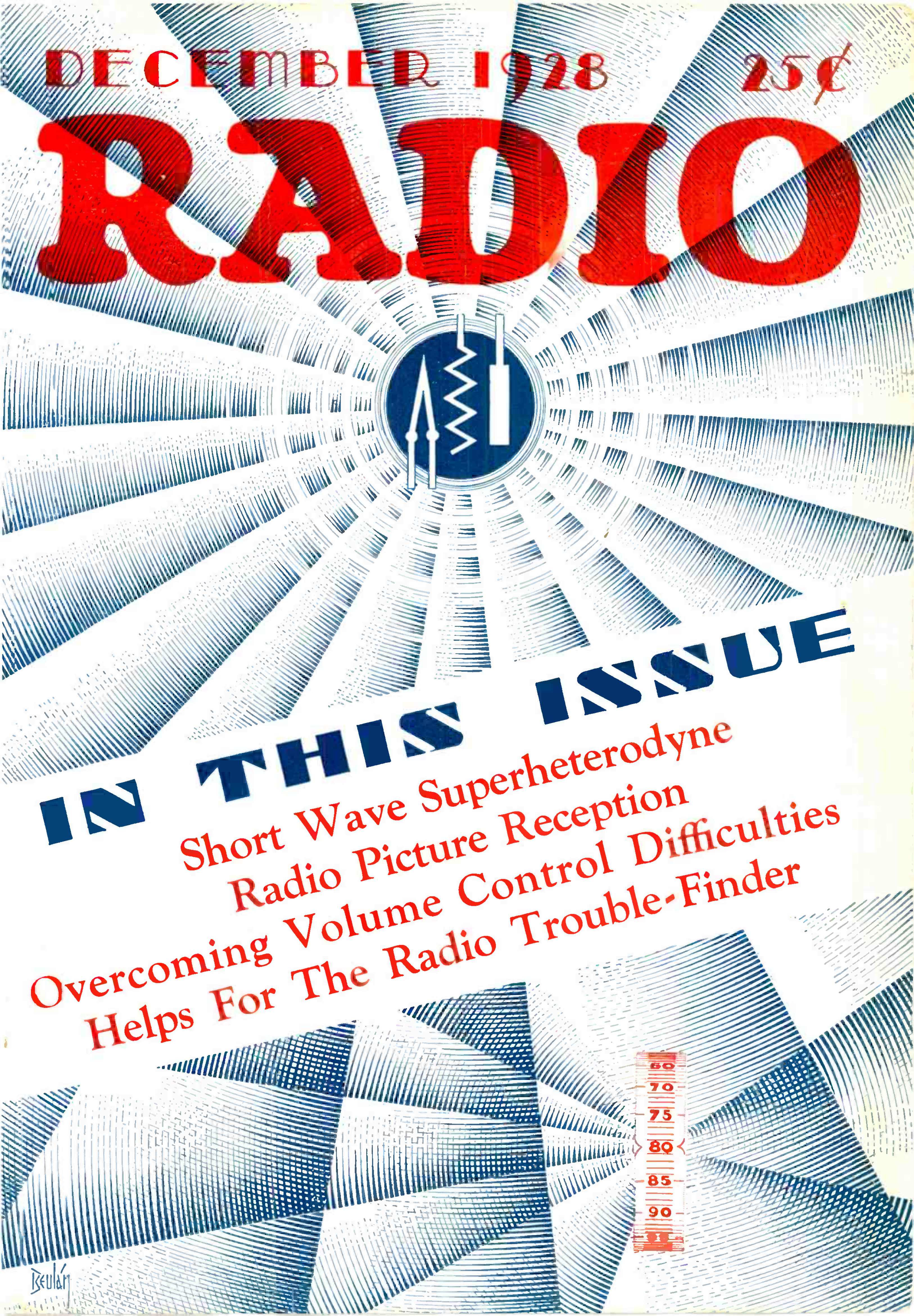
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RADIO
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Radio Picture Reception
Overcoming Volume Control Difficulties
Helps For The Radio Trouble-Finder
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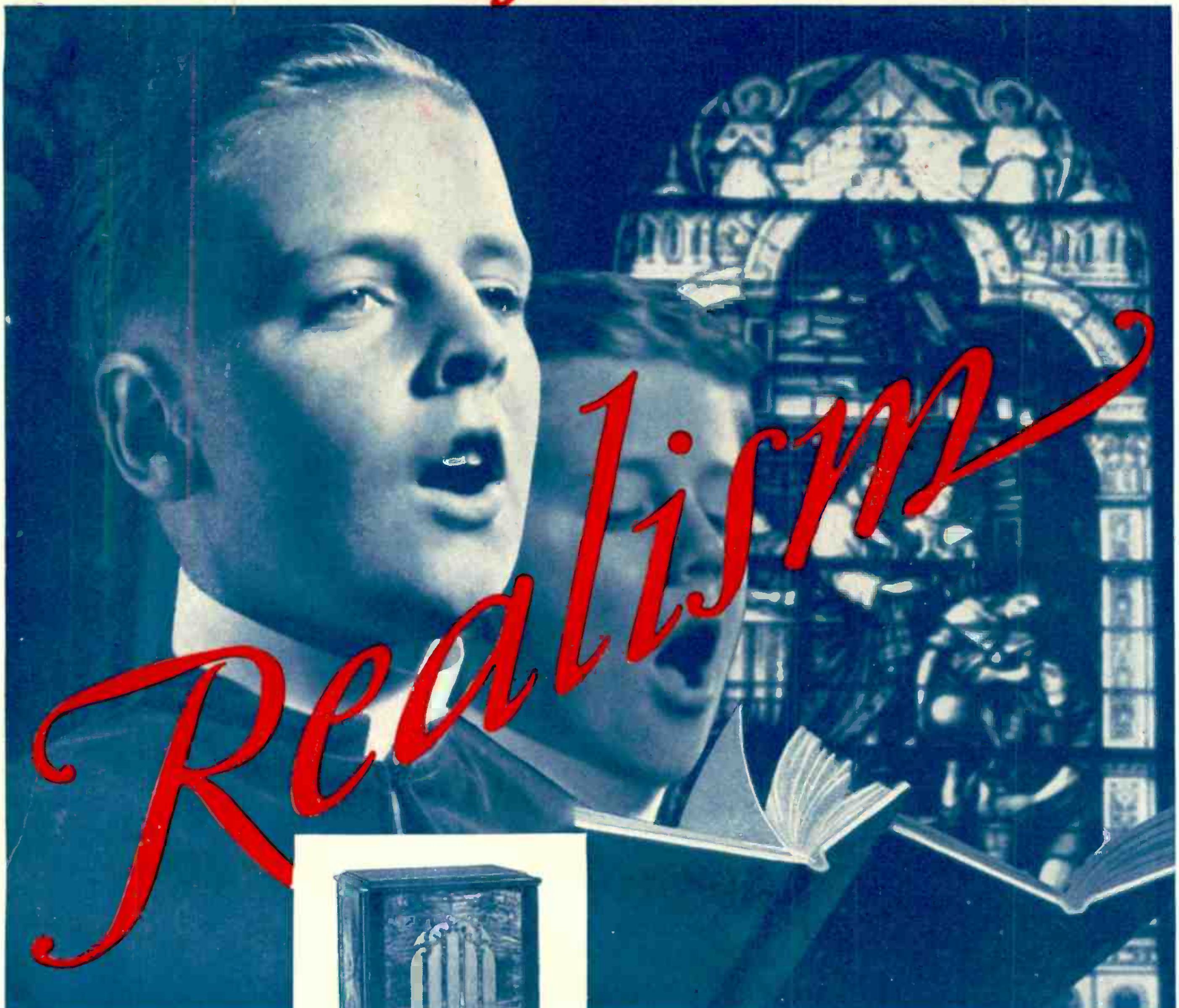
Beulah

# MAGNAVOX "Dynamic" SPEAKERS

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# RADIO

Established 1917

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Frank C. Jones discusses the dynamic loud speaker. John P. Arnold describes the use of light-sensitive cells in visual communication, the Rayfoto system of still picture reception, and a neon-lamp stroboscope. J. G. Eisenberg continues his "Help for the Radio Trouble Shooter." D. L. Bedingfield completely outlines the design of low-loss inductance coils. Glenn E. West instructs in calibrating a wave-meter from 5 to 90 meters. G. F. Lampkin's promised article on the construction of a crystal-controlled transmitter is definitely scheduled for this issue. If space permits, C. A. Kuhlman's nomograph chart for determining the constants of band-pass filters will be printed. Some unusually interesting material will appear in the "Technical Briefs" and "Commercial Brasspounder" departments.


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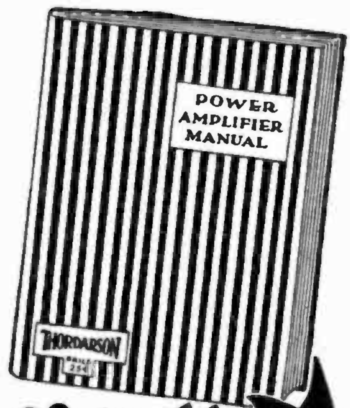


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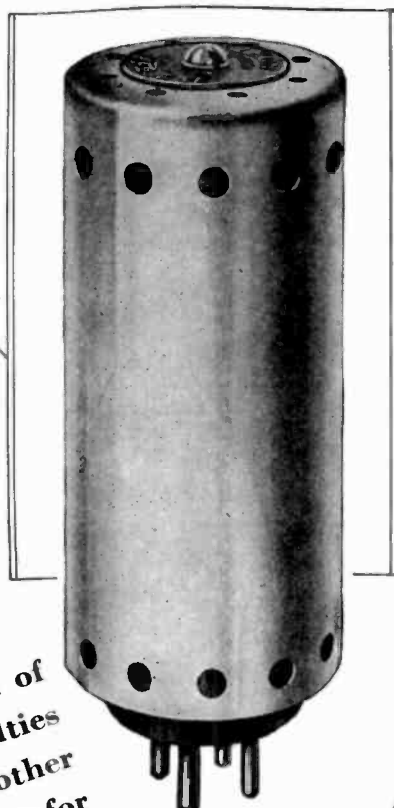

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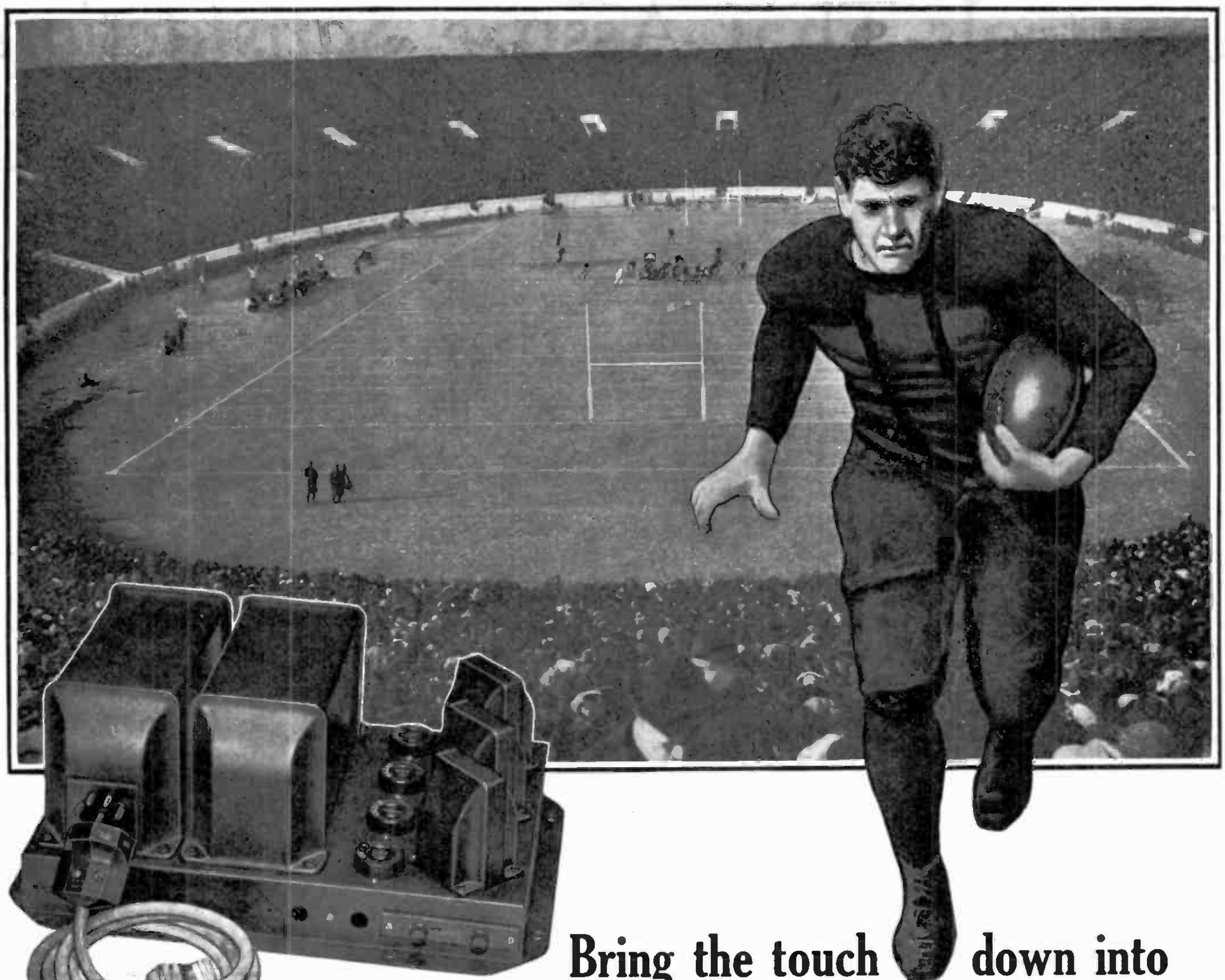

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# RADIO

VOLUME X | DECEMBER, 1928 | No. 12

## Radiotorial Comment

THE United States Supreme Court has decided that De Forest's regenerative patents are valid. This decision probably ends a controversy that has been bitterly waged for years. The feed-back circuit thus becomes the first of the controversial radio patents to be adjudicated by the court of last appeal.

Although Armstrong had the first regenerative patent, De Forest had discovered and applied this principle during his early experiments with the three-electrode vacuum tube, of which he was the inventor. After successfully fighting the interference claims of Armstrong, Langmuir, Meissner and Arnold in the patent office and lower courts, De Forest was finally granted patents on regeneration and oscillation in 1924, twelve years after the performance of his original experiments.

His patents do not cover all methods of producing regeneration. In receiving circuits, Armstrong still retains the right to use an inductance in the filament lead which is common to both the input and output circuits. For transmitting, Hartley has a patent on a circuit without a grid condenser. This patent is owned by the Radio Corporation of America, which, through transfer of rights, may also use the De Forest patents.

Consequently De Forest has finally won the right for his company and licensees to use regeneration, but he cannot restrain the R. C. A. from doing likewise. However, regeneration is not public property; non-licensed regenerative receivers and transmitters still infringe upon strongly-held patents. The De Forest patents have thirteen years to run, and the Armstrong patent expires in 1930.

* * *

ONE probable result of operation with the broadcast allocations which became effective on Armistice Day is a general recognition of the need for new legislation to supplement the Davis-Dill amendment, under which the new wavelength and time assignments were made. With the present set-up, each zone is limited not only to the same number of wavelengths, which seems equitable, but also to the same number of stations simultaneously using each wavelength, which seems inequitable.

For instance, no more stations are allowed to serve the very large areas of the third and fifth zones than serve the small area of the first zone. The common denominator for all zones is the number of stations which can simultaneously operate without interference in the smallest zone. This deprives many localities of day and even night service from small stations that might otherwise operate without interfering with each other.

As this discrimination against the larger zones cannot be corrected under the present equalizing law, another amendment is necessary. However, it is unlikely that adequate consideration of the matter can be given during the short term of the present Congress. So its enactment will probably be delayed until the new Hoover administration assumes control.

* * *

RADIO television, in crude form, is now possible for the class of experimenter who is able to read and understand the kind of articles which are printed in a semi-technical radio magazine. Those who know enough to build their own receivers and who do not yet expect perfection of performance can see moving shadowgraphs if they are within the effective range of a station which is broadcasting television signals.

But this does not mean that the art has yet reached a stage where the general public can expect to see radio pictures in the home as they now hear radio programs. Nor is it any reason for postponing the purchase of a set for aural reception. When television "arrives," a separate piece of equipment will be necessary for its reception.

* * *

BROADCAST advertising employs electricity instead of paper as an effective medium for shortening the distance between seller and buyer. Thus, for some kinds of mass selling, the spoken word is gradually replacing the written word. The sales appeal is to the ear rather than through the eye of the buyer. Some people say that Smith's radio speeches were responsible for Hoover's victory.

* * *

CONSIDERABLE interest has been aroused in radio prospecting or the use of high frequency electric current for locating ore bodies. The general methods have frequently been described in these and other columns. But it has remained for J. J. Jakosky to present a complete technical discussion of the subject in the October, 1928 *Proceedings* of the Institute of Radio Engineers. His conclusion is that the results of any electrical geophysical survey, to be of value, must be interpreted by a trained staff of mining engineers and geologists. This work opens another new field for the man who is familiar with radio principles and equipment.

The mining profession was sceptical when these experiments were first made, regarding them as a modern revival of the ancient divining rod. But so many successful surveys have been conducted by this means that the work of competent operators now commands the respect that it deserves. A recent bulletin from the U. S. Bureau of Mines describes some of the practical methods which are employed.

* * *

READERS of technical radio literature who hereafter encounter the "Deci-Bell" or "DB" will be interested in knowing that this is the new name for the transmission unit or "TU," which is the engineer's yardstick for measuring the efficiency of an electrical communication circuit. Nearly all countries which use the radio or telephone have agreed to the adoption of this new term. DB is interchangeable for "TU" wherever the latter occurs in the older writings, the values being the same.

Obviously the change honors the name of Alexander Graham Bell, just as the names of Volta, Ampere and Watt are honored by the ordinary electrical units for potential, current and power. Deci is a prefix signifying tenth.

The expression is mathematical and relates to the ratio of power, voltage or current conducted by electrical circuits. Thus, if one circuit transmits 10 times as many watts as another, there is a difference of 10 DB between them. If the power ratio is 100, the difference is 20 DB. If it is 1000, the difference is 30 DB. For 10,000 it is 40 DB, etc. It will be noted that the number of DB is 10 times the logarithm of the power ratio.

As voltage or current ratios and not power ratios are usually measured in radio circuits, and as power ratios are equal to the square of voltage or current ratios, the number of DB becomes 20 times the logarithm of the ratio of voltage or current. For example, a two-stage audio amplifier giving a voltage amplification of 400 has $20 \log 400 = 52$ DB.

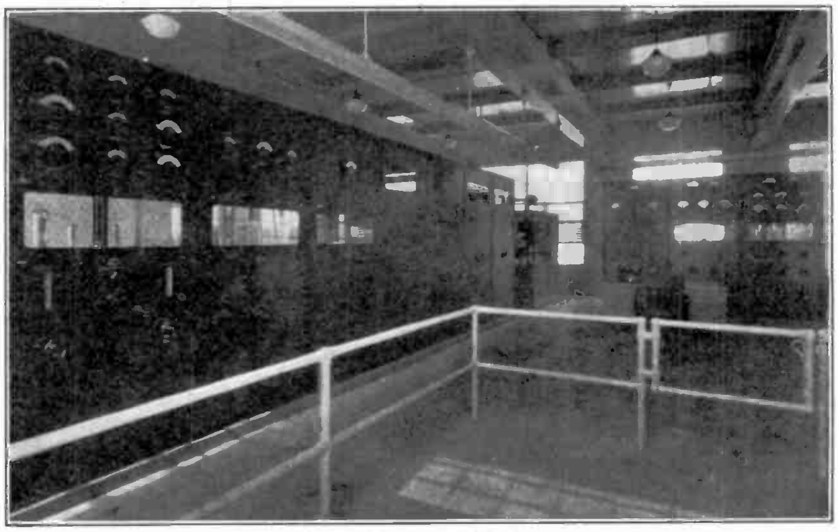
This distinction between power and voltage ratio has frequently been overlooked in the preparation of curves showing the efficiencies of transformers and loud speakers at different audio frequencies. Amplification measurements are ordinarily made with a voltmeter. When the voltage readings are converted into DB units some workers have multiplied the logarithm by 10 instead of by 20, thus giving an erroneous curve.

One of the reasons for employing this apparently cumbersome notation is that it is true to nature. We hear logarithmically. The ear's response is proportional to the logarithm of the sound energy. A full orchestra playing at its loudest, sounds only sixty times as loud as when playing at its softest, although the amount of sound energy is a million times greater. ($10 \log 1{,}000{,}000 = 60$). This fortunate provision of nature protects us against injury from very loud noises.

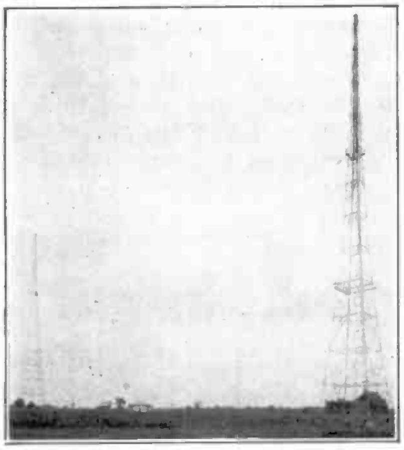
The normal human ear is just able to detect a difference of one DB between the loudness of two notes. In the present state of the radio art an amplifier or loud speaker may be considered as passably good if it gives a differentiation of less than 10 DB between a high and a low note. This means that if the voltage amplification of a 100-cycle note, for example, is not less than about one-third that of a 1000-cycle note, the equipment will give fairly satisfactory reproduction of music. ($20 \log 3 = 9.54$ DB).

# WLW'S 50,000-Watt Transmitter

Nation-wide reception of WLW's new 50,000-watt transmitter at Mason, Ohio has aroused interest in the equipment whereby this was made possible, especially as it contains several innovations in the standard Western Electric apparatus. These changes include 100 per cent modulation of the carrier instead of the customary fractional modulation, a harmonic filter, and an especially effective antenna ground system.



*Control Room at WLW*



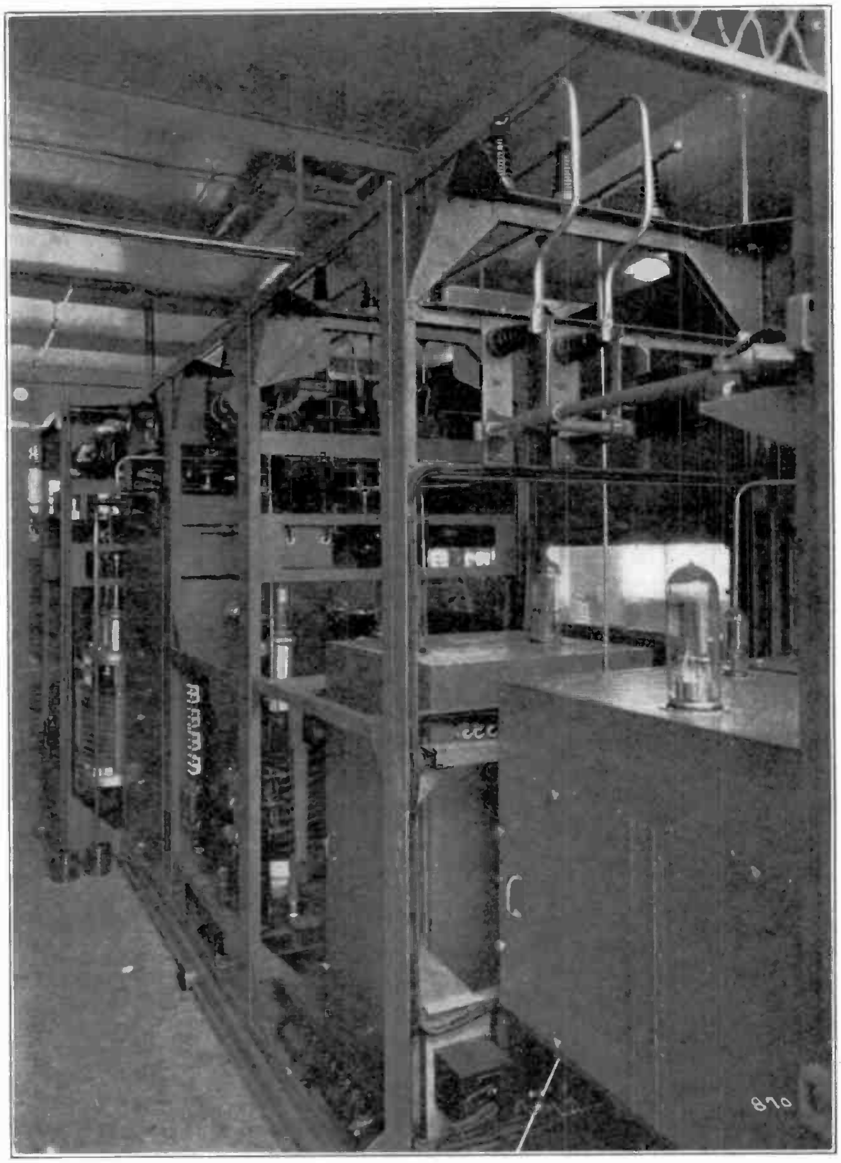
*300 Ft. Towers at WLW*

The 300-ft. steel towers are spaced 600 ft. apart on a north and south line, 400 ft. west of the transmitter. Under the center of the antenna is located the coupling house which is shielded from the intense field by means of a copper roof. Within this house is the junction of four heavy diagonal ground busses to which are soldered 30 miles of ground wire buried 10 in. deep in furrows 2 ft. apart. From this house also runs the insulated transmission line which carries the modulated high-frequency electric current from the transmitter.

The transmitter is installed in a two-story brick, concrete and steel building, the transmitter itself and the control room being on the main floor, and a duplicate set of motor-generators, rectifier transformers, fans and pumps in the basement. In the basement also is the high-voltage filter system, whereby harmonics are eliminated before the energy is radiated. Constancy of frequency is

(Continued on Page 44)

*High Voltage Filter System*



*Amplifier and Modulating Unit*

# High Frequency Electric Furnaces

## Methods and Equipment Used for Melting Alloys for Dental Use

*By* PAUL W. HERMANN

A REAL field of application for the high frequency induction furnace has been found in the melting of precious metals and their alloys for dental use. Although this has been picturesquely advertised as "melting by radio" it is merely another industrial application of the high frequency current which is also used for radio transmission. The output of a high frequency generator is connected directly to an induction coil whose electromagnetic field is intercepted by the material to be melted, this being placed within the coil. The eddy currents thus produced are effective in heating the material to very high temperatures.

This conversion of electric power into heat is accomplished by using a relatively weak magnetic field and a relatively high frequency. The typical furnace installations illustrated in Fig. 1 utilize the 2000 kilocycle output of a mercury discharge-gap oscillator which delivers about 5 amperes at from 6000 to 8000 volts.

Figs. 2 and 3 show the construction of a furnace unit. It consists essentially of a cylindrical chamber surrounded by a coiled conductor, which is insulated from it both thermally and electrically.

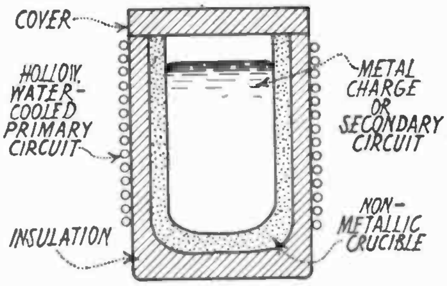



*Fig. 3. Cross-Sectional View of Induction Furnace*

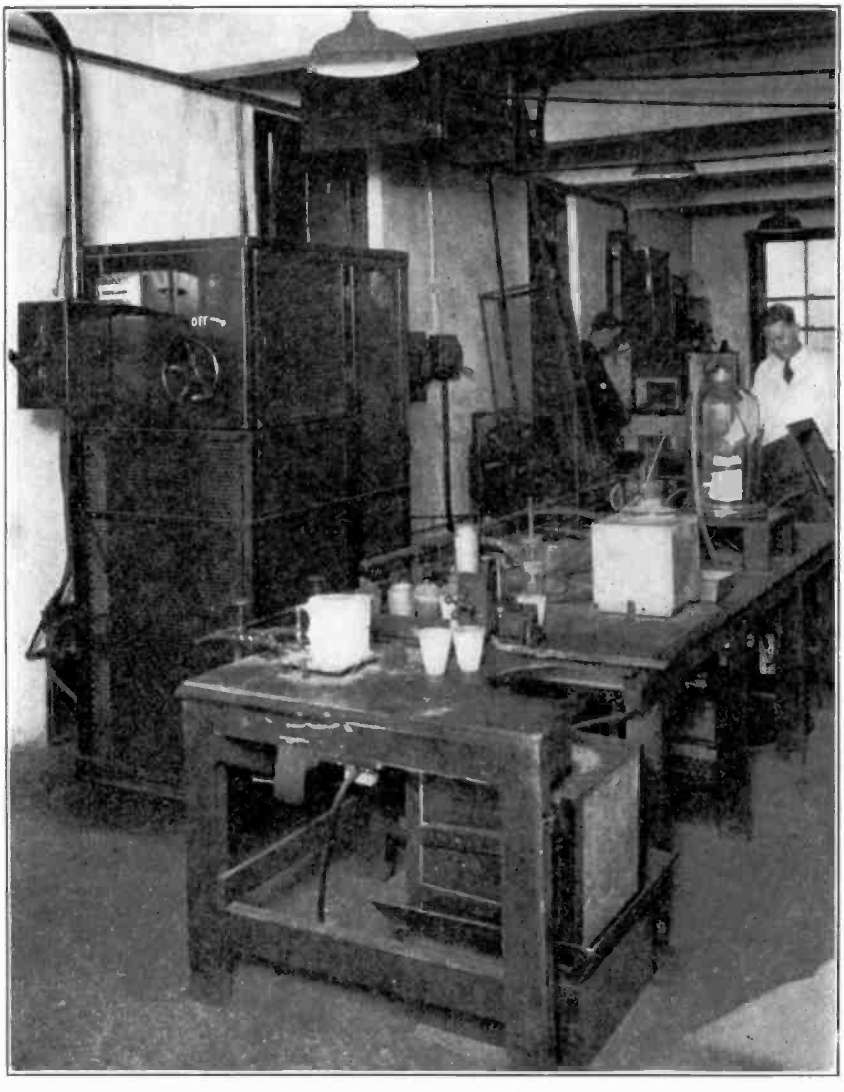


*Fig. 1. Typical Installation of Small High Frequency Furnaces*

The thicker the insulation, the less is the electromagnetic energy which enters the chambers, since a smaller part of the field cuts the resistor. The thinner the thermal insulation, the greater is the amount of the heat energy radiated outward from the crucible and lost. The primary is a coil of copper tubing through which water is circulated so as to keep it cool. The secondary is the metal to be melted. Glass or other nonconductor cannot be melted in this type of furnace unless it is placed in a crucible

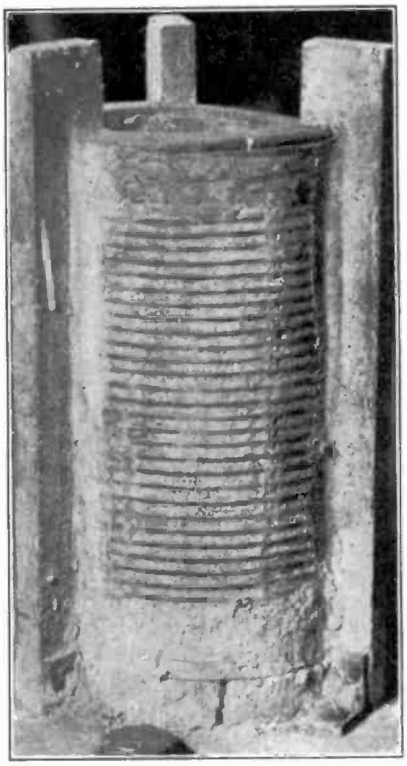


*Fig. 2. View Showing Furnace Construction*

which is itself a conductor, such as graphite.

Temperatures attained are in excess of 5000 degrees F., as compared with less than 3000 degrees F. in a standard gas or oil furnace. This is sufficient to melt platinum in so short a time that a strip of metal may be held in the hand, as in Fig. 4 and melted within an inch or so of the fingers without any discomfort. The electromagnetism, and thus the heat, is concentrated toward the center of the crucible so that surrounding objects are not heated.

The operator has easy control of the temperature by varying the magnetizing current so that the charge is not superheated. Furthermore the eddy currents in the molten metal set up a vigorous stirring action which brings about the complete mixture necessary to form a true alloy. All previous methods of mechanical stirring would allow platinum, with its specific gravity of 21, to segregate from gold or copper in the billet, thus giving undesirable characteristics for dental work.

The furnace can be operated in a vacuum, as in Fig. 5, or in a highly reducing atmosphere so as to prevent oxidation. This eliminates the necessity for fluxes and their consequent inclusions.

*Fig. 4. Melting Platinum in High Frequency Furnace*

One high frequency induction furnace will melt more high-fusing metal in half an hour than can be handled by a gas furnace in a full day. With 16 kw. input 30 ounces of platinum can be melted in two minutes. There are no fumes, smoke or gases, and no heat radiation from the furnace, so that the operator works in comfort. The former foundry becomes an immaculate laboratory.

Much of the development work for this type of furnace, which was originally invented by Dr. E. F. Northrup, has been accomplished by the Williams Gold Refining Company in co-operation with the General Electric Company and the Ajax Electrothermic Corporation. They have recently perfected a small furnace, which is supplied with high frequency current from a 250-watt vacuum tube converter.

Most of the industrial installations, however, use either mercury discharge-gap oscillators or high frequency generators of the non-inductive type. Relatively lower frequencies are used with the latter, 960 cycles being common. Large furnaces are in service for melting silver in 900-pound charges and copper alloys in 700-pound charges. Units of 250-pound capacity have been successfully used for melting nickel and pure iron for the production of permalloy.

*Fig. 5. Furnace Operated in Vacuum*

Fig. 6 shows the circuit diagram for a mercury discharge-gap oscillator and furnace. In this type of equipment power is delivered from the oscillator at from 5 to 100 k.c. The frequency is increased as the size of the coil or the number of condensers is reduced, smaller furnaces requiring higher frequencies. The same amount of heat may be created with a field of unit strength and a frequency of 60 k.c. as with a field 1000 times as strong and a frequency of but 60 cycles per second.

The Bureau of Metal Research at the Carnegie Institute of Technology has recently applied the high frequency furnace to the refining of manganese. The metal is placed in a magnesia crucible which is covered by another inverted crucible to collect the distilled metal. These crucibles are placed inside a fused quartz tube, 4 in. in diameter and 2 ft. long, closed at both ends. The quartz tube is surrounded with a water-cooled copper coil through which 2 amperes of high frequency current is inductively passed at 7700 volts. This produces the pure metal which is necessary in some steel alloys. Many other industrial applications of the high frequency furnace are in process of development.

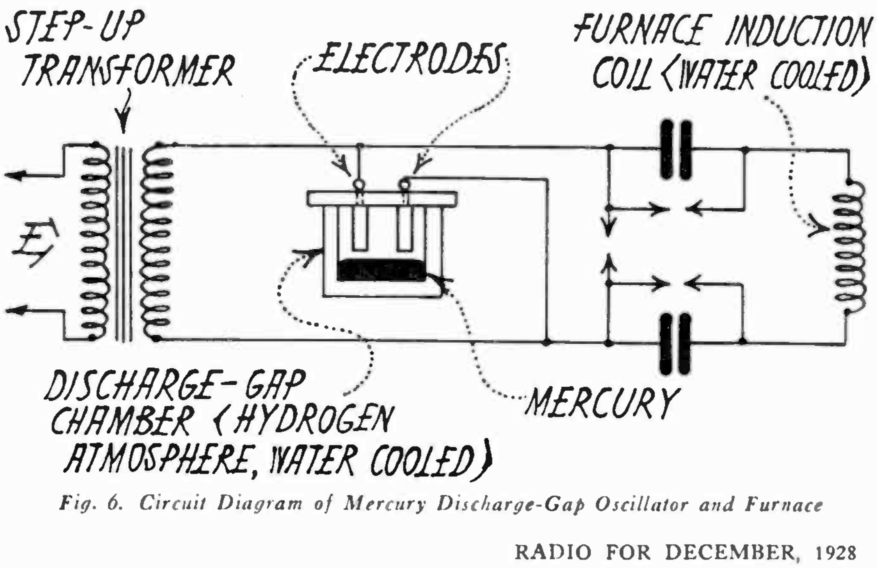



*Fig. 6. Circuit Diagram of Mercury Discharge-Gap Oscillator and Furnace*

## BROADCASTING IN PARIS

*By* R. Raven-Hart

Programs—often magnificent. Transmissions—almost invariably bad. And bad to a degree that an American listener would hardly credit. It is no exaggeration to say that neither of the two "official" stations (the Eiffel Tower and the "PTT," otherwise the Higher School of the Post, Telegraph and Telephone Department) would have been tolerated in America ten years ago, and at the present day they can only be regarded as rather tedious jokes, not in the best of taste.

Unfortunately, some of the best programs come from them; above all, the Saturday and Sunday concerts of the Pasdeloup orchestra. It is hard to imagine anything more exasperating than to see pieces on the programs which one would love to hear, and to tune in, with the hope that possibly some miracle may have occurred, and then. . . .

Were it not for the private stations, it would be difficult to believe that any radio sets are sold; more especially Radio Paris (run by the largest radio company), the "Petit Parisien" (run by the newspaper of that name), Vitus, and L. L. (run by smaller manufacturers). All these four have decent modulation, and the first named can be relied on for passable programs with occasional gems. The second does not transmit daily, and its programs are as a rule rather hackneyed. The two last are low-powered and rather masked by buildings—they are as a result none too easy to pick up, even within commuting distance of Paris. This is a pity, as their programs are of a varied nature, often quite exceptional; in the case of "Radio Vitus" whose subtitle is the "Montmartre Radio"; one sometimes begins to wonder whether the mike is not getting overheated, or some of the plates of the tubes blushing!

According to the strict letter of the law, radio is a government monopoly.

(Continued on Page 38)

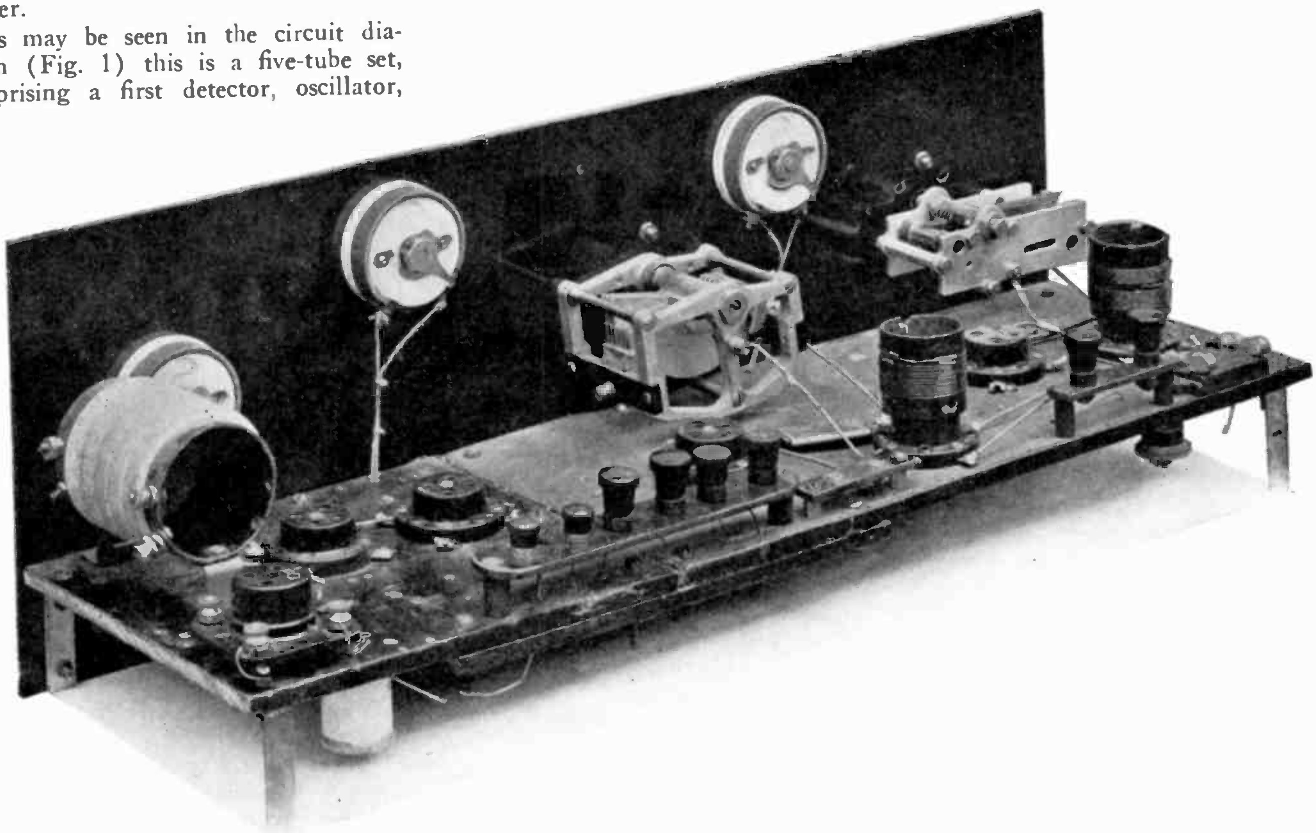
# A Short-Wave Superheterodyne

*By* R. WILLIAM TANNER

THE most sensitive and selective set for receiving telephone or telegraph signals, whether long or short wave, in the author's experience, is the superheterodyne. Furthermore only four plug-in coils are required to completely cover the spectrum from 20 to 200 meters, with a .00015 mfd. condenser.

As may be seen in the circuit diagram (Fig. 1) this is a five-tube set, comprising a first detector, oscillator, two intermediate frequency stages, and second detector. The set is designed to use '99 type of tubes throughout, though slightly greater signal strength may be had with '01-A tubes in the i.f. and second detector sockets.

The first essential for selectivity is low resistance in the first detector circuit. This may be secured by space winding the coils, *L* in the circuit diagram, with No. 28 enamel wire on old UX tube bases. The primaries are ¾-in. diameter and 1 in. long and are placed inside the bases. The secondaries are wound outside the bases and are 1 in. in length. The leads are soldered to the



*Rear View of Short-Wave Superheterodyne*

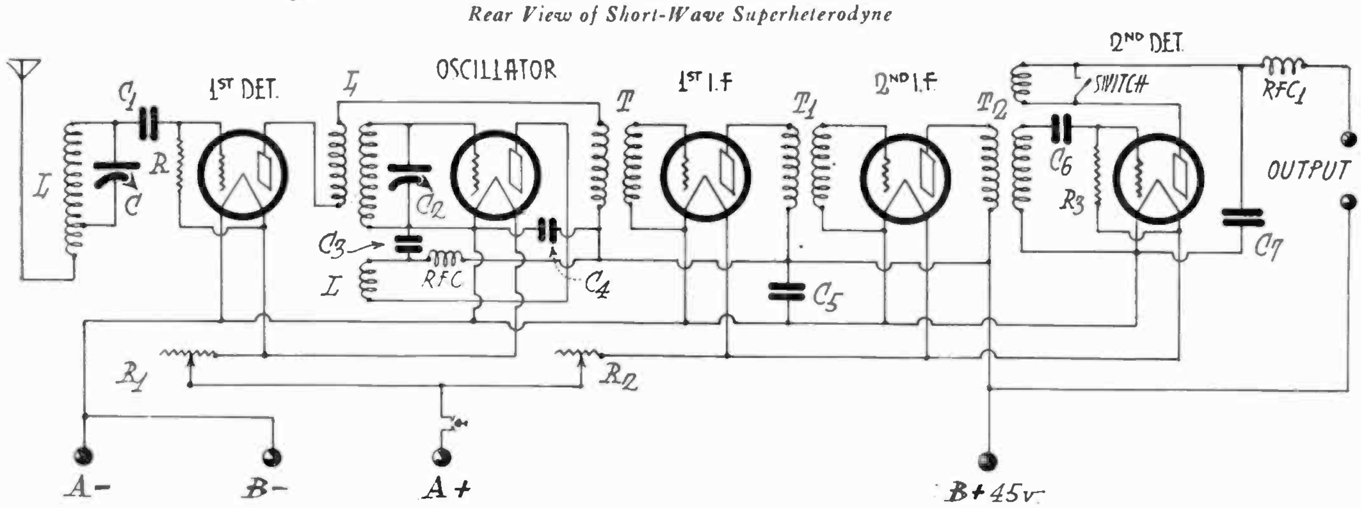



*Fig. 1. Circuit Diagram of Short-Wave Superheterodyne*

L—See text.
C—.00015 mfd. detector tuning condenser.
$C_1$—.00025 mfd. detector grid condenser.
$C_2$—.00015 mfd. oscillator tuning condenser.
$C_3$—.0025 mfd. oscillator bypass condenser.
$C_4$, $C_5$—1 mfd. bypass condenser.
$C_6$—.0005 mfd. second detector grid condenser.
$C_7$—.002 mfd. second detector bypass condenser.

R—5 to 10 megohm grid leaks.
$R_1$, $R_2$—30-ohm rheostats.
$R_3$—2-megohm grid leak.
T, $T_1$, $T_2$—See text.
RFC—200 turns No. 36 enamel wound on a thread spool ¾ in. diameter in 25 turn sections, 1/16 in. between sections.

$RFC_1$—See text.
SW—Tickler switch.
$SW_1$—Filament switch.
7 UX sockets.
5 UX 199 tubes.
2 binding post strips.
7 in. x 21 in. panel.
7 in. x 20 in. baseboard.
2 panel brackets.

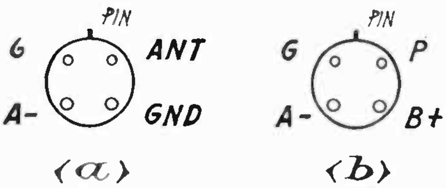



*Fig. 2. Lead Connections for First Detector and Oscillator Coils.*

prongs as shown in Fig. 2 (a). The number of turns for the different coils are as follows:

| | 20 meters | 40 meters | 80 meters | 160 meters |
|---|---|---|---|---|
| Primary | 3 turns | 6 turns | 10 turns | 10 turns |
| Secondary | 7 turns | 14 turns | 29 turns | 60 turns |

A tuning condenser capacity of .00015 mfd. is secured by removing all but three of the rotary plates of a .0005 mfd. condenser, or any good low-loss condenser of equivalent capacity may be used.

The grid leak should be from 5 to 10 megohms; the grid condenser from .0001 to .00025 mfd., the lower value being better for 20 meters. An extra control for regeneration does not seem to be justified for the slight increase which it gives in sensitivity.

The oscillator is of the series feed type. The tuning condenser is connected across the grid coil only and not from the grid to the plate as is usually done in broadcast supers. The rotor is then at ground potential, thereby eliminating hand capacity effects. A by-pass condenser of .0025 mfd. is shunted across the plate supply. The r.f. choke prevents the r.f. currents from getting into the *B* battery. The energy is fed to the first detector by coupling a loop brought out from the plate circuit of the detector to the oscillator coil. This loop consists of 10 turns of No. 28 enamel wire wound around the oscillator coil socket.

The oscillator coils are wound on UX tube bases with the same size wire as is used on the detector coils.

| | 20 meters | 40 meters | 80 meters | 160 meters |
|---|---|---|---|---|
| Grid | 8 turns | 16 turns | 33 turns | 65 turns |
| Plate | 8 turns | 16 turns | 33 turns | 65 turns |

The 160-meter coil will have to be two bank wound in two equal sections as the tube base is not long enough to accommodate a total of 130 turns. D. C. C. wire is used in this case as it is superior to enamel for bank windings. Not only is it easier to work but the distributed capacity is much lower. In bank winding coils two turns are wound on tightly, then one turn is wound on top of these. Next bring the wire back down to the tube and wind on another turn, then wind the next turn on top of this and so on. At the cross overs bend the wire sharply with the thumb nail. Those who have had no experience with this type of winding had better practice with some old wire before attempting to make a permanent coil. It is very easy after a little experience. See Fig. 3 (a).

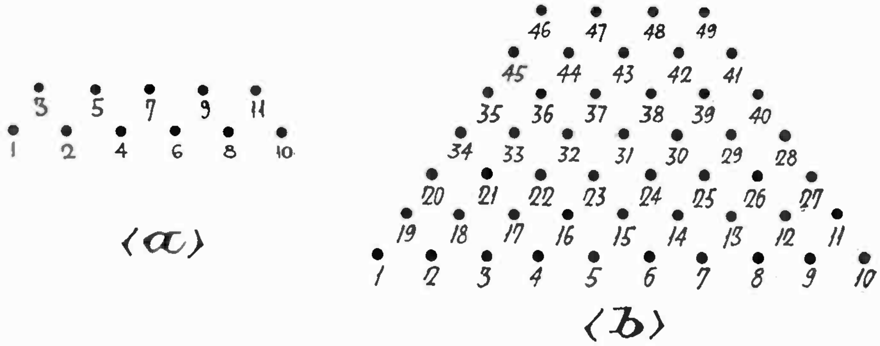



*Fig. 3. Bank Winding Details*

The grid parts of the coils are wound near the bottom and the plate section at the top. Grid and plate connections are made to the outside ends. The inside ends go to the *A* negative and the *B* positive. See Fig. 2 (b). Tuning is done with a .00015 mfd. condenser of the straight line frequency type.

The intermediate frequency amplifier is the heart of the super. This one gives a large gain per stage with a minimum of noise, and can be sharply tuned without cutting off the side bands. The frequency is 160 kilocycles, or about 1800 meters. Two stages proved to be sufficient.

This required three transformers which are of different construction than those usually employed. The secondaries are group bank wound of 476 turns of No. 28 D. C. C. wire on bakelite tubes 2 in. in diameter and 3 in. long. The method of winding is shown in Fig. 3 (b) except that there are 20 turns on the bottom layer. Four groups of 119 turns are required for each secondary. Wind

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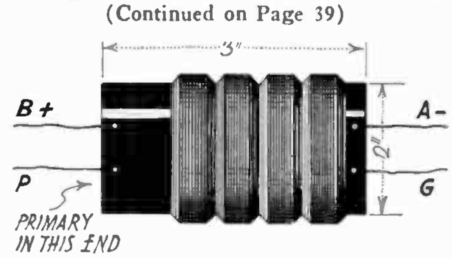



*Fig. 4. I. F. Transformer Details*

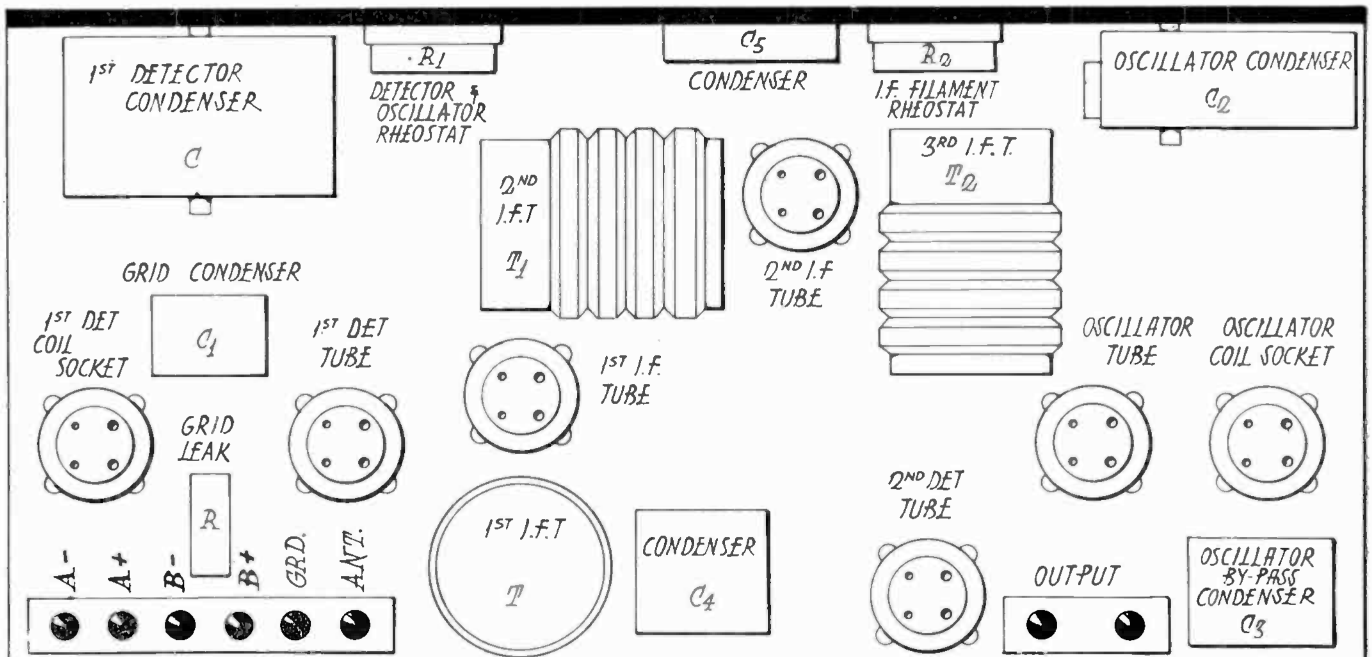



*Fig. 5. Layout of Parts for Short-Wave Super*

# Experimenting With the Grid Leak

*By* L. W. Hatry

OLDER textbooks tell us that the function of the grid leak is to dribble away electrical energy with which the grid condenser brims. Later wisdom presents a theory, easier both to believe and to understand, which views the resistance as the essential element. Stuart Ballentine says, "So far as the process of detection is concerned, the grid condenser is not only superfluous but harmful as a potential source of frequency distortion."

The condenser by-passes *all* alternating currents in the circuit, offering greater impedance at the lower frequencies. This means that the detector seriously favors the treble at the expense of the bass; a fact that has been substantially proven by experiment. The realization of this fact has led, of course, to the desire to substitute a better device for the resistor and condenser, some other type of impedance that would be less discriminating in its choice of frequencies.

The secondary of certain good a.f. transformers would do the trick very nicely, as shown in Fig. 1, except for the fact that with the primary hanging free, there is entirely too much stray capacity to various nearby wires. Moreover, as the grid voltage is 5 volts positive instead of (in the case of the 201-A tube), about .2 volts positive, a potentiometer is necessary to allow variation of the grid voltage between 1 volt negative and 5 volts positive, so that the tube has a chance to perform at its most effective grid potential.

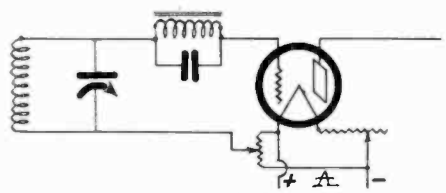



*Fig. 1. Replacement of Grid Condenser by A. F. Choke*

But Fig. 1 is by no means the circuit to be recommended. Fig. 2 shows another method of using the choke. But after trying every available iron core inductance I finally decided that I should continue to use the old-fashioned grid leak and condenser, except in a superheterodyne.

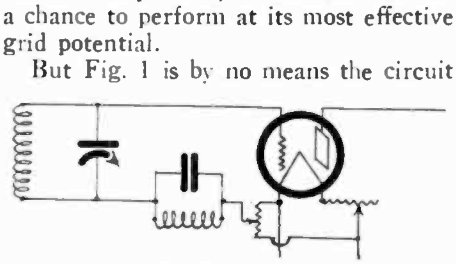


*Fig. 2. Another Method of Using A. F. Choke as a Grid Impedance*

In the first detector of a superheterodyne the use of the grid leak and condenser is attended with great difficulties, because detection ordinarily takes place by plate circuit rectification instead of the usual grid rectification. Facing the inadequacy of the grid leak-condenser combination as a higher frequency impedance we discover upon calculation that at 100 k.c., detection is only 4% efficient. (See Stuart Ballentine, Proc. I. R. E., May, 1928). In substituting another form of impedance in the first detector grid circuit we find that, as we are not dealing with audio frequency, an iron core choke is not to be considered, unless it is desired to add the effects of resistance. What we must do then is to devise a tuned r.f. circuit.

To quote Ballentine: "I investigated several years ago, the scheme shown in Fig. 9 (Fig. 3 of this article). Here the circuit *LC*, anti-resonant at the intermediate frequency, is placed in series with the grid and replaces the grid condenser and leak. The efficiency of detection in the grid-circuit is thus increased from 4 to about 50%."

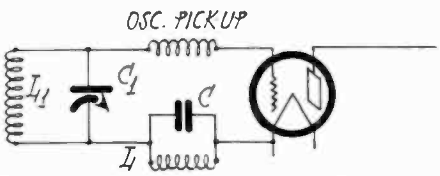



*Fig. 3. Theoretical Use of A. F. Choke with First Detector of a Superheterodyne*

As Ballentine says, *LC* causes the detector to become a tuned-plate-tuned grid regenerative rig at the intermediate frequency. Fig. 3 is both incomplete and impractical (it was intended only for a theoretical illustration) because the wrong grid-bias is inevitable and because the two-terminal loop $L_1$ is seldom used. When it is used the rotor plates of the tuning condenser $C_1$ should be at ground potential and connected to *F* positive or negative.

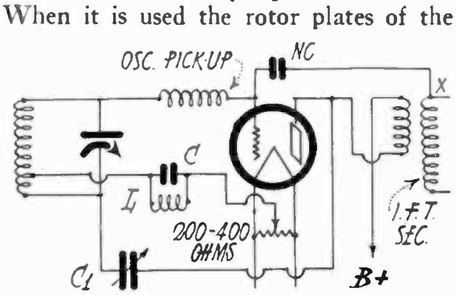



*Fig. 4. Practical Circuit for Three-Terminal Loop*

The practical circuit for the three-terminal loop takes the form of Fig. 4. *LC* is tuned to the intermediate frequency. $C_1$ is the usual regeneration control midget of .00005 mfd. maximum. The special 200 or 400-ohm potentiometer controls detection effectiveness and will prove a better volume control than the usual intermediate potentiometer which can be set and forgotten. *NC* is a very small capacity made of a couple of metal angles which can be moved apart; it is a neutralizing condenser to prevent the first detector from oscillating at the intermediate frequency. If it does not work reverse the connections from the detector to the primary of the first I. F. T. The best neutralizing method would be made possible by the use of a center tap in the primary of the I. F. T.—which, of course, would have to be specially made.

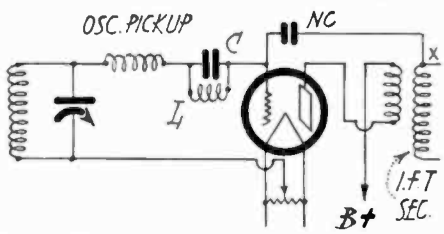



*Fig. 5. Practical Circuit for Two-Terminal Loop*

The practical circuit for the two-terminal loop is shown in Fig. 5. *LC*'s sharpness is reduced by the normal input resistance of the detector. As there is no important reason why the oscillator pick-up should be in series with the grid lead, it may be placed in the *F* return, the wire to the potentiometer center arm.

Either Figure 4 or 5 is a working circuit. Both are superior to detection with a *C* battery which in turn is superior to detection with the grid leak and condenser. I am not sure whether the tuned grid-impedance is superior solely because of its effect upon rectification or largely because of the I. F. regeneration it puts into the detector circuits. Used with the shield-grid tube at a frequency of about 400 kc. ("one-spot" tuning) the difference between the grid-impedance and the *C* battery was marked.

In both Fig. 4 and Fig. 5 *NC* is fixed only if the voltage at *X* is not artificially attenuated, as, for instance, by change of the I. F. A. potentiometer. Consequently the I. F. A. potentiometer should be set near maximum and kept there while volume is controlled with the detector biasing potentiometer. As mentioned, however, the better circuit demands a center-tapped primary on the detector-coupling I. F. T.; then the setting of the detector potentiometer may remain at optimum adjustment which allows maximum loop selectivity and eliminates upset of carrier frequency regeneration.

# Radio Picture Transmission and Reception

## Photoelectric Equipment and Methods for Visual Communication

*By* JOHN P. ARNOLD, *Departmental Editor*

### TELEVISION STATIONS

| *Station* | *Location* | *Wave-length* | *Disc Holes* | *Pictures per second* | *Tentative Schedule* |
|---|---|---|---|---|---|
| WGY | Schenectady, N. Y. | 379.5 | 24 | 21 | 12.30-1.00 p. m., Tu., Th., Fri. |
| 2XAF | Schenectady, N. Y. | 31.4 | 24 | 21 | 10.30-11.00 a. m., Tu. |
| 2XAD | Schenectady, N. Y. | 21.96 | 24 | 21 | 9.15-9.30 a. m., Sun. |
| WRNY | New York City | 325.9 | 48 | 10 | First 5 min. of each hour |
| 2XAL | New York City | 30.91 | 48 | 7.5 | First 5 min. of each hour |
| 3XK | Washington, D. C. | 46.72 | 48 | 15 | 9.00 p. m., Mon., Wed., Fri. |
| WCFL | Chicago, Ill. | 61.5 | 45 | 15 | Irregular |
| WKBI | Chicago, Ill. | 215.7 | 48 | 15 | Have applied for license |
| WIBO | Chicago, Ill. | 305.9 | 45 | 15 | 1.00 a. m., Mon., Wed., Fri.; 1.30 a. m., Thur., Sat. |
| KGFJ | Los Angeles, Calif. | 212.6 | 48 | — | 1.00-6.00 a. m. |
| WLEX | Lexington, Mass. | 62.5 | 48 | — | Building new apparatus |

*Note*—No. of pictures per second, multiplied by 60, equals r.p.m. of motor. No. of holes in scanning disc is same as No. of lines scanned per picture.

### TELEVISION RECEPTION METHODS

THE first consideration that governs the construction of a television receiving outfit is the character of transmissions which are available for reception. Whether they are on long or short wavelengths will not only determine the type of radio receiver, but also, usually, the size of scanning disc. The 24-line pictures are ordinarily transmitted on the regular broadcast wavelengths and the 48-line pictures in the short-wave carriers.

Reception of a 24-line picture requires a receiver that will tune, detect and amplify a 5000-cycle frequency band without favoring any particular part of it. This is ordinarily possible only when resistance or impedance coupling is used in the amplifier, as transformer coupling does not yet give the uniform frequency amplification, which is essential to good quality of television images.

For the 48-line picture the same type of audio amplifier is necessary for as high as a 20,000 cycle band. The tuner may be either a regular short-wave regenerative outfit or an r.f. stage may be used. Plate detection gives better quality than grid detection, although the signal strength is less.

The first requisite is that the television signal, as picked up by the antenna, is of sufficient strength. Otherwise poor results will be obtained. As in aural reception, very weak television signals greatly amplified with a lot of interference of equal or greater signal strength are unsatisfactory.

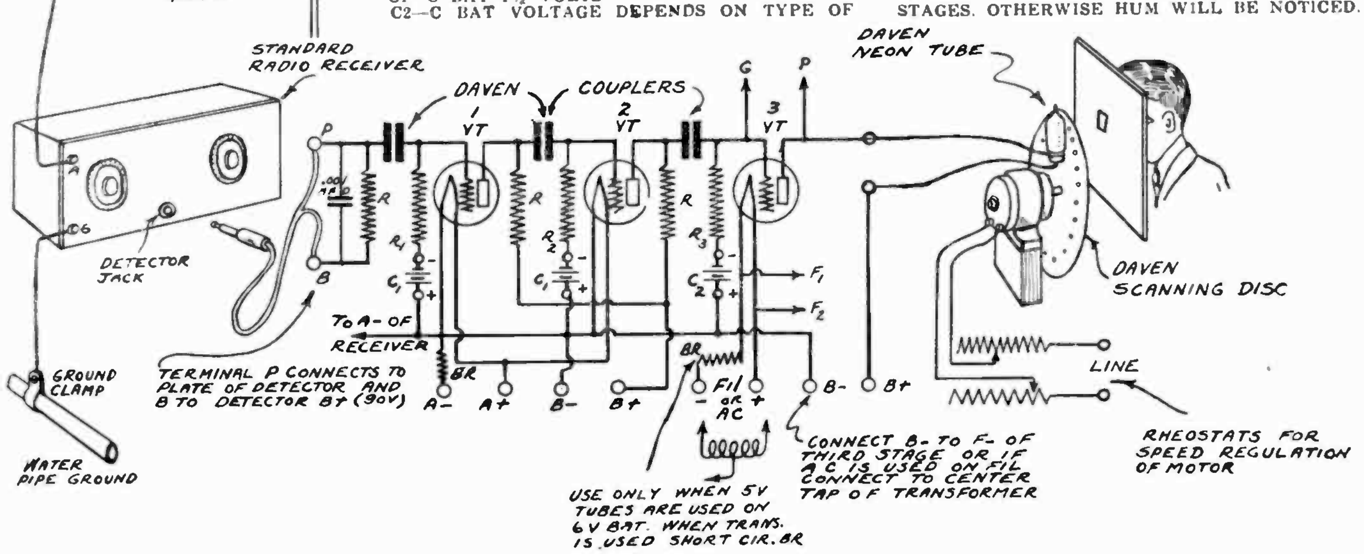
For 24-line pictures the scanning disc can conveniently be made 12 in. in diameter. Allowing ½ in. from outer hole of spiral to edge of disc, will give a picture a little less than 1½ in. wide at its top. For a 48-line picture the disc is usually 24 in. in diameter and the picture again will be 1½ in. in width. The disc should be centered properly, the holes drilled accurately, and the size of the hole about 10 per cent larger than calculated so that the paths will overlap. The discs should be perfectly flat and have sufficient strength. The weight should be kept at a minimum so that the size of motor required will not be unduly large.

The motor should have sufficient power to rotate the disc at the various speeds required, but not much more. It should be of the variable speed type. A universal motor of about 1/15 h.p. and 1800 r.p.m. may be used with a light 48-hole disc. With a rheostat of a suitable resistance and current-carrying capacity the speed can be varied within that required for television reception, and manual synchronization maintained.

The most important part of the television unit is the neon lamp, the light of which varies directly with the current that operates it. It requires from 50 to 90 m.a. modulated output from a 210-

R—.1M GLASTOR OR SUPER DAVOHM
R1—1.M GLASTOR
R2—.5M GLASTOR
R3—.25M GLASTOR
C1—C BAT 1½ VOLTS
C2—C BAT VOLTAGE DEPENDS ON TYPE OF TUBE AND B VOLTAGE
BR—FIL BALLAST

CAUTION—USE ONLY RAW AC ON THE FILAMENT OF THE LAST AMPLIFIER STAGE OR STAGES. OTHERWISE HUM WILL BE NOTICED.




*Circuit Diagram of Daven Television Amplifier* power tube to give sufficient illumination for a 48-line picture 1½ in. square.

Little difficulty will be experienced in assembling the parts. Although an elaborate set-up as shown in the picture may be desirable, it is not absolutely necessary. For instance, a large piece of black cloth will prevent the diffusion of the neon lamp glow in various directions as well as the large cabinet, although the latter will keep the observer away from the revolving scanning disc and avoid any damage which may occur by the hand or other objects coming in contact with it.

*Complete Set-Up of Daven Television Receiver*

The circuit diagram needs no further explanation. The radio set and the resistance-coupled amplifier have no unusual features which have not been found in ordinary radio construction. The motor and scanning disc should be placed at some distance from the set and amplifier. Use shock-absorbing supports so that motor disturbances and mechanical vibrations will not affect the amplifier tubes. Such effects often become visible as a permanent distortion of the images and thus can be distinguished from such transients as atmospherics, phase distortion and other communication channel disturbances.

Just one word to the uninformed constructor: do not expect too much in the way of quality. No one seriously contends that television is now any more than an experiment; but the more investigators who undertake to solve its problems, the sooner we can expect better results. Therefore if you like to experiment, go to it; even the present-day results in television reception are interesting although imperfect.

# The Jenkins Radiovisor

*By* C. FRANCIS JENKINS

IN TELEVISION (wire carried vision) and radiovision (radio carried vision) the picture scanning device consists of a disc with a spiral arrangement of holes therein, the disc making one revolution for each picture. The picture can only be as wide as the narrowest separation between two adjacent holes in the spiral, and only as high as the offset of the ends of the spiral.

As the minute apertures in the disc pass light so inefficiently, I made the apertures large, put lenses over each, and secured the required scanning spot by focusing the light source as an image point on the picture screen (U. S. Patent 1,679,086). This lens-disc was used in a public demonstration of radiovision and radiomovies in June, 1925, broadcast from Navy Station, NOF, Anacostia, and received in my laboratory in Washington, in the presence of many government officials.

But the disc scanner, whether apertured disc or lens-disc, has physical limitations in practical application, which seem, as at present employed, not to permit very much development.

The drum method is much more promising, for a cylinder, or drum, has none of the limitations of the disc, and has some meritorious features.

To get a mental picture of it (Fig. 1) structurally, imagine a hollow cylinder, fitted with a hub, hollow for the length of the drum. The hub has an extension

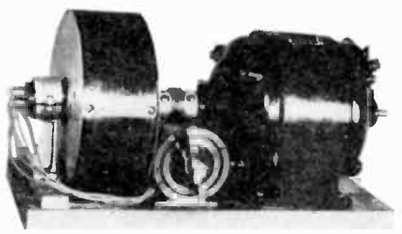


*Fig. 1. Mechanism of the Jenkins Radiovisor.*

outside the drum which slips on the shaft of a small motor. The scanning apertures are punched or drilled in the peripheral wall of the drum, each aperture of elementary area. The apertures are arranged in four helical turns.

Inside the drum-hub, a 4-target cathode-glow neon lamp, is held, by a clamp mounted on the motor platform, at the open end of the drum, preferably. Between the lamp and the periphery of the drum are tiny quartz rods, each rod ending under its particular minute aperture in the drum surface. A quartz rod has the peculiar property that light flows through it like water flows through a pipe. That is, the use of quartz rods avoids the light loss due to the inverse square law.

The cathode targets are located one each under each of the rows of quartz rods, and are lighted in succession through a 4-segment commutator, by current from the plate of the last tube of the radio receiver-amplifier. Because the movement of the inner ends of the rods is so short, these cathode targets need be only very small. These miniature targets obviously require only a small amount of current compared with the current required for a disc-scanned picture.

A multiple-spot lamp and drum apertures in a multiple-turn helix permits a small scanning mechanism, and a brighter and larger picture for a given radio energy. A 7-in. diameter drum Radiovisor with scanning apertures in four helical turns gives a picture which appears, magnified, to be about 6-in. square. Five or six people can conveniently enjoy the story told in the moving picture it produces. A 7-in. drum with six helical turns of scanning apertures gives a 3-in. picture, unmagnified; which is more than twice the area of any picture possible with a 36-in. scanning disc.

The transmitting equipment can be attached to any broadcast station apparatus. The drum scanner permits the

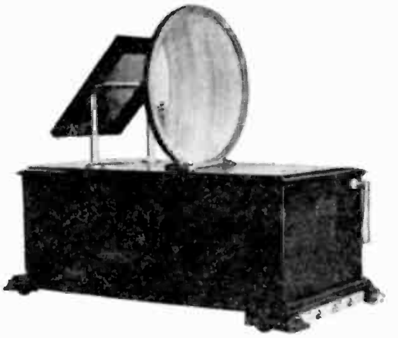


*Fig. 2. Radiovisor for 6 by 6-in. Pictures.*

construction of an inexpensive, practical-sized receiver (Fig. 2) for movie entertainment in the home.

Editor's Note: In this article Mr. Jenkins discusses the disc and drum methods of scanning, pointing out that the latter is a step toward more compact apparatus for television. Another feature of this system is the use of a four-target neon lamp which is required for this scanning method. He employs a moving picture film of the subject to be transmitted and this is received as a moving silhouette. This is the logical starting-point toward solving the more difficult problem of presenting extended views of natural scenes in graduated tones. The practical result of Mr. Jenkins' work has been to induce the radio amateur to experiment with the reception of images.

# How to Overcome Volume Control Difficulties

## A Discussion of Their Nature and of Methods for Solving Them in A.C. Receivers

*By* FRANK C. JONES

AN a.c. receiver offers many difficulties in securing an effective control of volume without affecting the quality or tuning of the set. Control in the audio amplifier, without provision to prevent the detector tube from being overloaded, introduces distortion. Detuning the r.f. amplifier of a selective set decreases the strength of the low frequencies adjacent to the carrier frequency and thus causes an over-emphasis of the high and intermediate frequencies. Varying the filament current with a rheostat soon introduces noise due to corrosion or dirt and is too slow on account of the delayed response of the heavy filament to changes in current.

The use of a variable high resistance in series with the *B* supply is effective in controlling the volume, but varies the plate voltage on all other tubes if a *B* eliminator is used. It also becomes noisy because of the d.c. flow to the variable resistance slider or arm. By keeping the plate current out of the variable resistance it is more likely to remain quiet.

There are several ways of controlling the volume quietly in or ahead of the r.f. stage. Many set builders use the method of antenna volume control shown in Fig. 1 (a). For receivers having little r.f. amplification this is quite satisfactory. In some receivers an r.f. choke is shunted from aerial to ground so as to pass only the broadcast band through to the r.f. amplifier. But unless the receiver is doubly shielded the pick-up from the other stages of r.f. is great enough so that local stations will roar in on the minimum setting for volume.

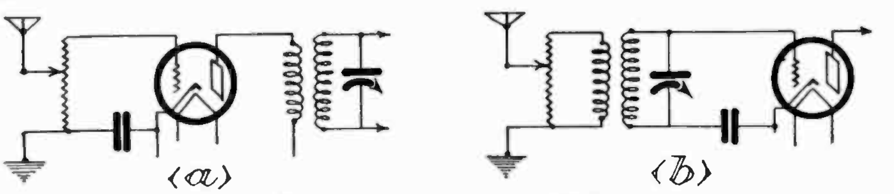



*Fig. 1. Antenna Volume Controls*

Fig. 1 (b) shows a better type of antenna volume control having a tuned input from the antenna to the tube, being in effect equivalent to an additional r.f. stage. However, it has the common fault of not providing any control of volume on local stations if three or four stages of r.f. amplification are used.

Several plate circuit control systems are shown in Fig. 2. The method of Fig. 2 (a) generally gives slightly better control than the arrangement of Fig. 1, because it not only shunts the signal to ground, but also drops the amplification of that stage due to the low plate load impedance. Most of the plate current will go through the r.f. coil primary and not through the resistor because of the former's lower d.c. resistance. This means a fairly quiet volume control and if the variable resistance is constructed so that its resistance varies not directly as the setting but as the square or even cube, then a fairly even control of sound will result. This scheme looks fine but, when the resistance is fairly low, it practically puts a short across the r.f. transformer primary, which in turn lowers the effective inductance of the secondary winding. This means that the tuning will change with volume control setting so that the circuits will not stay lined up for single tuning control. The receiver will tune broadly at one end of the broadcast band or the other, depending upon which end has been lined up properly.

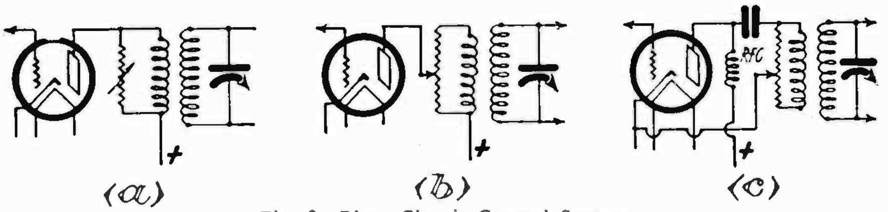



*Fig. 2. Plate Circuit Control Systems*

Fig. 2 (b) gets away from the latter effect but causes a variation of d.c. plate potential with the troubles mentioned at the beginning of the discussion. Fig. 2 (c) removes this fault but costs more, since there is an additional r.f. choke and by-pass condenser. However, this arrangement is far better than any covered so far for receivers having not more than two or three stages of r.f. amplification. For receivers having three or more stages of efficient r.f. amplification, a single control will hardly suffice for local reception. More will be said on that later.

The grid circuit control method shown in Fig. 3 requires at least ½ megohm resistance, while in the previous schemes a maximum value from 5,000 to 25,000 ohms was correct. Fig. 3 (a) gives a scheme which controls the volume very nicely on a receiver using as many as three stages of r.f., with four tuned circuits. It has the bad effect of changing the tuning because of the tube input capacity. At maximum volume setting this capacity is in shunt to the tuning condenser, so this arrangement is not very desirable. If the tuned circuits are lined up for maximum distance reception, the volume will cut off very suddenly as the grid slider is moved down the variable resistance because this circuit is thrown out of line.

Fig. 3 (b) gets around this trouble since the tube input capacity is always across the tuned circuit. However, the same tuned circuit has now a variable resistance across it which ruins the selectivity at lower volume control settings. Generally this doesn't hurt if there are three or four other tuned circuits, since the set will be selective enough to cut all local stations except the one desired.

Connecting a resistance as shown in either Fig. 3 (a) or (b) causes that tuned circuit to be thrown out of line. But if the other tuned circuits have trimmer condensers this may be compensated. The leads to the volume control and the resistor itself have capacities to ground which are across the tuned circuit. The drop in amplification is somewhat noticeable if the maximum resistance is much less than ½ to 1 megohm.

Placing the volume controls between

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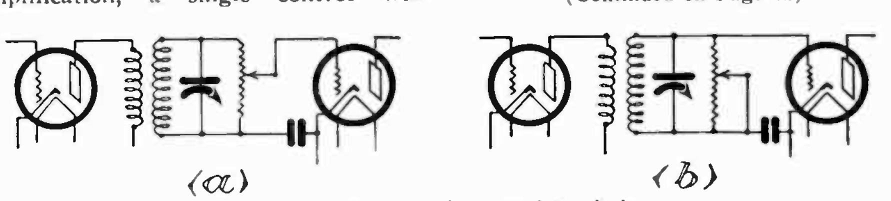


*Fig. 3. Grid Circuit Control Methods*

# The Radio-Frequency Choke

## Its Impedance, Calculation and Measurement

*By* GLENN H. BROWNING

THE function of a radio-frequency choke is to hinder r.f. current passing through that part of the circuit of which it is an integral part. Thus an r.f. choke is connected in series with the phones in a three circuit tuner with a fixed tickler coil and a throttle condenser to keep the r.f. current out of the phones and to force it through the condenser which controls regeneration.

Likewise a choke connected in series with the plate resistor of a resistance coupled audio amplifier keeps out high frequency currents and prevents a tendency to motorboat. A choke may be used as an impedance input from the antenna or it may be used as an impedance coupling between two r.f. stages, as in Fig. 1, so that no neutralization of the tuned stages is necessary.

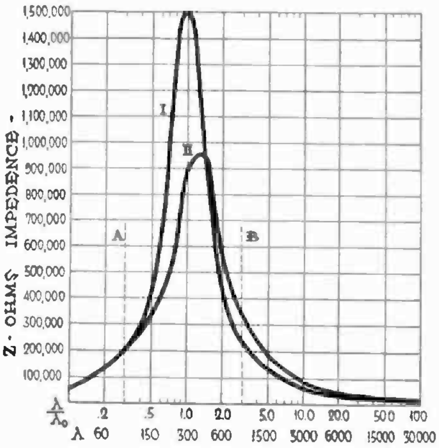


*Fig. 3. General Impedance Characteristics of R. F. Choke*

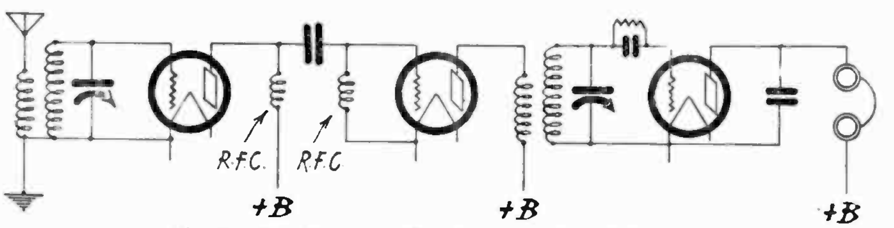


*Fig. 1. Impedance Coupling Between Two R.F. Stages*

In all these uses the writer has found that the important factor in a choke is its impedance to the r.f. current and not merely its inductance, in which terms it is ordinarily rated. The higher the impedance, the better the choke. In most of the cases cited it is also necessary to consider the effect of the tube capacity which may be shunted across the choke, as well as the choke's distributed capacity.

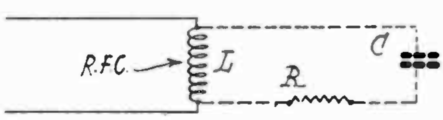


*Fig. 2. Inductance, Capacitance, Resistance Relation in R. F. Choke*

These capacities may be considered as a lump capacity across the winding, as in Fig. 2, which is a tuned circuit whose general impedance characteristics are shown in Fig. 3. Here the impedance is plotted against the ratio $\lambda/\lambda_0$, $\lambda$ being the wavelength at which the choke is being used and $\lambda_0$ the resonant wavelength to which the choke is tuned by its distributed capacity.

In curve I the resistance of the choke is small, while in curve II the resistance is ten times that of curve I. It should be noted that in the case of greater resistance, the peak of the curve shifts to the right and at the same time flattens out somewhat. These are two general curves for the circuit shown in Fig. 2.

The peak of either curve may be shifted as a whole to either the right or left by changing the inductance or distributed capacity of the choke. It is observed that the highest impedance to r.f. current may be obtained by so designing the choke coil that it will be used over a wavelength spectrum represented by the dotted lines *A-B* in Fig. 3.

Now that the theoretical possibilities of the radio-frequency choke have been examined, it remains to obtain some easy laboratory method of measuring their impedance and then by the cut and try method to design a choke which as nearly as possible gives the same characteristics as shown in Fig. 3.

The direct method of attack on the problem of measuring efficiency would be to put an r.f. voltage of the desired frequency across the choke and measure the current flowing through this circuit. In the average laboratory this is not possible, for an r.f. oscillator with a 210 tube will not supply much more than 150 to 100 volts without coupling very closely to the oscillatory circuit. Therefore, if the choke has an impedance of only 50,000 ohms, the r.f. current to be measured would be 2 m.a. This could be read by various means but not readily on a Rawson thermal multimeter, which is as sensitive an a.c. meter as most laboratories have available.

In trying to measure small radio-frequency currents it occurred to the writer to measure the voltage across a fixed resistance by means of the vacuum tube voltmeters and the method was found to be satisfactory and applicable to all cases where a sufficiently large impedance was already present in the circuit so that the addition of 5000 ohms or so was immaterial. The average vacuum tube voltmeter is capable of good accuracy from about .1 to 4. volts. Thus a current of 2 m.a. through 1000 ohms would be very easy to read. The resultant circuit used is shown in Fig. 4.

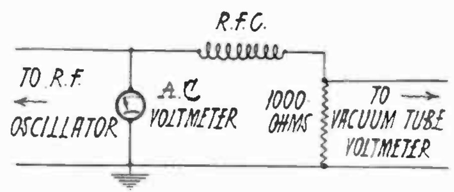


*Fig. 4. Circuit of R. F. Measurements*

An a.c. voltmeter reads the incoming voltage while the current through the resistance *R* may be readily calculated from the vacuum tube voltmeter readings.

The results of the measurements on a number of commercial chokes are shown in Figs. 5 and 6. In Fig. 5, the impedance of the chokes is shown without any external capacity placed across them. It is readily seen that choke No. 1, which was designed by the writer after a study of the theoretical possibilities, is somewhat superior to the others, having an impedance as high as 1,500,000 ohms from 300 to 350 meters and more than 200,000 ohms at its lowest point. This choke is being worked at exactly the right place as may be seen by reference to Fig. 3, while it would seem that choke No. 4 is being worked at higher wavelengths than it was designed for. Choke No. 1 has an inductance of 10 m.h., yet its impedance is higher than chokes having an inductance as low as 2.6 m.h. and as high as 168 m.h. It is queer that manufacturers should rate their chokes by inductance, which may or may not mean anything, instead of the average impedance over the wavelength band for which they are designed.

Now let us examine the impedances of these same chokes when a condenser, comparable to a tube capacity, is placed

(Continued on Page 45)

# Help for the Radio Trouble-Shooter

## The First of a Series of Articles Concerned with the Details of Servicing A.C. and D.C. Receivers

*By* J. GARRICK EISENBERG

THE advent of the a.c. receiver has intensified public criticism of the inability of some service men to correct the faults that a radio set occasionally falls heir to. So a few constructive suggestions on radio servicing should not be amiss. These include a discussion of the a.c. tube, an orderly scheme for checking trouble, and a description of apparatus which can be used without having to reach parts which are difficult of access in many of the modern receivers.

There are two types of tubes whose filaments are heated with alternating current. These are ordinarily known as the '26 type, for amplifier work, and the '27, or heater type, for use either as a detector or an amplifier.

The filament of the '26 type is connected directly to a low voltage a.c. source. Thus the grid return and the negative *B* return are connected to the a.c. supply. It is low in cost and reasonably efficient. As its filament has high inertia to movement, the a.c. fluctuations have less effect upon the electronic arrangement inside the filament structure than in the case of the usual d.c. filament. However, some fluctuation does occur and is repeated in the form of a 60-cycle plate current variation, if the tube acts as a rectifier in even the tiniest degree.

Thus it is imperative to maintain the operating point always within the straight line characteristic of the tube. Slight variations from this point, which might be permissible from distortion considerations with the d.c. filament type, will result here in a pronounced a.c. hum.

Receivers which develop such a hum, not directly traceable to the *B* eliminator, may be remedied by inserting a series grid resistance, permitting the adjustment of grid bias at will, dependent upon the applied plate voltage, so that the operating point can always be maintained on the straight line portion. A scheme for such an arrangement is shown in Fig. 1.

The resistance in series with the negative *B* return affords a negative drop, i. e. the point $X$ will be more negative than the point $Y$. The value for $R_1$ is found from Ohm's law: the normal plate current being known the amount of voltage drop through $R_1$ is the product of $IR$. A 2-volt negative bias would be obtained, for example, if the plate current is 10 milliamperes by the use of a 200-ohm resistor ($E/I=R$).

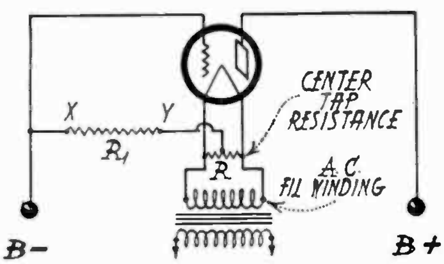

*Fig. 1. Use of Grid Series Resistance to Minimize A.C. Hum*

The center tap filament resistor is necessary because when the filament potential is reversed, with respect to either side of the filament, there would be a movement of electrons from the minus-*B* return to whatever side of the filament happened to be positive at the moment, if the *B* return were connected to one side of the low resistance filament. This would result in a perpetual unbalance and produce a hum dependent on this change of direction of electrons around the filament. The *B* return is therefore connected into the exact electrical center of the filament so that the movements in either direction will cancel.

To accomplish this purpose, *R* is of such proportions that the movement through it will be relatively small compared to the movement through the filament (the filament resistance is only about 1.4 ohms). For the sake of flexibility, *R* should permit of variation of the center tapping contact.

The '27 tube is more desirable and more expensive. It does not require any balancing scheme for elimination of a.c. hum, since the a.c. circuit is entirely isolated from the radio circuits proper. It uses a cathode or heater element which contains the electron-emitting substance, the a.c. filament serving merely to heat this can-like device placed around it. The cathode, being the electron-emitting source, has the grid return and negative *B* return brought back to it, for completion of the circuit. Whatever fluctuations occur in the a.c. supply, therefore, can be disregarded, with respect to filament unbalance, since the actual heating of the cathode will be uniform regardless of directional variations around the filament proper.

It might be pointed out, however, that, under this scheme, there is no way to obtain a positive bias on the grid, for detector purposes, except through the use of an external battery. Plate rectification is consequently used, the grid operating on a negative bias, and the familiar gridleak-condenser arrangement not being used.

A somewhat more sensitive detector stage may be had by wiring a gridleak and condenser into the circuit, and connecting a small battery between grid and cathode to give a positive bias.

The rest of the a.c. receiver circuit is practically identical with that of a battery-operated set, except that an additional r.f. stage is often added to make up for the lack of sensitivity of the present a.c. circuit arrangements. So we can now consider actual circuit troubles and methods of analyzing these. To do so we must first determine the test equipment necessary to our purposes.

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A MODERN test set must include a high resistance voltmeter having several low and high reading scales; a low and high reading milliammeter, and a low-high range a.c. voltmeter. To incorporate these several meters into the kit may mean not only a cumbersome, but an expensive arrangement, if separate meters be used for each individual purpose. But multi-scale meters are now available at reasonable cost, so that two such meters should suffice for all a.c. and d.c. tests. A multi-scale d.c. meter may easily be constructed from an inexpensive 0-10 milliammeter; a 0-100 m.a. scale may also be calibrated for this meter, by the use of a suitable shunt. We will again diverge somewhat from our main purpose to describe briefly how such a meter may be calibrated.

Ammeters are invariably wound with a few turns of low resistance wire so that they do not offer much difference of potential across their terminals. The amount of current flowing through the meter winding depends directly upon this resistance. Sensitive meters are constructed with an external resistance in parallel, so that only a tiny proportion of the actual measured current flows through the meter itself, its scale being calibrated for proportionate current flow.

If a 0-10 milliammeter be shunted with a smaller resistance, which permits only one-tenth as much current to flow through the meter winding as through the resistance, then the original scale may be used to read in multiples of 10. The shunt resistance must be of such an order that it will pass 100 milliamperes without heating or changing its resistance characteristics; it must be very accurate; and the actual calibration for the 0-100 m.a. scale should be checked with a known standard.

To use the meter as a voltmeter, it will be necessary to add resistance in series with it. The 0-100 m.a. shunt is opened now and, since the external series resistance will be large, the actual resistance of the meter winding can be disregarded in the calculations.

According to Ohm's law, the unknown voltage $E$ is equal to the product of a known current flow $I$ and a known resistance $R$: $E = IR$. The current $I$ also flows through the meter winding, so that the ammeter can be calibrated as a voltmeter having, say, a resistance of 1000 ohms per volt. Then, since $I = E/R$, with 1000 ohms in series with the meter winding, an indication on the meter scale of 1 milliampere would mean an applied voltage of 1; with 10,000 ohms in series with the meter, 1 milliampere would indicate an applied potential of 10; 2 m.a. a potential of 20 volts, etc., etc.

As many different values of resistance as desired may be used to secure a multiscale meter invaluable for checking $B$ eliminator voltages, for making emission characteristic tests, and for any use where a high degree of accuracy is requisite. The resistors should be secured from some reliable laboratory and marked for the percentage of error present. They must be designed for a wide margin of current-carrying capacity over ordinary load conditions, otherwise they may change in value when in use.

In the test set designed by the author, a standard d.c. test unit was used, as time did not permit the necessary recalibration work. For a.c., however, two meters—one a 0-3 and 0-15 range, the other a 0-150 volt range—were used, affording a somewhat more flexible and less expensive assembly, and also permitting a more symmetrical panel arrangement, than if one single multi-scale a.c. meter had been used.

The internal connections of the d.c. test unit are shown in Fig. 2, but no attempt has been made to preserve strict accuracy here. For example, the external binding posts for d.c. voltmeter connections have been omitted, as they simply parallel the internal voltmeter circuit. The 0-500 volts resistance has been purposely left incomplete, so as not to complicate the wiring. This connection is identical with the 0-100 volt resistor.

Either a.c. or d.c. voltages may be measured at a tube socket by plugging in the cord connecting to the terminal block. The double-throw double-pole switch makes the necessary changeover for d.c. or a.c. meters.

The 0-100 milliampere shunt is not in use when the voltmeter connection is made. The unit permits of reversed filament and grid readings being made, by a pushbutton arrangement also omitted. This simply reverses the meter terminal connections at will.

Additional apparatus in the test set includes (1) a tube rejuvenator, (2) an oscillator for accurate circuit adjustments, and which may be used as the driver for a laboratory beat frequency oscillator if desired, and (3) a high quality comparison amplifier, the uses for which are manifold. A load resistor has also been arranged in series with the milliammeter and provided with a cut-out switch, so that load conditions may be simulated for checking the output voltages of battery eliminators. This auxiliary equipment and the uses therefor will be described in detail, except for the rejuvenator, whose purpose and use should be obvious. The wiring arrangements are shown in Fig. 2.

A detailed description of the procedure to be followed in finding and correcting the troubles which may develop in a receiver is given in the next installment of this series, to be published in January RADIO. This includes a full account of the methods for using the test set whose circuit diagram is here given, especially the comparison amplifier and the oscillator.

(To be continued)

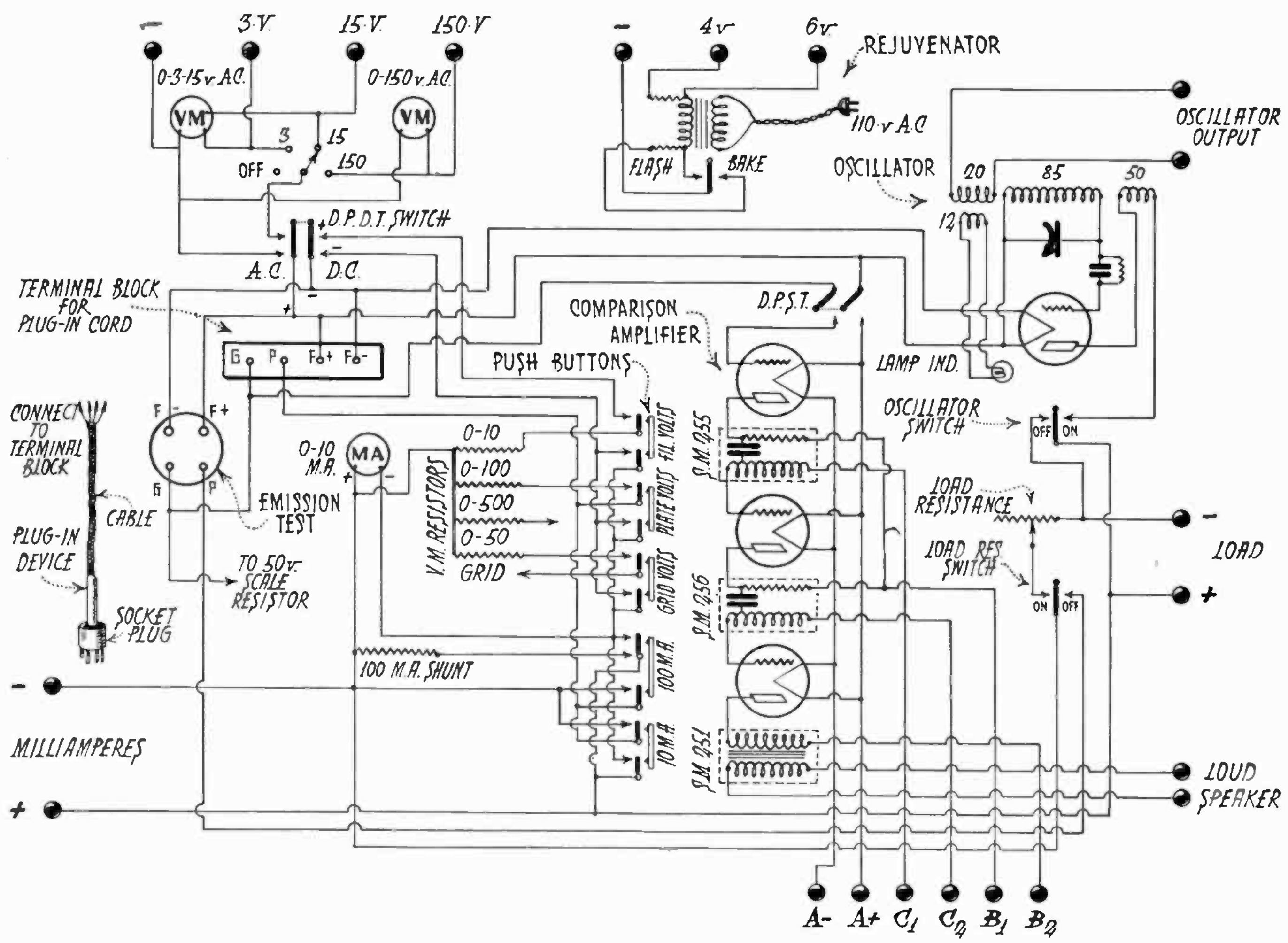


*Fig. 2. Circuit Diagram for Complete Test Set*

# TECHNICAL BRIEFS

VERY low frequencies are seldom heard in chain broadcasts, because the connecting telephone lines are equalized to give a fairly flat characteristic between 100 and 5000 cycles per second, with a sharp cut-off beyond these limits, especially on the lower end. Furthermore most radio sets and loud speakers cut off above 100 cycles per second.

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A HEATER type '27 a.c. tube will operate with longer life on 1.9 to 2.0 volts than on 2.5 volts. It takes two or three times as long to heat up, but once hot, operates practically the same as at the higher filament voltage. The insertion of a small heavy duty resistance in series with the filament leads from the power transformer will adapt almost any a.c. tube receiver for operation with lower filament voltage. The resistance can be calculated from Ohm's Law. Similarly a '71 or 112 tube will operate satisfactorily at 4.7 volts instead of the usual 5.0 volts with correspondingly greater life. The type '50 and '10 tubes will operate much longer with 6½ to 7 volts with practically negligible effect on the sound output.

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AN 0-10-ohm filament rheostat shunted directly across the moving coil of a dynamic loud speaker provides a convenient "hum" reducer at low volume of sound. Even a good a.c. receiver, with volume control in the r.f. amplifier, may have quite a bit of hum which is objectionable for soft music. Shunting the moving coil with a 4 to 8-ohm resistance will reduce the hum to nearly half of its usual intensity. Because the impedance of the moving coil increases with frequency, this scheme may reduce the high frequency response too much. So a better scheme is to use a few dozen turns of No. 26 wire wound on a ¼-in. diameter iron bolt. Two or three taps will allow the most suitable number of turns to be found and this will give more uniform response from the speaker than when using an ordinary resistance.

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MOST dynamic speakers have a low-pass filter connected across the primary of the stepdown transformer. This filter generally consists of a series inductance of from 100 to 200 millihenries and two shunt capacities of .01 to .02 mfd. It is designed to cut off at about 3500 cycles so that there is practically no response above 4000 cycles per second. This tends to so over-emphasize the low notes that some people dislike a dynamic loud speaker because the reproduced voice does not sound natural. This filter is ordinarily incorporated because it apparently reduces the overloading effect when a '71 tube is used with 120 to 150 volts, instead of the recommended value of 180 volts on the plate. Larger power tubes with proper voltages do not require such a filter and consequently give a brilliance of music and speech which is otherwise lacking.

Overloading may also be avoided by increasing the voltage applied to the field windings. Recent tests with several makes of dynamic speakers showed an increase of sensitivity of about 3 DB (or TU) when the voltage was increased from 6 up to 9 volts, thus calling for but half the power output from an amplifier to give the same undistorted sound output from the speaker.

Many a.c. models now use rectifiers which give from 7½ to 12 volts across the field winding, thus giving a much more intense field across the air gap in which the moving coil is located. Increasing the current from 40 milliamperes to say 60 or 65 milliamperes through the field winding of the high-voltage type field, will increase the sensitivity 2 to 3 DB in most makes which are rated for 40 mils.

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THE difficult problem of measuring antenna resistance for frequencies between 4,000 and 20,000 k.c. has apparently been solved by the pyrometer method of determining vacuum tube efficiency. Resistance is equal to power divided by current squared. The current is measured directly at the current node of the antenna. The power is measured indirectly as the difference of the tube output for the same current when the antenna is connected and disconnected.

The pyrometer method, as described by Crossley and Page in the I. R. E. *Proceedings* for October, 1928, secures identical temperature measurements of the outside glass wall of a vacuum tube when it is oscillating, with a known d.c. plate watts input, and when it is not oscillating, with a different watts input. The difference in wattage between the two measurements represents the r.f. output power. The temperature of the glass wall is measured with a Cambridge surface pyrometer, which is essentially a flat strip thermocouple and millivoltmeter.

This method is also applicable to the measurement of condenser and coil resistances and the efficiency of vacuum tube circuits at various frequencies. Thus tests show that a 250-watt three-electrode tube is a more efficient amplifier at high frequencies than is a shield-grid tube of the same size.

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AUDIO frequency transformer curves frequently show excellent low and high frequency characteristics which are not duplicated from a good dynamic loud speaker. Most of these curves are made when operating out of a 10,000 ohm impedance, representing an amplifier tube, and operating into a vacuum tube voltmeter instead of an amplifier tube. A vacuum tube voltmeter has a very low input capacity, much lower than an amplifier tube, since the plate circuit of the former has nearly zero impedance.

The input capacity of a tube depends on the plate circuit load effective resistance as shown by the expression

$$C = C_{g\text{-}f} + C_{g\text{-}p}\left(1 + \frac{\mu R_2}{R_p + R_2}\right).$$

For a tube voltmeter the second part of the equation is not much greater than the static grid-to-filament capacity $C_{g\text{-}f}$. However, for an amplifier tube, the second term may become 10 to 50 times as great as $C_{g\text{-}f}$ alone and it is this total capacity which is in shunt to the audio transformer secondary. This large capacity, 50 to 100 mmfd. in shunt causes a drop in the higher frequencies, or sometimes a peak with some transformers, which is not apparent in the curves measured on single transformers.

Again, when a transformer works out of a detector tube, the plate resistance is not 10,000 ohms, but is from 15,000 to 30,000 ohms, depending on the type of tube used. These values are for grid-leak detection, since the plate impedance may be from 50,000 ohms up to several hundred thousand ohms for plate detection. The value of 20,000 ohms, with an average 201A used tube as a detector, causes a drop in both high and low frequencies. The drop in low frequencies is due to the fact that the primary impedance of a transformer decreases with decreasing frequency and so a greater percentage of the audio frequency voltage available from the detector is lost in the plate impedance of the tube. Naturally, the higher the impedance of the tube the greater the loss of low frequencies.

The loss in high frequencies when the tube impedance is higher, such as in a detector tube, is harder to comprehend. Perhaps it can best be explained by the fact that most audio transformers depend for their high frequency response upon the effect of resonance between the leakage reactance of the transformer and the distributed and shunt capacities to ground. The leakage reactance can be represented as an external inductance in the primary circuit and so naturally the resonance effect is lessened by having a larger resistance, $R_p$, in series with the circuit. This means less voltage to swing the grid of the following tube on the higher frequencies.

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THERE have been several requests for a circuit using a.c. tubes, and as many of the parts from old 8-tube loop type superheterodynes as was possible. Assuming that the arrangement of parts, including panel apparatus, is the same as that in the d.c. model described in the October RADIO, the circuit shown in Fig. 1 indicates what changes in the circuit will be required for a. c. tubes. The r. f. amplifier, oscillator, mixer, detector and first audio tubes are of the heater type, the shielded grid tube having a 2½ volt heater the same as for the type 27-tube, and thus requiring a five prong socket, as would also be needed for the other tubes mentioned. The only tubes using raw a.c. on the filament will be the three i.f. amplifier tubes and the power tube, so that five a. c. five prong sockets, and four ordinary four prong sockets will be necessary. It is important to use an a.c. filament transformer having sufficient power output to supply five a.c. heater type tubes, the total current drain from the 2½-volt winding being about 7 amperes. The volume control is somewhat different from that employed in the d.c. model, but is nevertheless effective.

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SEVERAL of the new a.c. receivers obtain good reproduction with only one stage of audio frequency amplification. This is secured by using plate detection with a very high negative bias on the grid and no grid leak and condenser. The detector supplies from 10 to 30 volts to the grid of a power tube.

While this gives a slight decrease in sensitivity, since the detector does not operate effectively as an audio amplifier, a much greater output is obtained. An additional stage of r.f. amplification is necessary.

With a '27 type of tube as a detector there should be 180 volts on the plate and a negative bias of at least 40 volts on the grid. The tube operates on the lower portion of the grid voltage, plate current curve, and so approximately follows the square law. If it operated purely on the square law theory, there would be no distortion. However, the slope of the curve is not absolutely constant, especially on greater output voltages, where the tube begins to operate on the straighter portion of the curve. This causes second harmonics of the audio tones, but these are not discernible until they reach a magnitude of from 20 to 30 per cent of the fundamental tones in ordinary radio reception.

The detector tube has about 70,000 ohms plate impedance when thus used. This is too high to work into the primary of an ordinary audio transformer, as all of the low notes, as well as high notes, would be lost. This difficulty is overcome by using resistance or impedance coupling or a specially designed transformer with a resonated primary to prevent loss of the low frequencies. Even shunting the primary of a very good audio transformer with a resistance of from 30,000 to 100,000 ohms helps to flatten out the frequency characteristic with only a small increase of second harmonic distortion and decrease of signal strength.

The advantages of this scheme are less a.c. hum in a.c. receivers and cheaper construction in the receiver power pack.

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FILTER condensers can be protected against voltage surges, and consequent blowout, by shunting each section with a ½ or 1 megohm grid leak which has good heat-radiating properties. The voltage-divider resistance is sufficient to protect the end condenser, but the others may be blown by a large surge unless protected. Their filtering action is not impaired. The same idea may be used to prolong the life of a loud-speaker filter, as the speaker windings cannot be damaged by a direct current of less than 1 milliampere, which flows to ground or filament.

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FOR small detector tube output voltages grid-leak and condenser detection has been shown to cause a loss of the higher frequencies. The input impedance of a detector tube is fairly high even when the grid leak is brought back to the positive side of the filament, so the higher frequencies are shunted to ground by the grid condenser. Using a ½ megohm grid leak and a .0001 or .00005 mfd. grid condenser will lessen this effect. However, the loss in overall signal strength is quite noticeable and an additional stage of r.f. amplification is generally necessary to make up for it.

This method is not recommended for a receiver whose audio amplifier has a decided peak on the higher frequencies, as the higher piano or violin notes will be over emphasized. The quality on distant reception is also likely to be poorer, due to increased regeneration in the r.f. amplifier. The best test for the average person is to replace the present detector grid leak in his receiver with a ½ megohm size and listen for improvement or decrease in quality on local reception.

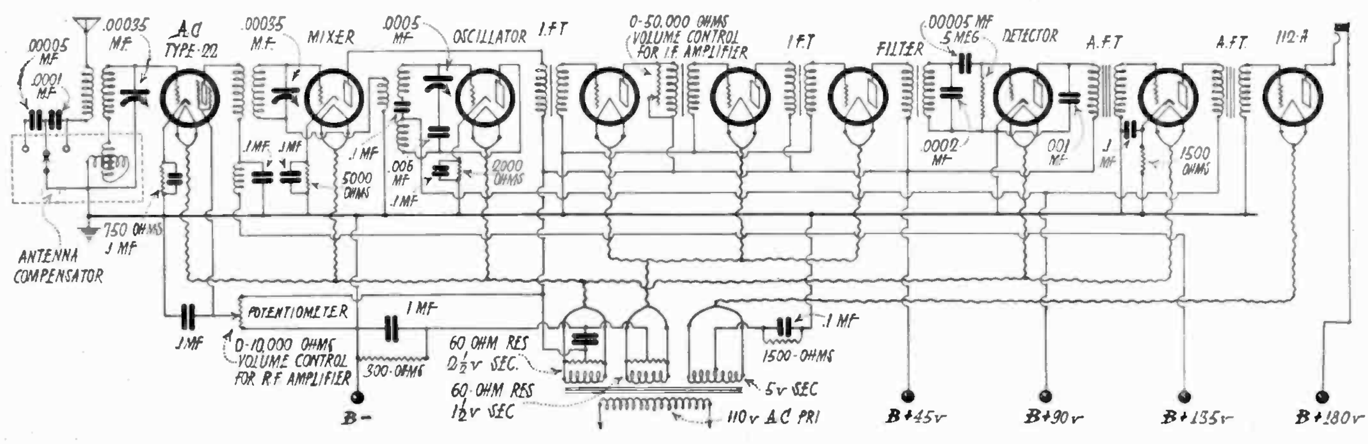



*Fig. 1. Circuit Diagram for 45,000 Cycle Superheterodyne with A.C. Tubes*

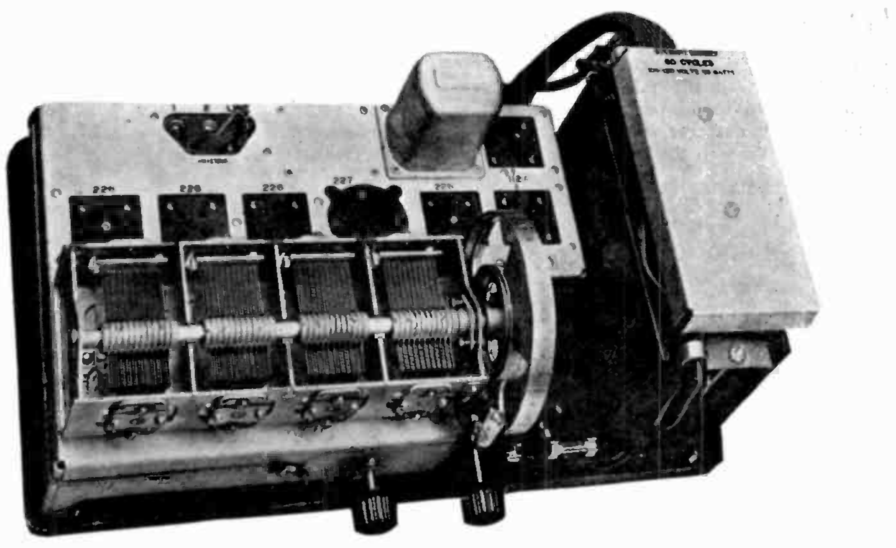
# Inside Stories of Factory Built Receivers

## Stewart-Warner Model 801, Series "B"

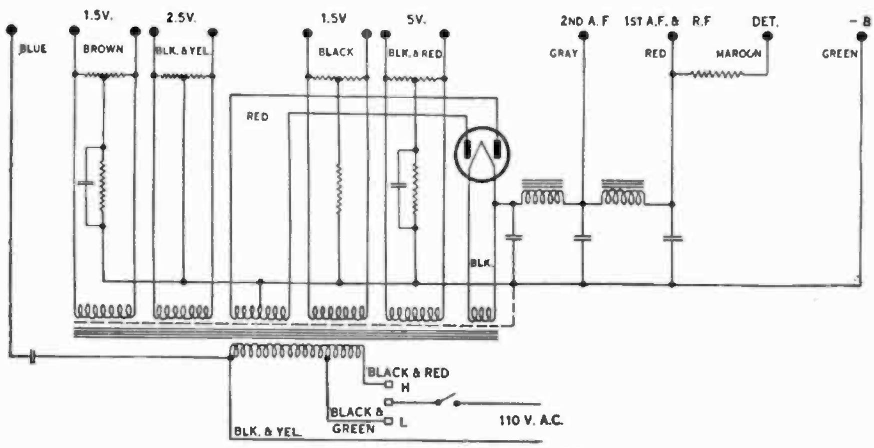
This is a six-tube receiver with built-in power plant. The three r.f. stages and the first audio use '26 type of tubes, the detector a '27 type, and the second stage of audio two 112-A tubes in push-pull connection. The power plant supplies 1½, 2½ and 5 volts a.c. for filament supply and, by means of a full-wave tube rectifier of the '80 type, supplies 45, 67, 90 and 135 volts d.c. for plate voltage and — 4½ and — 9 volts grid bias.

The set is tuned by means of one knob-controlled drum dial which is calibrated in wavelengths and operates from gang condensers, as may be seen in the picture or circuit diagram. It has a built-in light-socket aerial for local reception and is also equipped for connection to an outside aerial for long-distance reception.

Especial care has been taken to make the condensers sturdy and permanent in adjustment. No trimmers are used nor is any adjustment necessary. The r.f. coils are tested for accuracy by means of crystal-controlled oscillators.



*Stewart-Warner Model 801 Chassis*




*Circuit Diagram of Stewart-Warner Power Unit*

The audio stages are transformer coupled and have an output transformer to protect a magnetic cone speaker. The transformers are designed for minimum coil saturation, and their impedances are accurately matched to the input and output of the tubes with which they are used. A two-tip receptacle is provided for the attachment of an electrical phonograph pick-up unit.

The power-unit is enclosed in a shielded cabinet attached to the main baseboard. Provision is made for high and low voltage taps between 105 and 130-volt supply, 50 or 60 cycles. This is accomplished by placing a safety fuse in one of two positions. The manufacturer emphasizes the fact that dry condensers are used in the filter system.

The entire set is housed in a heavy metal cabinet, 16¾ by 10⅜ by 7¾ in., decorated in gold and bronze. The escutcheon plates are of polychrome bronze and the control knobs of walnut bakelite. The cabinet shields the entire electrical assembly.

The Model 811 A C receiver is identical with the Model 801 except that it is designed for operation with 25 to 40-cycle current, 105 to 130 volts. The Model 806 is the same except that it uses d.c. 5-volt tubes. Models 801-A and 811-A have cabinets whose covers are drilled for mounting a Model 435-A speaker.

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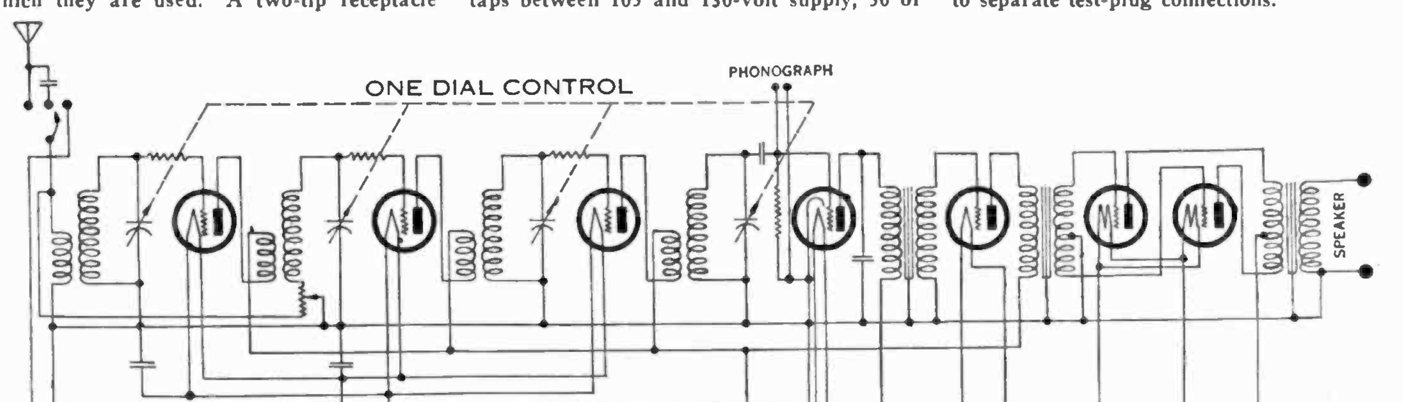
Errata Notice.—The circuit diagram of the portable a.c.-d.c. test kit on page 35 of October Radio shows both terminals of the a.c. voltmeter connected to the same terminal on the socket. This is obviously an error on the draughtman's part as Mr. H. W. Andersen's original circuit was correct. The voltmeter terminals should be connected to separate test-plug connections.




*Circuit Diagram of Stewart-Warner Model 801, Series "B"*

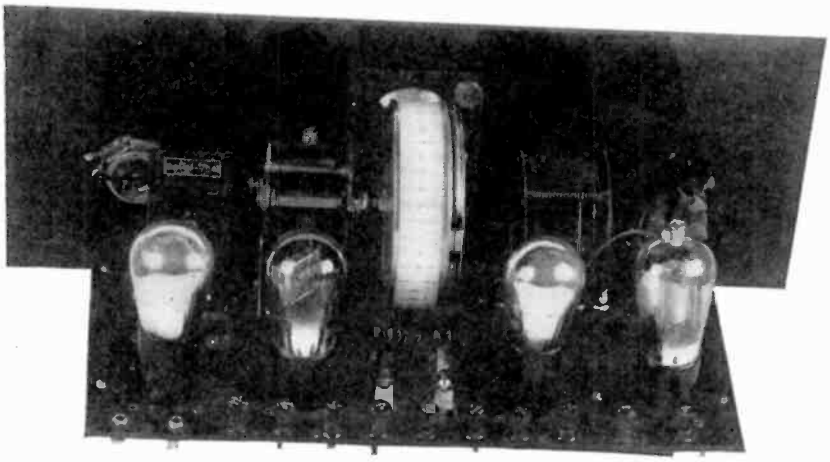
# Radio Kit Reviews

## AIR KING SHORT-WAVE RECEIVER

This list of parts provides a complete four-tube set for the reception of short-wave broadcast programs. It uses a screen grid 322 tube in the r.f. stage to increase sensitivity and avoid oscillation, a high mu 340 tube as a detector, a 301A tube with resistance coupling in the first audio stage, and a 112A power tube with transformer coupling to provide loud-speaker volume from the second audio stage. The set may also be used for the reception of code and television.

The assembly is easily made from the parts and printed directions which accompany the kit and presents a very neat appearance. The panel has but three controls: the drum-tuning dial or selector, the sensitivity knob, and the volume knob.

As may be seen in the circuit diagram of Fig. 1 the r.f. stage is aperiodic. An r.f. choke of from 85 to 125 millihenries is used as an antenna input inductance. The grid bias for the screen grid tube is obtained from the voltage drop of $R_3$, which is in series with the detector filament. This is 1.7 volts negative, whereas if the drop were taken from $R_1$, in accordance with the usual custom, the grid bias would be 2.7 volts and would necessitate the use of a tapped resistance at $R_1$. Both the screen grid and the plate voltage source of the r.f. tube are by-passed to the negative side of the filament, each through a .006 mfd. condenser.



*Rear View of Air King Short-Wave Receiver*

The Air King short-wave coil kit is used as a tuning unit. This kit has three windings, inductively coupled, and is designed for use in the regular three-circuit regenerative receiver. $L_1$ is the coil that is usually used as the secondary, and it is tuned by a .00014 mfd. variable condenser. $C_4$ is an isolating condenser designed to keep the plate voltage off the grid of the detector tube. Its capacity is .0005 mfd. and it should have a dielectric of mica.

$Ch_2$ is another high impedance r.f. choke of from 85 to 125 m.h. $L_2$ is the adjustable coil, usually used as the primary, in the coil kit. Closely coupled to it is $L_3$, the plate coil, or tickler. Regeneration is controlled by the variable feedback condenser $C_6$, which is of the midget type and has a capacity of .0001 mfd. The rotor of this regeneration condenser, hence the filament of the detector tube, is grounded, a feature which eliminates body capacity.

A 65 m.h. choke is used to couple the plate of the detector coil to the input of the audio frequency amplifier. $C_8$ should be a mica condenser, as it must keep the plate voltage off the grid of the first audio tube. A negative bias of 3½ volts from a $C$ battery is imposed on the grid of this tube while 9 volts from the $C$ battery are used as a grid bias for the second or transformer coupled audio stage.

## AN AUDITORIUM POWER AMPLIFIER AND DYNAMIC SPEAKER

This outfit is designed for those who want good quality of reproduction at very great volume. The voltage amplification of each

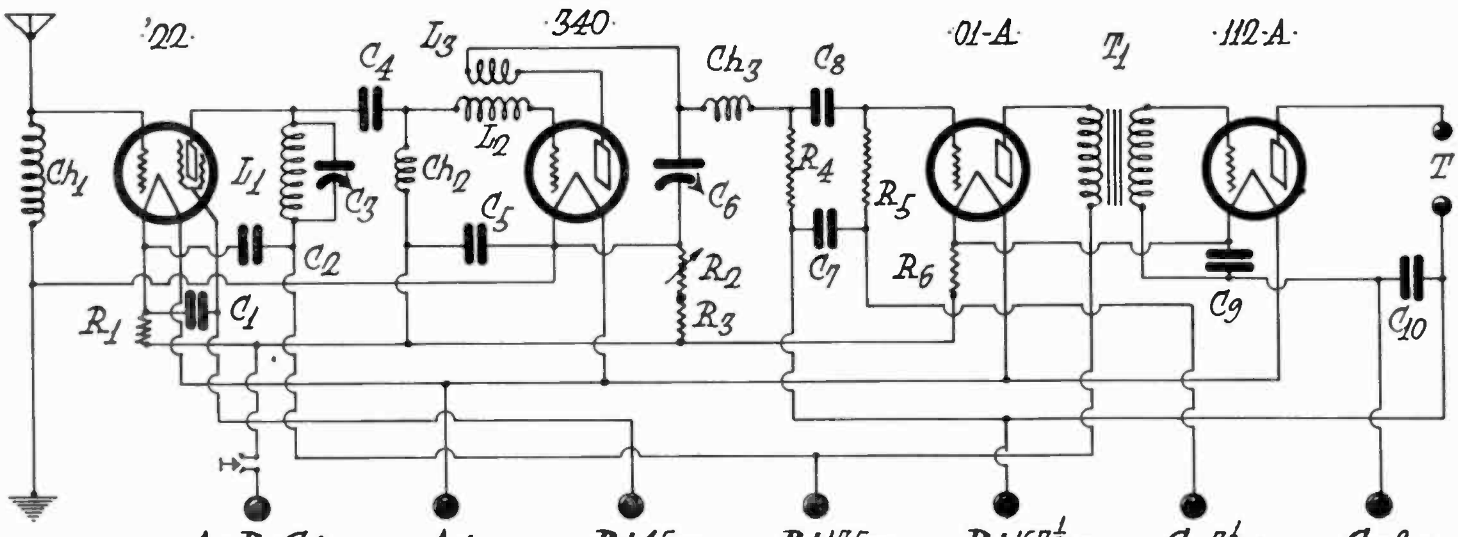



*Fig. 1. Circuit Diagram of Air King Short-Wave Receiver*

$Ch_1$, $Ch_2$—R. F. choke coils, 85 to 125 millihenries.

$Ch_3$—One 65-millihenry r.f. choke coil.

$R_1$—One 622 amperite.

$R_2$—One 20-ohm rheostat, with switch $S$ built-in.

$R_3$—One 1A amperite.

$R_6$—One 112 amperite.

$C_1$, $C_2$, $C_5$—Three .006 mfd. mica fixed condensers.

$C_4$—One .0005 mfd. mica fixed condenser.

$C_3$—One .00014 mfd. variable condenser.

$C_6$—One .0001 mfd. midget type variable condenser.

$C_8$—One .01 mfd. mica fixed condenser.

$C_7$, $C_9$, $C_{10}$—Three .5 mfd. by-pass condensers.

$L_1$, $L_2$, $L_3$—One set of three Air King short-wave coils, 17 to 133 meters; each coil as the two specified windings, the third being built in the coil receptacle.

$R_4$—One 0.1 meg. resistor (with mounting).

$R_5$—One 2 meg. resistor (with mounting).

$T_1$—One audio frequency transformer.

$TJ$—One pair of tip jacks.

Nine binding posts (Ant., Gnd., A minus, B minus, C plus, A plus, B plus 45, B plus 135, B plus).

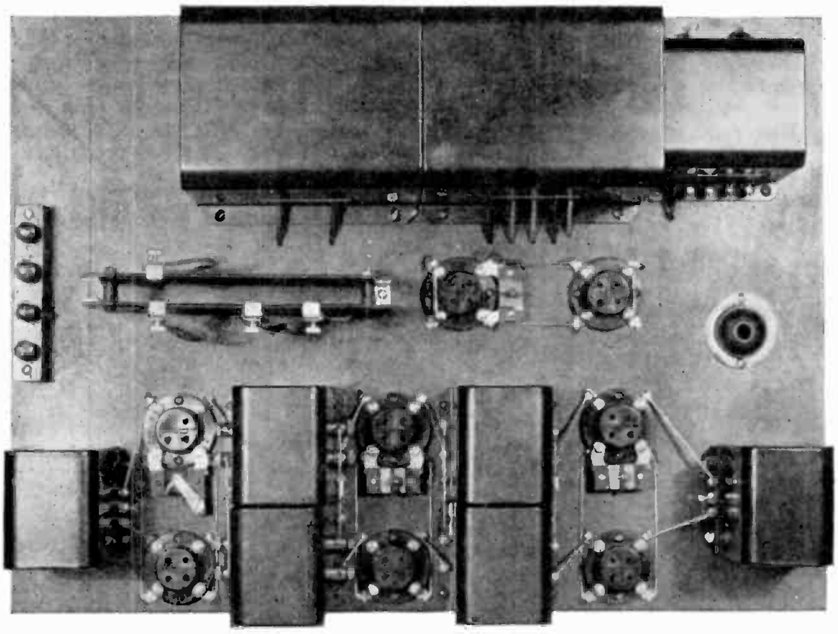
One dial, one knob for rheostat, and one knob for regeneration condenser.

One 7x18 in. front panel.

One 7x14 in. subpanel.

Four sockets.

One small angle bracket for securing tuning condenser to subpanel.



*Top View of the Assembled General Radio Amplifier Kit*

stage furnishes the correct input to the following stage, thus allowing all tubes to work at their normal capacities. Push-pull amplification has been used in all three stages, not only to increase the amplification, but also to minimize the a.c. hum.

One push-pull transformer was used in the input circuit of the first pair of tubes. These tubes are of the '26 type with 135 volts on their plates. They are in turn coupled to the next pair of '26 tubes through a pair of double impedances. It will be noted that the primaries and secondaries of the two impedances have been connected in series, the two *B* plus posts being connected together and forming the center tap for the primary, and the two filament posts similarly connected to form the secondary center tap.

The second pair of '26 tubes, with 180 volts on its plates, is coupled through transformers to the final pair of 350 tubes, whose plates are supplied with 450 volts. A push-pull output transformer designed for

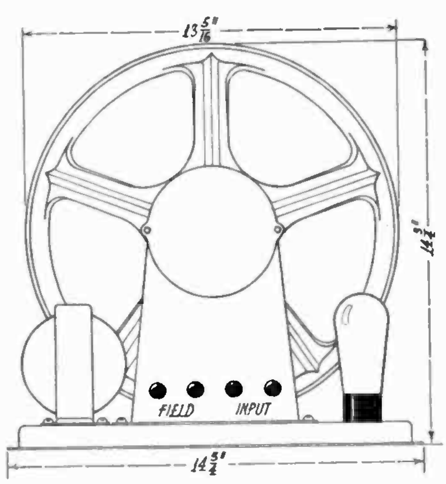



*Fig. 2. Constructional Plans for the Jensen Auditorium Model Dynamic Speaker*

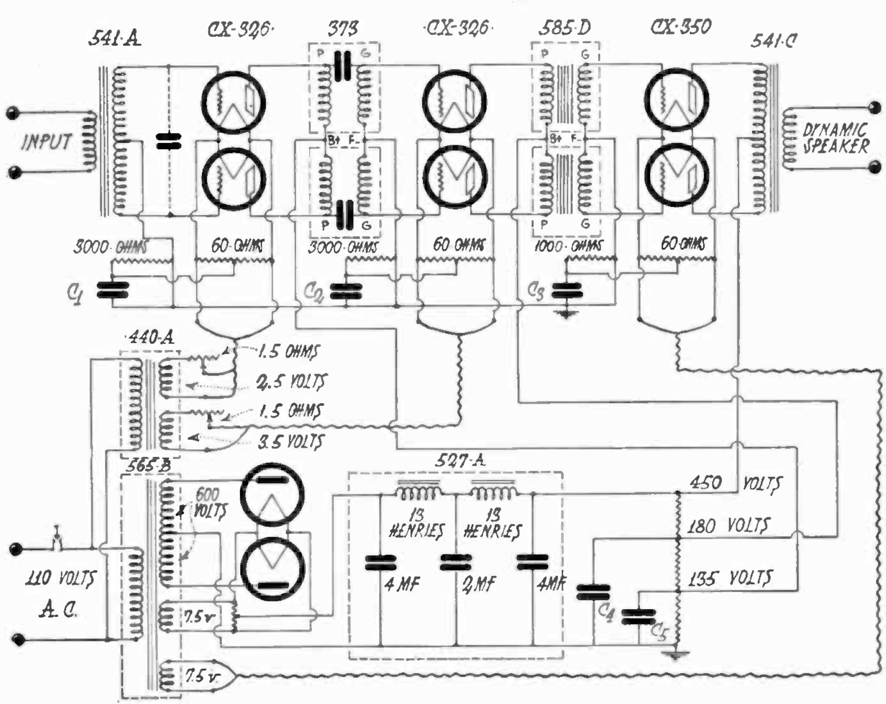



*Fig. 1. Circuit Diagram of the Power Amplifier*

the ordinary dynamic speaker handles the output of the third stage.

Power is supplied from a 600-volt, full wave transformer, and rectified by two '81 tubes. The chokes and condensers comprising the filter are all included in one metal case, which may be seen to the left of the power transformer at the top of the picture. The filament transformer is at the right. Two G. R. No. 446 voltage dividers are used in series, having a total resistance of 33,000 ohms, and from these are taken the plate taps for the three stages in the amplifier as well as any other *B* voltages needed for the radio set. All connections are made under the baseboard, which stands high enough off the table to hold the by-pass condensers.

The *C* bias for the first two stages is obtained from the drop through 3000 ohm resistances connecting the filament center taps to the grid returns and minus-B lead. One thousand ohms are used in the last stage. In each case a 2 mfd. condenser shunts the resistance.

**LIST OF PARTS FOR AMPLIFIER:**

- 4 Arcturus 126 tubes
- 2 CX 350 tubes
- 2 CX 381 tubes
- 8 G.R. tube sockets
- 1 G. R. 541A input transformer
- 2 G.R. 373 double impedances
- 2 G.R. 585D amplifying transformers
- 1 G.R. 541C output transformer
- 2 3000-ohm Electrad resistances
- 1 1000-ohm Electrad resistance
- 5 2 mfd. by-pass condensers
- 2 G.R. 446 voltage dividers
- 1 G.R. 440A filament transformer
- 2 1.5-ohm rheostats
- 3 G.R. 439 center-tapped resistances (60-ohm)
- 1 G.R. 437 center-tapped resistance (60-ohm)
- 1 G.R. 565B power transformer
- 1 G.R. 527A filter
- 1 Binding post strip
- 4 Eby binding posts
- Baseboard and stand-off sides

When completed, it was found that four or more ordinary dynamic speakers were required to handle the output of the amplifier. The new auditorium model dynamic just completed in the Jensen factories was then tried and found to handle the volume very nicely. The ideal combination for public address and theater work seems to be the described amplifier working at full volume and feeding into two Jensen auditorium model dynamics.

As will be seen in Fig 2, the new model is much larger than the standard speaker, allowing room for a larger field coil and cone. The field is energized by one type 280 full-wave tube, which delivers approximately 90 milliamperes at 200 volts. The resistance of this field is 2250 ohms, although it may be wound by the user for a low voltage to be supplied by dry rectifiers of sufficient capacity to deliver the necessary 15 or 20 watts.

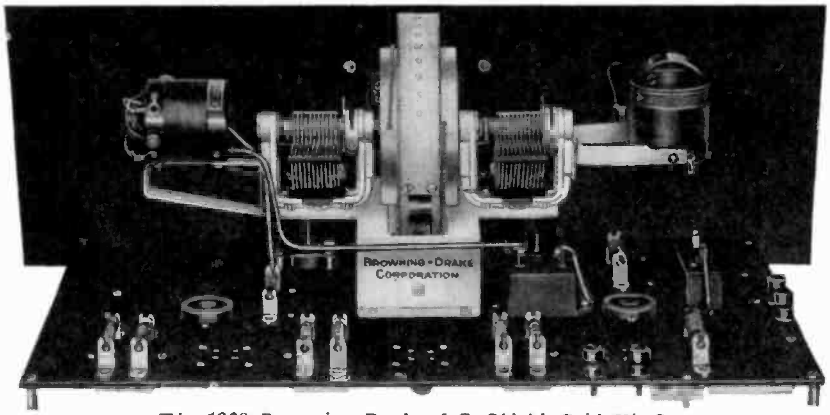
By taking off the two nuts which hold the back plate in place, the field coil may be removed without touching the head assembly and cone. Speakers will probably be available with an empty bobbin for the user who wishes to experiment with different types of field coils. The resistance of the movable coil is 8.2 ohms and its impedance is nearly identical with that of other types of dynamic speakers, so that standard push-pull or single tube dynamic step-down transformers will operate the auditorium model very satisfactorily. The inner core is held in spaced relation with the surrounding pole piece by means of a spacing ring fastened to the top plate. It is 1½ in. in diameter. The paper cone is 11 in. in diameter and the cone angle is 40 degrees. A stroke of 3/16 in. is permitted on each side of the neutral position, allowing a total swing of ⅜ in.

## THE 1929 BROWNING-DRAKE A. C. SHIELD GRID KIT-SET

This kit-set is capable of complete a.c. operation, with its power supply built into the set cabinet. The set has single control, with ample selectivity and sensitivity for even the most congested areas. The construction is simple and the cost of the parts much lower than in former years.

The r.f. transformer is designed to utilize the high plate resistance and amplification factor of the screen grid tube so as to give nearly twice the amplification for all wavelengths from 200 to 550 meters as is possible from the '01A type of tube. This was accomplished, with negligible capacity between primary and secondary, by increasing the coupling coefficient from a normal of 0.5 to an actual of 0.91. (The maximum theoretical value is 1.0.) The secondary is short and the primary is placed on a slot about ¼ in. from the low potential end. No neutralization is necessary and by careful placement of parts even the shielding may be omitted.

Tests have demonstrated that better selectivity is obtained with this tighter coupling. In fact it is better than that obtained from an auto transformer (tuned impedance), though the amplification of the tuned impedance system is slightly greater. One r.f. stage with tickler feed-back is used in the kit though two stages may be built by those who so desire. Single control is obtained by using a primary as shown in the diagram.



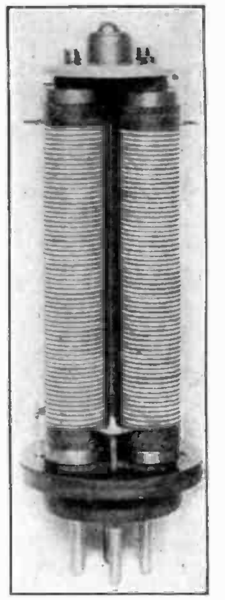
*The 1929 Browning-Drake A.C. Shield Grid Kit Set*

The audio system consists of three stages of resistance coupling. Full constructional details are furnished with the kit.

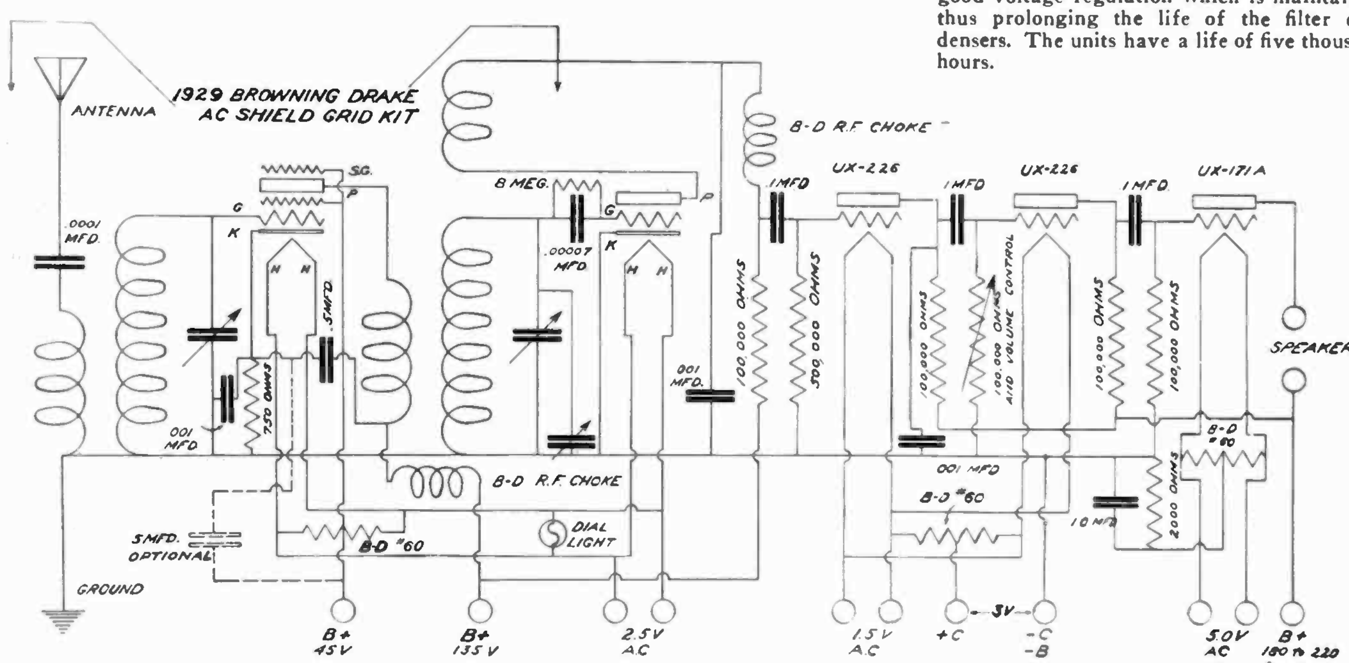
**The Electrad Truvolt Divider** is intended to eliminate guesswork in "B"-eliminator design. Without a voltmeter and without laborious calculation, it provides the


proper plate and grid voltages for any type of receiver requiring a maximum of 180 volts. This is accomplished by means of five knob-controlled slider contacts which wipe three wire-wound resistor units, 8000, 2000 and 1000 ohms, respectively, connected in series. Thus from any 220-volt rectifier-filter system it is possible to obtain 180 volts, 110-160 volts adjustable, 65-110 volts adjustable, and 20-60 volts adjustable "B" potentials, as well as 1-20 volt and 40-volt negative grid bias. This device is rated to handle 50 watts without overheating.

**The Elkon EBH Metallic Rectifier Unit** consists of four stacks of alternate electro-positive and electro-negative discs, held under pressure and mounted on a four-prong base designed to fit the standard UX tube socket. It is shielded in a ventilated alumi-



num housing. An alloy of aluminum and magnesium is used as the electro-positive and cupric sulphide as the electro-negative element. When an alternating current is applied to the unit a film is formed in each pair of discs which seems to unite the discs as though they were fused together, forming a conductor which offers a relatively high resistance to the passage of current from the alloy to the cupric sulphide and a relatively low resistance to the passage of current from the cupric sulphide to the alloy. In this way only one-half of the alternating current cycle is allowed to pass. By using the four stacks in conjunction with a center-tapped transformer, full wave rectification may be had, and voltages as high as 350 R.M.S. may be handled. The current output is 30 m.a. at 300 volts, 87 m.a. at 180 volts, and 130 m.a. at 90 volts. Such an assembly requires 240 couples, each of which is designed for 3 volts. A notable feature of their operation is the good voltage regulation which is maintained, thus prolonging the life of the filter condensers. The units have a life of five thousand hours.



*Circuit Diagram of Browning-Drake A.C. Shield Grid Kit Set*

# With the Amateur Operators

## REVISED AMATEUR REGULATIONS

[Superseding those dated March 6, 1928]

An amateur station is a station operated by a person interested in radio technique solely with a personal aim and without pecuniary interest. Amateur licenses will not be issued to stations of other classes.

Amateur radio stations are authorized for communication only with similarly licensed stations, except as indicated below, and on wavelengths or frequencies within the following bands and at all times unless interference is caused with other radio services, in which event a silent period must be observed between the hours of 8 p. m. and 10:30 p. m., local time, and on Sundays during local church services.

| Kilocycles | Meters |
|---|---|
| 401,000 to 400,000 | 0.7477 to 0.7496 |
| 60,000 to 56,000 | 5.00 to 5.36 |
| 30,000 to 28,000 | 10.00 to 10.71 |
| 14,400 to 14,000 | 20.83 to 21.43 |
| 7,300 to 7,000 | 41.1 to 42.9 |
| 4,000 to 3,500 | 75. to 85.7 |
| 2,000 to 1,715 | 150. to 175. |

Amateur radio telephone operation will be permitted only in the following bands: 60,000 to 56,000 k.c. (5.00 to 5.35 meters), 3550 to 3500 k.c. (84.50 to 85.70 meters), 2000 to 1715 k.c. (150 to 175 meters).

Amateur television and operation of picture transmission apparatus will be permitted only in the following bands: 60,000 to 56,000 k.c. (5.00 to 5.35 meters), 2000 to 1715 k.c. (150 to 175 meters).

Spark transmitters will not be authorized for amateur use.

Amateur stations must use circuits loosely coupled to the radiating system or devices that will produce equivalent effects to minimize key impacts, harmonics, and plate supply modulations. Conductive coupling, even though loose, will not be permitted, but this restriction shall not apply against the employment of transmission line feeder systems to Hertzian antennae.

Amateur stations are not permitted to communicate with commercial or Government stations unless authorized by the licensing authority except in an emergency or for testing purposes. This restriction does not apply to communication with small pleasure craft such as yachts and motor boats holding limited commercial station licenses which may have difficulty in establishing communication with commercial or Government stations.

Amateur stations are not authorized to broadcast news, music, lectures, sermons, or any form of entertainment, or to conduct any form of commercial correspondence.

No person shall operate an amateur station except under and in accordance with an operator's license issued to him by the Secretary of Commerce.

## THE NEW "Q" SIGNALS

The "Q" signals, long used as abbreviations for questions which are asked or answered in code, have been completely revised by the Washington convention, to become effective January 1, 1929. As many changes have been made in the meanings of the old signals, it is necessary for every operator to learn the new code.

The most notable change is the complete abandonment of the QST signal and the substitution of CQK as a general call with a request for reply. Likewise CQ is again to be used as a general call without request for reply.

The signals are herewith listed as answers, it being understood that the same signal, when followed by a question mark in code, is the question to which the answer is to be given. This list gives only the QR and the QS signals, as the QT signals are concerned principally with radio compass bearings.

| | |
|---|---|
| QRA | The name of my station is ——. |
| QRB | The distance between our stations is ——. |
| QRC | The charges of my station are paid by ——. |
| QRD | I am going to ——. |
| QRE | The nationality of my station is ——. |
| QRF | I come from ——. |
| QRG | Your wavelength (or frequency) is ——. |
| QRH | My wavelength (or frequency) is ——. |
| QRI | Your tone is bad. |
| QRJ | Your signals are too weak. |
| QRK | Your signals are good. |
| QRL | I am busy. |
| QRM | I am being interfered with. |
| QRN | I am troubled by atmospherics. |
| QRO | Increase power. |
| QRP | Decrease power. |
| QRQ | Send faster. |
| QRS | Send more slowly. |
| QRT | Stop sending. |
| QRU | I have nothing for you. |
| QRV | Send a series of V's. |
| QRW | Advise —— that I am calling him. |
| QRX | Wait until I have finished. I will call you at —— o'clock. |
| QRY | Your turn is No. ——. |
| QRZ | You are being called by ——. |
| QSA | The strength of your signal is<br>1 (Hardly perceptible; unreadable.)<br>2 (Weak; readable now and then.)<br>3 (Fairly good; readable with difficulty.)<br>4 (Good; readable.)<br>5 (Very good; perfectly readable.) |
| QSB | The strength of your signals vary. |
| QSC | Your signals disappear at intervals. |
| QSD | Your keying is bad; unreadable. |
| QSE | Your signals run together. |
| QSF | Your automatic transmission fades out. |
| QSG | Transmit the telegrams by a series of ——. |
| QSH | Transmit one telegram at a time, repeating it twice. |
| QSI | Send the telegrams in alternate order without repetition. |
| QSJ | The charge to be collected is ——. |
| QSK | Suspend traffic till ——. |
| QSL | I acknowledge receipt. |
| QSM | I have not received your acknowledgment of receipt. |
| QSN | I cannot receive you now. Continue to listen. |
| QSO | I can communicate with —— directly or through ——. |
| QSP | I will relay to —— free of charge. |
| QSQ | Send each group or word once only. |
| QSR | The distress call received from —— has been attended to. |
| QSU | Send on —— meters (or k.c.) waves of Type<br>A1 (Unmodulated C.W., varied by telegraphic keying.)<br>A2 (C.W. modulated at a.f., also with telegraphic keying.)<br>A3 (C. W. modulated by speech or music.<br>B (Damped waves.) |
| QSV | Shift to —— meters (or k.c.) and continue after sending several V's. |
| QSW | I will send on —— meters (or k.c.) on waves of Type ——. |
| QSX | Your wavelength (frequency) varies. |
| QSY | Send on wave of —— meters (or k.c.) without changing type of wave. |
| QSZ | Send each word or group twice. |

## CALLS HEARD

**At KDUV, by E. O. Schwerdtfeger, on Pacific Ocean between 170th and 160th Eastern Meridians (latter part of August, 1928), Great Circle Route, Seattle-Shanghai**

2uo, 3xw, 5cj, 6acz, 6alm, 6akg, 6aov, 6arb, 6asj, 6avj, 6avl, 6bdy, 6bhy, 6bqh, 6ch, 6chl, 6chn, 6cut, 6cyx, 6dfm, 6dfs, 6dkh, 6dkv, 6dlx, 6dnm, 6dwi, 6dwn, 6dwz, 6dxt, 7aax, 7ac, 7ar, 7akv, 7alk, 7alr, 7ep, 7mi, 7mo, 7nr, 7ou, 7sw, 8bor, 9hak, 9pl, 9rm, nc-5an, oz-2gp, op-1cm, op-1dr, op-1hr, gdzv, jdr, jpp, jxr2, kewe, ktz, kzet, rdx, xda, xmd.

**By EF-8XD (Near Lyon, France)**

NU: U. S. A.: On QRH 37 band: (1abd), 1abv, (1aba), 1adb, 1ade, (1adm), 1afb, 1age, (1aha), (1alr), (1als), 1aqp, (1aqt), 1arb, 1asd, 1asp, 1asv, 1aue, 1auj, 1auz, (1avk), 1axq, 1axx, 1bbe, (1bft), 1bjx, 1bke, 1bnm, (1bux), 1cak, 1cki, 1cmp, (1cpc), 1cmx, 1cuf, 1eh, 1gc, 1mx, 1oh, 1nq, 1ry, 1xl.

2aad, 2adl, 2aeb, 2aeo, 2aeu, 2afb, 2afo, 2afw, 2afr, 2ahh, 2ajg, (2aib), (2akj), 2alu, 2api, 2apv, 2arq, 2ass, 2atq, 2atr, 2atx, 2aub, 2as, 2avw, 2az, 2bav, (2baz), 2bbe, 2bcc, 2bda, 2bdf, 2bck, 2bin, 2ber, 2bjg, (2bif), 2bgg, 2blx, 2bmj, 2bfp, 2bke, (2cin), 2crb, 2cqd, 2com, (2cuq), 2cuz, 2cxl, (2cyx), 2dg, 2fd, 2fs, (2ge), (2gx), 2hc, 2hr, (2jd), 2nm, 2tt, 2rs, 2uc, (2sz), 2wr, 2zz.

3afj, 3afx, (3afu), 3agc, 3ahh, 3aih, 3aif, (3anh), 3akw, 3aod, 3aqm, 3ard, 3aic, 3ark, 3aso, 3avd, 3aws, 3blp, 3bqv, 3cc, 3cdl, (3cfg), (3cjn), 3ckl, 3ez, 3lz, 3lw, 3qe, 3sz, 3sn, 3vg.

4aba, 4abl, 4abr, 4abw, 4aby, 4acn, 4acv, 4acz, 4aef, 4aej, 4aek, 4afa, (4ahl), 4ahy, 4afc, 4aou, 4bb, 4bl, 4br, 4cj, 4ea, 4ge, 4js, 4hy, 4nu, 4oc, 4fl, 4qs, 4td, (4tk), 4th, 4uc, 4vl, 4wc.

5acl, 5afe, (5atf), 5ayl, 5jc, 5vx, 5yb.

(8adg), 8aht, 8apd, 8ary, 8awu, (8baf), 8bbg, 8bbl, 8bbs, 8bhi, 8bhz, 8bjb, 8bm, 8bou, (8box), 8bpl, (8bqr), 8brl, 8brh, 8bto, (8bth), 8btr, 8ccg, 8cft, 8ciw, 8cnt, 8ccs, 8ctl, 8dcc, 8dcm, 8did, (8dnf), 8don, 8drj, 8dsy, 8duw, 8gz, (8hx), 8kx.

9ama, 9ari, 9be, 9bfc, 9cad, 9cee, 9cnm, 9crd, 9cue, 9ecz, 9ecx, 9ejo, 9eln, 9ekx, 9epa, 9fax, 9fqp, 9fqn, 9fs, 9tm.

Wnp, ngm.

On QRH 20 band: 1abt, 1aff, 1ak, 1alb, 1arq, 1aze, 1awe, 1bat, 1bcv, 1bux, 1byv, 1cjh, 1cki, (1cmx), 1ckb, 1fs, 1ka, 1mo, 1mx, 1qh, 1rp, 1sz, 1ry, 1dv.

2aca, 2aer, (2aib), 2alw, 2api, 2arb, 2ary, 2avl, 2avz, 2ays, 2bad, 2bfq, 2cuq, 2cxl, 2md, 2nm, 2ow, 2sj, 2rs.

3adm, 3aqm, 3aqi, 3awq, 3bph, 3gi, 3nr.

4aep, 4km, 4wm.

6wb, 6zzd.

7acs.

8adg, 8ail, 8asf, 8aw, 8aq, 8baz, 8bdt, 8bc, 8bfw, 8bgx, 8bzl, 8clp, 8cnh, 8cnz, 8cpr, 8dcc, 8dod, 8dog, 8dkt.

9adn, 9bcn, 9bxi, 9crr, 9cuh, 9bqy, 9eap, 9ejo, 9ell, 9eln, 9fci, 9fof.

Wnp.

NC: (1br), 1ad, 3he, 2ba, 2ca.

NF: éo12d.

NJ: longban, 2pa.

NM: 1rz, 8a.

NN: 1nic, 7ni.

NQ: 2ac, (2iq), 2cf, 2sf, (2ro), 5ay, 5by, 5cx, (5ea), 5fc, 5fl, 7cx.

NR: 4ac.

NS: 1fmh.

NT: 2fp.

NZ: fr5.

Crd to any of above on request. All QSL's appreciated! All cards answered! QRK ef 8XD?? QSLL via R.E.F.

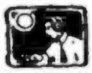
## PUBLICATIONS RECEIVED

Reprints from the Bureau of Standards *Journal of Research* for October, 1928, include papers No. 16 and 19, which can be obtained from the United States Government Printing Office, Washington, for 10 and 15 cents respectively. No. 16 by F. W. Grover, describes methods for the derivation and expansion of formulas for the mutual inductance of coaxial circles and for the inductance of single-layer solenoids. No. 19 by Haraden Pratt and Harry Diamond, illustrate and describe receiving sets used for aircraft beacons and telephony.

Catalog No. 135 from Insuline Corporation of America, New York City, illustrates and describes their radio and television products. These include radio panels, tubing, spaghetti, insulated wire, dials, knobs, sockets and insulators, as well as complete television kits and parts for experimental and dealer display use.

# The COMMERCIAL BRASSPOUNDER

## A Department for the Operator at Sea and Ashore



*Edited by* P. S. Lucas
R. O. Cook, *Assistant*

WELL, now that all the new calls are memorized, it is time to tackle the "Q sigs." The committee certainly was feeling fit when it came to that page in the "regs," as the results of its tussle ably show. In addition to the fifteen *new* signals adopted, twenty-five of the old ones have been given entirely different meanings.

No longer does QRV indicate readiness, nor QRW mean that your pipe needs filling. The old insult, QSC, has been passed down to QSD. QSK is replaced by QTA, and the QTA request for a repetition is "lost and gone forever." ?AA, ?AB, ?AL and ?BN are supposed to take its place. QTA will be mourned.

We have received several disgusted explosions at the "bench-warmers" who evolved these "useless, confusing and senseless changes," (please note the quotes) but we fail to see how squawking will help matters. And when you come right down to the point, it can be seen, and might as well be admitted, that the new list is far superior to the old. Subjects appear in better alphabetical order; *e. g.*, in the 1912 list the subject of bearings and position was scattered from QRC to QTE; now it is held to one section which is given over exclusively to bearings, beacons, and positions.

No, the only thing to do is to promptly *forget* that there ever was another list of abbreviations, and use the new one consistently. The miscellaneous abbreviations likewise chosen at the conference should also be adhered to consistently. We have always wanted a universal abbreviation vocabulary; now we have it. Let's make use of it.

## TAKING THE SCREEN GRID TUBE TO SEA

*By* Harry F. Washburn

THE four element tube has been on the market for more than a year now, but not until it has reached the stage of obsolescence will it find its way into commercial ship receivers. Therefore I did a little experimenting on my own in order to determine whether or not the claims made for the screened grid tube as a radio frequency amplifier in a broadcast receiver would hold good on the longer waves. The results have been so satisfactory that they justify a description of my 550 to 1400-meter receiver, so here goes:

One screened grid (UX-222) tube was used in the stage of radio frequency, with '99s as detector and audio amplifiers. The only reason I used '99s in the last three sockets was because no six-volt battery was available. The r.f. stage is untuned in order to cut down the number of major controls as well as to prevent undesirable oscillation if the stage is not heavily shielded. The detector circuit is the same old standby which has been running along on all six since Babe Ruth started to hit homers.

To improve selectivity the plate supply for the '22 is shunt fed through an r.f. choke and the circuit coupled to the detector by a .001 mfd. fixed condenser. The choke must be a good one and large enough to keep the r.f. in its place. The Silver-Marshall No. 276 choke is especially manufactured for receivers working on waves over 600 meters and is to be recommended, both for the aperiodic tuning coil in the grid circuit and for the r.f. choke.

The detector coil consists of 110 turns on a 3-in. tube with a tickler rotating inside. Plug-in coils may very well be used here so that the range of the set could be increased to cover from 200 to 3000 meters. When using plug-in coils, however, the capacity method of obtaining regeneration should be used, as the old style of varying the coupling is unsatisfactory. The resistance across the secondary of the first audio transformer makes oscillation control smoother when tuning for CW.

One tuning control and one regeneration control are all that are needed, as the r.f. stage is aperiodic. Yet it is amply selective and its sensitivity is astonishingly greater than average for these bands. The 10,000-ohm potentiometer varying the voltage to the screen affords a very handy volume control, eliminating the necessity of detuning the regeneration or tuning controls.

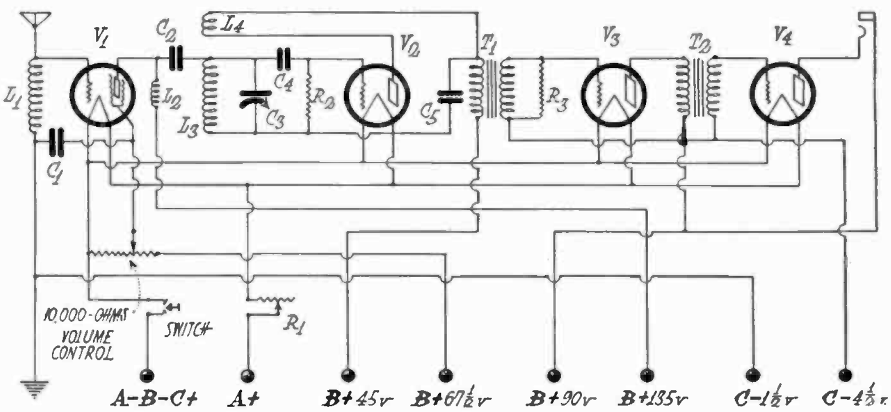



*Fig. 1. Circuit Diagram of the Four-Tube, Screened Grid, Ship Receiver*

$L_1$—Silver-Marshall R.F. Choke No. 276.
$L_2$—Silver-Marshall R.F. Choke No. 276
$L_3$—110 turns No. 22 d.c.c. wire on 3-in. tube.
$L_4$—40 turns No. 28 d.c.c. wire on 2¼-in. rotor inside grid end $L_3$.
$C_1$—1 mfd. Tobe by-pass condenser.
$C_2$—Sangamo .001 mfd. fixed condenser.
$C_3$—.0005 mfd. variable SLF condenser.
$C_4$—Sangamo .00025 mfd. fixed condenser.
$C_5$—Sangamo .002 mfd. fixed condenser.
$V_1$—UX-222 or CX-322 tube.
$V_2$—UX-199 or CX-299 tube.
$V_3$-$V_4$—UX-199 or CX-299 tubes.
$R_1$—15-ohm rheostat.
$R_2$—5-megohm Tobe grid leak.
$R_3$—½-megohm Tobe fixed resistance.
$T_1$-$T_2$—Audio frequency transformers, 3½-1 ratio.

## WHO IS THE RADIO OPERATOR?

### A Few Caustic Comments Which Go Right to the Point

*By* George L. Bacon
*Opr. S. S. Edward Luckenbach*

AN old lady visiting a ship one day asked one of the officers if he were the wireless operator.

"No," he replied, "I am the captain."

"Well," she remarked, "That's a good job too."

Somehow or other the wrong impression is out in the world. The main reason for this, aside from the operators themselves, lies in the radio schools throughout the country.

In the present era of radio, many male humans (mostly boys) who become enshrouded in the net of fascination which goes hand in hand with radio, find themselves at sometime or other scrutinizing an advertisement that reads something like this:

SEE THE WORLD—VISIT FOREIGN LANDS—BE AN OFFICER—EAT IN THE SALON—EARN GOOD MONEY, ETC., ETC.

In some cases a picture of a dashing young thing dressed in white is shown; two gold bars weighing down each shoulder. He is standing on the bridge, (most masters don't

(Continued on Page 34)

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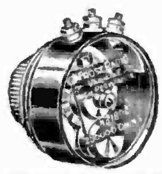

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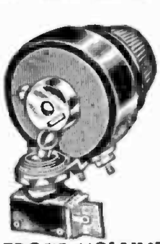
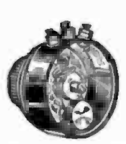


**FROST VOLUME CONTROL WITH A.C. SWITCH**

We equip our famous Volume Control with approved A.C. Snap Switch tested to carry 250 volts at 3 amperes, so that both switch and volume control may be handled by single knob. $2.75 and $3.00.

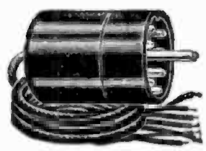
**FROST VOLUME CONTROL WITH D.C. SWITCH**

Equipped with sturdy German silver switch mounted on Bakelite panel, and with switch points fitted with sterling silver contacts, this Volume Control gives quick operation, positive-locking off position and saves space. For battery operated sets. $2.35.



**FROST GEM VOLUME CONTROL**

Identical with our standard size Volume Control units except in size. Gem units are only 1⅝ in. in diameter, and ⅝ in. thick. Great space savers. $2.25 and $2.50.



**FROST ALL-BAKELITE CABLE PLUG**

Terminals cannot work loose even when overheated. Color code moulded into Bakelite. Best quality cable, with colored rubber insulation on wires. Has 5 ft. seven strand braid covered cable. Plug and cord only, $2.25. Baseboard or sub-panel socket, 75c.

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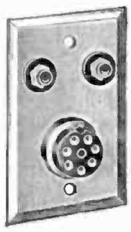
Single hole mount 110 volt A.C. Snap Switch. Tested to 250 volts, 3 amps. Underwriters' approved. 75c.



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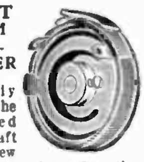
Fit std. outlet box. Brush brass or Bakelite plates. $1.00 to $3.25.



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Simply turn the slotted head shaft with screw driver to regulate. Smoothes the ripple out of A.C. current. Precision built. $1.00.


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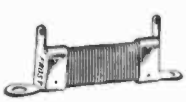
Cannot be affected by moisture or climate. Moulded Bakelite with finest mica dielectric. Easy to attach. 45c. to 90c.

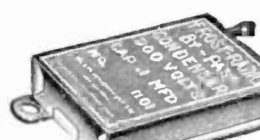


**FROST FIXED RESISTANCES**

Die cut flexible Bakelite strip holds windings firmly in place. Terminals are staked into Bakelite. .4 to 1000 ohms. Also as center tapped resistances, 6 to 64 ohms. 15c to 50c.

**FROST BY-PASS CONDENSERS**

Made from finest materials, thoroughly seasoned, vacuum impregnated and hermetically sealed. Accurate capacities and conservative voltage ratings. 1 to 2 mfs. 80c to $2.00.

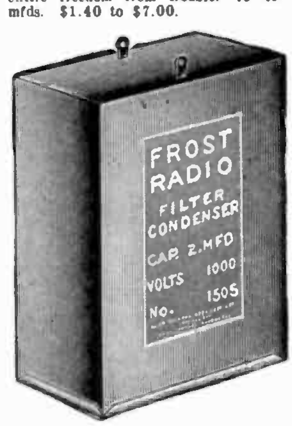


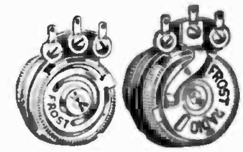
**FROST BLOCKING CONDENSERS**

Every particle of material used is of tested quality. Entire condenser enclosed in hermetically sealed cases after vacuum impregnation. Gold bronze lacquer finish; tinned terminals. $18.00.

**FROST HEAVY DUTY FILTER CONDENSERS**

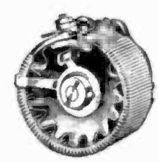
We use only finest quality linen paper and highest grade foils in building these Filter Condensers. Conservative ratings. Designed to give longest service with entire freedom from trouble. .5 to 2 mfds. $1.40 to $7.00.

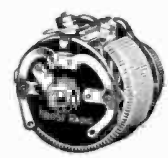
**FROST GEM RHEOSTATS**

Made to deliver a service that is not usually expected from little rheostats like these. Mighty good little rheostats, taking up little space and supplied either plain or with D.C. switch. Easy to solder to. Plain, 75c. With switch, $1.00.



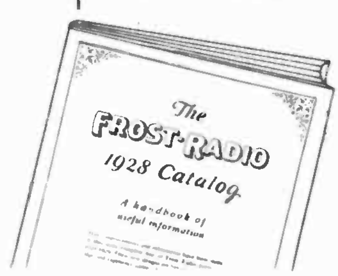
**FROST BAKELITE RHEOSTATS**

Long the standard air-cooled Bakelite Rheostat, as well as the original of this type. Resistance wire is wound on die cut Bakelite strip over moulded Bakelite frame. Wide choice of resistances. $1.00 and $2.50.



**FROST BAKELITE RHEOSTATS WITH D.C. SWITCH**

Cleverly mounted German silver D.C. battery switch is firmly attached to Bakelite panel on back of rheostat, affording quick on and off control of filament current. 2 to 75 ohms. $1.35.

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## WHO IS THE RADIO OPERATOR?

(Continued from Page 30)

allow operators on that sacred shrine), is all smiles, and is shown gazing at some tropical island. If he were really an operator the sight of Staten Island from the outside, would be about the only one which would cause him to smile.

The ads have their desired effect, as many graduates of radio schools pass examinations for government licenses; but what false impressions they have in their minds! Most new operators seem to have the idea that a radio operator is created to make possible the carrying on of commerce on the high seas, a thing that has been going on, Oh, so many, many years before Sparks was introduced to Mr. Commerce.

The radio schools are to blame for such propaganda, not only through their form of advertising but also through impressions given to students while attending school. The result is that many fellows who think they have certain egotistical claims to excellence go to sea, only to be immediately disillusioned and to do much harm to the profession.

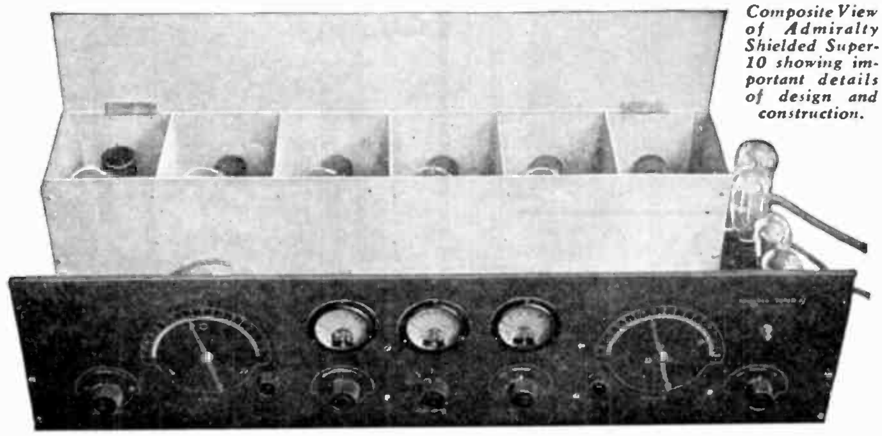
A brand-new third mate, who had spent eight years in the forecastle and a brand-new Sparks, fresh from a four-month radio school, happened to receive their first jobs together on board the same vessel. The mate, being new as an officer and anxious to be successful, had opened a discussion of how he might best succeed in the long hard pull to the mastership of a vessel. Now Sparks, being the superman of the two and knowing so much more about the ship and shipping, having joined the vessel six hours before the mate, said, "Always be honest, conscientious, sober and attentive to duties. As for myself, I'm different, I'm the WIRELESS OPERATOR—The Hell with 'em!"

How many operators have gone aboard a ship and found everybody with a bad taste in their mouths towards radio operators? Many, to be sure. Realizing of course (according to the last operator) that all captains, mates and engineers are dumb-bells, we are nevertheless put aboard to cooperate and help in all possible ways in the navigation of the vessel.

And don't believe that you are so important that a ship won't sail without the wireless operator. Some of the boys have been stung by this belief and have had to make earnest and pathetic pleas to the local American Consul in a faraway land.

As a radio operator, you may be a college man just going to sea for a vacation

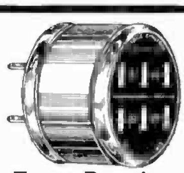
(Continued on Page 36)



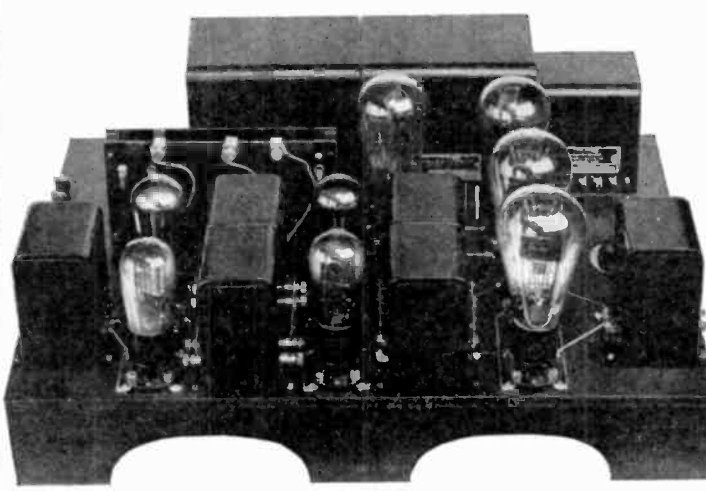



BIRNBACH









## WHO IS THE RADIO OPERATOR?

(Continued from Page 34)

and will return soon to finish your career. Or your dad, (through no fault of your own) may be a millionaire. But no matter what you are or think you are, to your fellow officers, you are just plain SPARKS.

The other officers aboard ship have attained their licenses and positions in most cases through many painful hard years in the forecastle, engine room or on the bridge and they cannot be blamed if a little hasty in passing judgment on an operator for some gross breach of marine etiquette. Marine customs die the hardest of any in the world. Discipline and the whims and caprices of a new radio operator do not jibe on board any ship. Operators are unfortunate insomuch that they do not go through the forecastle, but immediately upon going to sea have the privilege of the salon. In many cases it is the young fellow's first job.

It is almost a shame to write this when it is a known fact that there are so many fine, capable and modest fellows serving as radio operators in the maritime service, but it is done so with the hope that all Spark's will strive for a better understanding of their fellow officers aboard ship.

## SKEDS AND TRAFFIC NOTES

From Paul A. Girard, S. S. West Kedron:

HWE, Monrovia, Liberia, succeeded by RZC, and operated by the Firestone plantation for the local government and themselves. RZC communicates with surrounding provinces on about 34 and 600 meters CW. His 600 CW is hard to copy at times, but in the main it gets through static much better than Spark. RZC also communicates with U. S. A. (Akron, Ohio).

Most all towns of any size along the coast have an Army SW installation which will handle public traffic. As the landline in this country is very poor this SW traffic is increasing.

NAA comes in OK with his time ticks, but PX time is daylight here, and is unheard. No static is experienced on short waves.

GBR sends press on short waves at 8 a. m. G. C. T.

From Harry F. Washburn:

2XD, Tuckerton, N. J. (WSC). Stands watch from 2100 to 0500 GMT for ship calls on 36 meters except when occupied with tfc skeds. He also stands watch during the early morning hours and up until about 2 p.m. EST, for ship calls on 23 meters. Answers on 23.6. 1½ KW 500-cycle transmitter is used. QSJ same as for WSC.

GKT, Burnham Radio, England. Listens on 36 and answers on about 37. Mushy 500-cycle note. Tolls probably same as for GKU.

From Bill Breniman, KOZC:

KHK, Wahiawa, 22 miles from Honolulu, T. H., sends PX composed of items of local interest at 11 p. m. and 10 a. m. local time. This PX is broadcast on 2200 meters, free copy for all ships.

## BROADCASTING IN PARIS

(Continued from Page 13)

Fortunately, however, the two government stations are so bad that there is no possibility of the law being enforced against the protests that rage when there is any suggestion of doing so.

Advertisement by radio is also dealt with in the same law, and entirely prohibited; but as the official stations are the worst offenders in this respect, it is not surprising that the others follow suit. And it is direct advertising at that, usually one advertisement between each musical item and the next, or interspersed with the news bulletins. As a rule these advertisements are boring in the extreme; there are occasional exceptions, as for instance, the maker of underwear who has hit on the idea of repeating the official weather forecast at intervals through the day, adding appropriate remarks either on the desirability of not trusting the forecast too fully, and therefore of continuing to wear his products (when the forecast is optimistic) or of buying more of them (when, as is usually the case, it predicts rain and cold).

There is also a certain amount of indirect advertising, where the manufacturer pays for the program and the fact is duly mentioned before each item, but it is relatively rare. The practice of the manufacturer providing the entertainment and buying time is practically unknown.

Thanks to the poor quality of the transmissions, the average receiving set is intolerable from a musical point of view. It is no exaggeration to say that 90% of the sets have no provision for *C* batteries, and the average audio transformer is a miserable little skeleton that looks as if it had been designed for a portable set to be used on a walking tour. There is no doubt that a good American set would carry all before it, if it could be sold at a price to compete with the local products, and if it could cover the range of wavelengths necessary (up to 2650 meters).

The music is good (except for the jazz, which is ghastly—French bands seem incapable of getting the jazz spirit, and apparently only the worst of them play for the radio, anyway). For example, Radio Paris always gives one operetta or light opera a week, very well done; plus an average of two classical string quartettes or other chamber music items a day; plus as a rule at least one big item a week. By "big" I mean such things as the Bach B Minor Mass, or Honegger's "King David," with himself conducting, or a Beethoven concert with the Ninth Symphony.

But perhaps the best indication of the Frenchman's own point of view is to hear the customers at a big radio store—the one stock question asked is "Will it get Daventry?" If not, no sale.

## SHORT-WAVE SUPER

(Continued from Page 15)

on 20 turns, then wind back over this 19 turns, then 18 and so on for seven layers. Each layer has one less turn than the one preceding. When one group is finished bring the wire back down to the tube and start another. If the turns have a tendency to slip, put a little collodion around the edges as each layer is finished.) This type of winding was quite popular a few years ago, for coils used in the reception of long waves. Fig. 4 gives the details of the transformers.

To obtain a large gain per stage, capacity coupling between the primary and secondary must be low. Therefore the primaries should be wound with small wire and concentrated in as small a space as possible.

In this super the primaries are wound on wooden disks 3/8 in. thick that fit snugly inside of the bakelite tubing at the filament end of the secondaries. Three are required. Cut these so that they make a real tight fit, as they shrink somewhat after "boiling" in paraffine. Cut a slot around each disk about 1/16 in. deep with a hacksaw. Wind 175 turns of No. 36 enamel wire in each slot, in the same direction as the secondaries. If 201A's are to be used in the i.f. and second detector, wind only 100 turns on the disks as the internal capacity between the elements of a 201A is higher than a 199 tube.

After winding, boil the disks in paraffine to exclude all moisture. While doing this make sure that the paraffine is not hot enough to smoke. It takes about a half-hour for this job. After the disks are boiled and thoroughly dry, drill two holes in each and insert bolts 3/4 in. long. Place a soldering lug under the head of the bolts and solder the primary leads to these. Flexible wire may then be fastened to the bolts and connected to binding posts at the end of the tube.

The tickler in the plate circuit of the second detector is made like the primaries but has only 100 turns of No. 36 enamel wire. This coil is placed inside the form near the grid end of the secondary of the last transformer. Its use permits the reception of continuous wave signals. A switch is provided to short circuit this coil when phone is desired. Different tubes require different size ticklers. If the set howls when the switch is open remove some of the turns. If the tube refuses to oscillate (after reversing the tickler leads) add more turns; 100 however, will usually be about right.

A "losser" or potentiometer of 200 ohms resistance is placed across the *A* battery and the grid returns of the two i.f. tubes connected to the lever for controlling oscillations. It is possible to do away with this losser by moving the primaries away from the secondaries until oscillations stop. It takes a lot of experimenting to do this right, so is not recommended.

An r.f. choke is necessary in the plate circuit of the second detector to keep the r.f. out of the phones or audio amplifier. Eight hundred turns of No. 36 enamel wire wound on a common thread spool or any other form about ¾-in. in diameter will do very well. The grid condenser has a capacity of .0005 mfd. The grid leak is of 2 megohms resistance and is connected between the grid and positive side of the filament. If a condenser larger than .002 mfd. be used as a bypass across the output, the quality (of phone or music) will not be very good.

One 30-ohm rheostat is used to control the filaments of the two i.f. and second detector, and one for the oscillator and first detector. A plate voltage of 45 is sufficient for all tubes.

No audio amplifier is built into this set, so the reader may use his own ideas if one is desired.

The parts are mounted on a bakelite panel 7 by 21 in., and wooden baseboard which is about 1 in. shorter than the panel, allowing the set to be fitted into a cabinet if desired. Two metal brackets hold the baseboard to the panel about 2½ in. above the bottom, allowing the bypass condensers, r.f. chokes and the second detector grid condenser and leak to be placed underneath. The controls showing on the front panel are oscillator and first detector tuning condensers, filament rheostats, filament switch, tickler switch and potentiometer. In this set the potentiometer was mounted under the sub-panel as there was no room on the panel. It was set just below the oscillating point of the tubes and then left alone. However, it is better to mount it within easy reach.

The first detector and component parts are at the extreme right with the oscillator at the left. The i.f. amplifier is then mounted between these. See Fig. 5 for layout of the parts. The i.f. transformers are placed at right angles to each other with the tube sockets so arranged that the plate and grid leads are as short as possible.

The filament and *B* battery wires are all run under the sub-panel and bunched together. It is a good plan to do the wiring in steps. First run all of the *A* battery wires to the sockets, filament switch and rheostats. Then completely wire the first detector and oscillator. Next wire the grid circuits of the i.f. amplifier and second detector and last the plate circuits of this section. The bypass condensers, under the sub-panel, may then be connected. Where the wires are bunched together, tie with string at intervals of about 1 in. Feedback is partly eliminated by bunching these wires.

The terminal strip to the left of the second detector socket is for connecting to the phones or audio unit. The one to the rear of the first detector contains six posts, two for the *A* battery, two for the *B* battery and two for antenna and ground. The *A* and *B* negative is grounded, helping to eliminate hand capacity effects especially on the shorter waves.

After the super is completely wired, it is a good idea to see if the frequency changer is working. Place a pair of headphones in the *B* positive lead going to the first detector, light the filaments of the first detector and oscillator. Set the detector condenser at about the middle of the scale and vary the oscillator condenser. A point should be found where a hissing noise is heard. This indicates that this part of the circuit is operating properly. Now connect the phones to the output binding posts and light the filaments of all the tubes. Short circuit the tickler by closing the switch. If all of the transformers are in resonance (they should be if all are built exactly alike) strong oscillations will be noticed. Turn the potentiometer towards the *A* positive connection until the oscillations are suppressed. The point for greatest signal strength is just below the oscillating condition. However, for the reception of phone or short wave broadcasts, the quality will not be very good so regeneration will have to be decreased. The best place to set the potentiometer will depend upon the quality desired. Of course, distortion is not important for code work. In this case set the potentiometer just below the oscillating point and open the tickler switch. This causes the second detector to oscillate and produce beats with the received signal after it is passed through the i.f. amplifier.

An antenna with a total length of about 50 ft. may be used with fine results. The use of a long aerial with a super broadens the tuning considerably. Better selectivity may be had by using a counterpoise instead of a ground. This may well be about 30 or 40 ft. of almost any kind of wire run in the cellar or around the baseboard.

Slightly louder signals may be had, especially in the 80 and 160-meter bands, by connecting a loading coil in the antenna lead. This coil should consist of 100 turns of No. 28 enamel wire on a tube 2½ in. long by 2½ in. in diameter, tapped at 0, 3, 6, 10, 15, 25, 40, 55, 70 and 100 turns. There is not space enough on the panel for this coil, so it may be built into a small box with a hard rubber or bakelite panel on which is mounted the rotary switch to change the number of turns.

If the set does not tune sharp enough for the builder, remove 75 turns from the primary of the first i.f. transformer and shunt it with a .0005 mfd. fixed condenser. Moving the primary away from the secondary will also help to sharpen up the tuning.

# VOLUME CONTROL

(Continued from Page 19)

the last r.f. stage and the detector will generally give the most complete control of volume and cut down the r.f. hiss more if three or more stages are used. It may mean that the last or even next to the last r.f. amplifier is overloaded to such an extent that modulation or detection may occur in this stage with possibilities of audio distortion. This depends on whether or not the set is used very near a powerful local broadcasting station.

Most of the a.c. receivers will have satisfactory volume control on local stations if an antenna of not over 20 or 30 feet in length is used. A longer antenna may be used for distance reception, or if one is available, it may be used for local reception by cutting a .0001 or .00005 mfd. fixed condenser in series with it.

For a really satisfactory volume control on receivers using a.c. tubes, the control should affect more than one r.f. circuit, especially if the receiver is sensitive for weak signals. There is no reason why two or more variable resistances cannot be ganged on one knob so that two or more circuits will be affected. Fig. 2 (c) could be used for this arrangement for two succeeding stages such as aerial and 1st r.f. plate circuit. If the resistances were separated on an extension shaft so as to eliminate capacity coupling, one could be used at each end of the r.f. amplifier.

There are other methods of volume control such as having a copper or brass tube slide over one of the r.f. transformer primaries. This method along with any others which vary the primary coupling, are likely to throw the associated tuned circuit out of line, preventing single control. If single control is still maintained, it is generally at the sacrifice of selectivity at either the higher or lower wavelengths.

## WLW'S 50,000-WATT TRANSMITTER

(Continued from Page 11)

maintained by piezo crystals installed in duplicate in thermo-controlled compartments in which the temperature varies less than .1 degree.

As shown in the picture of the control room, the amplifying and tuning units are at the left and the rectifying unit is at the right. Each unit is enclosed in an electrically interlocked cage so that the opening of any door automatically shuts down the transmitter.

As the tubes are water-cooled, the water is circulated through cooling radiators upon which is blown cool air drawn from the outside by five immense fans. The hot air partially warms the building in winter and is carried in a stack through the roof in summer.

The short-wave transmitter W8XAL is installed in a separate room in the building. This also broadcasts the regular WLW programs.

The towers are also to be utilized as airplane beacons on the line between Cincinnati and Columbus.

## LIGHTNING STRIKES AERIAL ON HOME

By Edward P. Talbot

Whether an aerial protects a house from lightning or increases the risk of being struck is still an undecided question. Examples of direct hits are rare. A bolt which struck an aerial on a residence in El Paso, Texas, during a storm in July offers evidence on both sides of the argument.

The antenna was of the umbrella type, comprising four wires running from a central pipe mast to the four corners of the roof of a one-story brick bungalow. The lead-in came down the side of the house from one of the four wires and was connected to an air-gap type lightning arrestor grounded to an iron rod.

Inspection showed that the discharge apparently struck on or near the central mast and followed down the two wires extending to the rear corners of the house. These wires were anchored to a wooden sleeping porch, and the lightning made a splintered hole at each fastening, passed inside the porch, and jumped to both light and telephone wires which were about three feet distant.

The telephone bell-box was badly damaged, and the lightning arrestor in that circuit burned out, while the lighting system was deranged so that an engineer was required to find the trouble.

The aerial wires were burned or broken off, the insulators blackened, and the arrestor destroyed. The receiver, tubes, batteries and speaker were strangely left unhurt and performed as usual when the aerial was replaced.

### THE R. F. CHOKE

(Continued from Page 20)

across them. The curves are shown in Fig. 6. Note that all the impedances are much lower. Choke No. 1 is still the best of the group though the peak has changed sufficiently by the addition of the 15 mmf. condenser to bring it outside the 200-550 wave band. The characteristics of choke No. 4 have been changed so that its peak, which formerly was somewhat below 200 meters, is now about 250 meters.

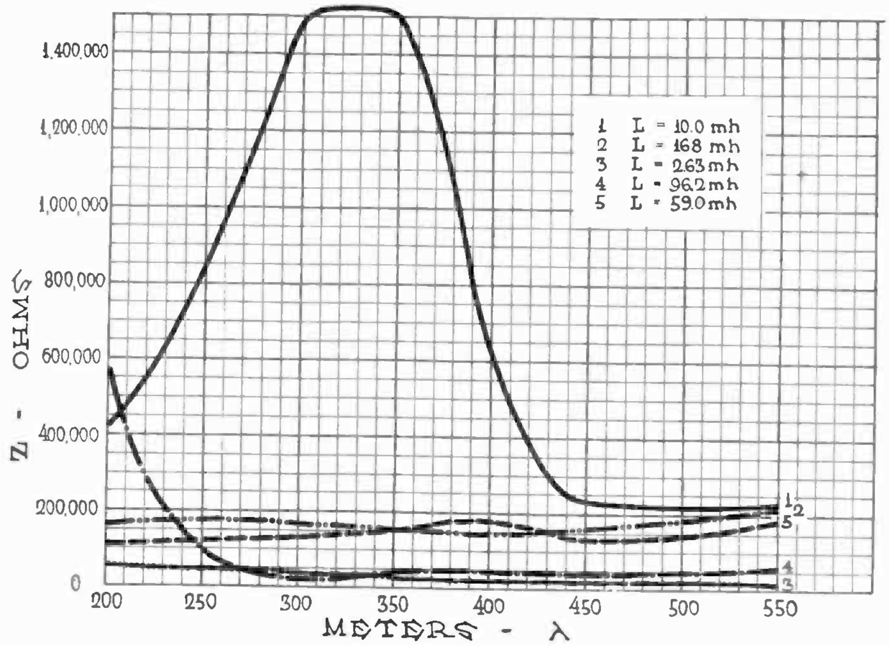



*Fig. 5. Impedance of Chokes without Shunt Capacity*

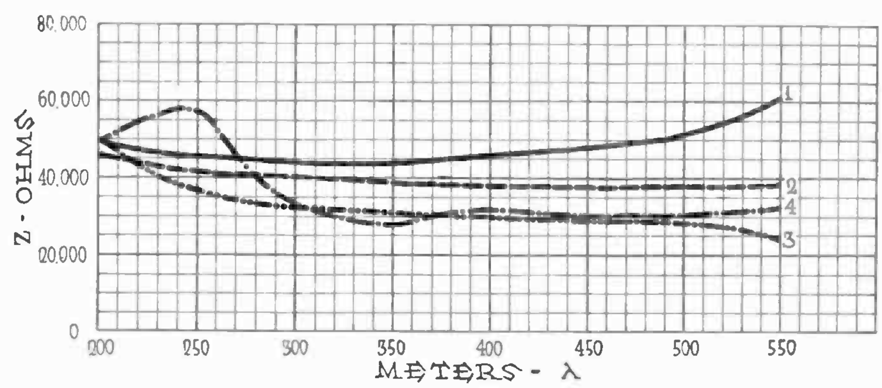



*Fig. 6. Impedance of Chokes with 15 mmfd. Shunt*

STATEMENT OF OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

"RADIO," published monthly at San Francisco, Calif., for October 1st, 1928.

State of California, County of San Francisco, ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared H. W. Dickow, who, having been duly sworn according to law, deposes and says that he is the Business Manager of "RADIO," and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to-wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Pacific Radio Publishing Co., Pacific Bldg., San Francisco; Editor, Arthur H. Halloran, Berkeley, Calif.; Managing Editor, None; Business Manager, H. W. Dickow, Pacific Bldg., San Francisco.

2. That the owner is:

Pacific Radio Publishing Co., Pacific Bldg., San Francisco; Arthur H. Halloran, Berkeley, Calif.; H. W. Dickow, Pacific Bldg., San Francisco; H. L. Halloran, Berkeley, Calif.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds or other securities than as so stated by him.

H. W. DICKOW,
Business Manager.

Sworn to and subscribed before me this 24th day of September, 1928.

(SEAL) JOHN L. MURPHY,

Notary Public in and for the City and County of San Francisco, State of California. My commission expires May 20th, 1929.



# RADIOADS

## A CLASSIFIED ADVERTISING SECTION READ BY BETTER BUYERS

**The rate per word is eight cents net. Remittance must accompany all advertisements. Include name and address when counting words.**

**Ads for the January Issue Must Reach Us by December Fifth**

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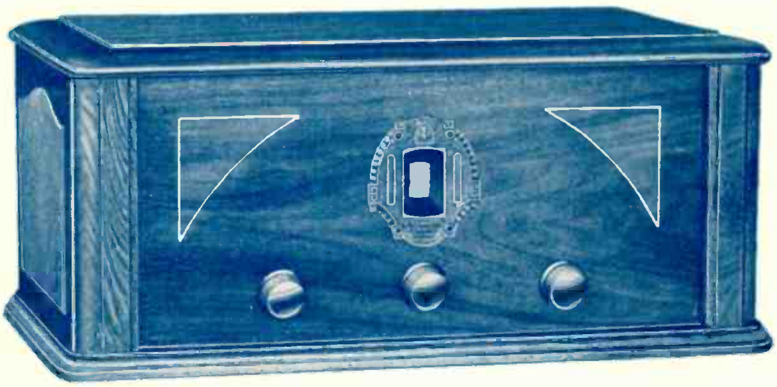

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DYNAMIC

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Oakland, California    Chicago, Illinois

286

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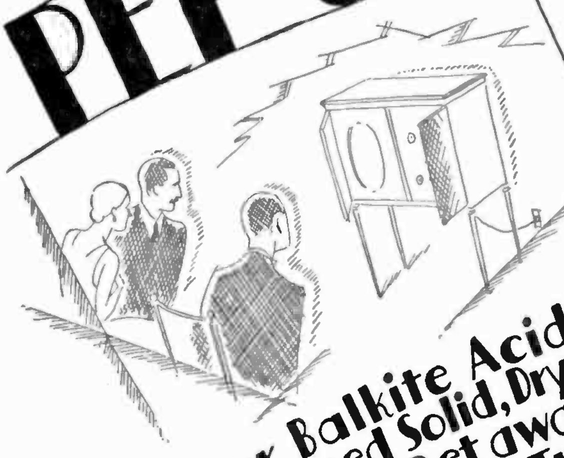

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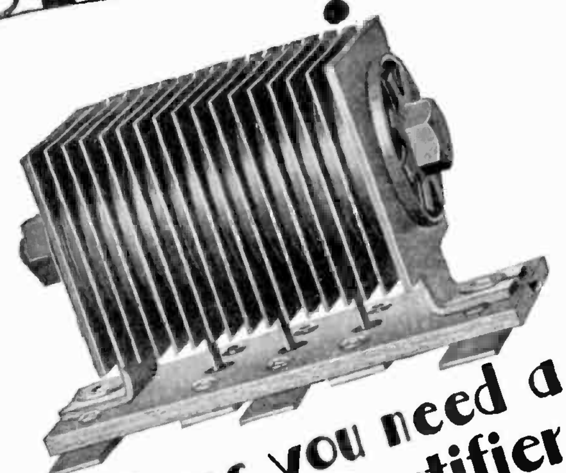
*Division of* P. R. Mallory & Co., Inc.



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Send me complete information on Elkon Radio Products.
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Address ..................

# RADIO

Established 1917

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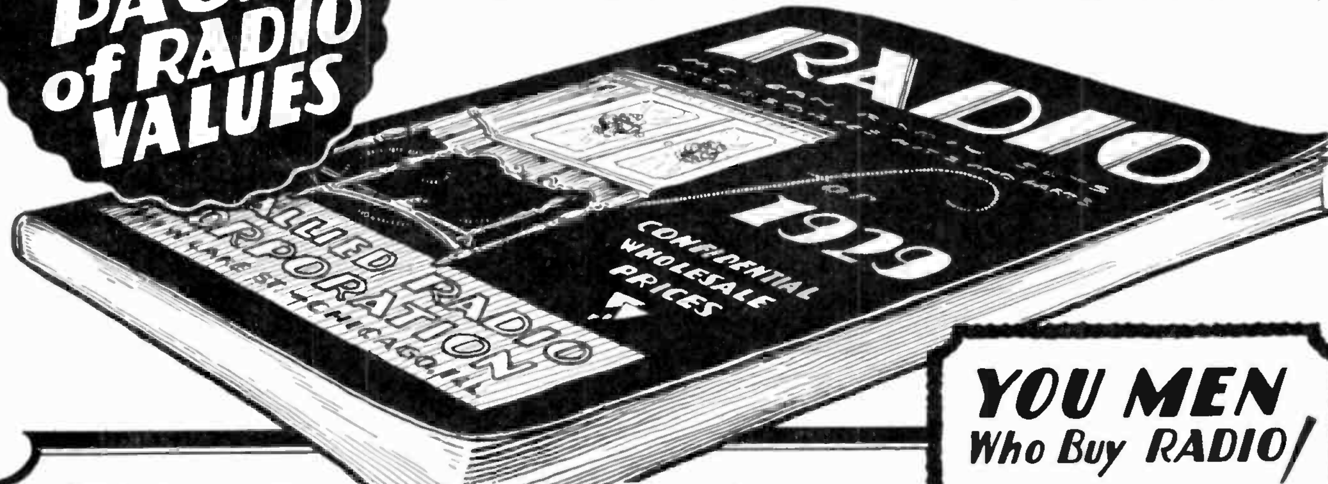
### FORECAST FOR DECEMBER ISSUE

J. Garrick Eisenberg has a helpful article on "Some Service Considerations." G. F. Lampkin describes the construction of a crystal-controlled transmitter. "Melting Precious Metals by Radio," is illustrated and described in detail. John P. Arnold has some more interesting information on radio transmission and reception of pictures. Circuit diagrams and descriptions are given of several new a.c. factory-built receivers. Articles necessarily omitted from the November issue, but definitely scheduled for December are "A Short-Wave Superheterodyne," by R. Wm. Tanner; "Impedance of R. F. Chokes," by Glenn L. Browning; and "Experimenting with the Grid Leak," by L. W. Hatry. In "Technical Briefs" will be found a circuit for adapting a 45 k.c. superheterodyne to the use of a.c. tubes. Frank C. Jones, who is better known as Francis Churchill, discusses the volume control methods used in a.c. receivers.

**164 PAGES of RADIO VALUES**

# A NEW CATALOG JUST OFF THE PRESS

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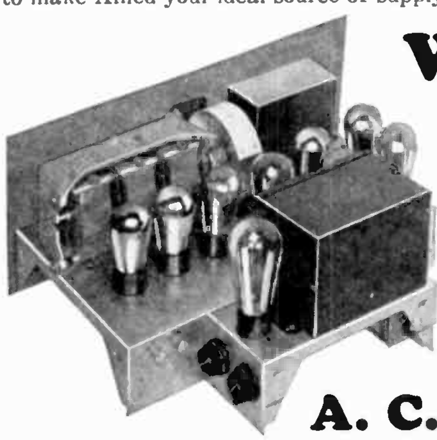

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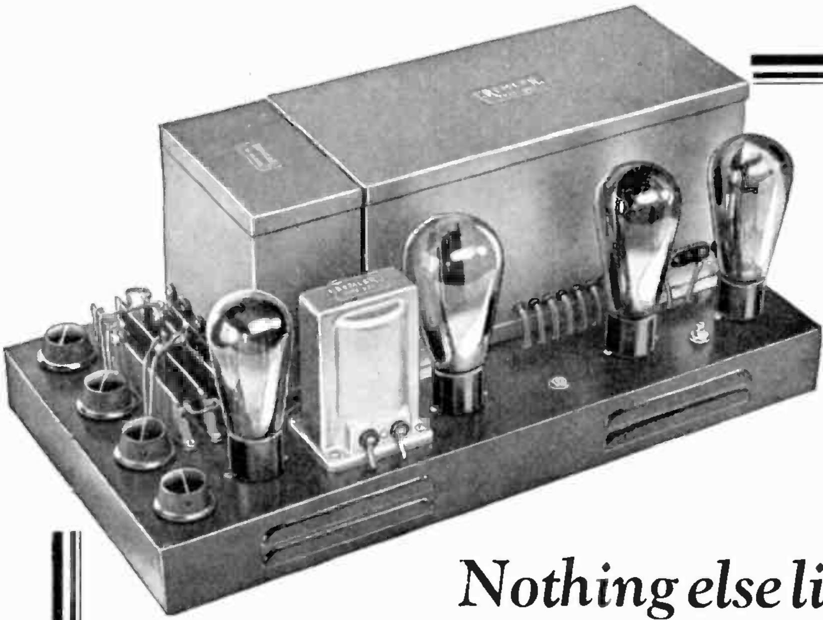

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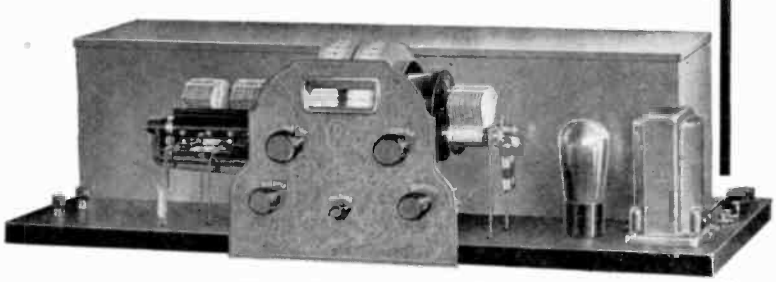

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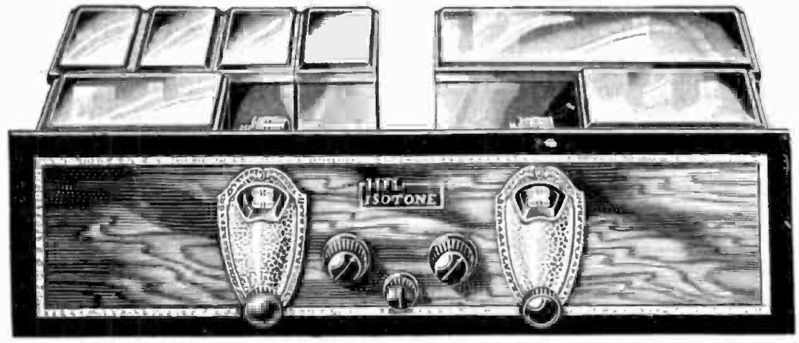


*Unlimited Range.* This excellent instrument employs practically every new engineering feature known to radio science. The range of the Isotone is almost unlimited. The three-stage screened grid amplifier having the unusually high gain of sixty-five per stage can be hand tuned by the operator which results in a perectly balanced instrument. The 450 kilocycle amplifier allows absolute one spot tuning.

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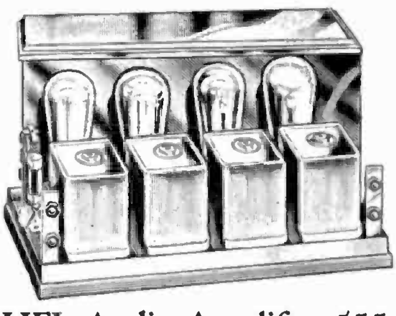
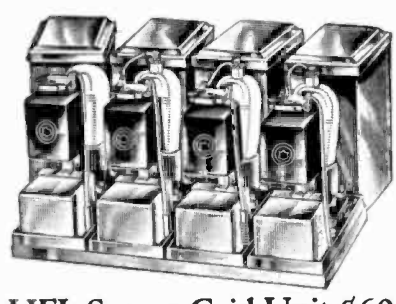


HFL Audio Amplifier $55



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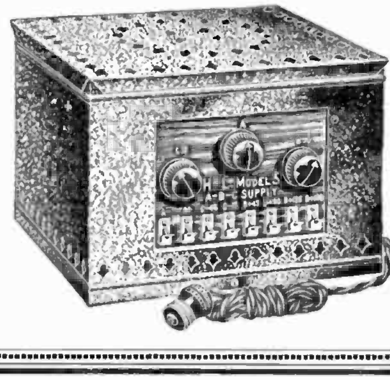

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1452 Market Street San Francisco, Calif.

# HFL

# Model 10 ISOTONE

# 70 Stations in one evening

## An amazing demonstration of ultra selectivity and extreme distance range.

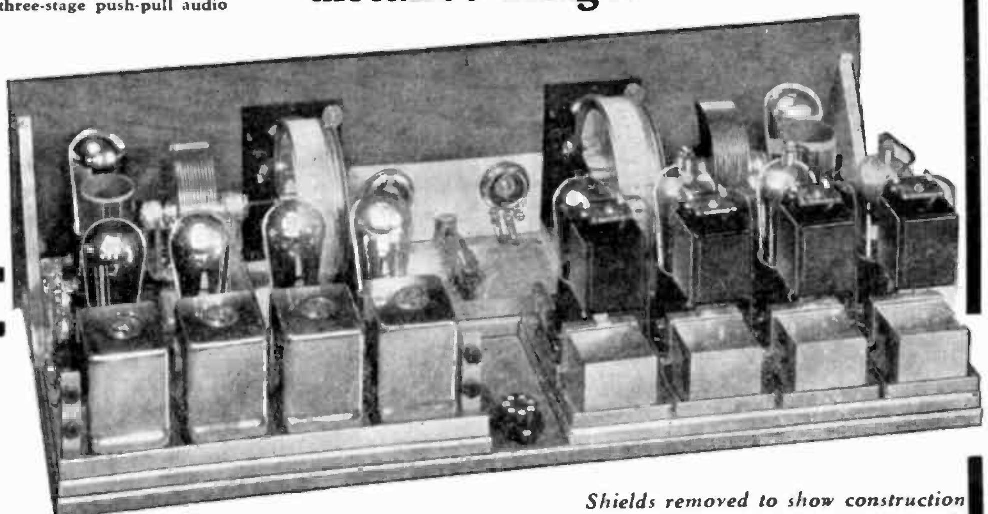
NEVER before has any receiver possessed such selectivity and unlimited power. Imagine perfect separations on every wave channel. Absolute 10 kilocycle splits—right alongside of the most powerful locals in the country.

You can choose your station with an Isotone and *you can get that station.* You can get it clear and you can get it without the annoying overlapping swishes that ordinarily ruin long distance reception.

The H F L Isotone is the supreme radio achievement. We believe that no other receiver in the country can show an actual radio frequency gain of 65 per stage consistent with absolute 10 kilocycle band selection.

Nothing has been sacrificed to obtain this unprecedented efficiency. The instrument is a beauty to behold. The three-stage push-pull audio amplifier produces tone quality that is a revelation. There is a choice of radio or phonograph reproduction. A master control switch—automatic ballasting systems—hand-tuned filter transformers—these and over 25 other new features play their part in making the Isotone the greatest radio receiver of all time.

Write to the factory for complete information and an eight-page booklet giving circuits and all technical data.



*Shields removed to show construction*

## *Can be Constructed by Anyone*

There is nothing complicated about the construction of an ISOTONE. Each of the three units is assembled, wired and laboratory tested at our factory. All you have to do in order to reproduce these wonderful results for yourself is to take a standard kit of ISOTONE parts and assemble the instrument with a few nuts, bolts and only ten wires. There is nothing to go wrong. Each piece fits together with absolute precision, and in less than an hour you can realize what is acclaimed by women as the most beautiful receiver of the day—and admitted, beyond a question of doubt, by radio engineers as the most efficient radio phonograph ever designed.

HIGH FREQUENCY LABORATORIES

Office R. 28 N. Sheldon St.

CHICAGO, ILL.

## *Absolute Guarantee*

Every ISOTONE kit and each ISOTONIC unit is fully guaranteed. All H. F. L. items must be mechanically and electrically perfect. Each instruments must test up to the standard set by our laboratories. Any unit that does not operate perfectly will be immediately replaced at no charge. No arguments—no lengthy correspondence—your ISOTONE must be right or we will make it right. Our guarantee gives you absolute protection. BUILD YOUR ISOTONE NOW and have the finest receiver in your neighborhood. Send for full particulars TODAY.

**FREE**

Circuit Diagram And All Information

*The Coupon Brings Complete Information*

HIGH FREQUENCY LABORATORIES
Office R, 28 North Sheldon Street,
Chicago, Illinois.

Gentlemen,—Without obligation, please send complete information on the ISOTONE receiver and the ISOTONIC A. C. power supply.

Name ..........

Address ..........

City .......... State ..........

*(Please print plainly)*

# OUT-SELLING ALL

*Single Dial Control*
*Verniers for long distance tuning*

## *"De Luxe Model"*
## SARGENT-RAYMENT SEVEN

**Uses Four Screen Grid Tubes, Detector, and Two Audio**

### *A Station for Every Dial Degree*

THAT is the average performance of the Sargent-Rayment Seven over the entire dial. Tuning from slightly over 200 meters up to 550 meters, this receiver will, under average night-time conditions, receive 100 stations per evening.

The outstanding performance of this receiver is due to very careful design throughout. Four stages of screen grid tube amplification are used. Each stage is completely isolated by heavy aluminum shielding. Lap Shield joints are used to insure against any possibility of having the slightest leakage from stage to stage. Each screen grid, plate and filament wire is by-passed and nine radio frequency chokes are used to prevent inter-coupling. As a result, the set is not critical to operate and does not oscillate at any wave length. Even with the full power turned on at 200 meters the receiver is fully stable.

### THE ANTENNA CIRCUIT

An entirely new type of antenna circuit is used. This input circuit at once assures fine selectivity and good sensitivity, and at the same time it is so connected that antenna capacity does not affect the setting of the gang condenser. Thus, although the antenna is sharply tuned, it is not necessary to compensate for changes in wave length. This is a special feature released for the first time in this set.

The full power of four screen grid tubes gives a degree of sensitivity that has never before been attained in anything that has been placed on the radio market. No suppressors or other counteracting devices are used to prevent oscillation, so that the full amplification of each tube becomes useful. As a result, the receiver will produce a louder signal on a distant station than any other set that can be put up against it, and the selectivity, which is 10 kilocycle in most cases, enables the owner to get long distance reception during the early evening hours when all the local stations are on.

### A Guarantee by the Designers

**Some very broad claims have been made in our advertising of the Sargent-Rayment Seven. Were it not for the fact that this set is unique in design these claims could not rightly be made. The Sargent-Rayment Seven has been thoroughly tested under the most adverse conditions and is unconditionally guaranteed to do everything claimed in our advertising. In case anyone desiring to purchase one of these sets is in doubt about this point, we will be glad to arrange so that that person can obtain the set on a ten day money back trial basis.**

**We are perfectly willing to stake our professional reputations as radio designers on this circuit and will leave it to the judgment of the radio fans at the end of the season whether or not any misleading statements have been made.**

*(Signed)* E. M. SARGENT, L. C. RAYMENT

### Seven Outstanding Features

**1** Ten kilocycle selectivity all over the wave band.

**2** More power, more amplification, more sensitivity than ever before available in any receiver.

**3** All present distance records smashed. Sets a new standard.

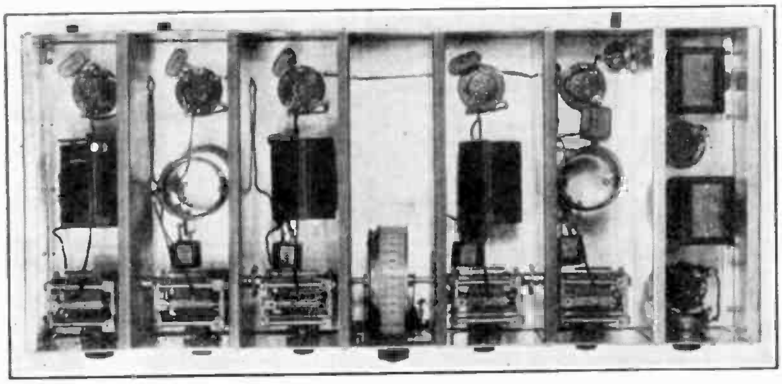
**4** Efficient all over the wave band. Plenty of power on the long waves.

**5** Tone quality unsurpassed. Uses the latest audio transformers. 210 or 250 tube can be used in last stage if desired.

**6** Tuning controlled by handsome, illuminated revolving drum. Only one control for master selector. Fine tuning verniers available for use when wanted.

**7** Requires no cabinet. Finished in grained aluminum with black and white trimmings, or in brown, crackle, crystalline lacquer.

# THE OTHER KITS!



"Built Like a Battleship"

## NOTE THE CONSTRUCTION

The above illustrates a top view of the receiver with the cover removed, giving an idea of how substantially this set is built. It shows the complete isolation of each radio frequency stage, the single drum control on gang condensers and the spacing and angling of the coils to prevent feed back. This is a triumph in radio set construction and at the Radio Shows at which it has been exhibited it has attracted widespread attention and comment.

## THE AUDIO SYSTEM

The audio system employed in the Sargent-Rayment Seven is noted for its clearness of tone. The small-sized Clough transformers Nos. 255, 256 and 251 have been purposely selected because they do not over-emphasize the base notes at the expense of the high ones. More powerful transformers could have been selected, but as the set contains plenty of radio frequency power a distinct gain was made by choosing the less powerful but clearer small transformers.

## WHAT FINISH DO YOU LIKE?

The Sargent-Rayment Seven is supplied in two finishes. For the dyed-in-the-wool radio fan there is a standard grained aluminum finish, while for those who prefer a darker set which will better harmonize with living room furnishings we are prepared to supply the usual brown, crackle, crystalline finish. The set can be obtained either built up or in kit form, with finish desired at the prices given below. The models are identical in every respect except for the finish.

The De Luxe model is put out exclusively by Radio Constructors Corporation and can only be bought from us or from jobbers listed on this page. All parts are manufactured by Silver-Marshall and the De Luxe Finish is applied by us.

We especially recommend this model. It is unexcelled in appearance and harmonizes with all furnishings.

### PRICES—FOR THE COMPLETE KIT

The SM-710 Sargent-Rayment Seven Kit is complete in every respect. All parts are inspected at the Silver-Marshall factory for both electrical and mechanical defects and are fully guaranteed by both Silver-Marshall and by Radio Constructors Corporation to be in first-class condition. Everything is carefully packed to withstand shipment. Complete instructions for assembling and wiring the kit are included. These instructions are so explicit and so well illustrated that the novice will have no difficulty in following them.

All hardware, screws, nuts, washers, brackets—everything necessary to build the set—is included. There is nothing additional to be bought. The kit includes even the "cabinet."

**No. 710 Standard Model, Grained Aluminum Finish, Code Word "Mercury"** ........ $130.00
**No. 810 De Luxe Model, Brown, Crackle Crystalline Finish, Code Word "Venus"** ........ $140.00

### FOR THE BUILT-UP SET

The completely built, wired, and tested Sargent-Rayment Seven receiver is carefully packed in a specially cushioned packing case. It exceeds the parcel post size limits and hence must be shipped by express. Full instructions for connecting the set to the power supply and operating it are included.

**No. 711 Standard Model, Code Word "Neptune"** ........ $150.00
**No. 811 De Luxe Model, Code Word "Jupiter"** ........ $160.00

IMMEDIATE DELIVERY

## RADIO CONSTRUCTORS CORPORATION

357 Twelfth Street — Oakland, Calif.

## Dealers

These jobbers can supply you with either the kit or built-up set

### WASHINGTON

WEDEL CO.,
520 Second Ave., Seattle, Wash.
HARPER-MEGGEE, Inc.,
4th at Blanchard St., Seattle, Wash.
INLAND RADIO CO.,
922 West First, Spokane, Wash.
HARPER MEGGEE & CO., INC.,
South 214 Howard St., Spokane, Wash.

### OREGON

STUBBS ELECTRIC CO.,
75 6th St., Portland, Ore.
UNIVERSAL SPECIALTIES CO.,
40 N. Ninth St., Portland, Ore.

### SOUTHERN CALIFORNIA

HERBERT H. HORN CO.,
1629 S. Hill St., Los Angeles, Calif.
C. C. LAWTON,
1125 Wall St., Los Angeles, Calif.
RADIO SUPPLY CO.,
912 S. Broadway, Los Angeles, Calif.
RADIO MFRS. SUPPLY CO.,
1000 S. Broadway, Los Angeles, Calif.
RADIO MFRS. SUPPLY CO.,
Long Beach, Calif.
MODERN ELECTRIC CO.,
308 West Center St., Anaheim, Calif.
SUNSET ELECTRIC CO.,
1141 1st St., San Diego, Calif.
WILLIAMS AND KLENTZ,
409 5th St., Santa Ana, Calif.

### NORTHERN CALIFORNIA

ELECTRIC SUPPLY CO.,
370 11th St., Oakland, Calif.
ELECTRIC SUPPLY CO.,
Room 250, Chronicle Bldg., San Francisco.
COAST RADIO SUPPLY CO.,
648 Howard St., San Francisco, Calif.
GILSON ELEC. SUPPLY CO.,
1106 Madison St., Oakland, Calif.
KIMBALL-UPSON CO.,
607 K St., Sacramento, Calif.
OFFENBACH ELECTRIC CO.,
1452 Market St., San Francisco, Calif.
PACIFIC RADIO SALES CO.,
357 Twelfth St., Oakland, Calif.

### COLORADO

VREELAND RADIO CORP.,
1639 Tremont St., Denver, Colo.

### NEW MEXICO

PACKARD SERVICE STATION,
417 West Gold Ave., Albuquerque, N. M.

### UTAH

INTERMOUNTAIN ELECTRIC CO.,
43 East 4th South, Salt Lake City, Utah.
LUND RADIO CO.,
Fairview, Utah.

### NEVADA

RENO MOTOR SUPPLY CO.,
Reno, Nevada.

### DEALERS—SET BUILDERS

Get established now in your community as headquarters for the Sargent-Rayment Seven. Fill in the attached coupon and send it to us for full information.

Radio Constructors Corporation,
357 Twelfth Street,
Oakland, Calif.

Please send me at once full details regarding the Sargent-Rayment Seven. I am a dealer or professional set builder and buy my supplies from the jobbers listed below.

Name ........................................

Address ........................................

City and State ........................................

Name of Jobber ........................................

Name of Jobber ........................................

*New Jensen*
*Model 6 Cabinet*

**In size and appearance the new Model 6 Jensen Cabinet is ideally suited for use in the most artistically furnished living room or music room.**

**Jensen Dynamic Speakers are made in types to operate with 110 volt A. C. house current, 6 volt storage battery, "A" eliminator or trickle charger, 110 volt D. C. house current and 90 to 180 volt D. C. current as provided by many of the late model radio sets. The sensitivity of the instruments is the same in any case.**

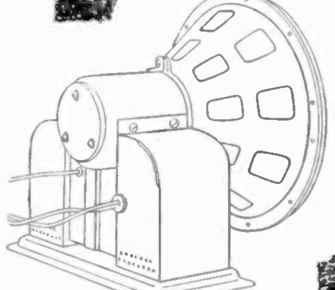
# *Jensen Dynamics Will Build Sales For You*

**Jensen**
***DYNAMIC SPEAKER***

**SHREWD dealers know that radio sets sell best when they sound best. These dealers are increasing their set sales and dynamic speaker sales every day by using Jensen Dynamics for demonstration. It is Jensen reproduction "true as the original" which provides this distinct selling advantage. It is the absolutely true, dependable reproduction of the entire musical scale which accounts for the vast public preference for Jensen tone quality. And the new distinctive cabinets in which Jensen units are enclosed is the final feature which clinches sales. Console cabinets sell better too when they are Jensen equipped.**

**All types of Jensen Dynamic Speakers are now ready for delivery to the trade. Dealers, jobbers and manufacturers are invited to write for particulars and an immediate source of supply.**

***Jensen Dynamic Speaker Units may be quickly and easily installed in radio or phonograph console cabinets. They may be operated with the same current supply as used for the radio receiver or electric phonograph. Prices for the Units for console cabinet installation range from $40.00 to $55.00.***

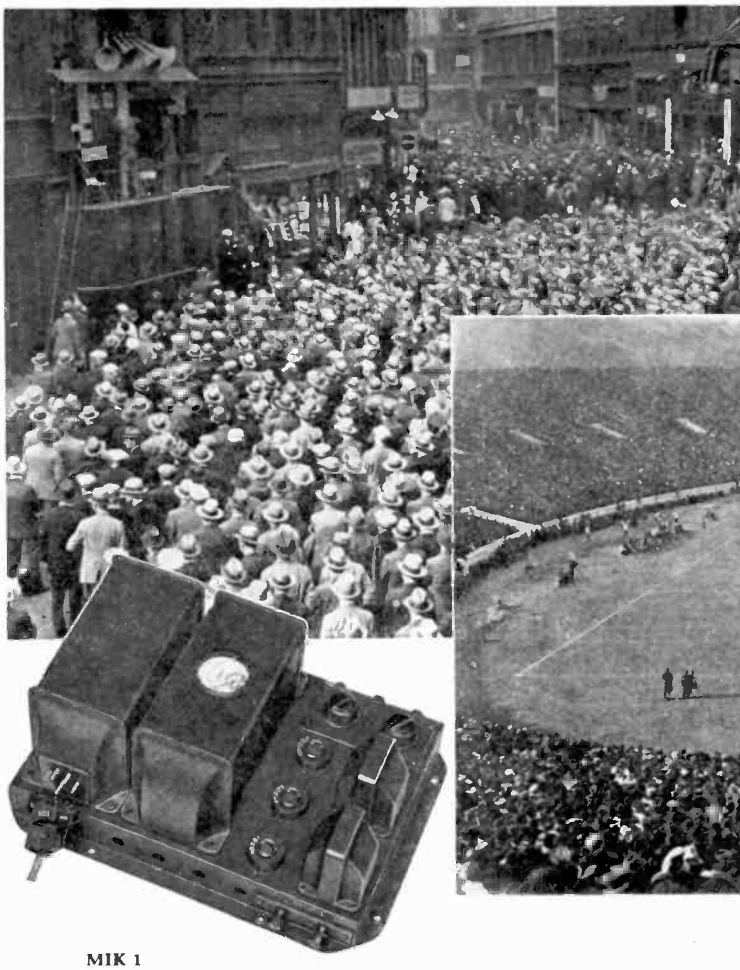


## Jensen Radio Manufacturing Co.

212 9th Street, OAKLAND, CALIF. 338 N. Kedzie Avenue, CHICAGO, ILL.

JENSEN PATENTS ALLOWED AND PENDING
*Licensed under Lektophone and Magnavox*

Bring the games to the crowd—and they'll welcome your message.



MIK 1
List Price $135.00
*Without Tubes*

PAM 16 or 17
List Price $125.00
*Without Tubes*

# Where Crowds Assemble--Use the Voice of a Samson

YOU can reproduce with great volume any radio music on the air or recreate the best recorded music by using a PAM 16 or 17. For the radio music connect PAM to detector tube of any radio set or to a tuning unit, and for recorded music connect it to a magnetic phonograph pick up.

You can make announcements before, during or after the game if you use a Samson MIK 1 (a 2-stage entirely AC operated microphone input amplifier) which uses the same high grade transformers we have supplied many of this country's better broadcast stations.

For even greater volume use the PAM 19 or 20 which has approximately 2½ times the undistorted output of the PAM 16 or 17.

Send for illustrated bulletin RB1 describing these units and other items showing why "PAM AMPLIFIERS are a Sound Investment."

*Main Office:* Canton, Mass.
Manufacturers Since 1882

Samson Electric Co.
MEMBER R.M.A.

Factories at Canton
and Watertown, Mass.

# RADIO

VOLUME X | NOVEMBER, 1928 | No. 11


## Radiotorial Comment

POLITICAL speeches may simultaneously be either the most or the least obnoxious kind of radio advertising—depending upon the political beliefs of the listener.

When a man ceases to criticize the radio conditions in his locality, he has lost his interest in radio. Then there is really something the matter with it.

Radio applause cards, once as numberless as the buffalos of the great plains, are now as nearly extinct. Advertising is killing them.

Good radio humor is the best of the twice-told tales. For if it "gets over" from a radio studio it will register where the teller is present. And it is always clean.

Television will soon add "synchronize" to the slang dictionary. Its meaning requires no definition, as applied to an individual, for anyone who has watched or manipulated a receiver screen.

* * *

A RADIO operator has always been judged largely upon his proficiency in sending and receiving code. Wire telegraph operators were once valued likewise. So also was a bookkeeper gauged on his ability to add, and a typesetter by his speed and accuracy as a hand compositor. But nowadays type is set on a linotype machine, adding is done with an adding machine, and telegraph messages are sent and received by means of machine printers. Eventually, also, the great bulk of radio traffic will be sent by photoradio.

In each of these cases the operator has graduated to higher duties which require more technical knowledge and which command higher pay. The world is rapidly approaching the point where it will be difficult to find men to cope with the modern machines which are being created. Radio, in particular, is a new field and is destined to great progress. The radio operator who keeps in step with this progress is also destined to a great future.

* * *

AN SOS is a signal for a broadcast station to cease transmitting. No matter how trivial or how important its program, whether a jazz request number or an address by the President of the United States, it must give way to the distress call. This was absolutely necessary to prevent interference in the old days of spark transmitters. But with the use of continuous waves from vacuum tube transmitters it is as needless as a hitching post for automobiles. No broadcast station on 545 meters or under need cause any interference on 600 meters. The portion of this law which requires a broadcast station to maintain continuous watch on 600 meters is virtually a dead letter. In view of the progress which has been made since the law was passed, it should now be wiped off the statute books. Aside from the unnecessary annoyance that it may cause broadcast listeners it may cause a direct financial loss to a station which is broadcasting a sponsored program.

* * *

THE subject uppermost in broadcast discussion today is the probable effect of the Federal Radio Commission's order that nine-tenths of the stations change their wavelengths on Armistice Day. At first glance it might appear that in this new deal just as much satisfaction would have been created by dealing five hands, one to each zone, from a well-shuffled deck of cards.

Yet a little analysis shows that the deck has been carefully stacked in an endeavor to improve reception conditions for the listener. So, aside from the temporary inconvenience of changing the logs or dial markings of most of the stations ordinarily heard, the average listener will probably hear his favorite stations to better advantage than he did last winter.

To understand the plan upon which the new allocations are based, it is necessary to know that there are ninety-six channels or highways in the broadcast spectrum between 550 and 1500 kilocycles. Each of these channels is ten kilocycles wide, the modulating or sound frequencies extending for five kilocycles on both sides of the station's carrier frequency. Incidentally, since the station frequencies are designated in multiples of ten so as to give this ten kilocycle separation, it is more convenient and less confusing to omit the final cipher and to designate the channels by numbers from 55 to 150, corresponding to 550 to 1500 kilocycles.

Naturally a collision occurs whenever two or more stations are radiating energy into the same channel at the same time. If the stations are very powerful and are not given sufficient geographical separation, these collisions or heterodynes will be heard as a high-pitched singing note, especially where the receiver is located between the interfering stations.

Of the ninety-six channels, six are assigned exclusively to Canada, leaving ninety channels for the use of six hundred and twenty-four stations in the United States and Alaska, an average of nearly seven stations per channel.

Heretofore, no station has occupied a clear channel unless the other stations assigned to its wavelength were not broadcasting. For instance, due to the difference in time, some Pacific Coast stations could be heard without heterodyning only after their Eastern channel-sharers had shut down. But as a general rule no station was free from a heterodyne whistle during some period of its operation. What could the Commission do to remedy the trouble?

* * *

There were two answers to the problem of preventing collisions on the radio highways: one to reduce the number of stations which employ them, and the other to reduce the time that some of the stations operate, thus allowing two or more stations to use the same channel during different periods, much as a thrifty landlord used one set of beds to accommodate three shifts of miners in the early days of the gold rushes. The Radio Commission adopted the latter plan.

Forty channels were cleared, eight in each zone. One-fourth of these were assigned exclusively for the use of single stations. On the other three-fourths, two or more stations are limited in time so that they do not operate simultaneously. Most of them are high-power stations. Consequently, during the night hours, there should be little or no interference on nearly one-half the dial. According to the Commission's original order the clear channels are Nos. 64 to 87 inclusive (excepting 78) and channels 97 to 119 inclusive (excepting 101 and 112). Subsequent allocations may slightly change these figures. This should revive interest in long distance reception on these channels.

Of the remaining fifty channels, four are assigned for simultaneous use in not less than two zones, thirty-five for not more than three zones, five for all zones for stations whose power does not exceed 1000 watts, and six for all zones for power not over 100 watts. The last two classifications cover 317 stations. Thus more than half the number of stations are accommodated on eleven channels and nearly a fourth of them are found on three local service channels, number 120 with 52, 121 with 45, and 131 with 51 stations.

These allocations, as well as this interpretation thereof, are somewhat tentative and many of them will be changed, if the number of protests is any criterion. But zone assignments of power and particular frequencies cannot be greatly altered because of the interdependence of the entire set-up.

* * *

Another revolutionary order which will be bitterly opposed by the stations, and as heartily approved by the majority of listeners, is that prohibiting the broadcasting of chain programs from more than one station for more than one hour a day where the chain stations are within three hundred miles of each other.

So the eleventh of November will probably mark the beginning of the end of much of the interference that the listener has endured for many months. But in the meantime active hostilities are in progress between station and station and between stations and the Commission. Many stations and communities are up in arms against what they consider unjust discrimination. Consequently, even if Armistice Day brings an armistice in this radio warfare, it will leave many hard feelings to be softened by subsequent peace negotiations.

# The Short-Wave Trans-Atlantic Radiophone

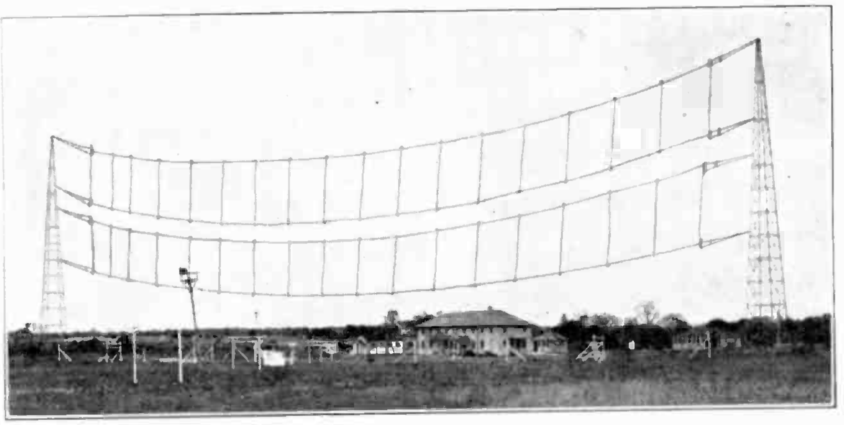
*By* S. R. WINTERS

A REGULAR radiotelephone service on short waves between the United States and England is soon to be in effect. This is a departure in that two-way communication is to be attempted on short waves, instead of the long waves by means of which the service was introduced. The Bell Telephone Laboratories, Inc., recently erected buildings and installed short-wave receiving equipment at Netcong, New Jersey, and the British Postoffice has completed a short-wave transmitting station in Scotland.

The radiotelephone calls between this country and Great Britain now average 30 a day, and occasionally the number of international radio conversations may reach 60 within twenty-four hours. To accommodate this increasing traffic as well as to determine the suitability of short waves for regular, dependable long-distance communication, the duplex, two-way system has been constructed in the two respective countries. Until quite recently England had no short-wave transmitting station for communication with the United States. The new short-wave receiving station at Netcong, New Jersey, is a mate for the recently built English high-frequency transmitting station.

The use of a radiotelephone for dependable communication over a distance exceeding 3000 miles requires the application of three pairs of short wavelengths. The vagaries of short waves are such as to require different frequencies for effective operation at varying periods of the day and night. For example, in the two-way trans-Atlantic radiotelephone service one wavelength will be used during daylight hours, a different wavelength will be employed for night service, and still a third wave channel of a frequency at variance with the other two will be necessary for effective communication when a portion of the signal path is shrouded in darkness and the other part illuminated by daylight.

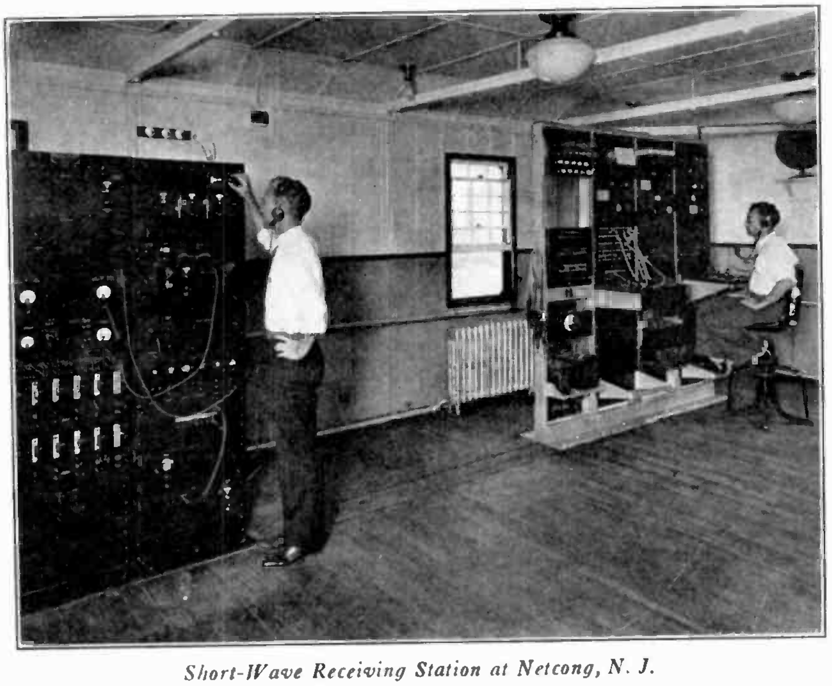
In this particular, the short-wave service differs essentially from that of long-wave trans-Atlantic radiotelephone communication. At present, in the use of long wavelengths, two-way operation is effected on a single wavelength by means of the single-sideband method of transmission and voice-operated relays. This arrangement permits of telephone currents traveling in but one direction on the circuit at any given moment. Single-sideband transmission and working both ways on one wavelength are not now practicable commercially on short waves, contend engineers of the Bell System. The voice-operated devices, however, are employed in connection with two slightly different wavelengths, one of which is used for eastbound speech and the other for westbound conversation.



*Short-Wave Telephone Transmitting Station at Deal, N. J.*

The short-wave transmitting station of the Bell Telephone Laboratories is located at Deal, New Jersey—occupying the grounds and housed in the building originally dedicated to the innovation of exchanging radiotelephone communications between shore and ship stations, about ten years ago. This is fitting that the same location should mark the inauguration of two such signal achievements in the art of radiotelephony. The ship-to-shore experiments were conducted from 1919 to 1922. Quite recently, a marine-service company in California inaugurated a regular radiotelephone service hourly between the Los Angeles harbor and a fleet of steamers and tugboats operating in the southern California waters.

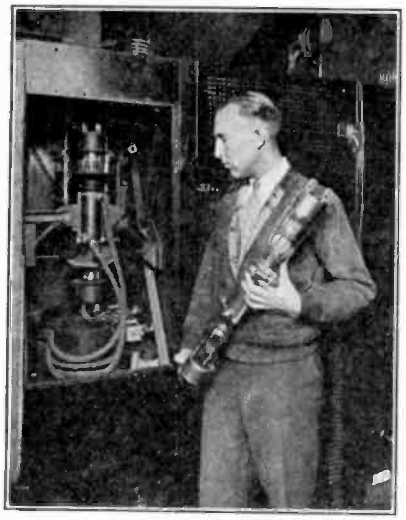
The New Jersey short-wave transmitter for trans-Atlantic communication is subject to quartz-crystal control, a thin slab of this mineral—encased in a constant temperature cabinet—governs the transmitting frequency or wavelength with remarkable precision. The shifting from one wavelength to another in the variable frequency operating schedule is effected in less than ten minutes. This change in operating wavelengths merely requires the substitution of one slab of quartz crystal for another of different thickness and the insertion of different inductance units in the output circuits of the high-frequency amplifier. These changes in operating conditions are not only dictated by variations in day and night periods but by seasonal de-



*Short-Wave Receiving Station at Netcong, N. J.*

mands—the change from summer to winter or vice versa, for example.

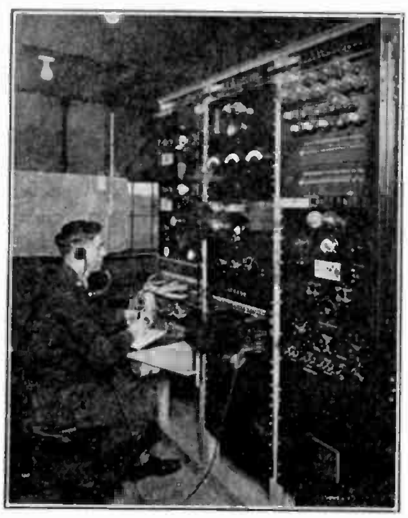
The short-wave receiving station at Netcong, New Jersey, is an absolutely new link in the radio and telephone communication chains of the Bell System—the buildings having been recently erected and the equipment newly installed. Both stations are linked by land wires with communication headquarters



*Transmitting Equipment*

of the Bell Telephone Laboratories at 24 Walker Street, New York City. At this point, the two one-way circuits converge and are thus transformed into a two-way circuit for connection through the long-distance switchboard to the lines of the Bell System.

This new undertaking of establishing two-way radio communication between America and England on short-waves



*Speech-Input Monitoring Panel at Transmitting Station*

should further contribute to our knowledge of a band of frequencies which radio amateurs discovered as having great intrinsic value. Already, the one-way trans-Atlantic communication has disclosed that static or atmospheric disturbances discriminate against long waves in favor of short waves for such long-distance service. Short waves, it has also been found, do not travel so nearly in a bee-line to their destination as do the long wavelengths. The exact path of short waves, however, remains to be defined and charted. Our knowledge of the skip effect and the fading of signals when employing short waves should be contributed to measurably by this regular radio service for spanning the Atlantic Ocean.

## SIMPLIFIED FORMULAS FOR REACTANCE

*By* Arthur Hobart

A delightful simplification can be made in radio's most fundamental equation, which says that the total reactance of a series circuit is equal to the difference between the inductive reactance and the capacitive reactance.

It is ordinarily expressed as $X = \omega L - 1/\omega C$, where $X$ is the reactance in ohms, $\omega$ is $2\pi f$, $f$ being the frequency in cycles per second, $L$ is the inductance of the coil and $C$ the capacity of the condenser. The circuit is resonant when $\omega L = 1/\omega C$, the reactance then being zero and the impedance to the flow of an alternating current being equal solely to the resistance of the circuit.

But the prodigious labor involved in calculating a resonance curve with this formula may be greatly lessened by simplifying it to meet the conditions found in practice. As the circuit conditions are constant when it has been tuned to resonance for a given frequency, the only variable is the non-resonant frequency, for which the impedance is to be found.

Thus it is common practice to use a 170 microhenry coil with a .0005 microfarad condenser to cover the broadcast band from 550 to 1500 kilocycles. A frequent problem is to determine the proportionate interference that may be caused by a carrier wave in a channel close to that to which the circuit is tuned. The reactance to the tuned frequency is zero and that to the interfering frequency is approximately $X = 4\pi Ld$ when $d$ is the difference in *megacycles* between the two frequencies and $L$ is expressed in microhenries.

The value of this approximation can best be illustrated by a typical problem. Assume that a circuit consisting of a 170 microhenry coil and a .0005 mfd. condenser is tuned to 1000 k.c., i.e. $X = 0$ at 1000 k.c. What is its reactance to 990 k.c.?

By the standard formula it is first necessary to find the $LC$ value of the circuit, either from a published table or from the formula $LC = 1/(2\pi f)^2$, which in this case is .02532. From this find $C$ as $.02532 \div 170 = .000149$ mfd. Then $X = 6.28 \times .990 \times 170 - 1 \div (6.28 \times .990 \times .000149) = 1057.4 - 1079.0 = 21.6$ ohms.

By the approximate formula $X = 4\pi \times 170 \times .01 = 21.4$ ohms, and how much easier it is to check the correctness of your work!

For a 5-ohm circuit tuned to 1000 k.c., the impedance is 5 ohms to 1000 k.c., and $\sqrt{5^2 + 21.4^2} = 22$ ohms to 990 k.c., or 4.4 times greater. So, for equal signal input, the 1000 k.c. signal is 4.4 stronger than the 990 k.c. signal at the circuit output, or the 990 k.c. signal is less than one-fourth as strong as the 1000 k.c. signal.

The method whereby this approximation, and also a very simple exact equation for reactance, may be derived is an interesting exercise. At the resonant frequency $f_R$, the inductive reactance is equal to the capacitive reactance,—$2\pi f_R L = 1/2\pi f_R C$, whence $LC = 1/(2\pi f_R)^2$ and $2\pi L = 1/(2\pi f_R^2 C)$. At any frequency $f$, $X = 2\pi f L - 1/2\pi f C =$

$$\frac{(2\pi f)^2 LC - 1}{2\pi f C} = \frac{\frac{(2\pi f)^2}{(2\pi f_R)^2} - 1}{2\pi f C}$$

$$= \frac{f^2 - f_R^2}{2\pi f_R^2 C f} = \frac{2\pi L(f^2 - f_R^2)}{f}$$

Let $f = f_R \pm d$, $f^2 = f_R^2 \pm 2 f_R d + d^2$. $f^2 - f_R^2 = \pm 2 f_R d + d^2 = d(\pm 2 f_R + d)$

So $X = 2\pi L d \left(\frac{\pm 2 f_R + d}{f_R \pm d}\right)$ and if $d/f_R$ is small, $X = 4\pi L d$.

As an example of the use of the exact formula, consider a circuit tuned to 1500 k.c., using a 170 microhenry coil. What is the reactance to 1510 and 1490 k.c.?

$2\pi L = 6.2832 \times 170 = 1068.124$, $d = \pm .01$, $f_R = 1.5$.

$$X = 1068.124 \times .01 \ \frac{(\pm 3 + .01)}{1.5 \pm .01}$$

$$= 10.68 \times 1.993 \text{ or } -10.68 \times 2.0066$$

So the reactance to 1510 k.c. is 21.28 ohms and to 1490 k.c. is 21.43 ohms. By the approximate method, $X = 21.4$ ohms for either case. The magnitude of the error introduced by this approximation is about $\pm d/2f_R$, which is negligible in most practical cases.

An equation of almost equal simplicity can be developed for a parallel or non-resonant circuit. Assuming that the losses due to resistance are small, and consequently neglecting $R$, the reactance $X$ of a parallel circuit is $\omega L/(1 - \omega^2 LC)$. Adopting the same method and notation as in the case of series reactance, this can be successively reduced to

$$\frac{-2\pi L f_R^2}{d} \ \frac{1 \pm d/f_R}{(\pm 2 + d/f_R)} \text{ or}$$

approximately $X = \dfrac{\mp \pi L f_R^2}{d}$

This method is much simpler and easier than the usual method of finding susceptances and reactances and is just as accurate.

# What Is an Underground Antenna?

*By* G. M. Best

Each radio season sees the advent of a crop of devices commonly advertised under the name of "underground antennas." To read the claims for such devices, as set forth in their published advertising and mail circulars, creates an expectation that they will give absolute freedom from static, power line interference, and other annoying noises usually present when a conventional type of antenna is used, and at the same time with no sacrifice of distance, selectivity or other impairment of operation of the receiving set.

As this seemed too good to be true, an investigation of the various devices of this type was made, with a view to determining their merits, if any, and also to obtain an accurate definition of an underground antenna as conceived by its inventors.

The principal patents covering underground antennas were granted to James Harris Rogers of Hyattsville, Md., in 1919 and 1920, and we understand that these patents have been sold by Mr. Rogers to other interests. A study of the patent papers discloses some very interesting data, and in Fig. 1, a reproduction of one of the many types of antenna systems covered by Mr. Roger's patents is shown, as a typical example.

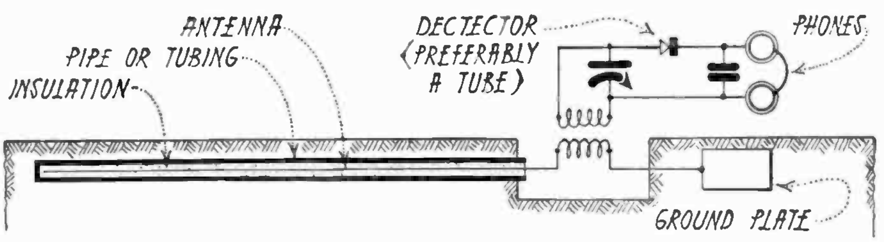


*Fig. 1. Rogers Underground Antenna*

The principal claim covering this type of antenna defines the antenna as "A radio signaling system comprising an antenna extending horizontally substantially parallel to the surface of the earth and insulated therefrom, a metallic covering inclosing said antenna but insulated therefrom and in intimate contact with the earth substantially throughout its length, signal instruments associated with said antenna, and a balancing connection on the opposite side of said instruments."

Referring to Fig. 1 it is obvious that the underground antenna consists of an indeterminate length of insulated wire enclosed in a metal sheath such as a lead cable, buried sufficiently so that the sheath is in good electrical contact with the earth, and parallel to its surface, the lead-in being brought to one side of the coupling inductance of the receiver, the opposite end of which is grounded. Many variations of this method are covered by the patents, including such an arrangement as is shown in Fig. 2, in which equal lengths of buried, shielded wire are placed on each side of the coupling inductance, and no ground connection whatsoever is used.

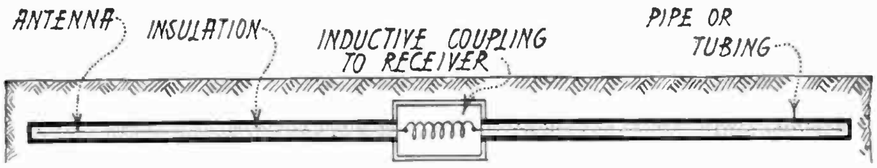


*Fig. 2. Underground Antenna of Equal Sections*

Other variations place the shielded cable on top of the ground but in contact therewith; place the cable on supports so that it is elevated a few inches above the earth; and several of the arrangements include grounding of the far end of the buried cable instead of insulating it as is done in Figs. 1 and 2.

Dr. Rogers developed his various underground systems before and during the World War, his first application for patents being made on May 2, 1917, and to him should go the credit for the remarkable work which he did at a time when radio was in its infancy and the apparatus with which he had to work was necessarily of crude form. Being interested in knowing just what Mr. Rogers thought of the various so-called underground antennas being sold to the general public, a letter was addressed him on the subject, and the reply thereto is reproduced below:

Rogers Radio Research Laboratory
Hyattsville, Maryland
August 22, 1928.

Editor, Radio

Sir: My brother Dr. J. Harris Rogers, who is unwell, begs me to acknowledge receipt of your kind letter of August 10, and to thank you for the credit you propose to give him for his pioneer work in underground and underwater radio, in your valuable publication.

His attention has been called to various publications and advertisements of devices utilizing the underground principle and making exaggerated claims, for which he is in no way responsible, and which are misleading and unwarranted, and likewise unjust to himself and to the public.

Referring to the class of devices referred to in your letter, he is frank to say that in his opinion they are not comparable in efficiency with the elevated antenna or the underground antenna when buried substantially parallel with the surface of the earth.

Again thanking you for your esteemed letter, I beg to remain,

Very truly yours,
(Signed) Jas. C. Rogers.

Having thus received confirmation of our opinion from the man best informed on the subject, a further investigation was made as to the nature of the various devices being sold, and the results obtained with them when used with an average broadcast receiver.

Practically all of them consist of a metal container, usually sealed and made of brass or copper, to which is connected a length of lead-in wire. In one or two specimens, the container was filled with a mixture of charcoal and common salt, the assumption apparently being that after the device had been buried for some time, the moisture in the soil would penetrate the container and make a better contact between the lead-in and ground. Some of the patent grounds which do not claim to be underground antennas have various combinations of chemicals, chiefly copper sulphate, which when combined with moist soil is supposed to provide an exceptionally good ground. This phase of ground connections is covered in detail in an article by Heckert Parker in August, 1928 Radio.

All of these devices have ordinary rubber and cotton covered lead-in wire, and the accompanying instructions direct the buyer to install it directly outside the wall of the house, under the window through which the lead-in wire is to be brought. From our own experience, when used with a broadcast receiver having an average degree of sensitivity, the results were so poor as to make the set useless except for local stations.

Experiments with a real Rogers antenna, similar to Fig. 1, using a sensitive superheterodyne, showed that a range of 500 miles at night, in the winter, might be expected, with loud speaker volume, from stations having a power of at least 1000 watts. The static level was very much lower than when using an elevated antenna, 40 ft. above the ground, and 80 ft. long. Although the volume on distant stations was much less with the underground antenna, a well-defined reduction of static to signal ratio was noted, and except for stations at distances of over 500 miles, the Rogers antenna was preferable.

However, when using the underground antenna with a 7-tube tuned r.f. set of well-known make, the results were much poorer than those obtained with the superheterodyne, due of course, to the lower degree of sensitivity in the tuned r.f. set. Stations 500 miles away which came in with good volume with the elevated antenna, could not be heard with the underground antenna, and this performance was made with the underground antenna arranged in such a manner as to receive the signals of the distant station to the best advantage. On local stations, however, the performance of the set was very satisfactory, and while the static level on the elevated antenna was so far down as to be barely noticeable, a difference could be detected when the underground antenna was used.

So much for the conventional buried wire in metal conduit. Several of the buried container antennas were then connected to the superheterodyne, and the results compared with those obtained with the Rogers system. Distant stations could not be heard, and only those locals which were within 6 or 7 miles of the receiver could be picked up with sufficient volume to give a satisfactory performance. In fact, with the superheterodyne, better results were obtained when a good water-pipe ground connection was used, with no antenna, than with the buried antenna. Hence, the conclusion was reached that if the lead-in from the buried antenna was cut off close to the ground, and only the lead-in used, better results would be had, and this proved to be the case. How much better it would be, then, for one to dig a small trench, say six inches deep, out through the back yard for a distance of fifty feet or more, and bury therein a length of lead covered wire, rather than to spend more money, and install what actually is nothing but a high resistance ground, with a small effective capacity thrown in.

It is necessary to give the devil his due, however, for one device proved to be quite satisfactory with sets such as the superheterodyne, and was the nearest to being an underground antenna of any of them. This device consisted of a sealed metal container, in which was coiled a roll of lead covered wire perhaps 60 ft. long. The wire passed through a hole in the container, and a 15 ft. piece was provided for the lead-in. Directions for installation called for burying the device in a vertical position, directly under the window through which the lead-in would pass, and did not call for any section of buried wire like the Rogers system.

The station log obtained with this antenna, using a superheterodyne, proved that a considerable amount of energy was being collected by the antenna, and that as compared with an elevated antenna, it was preferable except for the reception of extreme distance, in which case the elevated antenna was by far the best of the two. But the strangest part of the whole thing was that when the coil of wire was removed from the can, and laid out flat on the ground, the results were much better than when the coil was wound up and sealed within the buried container. "Why not eliminate the metal container then, dig a trench for the cable the same as for the Rogers system, and do a real job of it?" you might ask, but this would never do, for who would dare ask ten bucks for 75 ft. of lead covered wire? A copper-plated can filled with mystery looks ever so much more worth while to the average uninformed radio fan. Of course, digging the trench is a lot of bother, and conditions may be such that there is no room for a real Rogers antenna, which is the best argument the patent ground makers can bring forth.

A fair idea of how much money must be made on such devices can be gained by the writer's experience in answering a number of advertisements concerning them, for where the first quotation was list price, as advertised, subsequent follow-up letters gradually brought the price down until in one case the reduction amounted to nearly 70 per cent. It would be foolish to assume that they were not making a profit even at 70 per cent discount, so the reader can draw his own conclusions.

The moral of all this is that if you are satisfied with local reception, a short elevated antenna will give you the results you want with practically no static, except in the summer months, and unless the elevated antenna is impractical due to the location, the expense of a factory made underground antenna is not warranted. If you expect to receive distant stations, however, do not be disappointed if you meet with failure, for while you may find the static level very much lower than before, you will probably find the signal level has gone down in much the same proportion. So if you buy one, patronize the firm with the money-back guarantee and here's hoping you get your money back.

## NEW SYSTEM FOR DETERMINING SHIP'S POSITION

A radio acoustic system for determining the position of a survey ship when it is beyond the visibility of shore objects has been developed by the U. S. Coast and Geodetic Survey. As described in the Survey's special publication No. 146, it consists essentially of a radio transmitter at each of two widely separated shore stations and a radio receiver on the ship.

Each transmitter automatically radiates a characteristic signal whenever a submerged microphone is disturbed by the explosion of a bomb close to the ship. This disturbance or noise is also instantaneously transmitted by a submerged microphone at the ship. At varying periods of time, depending upon the distance from the two shore stations, their radio signals are also received. As the speed of sound in water is definitely known, as are also the station locations, the ship's position may be quickly plotted on the survey map.

When the position of the ship is wanted, a small bomb is fired in the water alongside. The instant of the explosion is automatically recorded on a chronograph aboard the ship. The sound of the explosion disturbs the submerged microphones at the shore stations and their resulting characteristic radio signals are received and recorded on the ship's chronograph. The ship thus obtains the time of travel of sound in sea-water from her position to each of the known positions of the shore station microphones, and therefrom is figured the distances. This method has successfully been used with a ship 75 miles away from the shore stations.

## RADIO SIGNAL TRANSMISSIONS OF STANDARD FREQUENCY, OCTOBER TO MARCH

The Bureau of Standards announces a new schedule of radio signals of standard frequencies, for use by the public in calibrating frequency standards and transmitting and receiving apparatus. This schedule includes many of the border frequencies between services as set forth in the allocation of the International Radio Convention of Washington which goes into effect January 1, 1929. The signals are transmitted from the Bureau's station WWV, Washington, D. C. They can be heard and utilized by stations equipped for continuous-wave reception at distances up to about 500 to 1000 miles from the transmitting station.

The transmissions are by continuous-wave radiotelegraphy. The signals have a slight modulation of high pitch which aids in their identification.

Information on how to receive and utilize the signals is given in Bureau of Standards Letter Circular No. 171, which may be obtained by applying to the Bureau of Standards, Washington, D. C. Even though only a few frequency points are received, persons can obtain as complete a frequency meter calibration as desired by the method of generator harmonics, information on which is given in the letter circular. The schedule of standard frequency signals is as follows:

RADIO SIGNAL TRANSMISSIONS OF STANDARD FREQUENCY

*Schedule of Frequencies in Kilocycles*

| Eastern Standard Time | Oct. 22 | Nov. 20 | Dec. 20 | Jan. 21 | Feb. 20 | Mar. 20 |
|---|---|---|---|---|---|---|
| 10:00—10:08 P. M. | 550 | 1500 | 4000 | 125 | 550 | 1500 |
| 10:12—10:20 | 600 | 1700 | 4200 | 150 | 600 | 1700 |
| 10:24—10:32 | 650 | 2250 | 4400 | 200 | 650 | 2250 |
| 10:36—10:44 | 800 | 2750 | 4700 | 250 | 800 | 2750 |
| 10:48—10:56 | 1000 | 2850 | 5000 | 300 | 1000 | 2850 |
| 11:00—11:08 | 1200 | 3200 | 5500 | 375 | 1200 | 3200 |
| 11:12—11:20 | 1400 | 3500 | 5700 | 450 | 1400 | 3500 |
| 11:24—11:32 | 1500 | 4000 | 6000 | 550 | 1500 | 4000 |

# Electric Phonograph Pick-up Units

## A Description of Their Methods of Operation and Suggestions for Improvement of Tone Quality

*By* FRANCIS CHURCHILL

WHILE many different phonograph pick-up units are available, but little information is given as to their proper use. An electric pick-up unit usually consists of a permanent magnet, a field coil and a moving armature. The armature is actuated either directly or through a link coupling, by the phonograph needle. The magnetic type is the most popular and seems to have the best frequency characteristic.

The frequency at which the needle moves across the groove of the record determines the pitch of the sound produced. The needle moves an armature, which in turn generates a voltage in the field coil, since it is cutting lines of force produced by the permanent magnet. This voltage is then applied to an audio frequency amplifier and loud speaker and is reproduced as sound.

As the design of the pick-up unit cannot be easily changed by the experimenter, the output frequency characteristics are not variable for a particular unit. That unit may not be very good on the low frequencies, or perhaps on the high frequencies, but by proper use it may be made to give satisfaction.

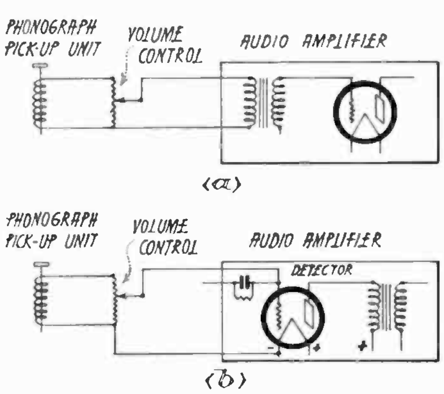



*Fig. 1. Usual Methods of Connecting Pick-up Unit*

Fig. 1 (a) and (b) show the usual methods of connecting a unit into the audio amplifier of a radio set. The ordinary pick-up unit has an impedance of about 1000 ohms at the low frequencies and may rise as high as 20,000 ohms at 5000 cycles, as shown in Fig. 2, whose curves were made with a standard impedance bridge and are typical.

When such a unit is connected as shown in Fig. 1 (a), the high frequencies may be lost if the volume control is of too low a value, since the load would then be equal to the pick-up or generator impedance at the lower frequencies. If the resistance is made high enough so that the pick-up unit works into, in effect, an infinite impedance, then a more uniform voltage output would be obtained for all frequencies. However, in such a case the primary of the first audio transformer would be across a variable impedance, depending upon the volume control setting, and so would not amplify uniformly.

Considering only the first transformer in the usual two-stage audio amplifier, the impedance across its primary should not be over 10,000 to 20,000 ohms. With impedances higher than this the low frequencies are lost, as also are generally the high frequencies. This means a peaked amplifier and poor tone quality. This is likely to happen at certain volume control settings if the resistance happens to be greater than 50,000 ohms. With this same arrangement at very low volume settings or at the highest settings, the primary of the audio transformer will be connected across a low impedance, which will improve the low frequency response and also the high end. This is undesirable, since changing the volume causes a change in quality.

A good way to get around this trouble is to connect the volume control as an ordinary variable resistance in shunt to the pick-up unit. With such a connection, the maximum impedance across the transformer will be somewhat less than that of the pick-up unit, which means a fairly low impedance at any volume control setting. This is desirable because the characteristic of the first audio transformer stays the same, as does the complete amplifier.

Let's see what happens when such a low impedance is connected across the amplifier. Curve A in Fig. 3 is that of a popular type of audio transformer when connected across a detector tube having about 20,000 ohms plate impedance. Curve B shows the same transformer with a pick-up unit across it. Due to the lower impedance, the low frequency response is much better and the transformer is nearly perfect on the lower end. However, the upper end has an enormous peak. Tests on a number of makes of transformers showed the same effect with the peak ranging from 4,000 to 7,000 cycles. Such a peak would cause over-amplification of the higher frequencies and needle scratch.

All audio transformers have a certain amount of leakage reactance and the secondaries have distributed capacity and capacity to ground, as well as the input capacity of the vacuum tube across it. All of these capacities resonate with the leakage reactance in such a way as to

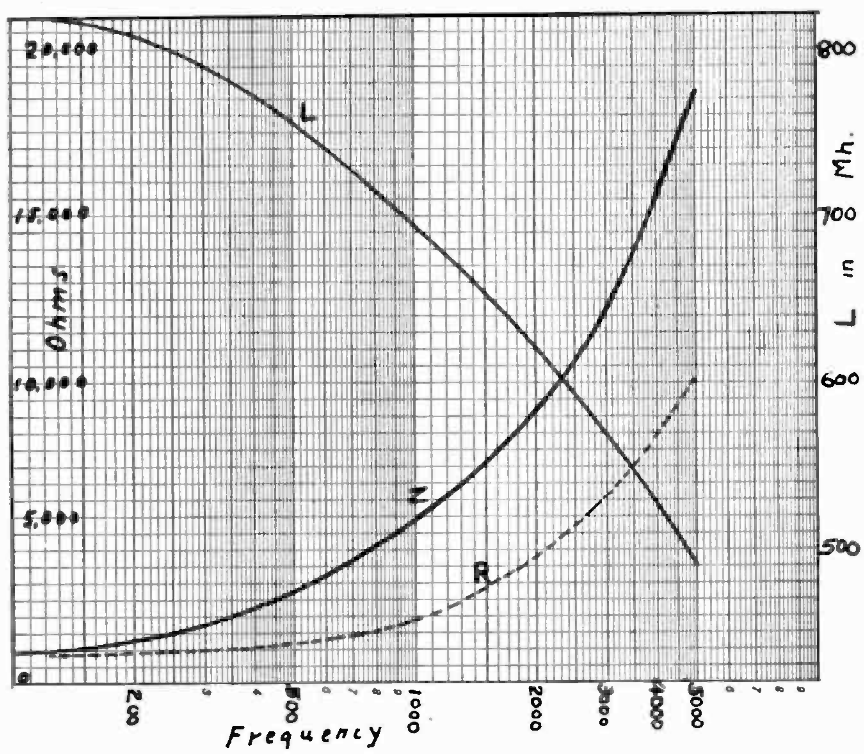



*Fig. 2. Resistance, Inductance and Impedance Curves of Typical Pick-up Unit*

cause a peak in the high frequency range. This leakage reactance can be increased by adding an external inductance in the primary circuit, which is exactly what we have done when connecting the pick-up unit across the primary. Naturally the lower the resistance in series with this resonant circuit effect, the higher will be the resultant peak. The pick-up unit has a fairly low resistance and so the curve B of Fig. 3 is obtained. There are two ways of overcoming this peak but first let us see whether it is desirable to eliminate it.

If the rest of the audio amplifier is not peaked on the high frequencies, such a peak in the first transformer can be put to good use. When the volume control resistance has a maximum value of say 10,000 ohms, the pick-up unit will not give a good high frequency response and the lower this value of resistance the poorer the response. Then the peak in the amplifier practically offsets the droop in output of the pick-up unit and so an excellent sound output is obtained over the whole range of frequencies.

Suppose that the amplifier has too high a peak or that the pick-up unit has naturally a greater output at high frequencies, then it would be desirable to eliminate this peak. This can be easily done in two ways; by inserting a 10,000 or 20,000 ohm resistance directly in series with the transformer primary, or by inserting a higher resistance in the grid return of the secondary.

The first scheme has the objection of causing a drop in the low frequencies as well as the highs, since the curve A will generally be obtained, but it has the advantage of being very simple to install, since it can be external to the radio receiver. The middle frequencies are not diminished, since even 20,000 ohms is only a very small portion of the transformer primary impedance at these middle frequencies.

The second scheme has the advantage of not affecting the low frequencies but does drop the higher ones. It has the disadvantage of having to be inserted in the audio amplifier and should not be used with a detector tube input, since the high frequencies would be practically lost.

Fig. 4 (a) and 4 (b) show the connections for these two schemes. In the latter,

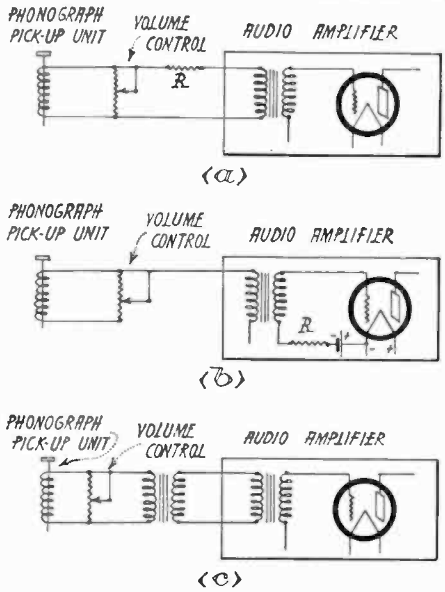



*Fig. 4. Suggested Connections for Pick-up Unit. (In 4b the volume control resistance should be connected to ground.)*

the resistance $R$ will vary between 50,000 ohms and 250,000 for different types of pick-up units and audio transformers. Its action is as follows: There is a capacity between the two windings of the transformer which is charged by the secondary induced voltage. The charging current flows to ground through this resistance $R$, causing an emf opposite to that of the secondary induced emf in its effect on the grid of the tube. Thus one voltage counteracts the other and so the hump on the high frequencies is reduced. At lower frequencies the charging current is less, due to the higher reactance and so the very low frequencies are unaffected.

Often the pick-up unit does not deliver enough voltage to properly operate the audio amplifier and loud speaker. When this occurs an intermediate impedance matching transformer may be used as shown in Fig. 4 (c) or the unit may be connected across the grid of the detector tube.

Curve C, Fig. 3 was obtained when such a transformer was used in conjunction with the first audio transformer. The rising low frequency response was obtained evidently from the effect of impedance matching at the very low frequencies, with a corresponding drop for all higher frequencies. Curve C does not show the voltage gain when using this step-up transformer but merely shows the frequency response with 1000 cycles per second as a reference.

Fig. 1b shows the method of connecting the pick-up unit and volume control into the grid of a detector tube. This can be most conveniently done by means of a flat adapter which will slip over the grid and negative filament prongs or cathode of an a.c. tube, after which the detector tube can be inserted in its socket. The volume control should be connected to ground and should be at least 50,000 ohms. A 500,000 ohm potentiometer would be more suitable and a more uniform frequency response would be obtained.

As stated before, the low frequency response with this last arrangement will not be as good as when the unit is connected directly across the audio transformer, but more gain will be obtained since the detector tube is used as an amplifier. There will be no high frequency peak, at least no more than when used for radio reception, but the pick-up unit will give more output at the high frequencies. Scratch filters may be used if the needle scratch is objectionable, though if the pick-up unit is used properly, such a filter is unnecessary.

Phonograph records are cut laterally. To prevent the cuts from cutting through to the next groove, the very low notes are undercut or in effect, attenuated. With a good dynamic speaker mounted in a large cabinet or baffleboard, the audio amplifier may be made to have a

(Continued on Page 47)

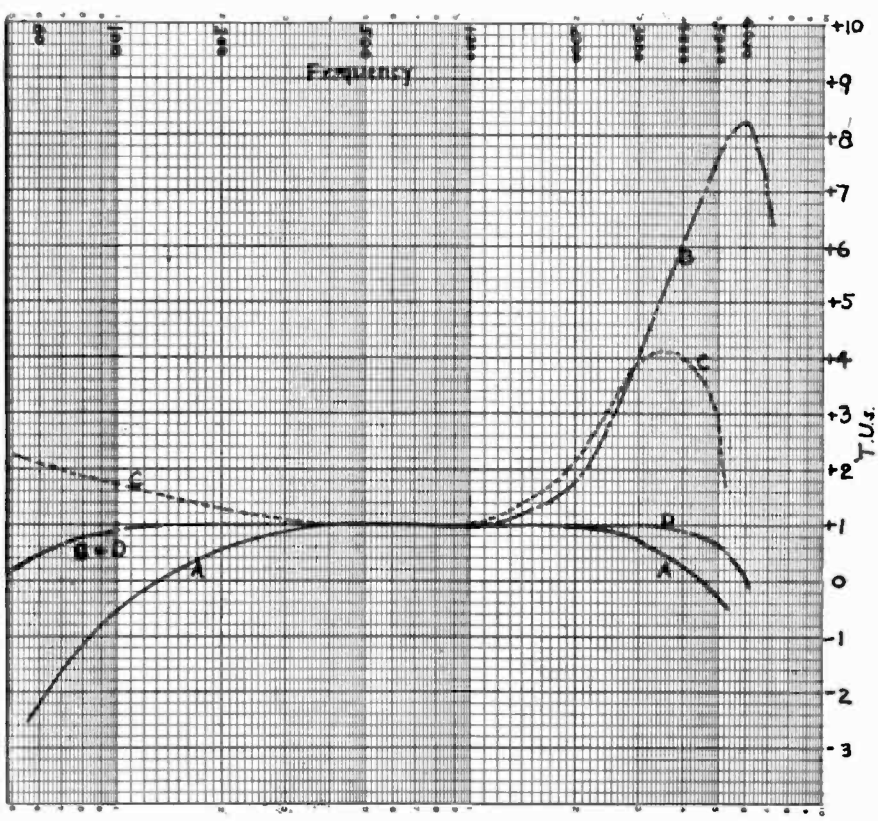



*Fig. 3. Effect of Different Impedances on Audio Frequencies*

# Radio Picture Transmission and Reception

## Photoelectric Equipment and Methods for Visual Communication

*By* JOHN P. ARNOLD, *Departmental Editor*

SOME of the future possibilities of the electrical transmission of photographs were strikingly demonstrated when signals, emanating from radiophone apparatus installed in the cabin of an airplane, flying a mile above the city of Philadelphia on the afternoon of August 14, were picked up by Station WFI in that city and rebroadcast for radio listeners who were equipped with picture receiving apparatus.

Due to the vibration of a wind-driven generator which supplied the power for the radio transmitter, the results were not highly satisfactory as far as the quality of the received pictures was concerned. But the demonstration itself, probably the first in the history of phototelegraphy, marked an epoch in the application of still picture transmission to modern problems such as the dissemination of military information to numerous points along a battle front, the location of forest fires by aerial patrols, and the transmission of photographs of important events while an airplane is in flight.

*Picture Transmitting Equipment in Plane*

The experiment was undertaken jointly by the Philadelphia airport, Ludington Philadelphia Flying Service, Inc., Station WFI of the Strawbride & Clothier Store and the Radiovision Corp. of New York. A Cooley "rayfoto" transmitter was installed in the cabin of a Fairchild monoplane. The short-wave radiotelephone equipment, having a maximum input of 75 watts, was mounted in the cockpit. A 65-ft. "fish line" antenna was used.

The flight over the central section of the city required more than an hour.

*Reproduction of Received Radio Picture of Colonel Lindbergh*

Half an hour was needed for the plane to gain the high altitude necessary to throttle down the engine so that it would not interfere with radio transmission. Photographs of Col. Lindbergh and Graham MacNamee, which had previously been converted to a "sound record" on a phonograph disc in accordance with the usual method employed in the Cooley system, were transmitted. Although this demonstration did not include the actual photographic operations of taking, developing and preparing the pictures for transmission aboard the plane, there would be no difficulties in carrying out these steps on an airplane especially equipped for this work.

The airplane was piloted by Robert P. Hewitt, assisted by John Busher, and the broadcasting apparatus was operated by John J. Leitch, Federal Radio Inspector of the Third District.

The picture signals were received on a short-wave receiving set on the roof of Station WFI and rebroadcast on that station's regular wavelength.

Essentially the system of transmission consists in converting the light and shade of a photograph into audio-frequency impulses which are received on a conventional radio receiver and converted to light impulses by a three-tube amplifier-oscillator circuit. This apparatus converts the audio-frequencies, which would ordinarily be fed into a loudspeaker in speech reception, into ultra-violet light variations radiated from a needle-point stylus. The light impressions are recorded on sensitive photographic paper, producing a positive reproduction of the transmitted pictures. It requires but three minutes to make a 4 x 5 picture consisting of 100,000 image impressions.

### A REVOLUTIONARY LIGHT-SENSITIVE CELL

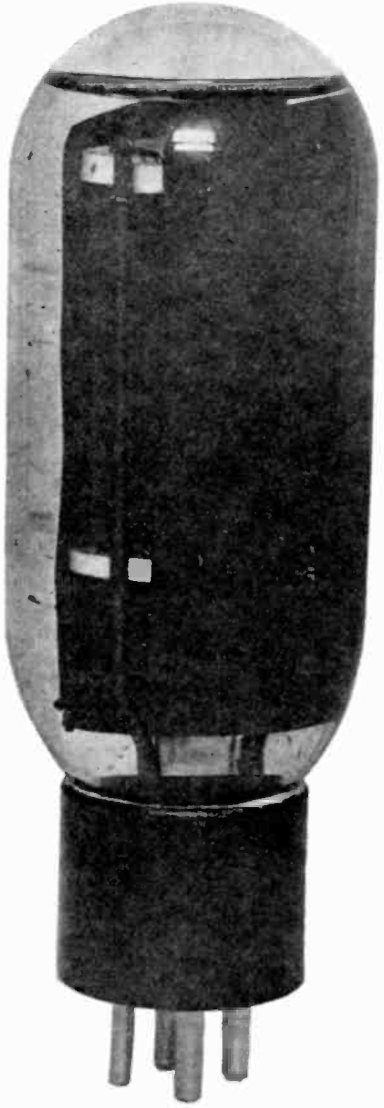
READERS of these columns have already been introduced to the well-known types of photoelectric cells; that is, those which employ the alkali metals or selenium as the light-sensitive material. Still another type is the photovoltaic cell which is an important development in photoelectric cell construction. It is quite likely that the recent perfection of this cell will solve some very troublesome problems in the field of visual communication and in the improvement of various sound recording and reproducing devices for which light-sensitive cells are commonly employed.

To go back a bit to the early period of photoelectric history. In 1873 Willoughby Smith observed a phenomenon which is now designated as the *photo-resistive* effect. In this case the substance changes (usually lowers) its electrical resistance when light falls upon its surface. The effect is observable in selenium, molybdenite, the metallic sulphides, oxides and various other crystalline forms. Selenium cells were the first to be used for practical engineering work; but their response is very slow.

The so-called true *photoelectric* effect, first noted by Hertz in 1887 and later more fully investigated by Hallwachs, refers to the emission of electrons *from* a metal or compound when illuminated. Stated in other words, a photoelectric body loses a negative charge due to the action of light. Potassium or the other alkali metals are usually employed for the construction of such cells.

The photovoltaic effect is a case where an electromotive force is generated between two metals in an electrolyte as the result of the action of light on one of the metals. The discovery of this effect extends back many years, probably before either the photo-resistive or photoelectric phenomena were observed. In any event, in 1878, Sabine designed the first practical photovoltaic cell, employing selenium deposited on an aluminum plate for this purpose. Cells of this type consist of two electrodes immersed in a liquid or electrolyte and, in operation, do not require the use of an external battery as is necessary in using selenium or potassium cells.

Although this particular effect was discovered many years ago and although various combinations of electrodes and



*Photovoltaic Cell. (Radiovision Corp.)*

electrolytes have been tried, satisfactory results were rarely achieved. It would be tedious to describe the reasons why the development of this type of cell was neglected all of these years; it will suffice to mention that the general belief is that fatigue precludes any successful results with them. As we learn more about the matter of fatigue, in regard to the photoelectric cell, it is conceded that the emission of electrons is an intrinsic property of the light-sensitive material, and that strong fatigue characteristics are often due to secondary causes which improved design is constantly eliminating.

Although it is too early to say that this is also true in the case of photovoltaic cells, nevertheless, careful laboratory tests, which would detect a delay in response of the order of hundredths of a second, have failed to reveal any fatigue. Moreover, there are additional reasons for believing that these cells may be used for practically all applications which require a high frequency of response. The credit for the perfection of the photovoltaic cell is due to Samuel Wein, of the Radiovision Corporation, New York, who has also made other valuable contributions to the science of photoelectricity.

The construction of this cell may be studied by referring to the accompanying picture. Two metallic plates, rigidly supported and separated about ½ in. from each other, are immersed in an electrolyte contained in a cylindrical glass bulb, 1½ in. in diameter and about 4½ in. long. The cell is fitted with a radio base and the electrodes are connected by wires to the prongs which correspond to the plate and grid of a radio tube.

By connecting a very sensitive meter in series with the electrodes, a large deflection will be noticed when one of the plates is illuminated. In direct sunlight, the writer has obtained deflections of ½ milliampere when the cell is exposed. When an opaque screen is interposed between the cell and light, the pointer of the meter immediately falls to zero. While such relatively small deflections may seem insignificant to the lay reader, it is enough to make the informed experimenter sit up and take notice, since such results are unusual in this type of cell.

This cell may be temporarily sensitized in the following manner. When the terminals of the cell are connected to a 45-volt battery for about 10 seconds, the battery then removed and a meter substituted, deflections of several milliamperes—in fact, three or four times the value before sensitizing—have been observed. The effect of this charging gradually diminishes and disappears in about an hour, but the charge can be renewed as often as desired. The makers of the cell are planning to insert an auxiliary electrode between the two metal plates, serving a purpose similar to that of the grid in a radio tube, by means of which a constant charge may be maintained indefinitely. However, it is not necessary for the cell to be charged, since its output is sufficient to operate sensitive relays directly.

Further characteristics of these cells may be gathered from the curves illustrating this article, and from the following facts which were taken from laboratory tests:

*Current Output:* In very feeble light the cells furnish a current of the order of $10^{-6}$ amperes.

*Internal Resistance:* The internal resistance of five cells measured at 1000 cycles in the conventional manner ranged from 15 to 52 ohms, with an average of 32 ohms.

*Photovoltaic Potential:* The voltage illumination curves (Fig. 1) indicate that the potentials are proportional to the incident illumination; the apparent deviations from this generalization are doubtless due mainly to the difficulty of measuring closely the distance of the illuminated plate from the source at

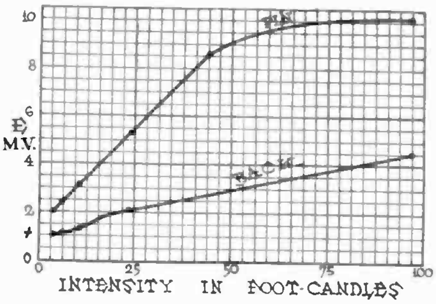



*Fig. 1. Voltage-Illumination Curves for Photovoltaic Cell Whose Plates Are Designated as "Pin" and "Back"*

high light values. At low intensities, between 10 and 20-foot candles, there is apparently a critical phenomenon, for nearly every plate exhibits a peculiar reaction as evidenced by change of curvature in the characteristic curve.

*Spectral Sensitivity:* A measure of the sensitivity of this type of cell to different spectral colors (Fig. 2) was obtained by means of Wratten light filters. The light source was a tungsten filament lamp with a concentrated filament supplied

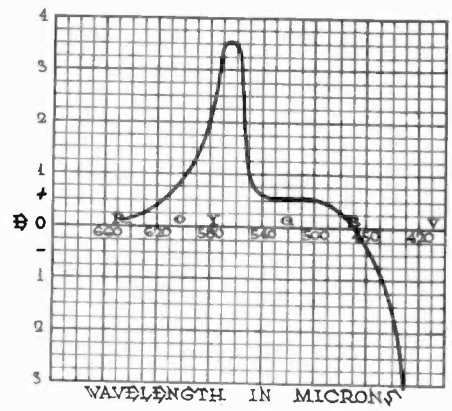



*Fig. 2. Wavelength Sensitivity Curve*

by a storage battery. The curve shown is purely qualitative as is any obtained by filters which pass a relatively wide band of frequencies. The cell shows a rather marked selective effect in the yellow. This rapidly decreases in the green and changes sign (positive to negative) in the blue. In the blue-violet the potential has reached an appreciable value of the opposite sign. The various spectral colors, red, orange, yellow, green, blue and violet are denoted by *R, O,* etc., in Fig. 2.

As has been previously noted the new photovoltaic cell may be employed for all the ordinary applications for which the other types of light-sensitive cells are used, with the additional advantage of not requiring external batteries.

## A PHOTOELECTRIC AMPLIFIER

THE practical employment of photoelectric cells involves as a rule the amplification of the extremely minute photoelectric current. To accomplish this purpose the cell is connected to the input of a vacuum tube amplifier.

For delicate measuring work or for amplifiers designed for "still" picture transmission or television, steady sources of potential are required; the usual *A*, *B*, and *C* batteries and, in addition, a fourth or *D* battery, as it is sometimes called, may be used to charge the photoelectric cell. The use of a power tube in conjunction with the cell requires batteries of several hundred volts, depending on the types of cell and tube.

Where photoelectric cells are used to control power circuits through a relay or for other similar purposes, variations in the supply source are not particularly harmful and it is possible therefore to design amplifiers which have the advantages of greater convenience and lower cost. Circuits have been devised to operate directly from a.c. or d.c. power circuits, although these are not as satisfactory as the "eliminator" described here.

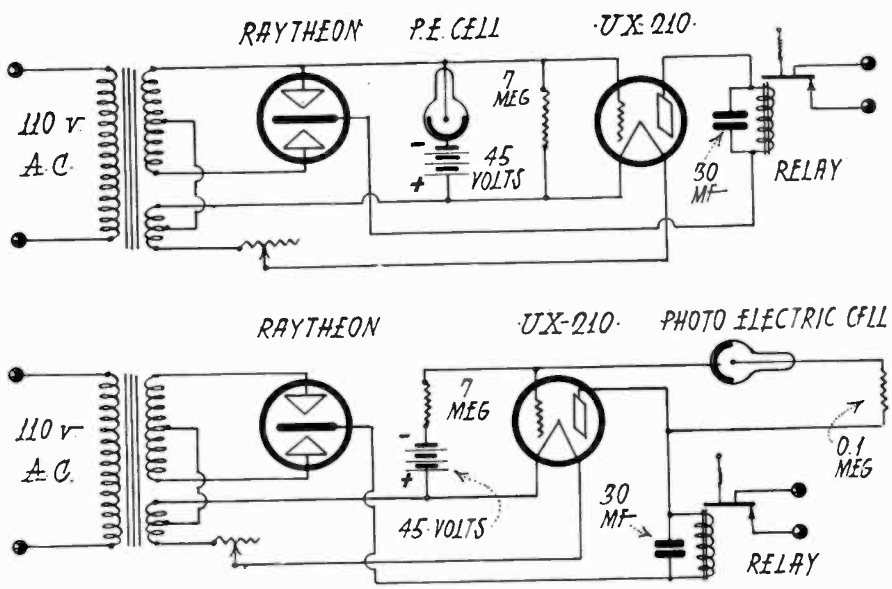
The circuits differ merely in the placing of the photoelectric cell and were described in a paper by Fox, Rood and Marburger in the *Journal of the Optical Society of America* for December, 1927. The specific purpose for which this apparatus was designed was to control a laboratory clock by photoelectric signals; but the amplifier itself is suitable for many other useful applications of photoelectric cells.

The circuit diagrams require no particular explanation since they are not unusual in any way. It is necessary, however, to mention that the photoelectric cell should be inclosed in a light-tight box, preferably fitted with an iris diaphram to control the beam of light which falls within. The source of light may be an ordinary incandescent filament lamp. The photoelectric cell used by the authors of the above-mentioned paper was a potassium hydride, gas-filled cell.

In operation, when light falls upon the sensitive cathode of the cell, the "light signal" charges the grid of the vacuum tube and actuates the relay in its plate circuit. The relay can be made to operate any apparatus that is designed.

The parts which are suggested for the construction of this power amplifier are the following.

1 Photoelectric cell, gas or vacuum type.
1 UX-210 Power Tube.
1 Type 365 General Radio transformer.
1 Raytheon BH tube.
1 Mershon 30 MF electrolytic condenser.
1250 ohm Ghegan relay.
2 Daven grid leaks, 7 meg and 0.1 meg.
1 Bradleystat.




*Circuit Diagrams for a Photoelectric Power Amplifier*

## A NEW TYPE OF SELENIUM CELL

AN extremely simple process of making selenium cells was recently described by R. E. Martin in the April, 1928 *Journal of the Optical Society of America*. This simplicity of construction should appeal to experimenters who are interested in making light-sensitive cells and especially those who must work with limited resources.

Powdered vitreous selenium is placed in a pyrex test tube and heated to slightly above its melting point (217 deg. C.) in an electric furnace or over a Bunsen flame. The selenium is then allowed to cool slowly and, as the temperature decreases, it becomes more plastic. By turning the tube nearly upside down, the viscous selenium can be poured from the edge of the tube in long cylindrical threads, the diameters of which depend upon the temperature. The size of the threads which were found to be most suitable for making up into cell form were about 2 cm. long and 0.1 cm. (79 x .039 in.) in diameter.

The annealing or rendering the selenium light-sensitive is the next step to be undertaken. A thread of selenium is placed on a piece of glass or mica which rests on a copper plate. This is heated from below by an open flame or, preferably, by an electric heater, the latter permitting better temperature regulation. As the temperature is gradually raised to about 130 deg. C. (266 deg. F.), the selenium changes from a shiny black material to the familiar dull grey of the light-sensitive crystalline variety. After the thread is entirely crystallized, the temperature is slowly raised toward the melting point and the thread is observed through a small magnifying glass. When the first signs of melting are noticed (that is, as soon as the crystalline structure shows signs of disappearing), the temperature is immediately lowered 6 or 7 degrees and held constant for about 30 minutes. Again the temperature is gradually lowered to about 180 deg. C. (357 deg. F.), held there for several hours, and finally reduced slowly to room temperature.


*Fig. 1. Construction of Selenium Cell*

The electrodes or terminals of the cell are now attached. These may be fine wires of platinum, nickel or copper which are passed through the holes previously drilled in the glass or mica insulating base and bind the selenium tightly to it. The advantage of this form of construction is that the electrodes may be attached after the cell has been annealed, since the metal of the electrodes combines with the selenium to produce metallic selenides, a combination which is thought to be detrimental to the action of the cell.

When this cell is connected in series with a battery and a current measuring instrument (0 to 15 scale milliammeter), a current flows through the cell even in the dark. Exposure to light lowers the electrical resistance of the selenium and the pointer of the milliammeter will indicate this by moving to a higher value according to the intensity of the light. These cells have a resistance of about ½ megohm.

Selenium fumes are poisonous, especially affecting the delicate membranes of the throat. Therefore, the experimenter should work either in the open air or carry out the heating under a hood as used in chemical laboratories.

## SYNCHRONOUS MOTORS FOR VISUAL COMMUNICATION

In a recent paper T. Thorne Baker observes that the attainment of absolute synchronism between transmitting and receiving equipment is one of the chief reasons for the success of modern phototelegraphic systems, as the greatest failures in the early days of this means of communication were largely due to the lack of perfect timing between the apparatus of the two stations.

The earlier methods of obtaining synchronism included the use of electrically controlled clocks, pendulums, etc. The so-called "stop-start" system was also in vogue. By this method the receiving cylinder was turned over at a rate slightly in excess of that of the transmitting cylinder and was stopped at the completion of each revolution by some mechanical means until a signal from the sending station released it as the transmitting cylinder began the next revolution. This system, while simple and economical, is not very effective in the transmission of photographs in which a high grade of reproduction is demanded.

Synchronism for television is only another name for trouble raised to the nth power. When it is seen that the sending of a single picture in about four minutes involves difficulties, the synchronizing of apparatus which must deal with about sixteen pictures per second, might seem to come under the head of impossibilities, although someone has said that the word should be banished from the dictionary.

At any rate, modern television experimenters, with very few exceptions, employ synchronous motors. Motors of this type are controlled by the application of a pulsating current. They are used, of course, to rotate the conventional Nipkow disc or some similar device which scans the scene or object before the transmitter, and recomposes the image at the receiving station.

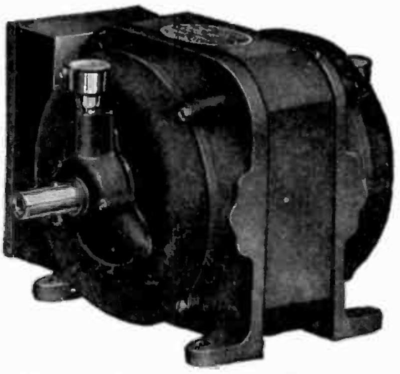
Alternating current motors for this work must be built in accordance with rigid specifications to obtain satisfactory results. The motor should be of the induction type, which does not rely upon a commutator either for starting or running. Since this motor must be placed rather close to the amplifying apparatus, a sparking commutator would create electrical disturbances which seriously distort the pictures. The ideal motor should be silent in operation and free from hum. Moreover, the motor at the receiving station must be so designed that, by inserting a suitable control mechanism in the form of a switch, and a variable resistance, reactance, or a combination of the two, its speed may be changed to and kept constant with the speed of the motor at the transmitting end of the system.

**As some of the problems of photo-electricity and electrical image transmission are highly technical, and consequently not of general interest to the average reader, such problems are often not fully treated in these columns. But in order that we may be of service to the more advanced experimenter, we will gladly answer specific questions of this nature by mail. There is no other obligation than that the correspondent accompany such requests for information with a self-addressed, stamped envelope. Address the communication to John P. Arnold, 541 S. Yewdell Street, Philadelphia, Penn.**

A recent engineering test of the requirements of motors employed for driving television scanning discs has revealed some interesting facts. The scanning disc as used for television reception is usually anywhere from 9 to 24 in. in diameter, 1/16 to ⅛ in. thick, and is often made of aluminum, although other metals and some materials like bakelite are used. Such discs can be driven by 1/15 h. p., 110-volt, 60-cycle, single-phase motors. With a perfectly true 15-in. disc, such a motor runs within 50 or 75 revolutions of the synchronous speed.

In order to reduce the speed to that required for the particular television system, it is only necessary to place a series resistance in the circuit with a means of short-circuiting about 15 per cent of the resistance. For example, a 15-in. disc, ⅛-in. thick, with a required speed of 1080 revolutions, needs a fixed resistance of 160 ohms, with a switch shunted across 25 or 30 ohms for the purpose of control.

Although this method has proved fairly successful, there is another way of obtaining more stable operation. As a flat disc is practically a frictionless load upon a motor, it is an advantage to load it in some way. For instance, if six small blades, 1 by 2 in. are placed around the circumference of the scanning disc, a slight load is placed on the motor, enabling the receiving operator to hold the speed of the disc more constant because the motor then responds to changes in speed much more readily. The motor will require only 30 ohms fixed resistance, with approximately 5 ohms to be short-circuited for adjustment, assuming the use of a 15-in. disc turning at a speed of 1080 r.p.m.



*⅛ H. P. Baldor Condenser Type Motor (Interstate Elec. Co.)*

With a load of this kind, it is possible to produce any speed from about 1700 r.p.m. down to 300 and maintain it very easily by the selection of the proper amount of resistance placed in the supply lead. A mechanical resistance, such as fins or blades attached to the scanning disc, helps to stabilize and enables the operation to more rapidly synchronize the receiving motor with the transmitter.

Although the 1/15 h. p. motor is quite satisfactory in the case of scanning discs of from 9 to 15 inches, when larger sizes are used or heavier loads are involved the ⅛ h. p. Baldor condenser type motor will be more suitable for the work. A motor of this type is shown in the accompanying illustration and is employed in both transmitting and receiving stations. Such motors can also be used for synchronizing in "still" picture systems.

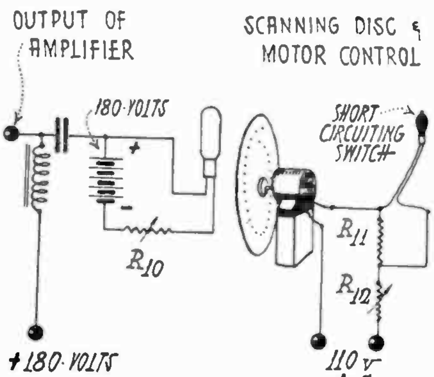



*Fig. 1. Circuit Diagram of Television Receiving Equipment*

The circuit diagram (Fig. 1) shows the use of such a motor with the usual television receiving equipment. The operator views the illuminated plate of the neon tube, the brightness of which varies in accordance with the television signals, through the scanning disc. When the motor gets slightly out of step with the transmitter, which will be noted when the image appears to be "out of frame," the short-circuiting switch may be closed, speeding up the disc slightly or, when open, the speed is somewhat decreased. In this way, synchronism is maintained between the transmitting and receiving discs.

### The Unholy Writ

We make no bones about defying the lexicographer when it suits our fancy to torment the language of our fathers; yet the recent verbal atrocity, "to televise," causes a rill of shudders to course our spine. We look forward with horror to the possibility of the report that some operatic tenor was "highly *enthused* to have been *televised* and *broadcasted* to an admiring world."

## PICTURES TRANSMITTED IN ONE MINUTE AT RADIO SHOW

A RADIOPHOTO apparatus capable of picking electrical impulses out of the air and converting them in less than one minute into a complete 5x7 photograph was demonstrated at the New York Radio World's Fair. This apparatus, developed in the research laboratories of the Westinghouse Electric and Manufacturing Company, has been used in experimental transmissions over short waves from Station KDKA at East Pittsburgh, Pa.

Because of the difficulty in securing radio wave channel assignment, the demonstrations at Madison Square Garden used wires, rather than air channels, for the transmission of the pictures. Westinghouse engineers state, however, that the equipment functions equally as well by radio as by wire within the limits of fading and static.

The Westinghouse apparatus employs standard photographic processes for making pictures. Its pictures are made by the exposure of sensitized paper to light, in exactly the same way pictures are customarily made in photographic studios.

*Dr. Vladimir K. Zworykin, Westinghouse Research Engineer, Inserting One of His Photoelectric Cells Into the Radiophoto Transmitter*

In addition to ordinary short wave transmitting apparatus, the system uses three principal pieces of equipment: a sending set, a receiving set, and a "synchronizer."

In the sending set, an ordinary photograph or manuscript is placed on a cylinder which rotates slowly and at the same time moves forward longitudinally. In this way, every point on the picture comes within the range of a tiny beam of light. By a system of mirrors, the beam of light is reflected at an angle from the photograph to a photoelectric cell, which gives out an electrical impulse corresponding in intensity to the degree of light or shadow of the particular pin-head of space on the photograph covered by the beam of light at that particular moment. This procedure, in other equipments, generally requires that a transparency be prepared.

*Westinghouse Radiophoto Receiving Set*

For radio transmission, the feeble currents given out by the photoelectric cell pass through three stages of amplification and then go by wire to the radio broadcasting station, which may be located a short or long distance from the radiophoto sending set. There the light waves, already converted into electricity, go out into the ether in the form of radio waves. At KDKA, the short-wave 63-meter channel was used.

At the receiving end, which could be situated anywhere within the effective range of short waves, a standard short wave receiving set is used to pick the impulses out of the air. The impulses are carried to a special lamp, which flickers according to the fluctuations in intensity of the current. The light from this lamp is focussed into a tiny beam which plays on a cylinder moving in the same ways and at the same speed as the cylinder at the sending end. This cylinder is covered with sensitized paper, and as the light falls on it with varying brightness, a series of impressions of varying degree are made on the paper, which, when "developed," present a facsimile of the picture placed on the sending cylinder.

An essential feature of this system is that the cylinders at the sending set and at the receiving set rotate and move forward at exactly the same speed. To accomplish this very difficult feat is the duty of the "synchronizer." Synchronization is accomplished by the transmission, over the same wavelength used for the radiophoto transmission, of a constant frequency note which regulates the speed of identical synchronous motors driving the two cylinders.

The finished photographs, after passing through the "dark-room" processes of developing and drying, correspond in practically every detail with the originals. If the pictures are held two feet away, it is impossible to tell the original from the copy which has been sent through the air.

## SCANNING FOIBLES

Aristarchus, a Greek and astronomer of classical times, noted that the moon has always providentially avoided collisions with our earthly planet. Feeling called upon to exploit away this perverse circumstance, he did so by recourse to the principle which Huygens, later, denominated *vis centrifuga,* a phrase which seems to denote, being translated, the centrifugal force of the physics textbooks. To bring this paragraph up to the very minute, we may point out that the conventional scanning disc for television is an excellent example of the tendency of parts of rotating systems to move away from their center of circumvolution. We mention this because it has been brought to our attention by experimenters who have been treated to impromptu demonstrations of the phenomenon that a disc, insecurely attached to a motor shaft, may depart from thence on a tangential and destructive journey and end up abruptly and partially buried in a wall or ceiling or, mayhap, in some other semi-inert body which stands in its path. Thus, by the operation of the very principle which Aristarchus believed governed the movements of the heavenly orb, a scanning disc will perform certain parabolic peregrinations which may reduce a parlour laboratory to debris and an ardent experimenter to sampling the contents of the arnica bottle. Such happenings are to be deplored; yet to suggest the remedy partakes of the obvious.

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Satisfactory radio reception for all tenants in an apartment house may be secured from an untuned antenna and a centrally located r.f. amplifier having a flat characteristic for all broadcast wavelengths. The amplified r.f. current corresponding to each channel may then be separated by a system of filters or fixed tuners. The amplified detector output from each channel can be conducted to a terminal board in each apartment. This board may be equipped with a number of jacks into any one of which the listeners can plug a loudspeaker cord. By providing each jack circuit with a resistance unit having the same impedance as the speaker, a listener may change from one channel to another without affecting the volume of reception in other apartments.

# Radio Aids Air Races

*By* WALLACE S. WIGGINS

OF the 350,000 people who watched the 1928 National Air Races from the grandstands at Mines Field, Los Angeles, from September 8 to 16, not to mention other thousands who failed to get closer than the gates, it is probable that only a few hundred were aware of the important part played by amateur radio in contributing to the success of this great event. The contribution was not "spectacular" in the common meaning of the word in comparison to the hair-raising aerobatics of the contestants, but in the minds of the officials it exceeded all expectations for its utility. The Amateur Radio Research Club of Los Angeles, affiliated with the American Radio Relay League, saw their opportunity to render a service. With the assistance of radio friends, they rendered this service to their credit.

In addition to the transcontinental and international races which finished at the field, several races were scheduled daily over distances of 25 to 120 miles around courses of five and ten miles each. The courses were marked by "pylons"—steel towers flying the "wind sock" at the top and having black and red checkered sides for greater visibility. As the planes circled the pylons, observers checked them according to their lap numbers and closely watched for fouling or cutting pylons, forced landings, plane trouble of any kind, crashes, etc., which made it necessary to have speedy and reliable communication from pylon to pylon and with the judges' stand at the field. Many minor needs for fast communication developed as the races progressed.

Signals by flags or semaphore between pylons were obviously impractical because of distances. Telegraph and telephone were too expensive and the time was too short for such installations. As a last resort, radio seemed to be the only practical solution to the problem, but the expense likely to be incurred might amount to more than the cost of either telephone or telegraph. The air meet was not intended to be a financial profiteering stunt, but rather as a means of contributing to the "air-mindedness" of southern California, in which endeavor it certainly succeeded.

M. E. McCreery, 6LJ, was a member of the committee on communications as sponsored by the Los Angeles Junior Chamber of Commerce. He saw the need of the race officials and put up the proposition to Robert Parrish, 6QF, president of the A. R. R. C. Parrish took the proposition to the members of the club who gave their hearty approval of the stunt and conferred upon their president full authority to supervise the job—and a generous share of the work.

*Bert Fox at 6EMI, Transmitter Constructed by Don Champion, 6FA*

Licenses were obtained from the Commission for five stations: one for each of three pylons, one for the judges' stand, and one for an aeronautical exhibit booth in the exposition. "Bob" Parrish, manager of the Pacific Engineering Laboratory Co., supplied the main transmitters and a few receivers. Other transmitters and receivers were supplied by members of the club.

The pylons were not supplied with power, so portable power was necessary. The final decision was for batteries, but how could they pay for them? The average radio club never gets endowments. At least 350 volts were necessary at each pylon to supply plate current to the 7½-watt transmitting tubes in tuned-plate tuned-grid circuits. Storage batteries were needed for all filament supply, but there was no means for recharging them. What to do? The answers to these questions came in the form of friendly cooperation of the French Battery Co., the Durkee Thomas Corp., and the Western Auto Supply who furnished all the batteries and tubes without charge.

From an inclosed box at the top of the crowded grandstand, a splendid view of the field was had by the operator at "6EMF." Directly in front of the stand was Pylon Number 1. Off to the right and to the west could be seen Pylon Number 2, at a distance of a mile. Here was located station 6EMH. On a line south of the grandstand and about two miles away was Pylon Number 3, with station 6EMI. Pylon Number 4, two and a half miles farther on and in line with Pylons 2 and 3, was designated as station 6EME. It was five miles around Pylons 1, 2 and 3, and ten miles around all four pylons.

Let's watch a race! Here are six planes at the starting line ready for the 720 cu. in. event. The planes are "at rest," waiting for the starter's flag, with motors turning over slowly. Dots and dashes from 6 EMF in the grandstand are flashed to all pylons and they form the following words: "QST QST DE 6EMF RACE ABOUT TO START QRX (Stand by) FOR QST TON (Take-off numbers)."

The operators at the pylons inform the observers and everyone is in readiness. The starter walks out to the first plane and suddenly dips his flag. The motor roars, the plane moves, rapidly gains speed, and soars into the air toward Pylon Number 2. 6EMF flashes: "THEY'RE OFF!" The remaining planes are started at thirty second intervals and are flown against time. To start all the planes at once would invite needless dangers. Take-off numbers are broadcast to the pylons, and as the last plane leaves the field, the first one may be seen on the home stretch of the first lap. When the "QST TON" has been completed, all pylons answer: "QST OK 6EMH," etc.

Watch these three planes in a bunch as they go around Pylon Number 1! Look at that little monoplane. See how it flits past the others like a little sparrow! Zoom! Zoom! Zoom! The three planes dart off toward Pylon Number 2 again on their second lap as the observers call off the numbers and check. The operator at 6EMF is constantly moving the dial on his receiver between two points. Operating on the 80-meter band, he finds the pylon stations only a few kilocycles apart. 6EMH is at 54, 6EMI at 49.5, and 6EME at 45.5. Not so bad.

Several laps have been completed now. Here comes a plane that seems to be having trouble. The motor sputters, indicating a broken pipe or valve, perhaps. Awful strain, these races on planes and pilots. The plane makes a graceful landing and taxis out of the way. The number is immediately flashed to all pylons. Why? Inside of three minutes would come as many inquiries about the plane and its failure to appear.

Now let's go out to 6EMI, at Pylon Number 3. We are out of sight of the grandstand, but we could reach it by auto in ten minutes through traffic. By airplane, we could get there in one minute! The surrounding country is practically level, but between us and Pylon Number 2 is a small ravine and some trees. We can see the planes coming straight toward us, flying dangerously low, barely clearing the tree tops, and now skimming along the ground to the pylon. They bank sharply, usually gaining a little altitude, circle the marker, and fly off toward the field. This is a five mile race, so they are not using Pylon Number 4.

(Continued on Page 46)

# Battery Charging with a Synchronous Rectifier

## Complete Details Regarding the Construction and Operation of a Synchronous Rectifier

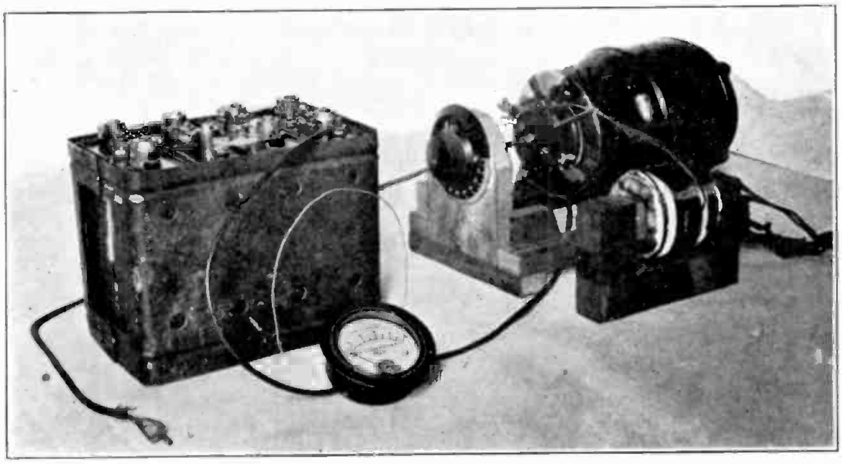
*By* G. F. LAMPKIN

A SYNCHRONOUS rectifier is an excellent source of high potential d.c. for transmitting, as testified by the many "syncs" owned by amateur operators. Such a rectifier, as may be known, utilizes a synchronous motor, a commutator disc, and a brush rigging. The commutator is rotated in step with the alternating current, and functions as a switch, reversing at the correct instant so as to bring the output voltage right side up. In its use for high-voltage, full-wave rectified supply it is eminently satisfactory. With a small amount of care it will function just as satisfactorily to deliver several amperes at comparatively low voltages.

The chief advantage of a sync lies in the range of currents and voltages over which it can be used. In the role of battery charging 20 amperes is by no means the limit of current obtainable; while for a transmitter the output voltage can be run upwards of 3000 volts. The metal to metal contact assures a high rectification efficiency. A disadvantage is that the rectifier works best into a resistance load. If an attempt is made to work into a condenser or inductance, as in a filter system, trouble immediately develops through sparking at the brushes. Only by special means can a filter be used on a sync.

A description of a synchronous rectifier will serve the dual purpose of illustrating the processes involved in its operation, and of affording a basis for constructional work. The heart of the rectifier is of course the synchronous motor. The usual nameplate data for a sync-rectifier motor are ¼ h.p., 1800 r.p.m., single-phase, 60-cycle, 110-volt. An 1800 r.p.m. motor allows the simplest sort of commutator construction with only two segments.

The brush rigging uses two brushes into which a.c. is fed, and two from which full-wave d.c. emerges—a total of four brushes equi-spaced around the commutator periphery. Fig. 1 shows the commutator position and current



*Complete Charging Outfit*

flow at the beginning of a positive half cycle, and at the start of the succeeding negative half cycle. The disc, turning 1800 r.p.m., advances one-quarter of a revolution in a half cycle, 1-120 of a second. Thus the conditions of the sketches hold true—though the direction of current in the a.c. source reverses, the commutator maintaining unidirectional flow in the output.

A ¼ h.p., single-phase induction motor can be made into a synchronous motor of only slightly less capacity by facing off four flats on the rotor, approximately 1/16-in. deep, as indicated in Fig. 2. It is a simple machining operation, which, with the turning of the commutator disc, is the total of machine work necessary. The flats on the rotor of an induction motor form air gaps across which the flux is reluctant to slip, and the rotor holds in step with the impressed frequency. The induction motor must of course have four poles, so that its name-plate speed would be around 1740 or 1760 r.p.m.

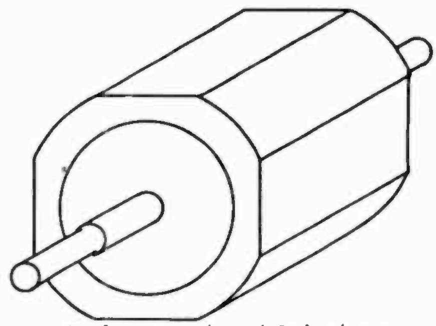


*Fig. 2. Conversion of Induction to Synchronous Motor*

The commutator disc in Fig. 3 was designed as small as was consistent for operation at 3000 volts. The larger the wheel, the greater is the space available

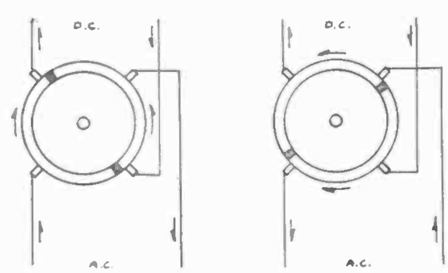




*Fig. 1. Commutator Positions*

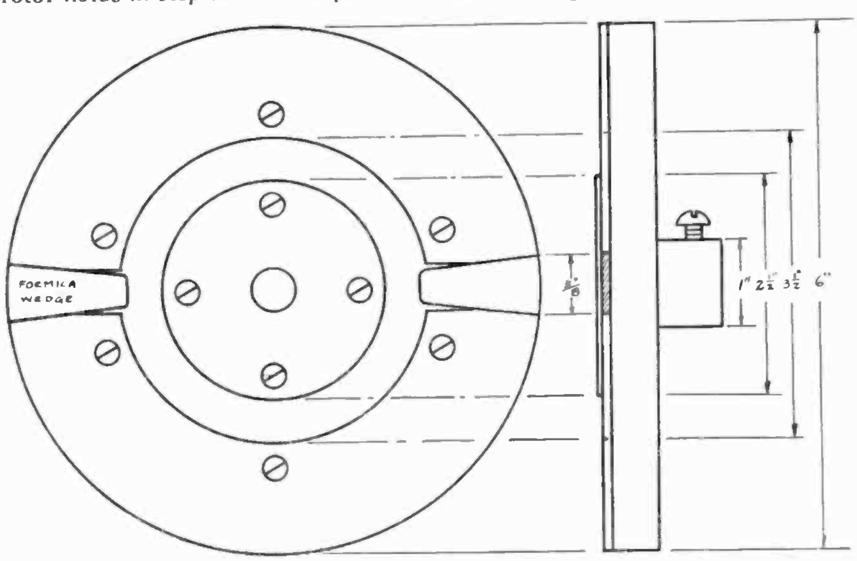




*Fig. 3. Commutator Disc*

for insulation. But also greater is the power necessary to turn the disc, for the friction and windage losses are increased. The disc proper, shown in the sketch, was cut from ½-in. micarta. The bushing for the shaft was turned from 2½-in. round brass bar; and the commutator was made from 3/32-in. brass. The latter was fastened to the disc by screws inside the brush path. Both this, and the filling of the slots between segments with drive-fit formica plugs, afforded a smooth brush path. Such a path not only reduces brush friction, but aids materially in keeping sparking at a minimum. In turning the disc a final smoothing cut should be taken over both segments and insulating sectors.

lamp to the other two. Determine and fix the position of the brushes for maximum brilliancy of the lamp. The rectifier is then ready to feed 20 amperes to a battery, or 3000 volts to a transmitter.

For ordinary battery-charging, a 50 or 75-watt toy transformer is ideal. It is cheap, convenient, and usually with adjustable secondary voltage so that the charging rate can be varied. For each charging rate it is necessary to adjust the position of the brushes slightly. Both angular position and pressure on the disc should be changed till sparking is at a minimum.

The design data for a transformer which has been in this use by the author for over a year are as follows:

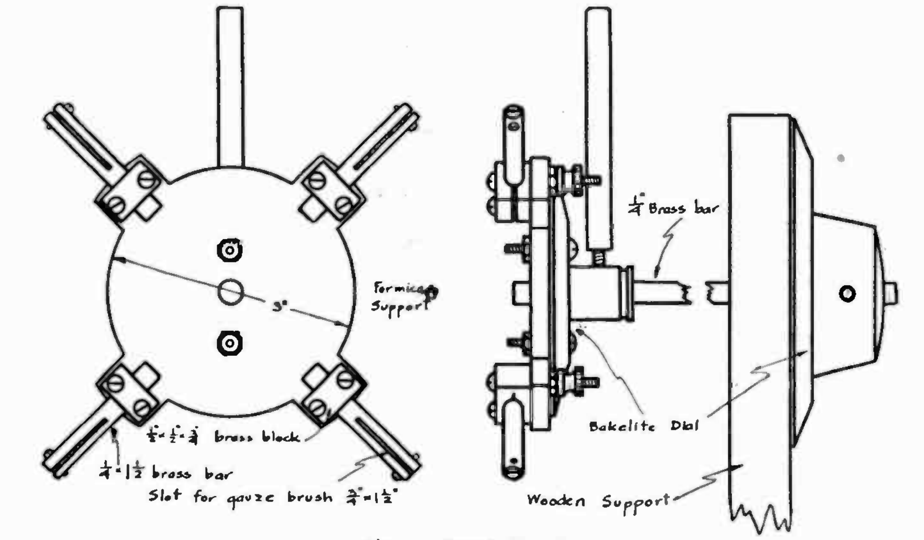



*Fig. 4. Brush Details*

Two bakelite dials were made to the foundation of the brush rigging. Copper gauze brushes and brass fittings completed the assembly, of which Fig. 4 gives details. The set-screw in one dial was removed and replaced by a threaded insert in an insulating rod. The latter was to afford a means of brush adjustment. Four thicknesses of medium copper gauze were used in each brush.

In the adjustment of the brushes lies the secret of sparkless commutation. When motor, commutator disc, and brush rigging have been assembled, the brushes should be carefully adjusted to bear equally on the commutator; the ends of the brushes should be parallel to a radius of the disc; the brushes should be exactly 90° apart; and two diametrically opposite brushes should make and break contact with the segments at the same instant. It is essential that severe sparking be eliminated, otherwise the brush and commutator life will be short. Elimination of sparking on a transmitter sync spells the difference between hash, and the distinctive, musical sync note.

Before using the sync under load the disc should be thoroughly cleaned, especially around the insulating sectors, of all metallic dust. Then place 110 a.c. on two brushes, 180° apart, and connect a

Core cross section.............................1½" x 1½"
Core window .......................................1¼" x 4"
Primary winding 330 turns No. 20 SCE on long leg.
Secondary winding 45 turns No. 12 PE over primary.
Voltage primary 110, secondary 16.3, 60 cycles.

The layout was used to charge an 8-cell, 20-ampere-hour Edison battery at around 20 amperes. Such a charge filled the battery up in short order. More conservative rates should be used, of course, when charging lead cells. The secondary voltage of the transformer may be cut as desired by reducing the secondary turns proportionally. That is, for a secondary voltage of $E$, the new number of secondary turns is $E \div 16.3 \times 45$. The charging rate may be varied by using variable resistors of appropriate rating in the transformer primary or secondary. The best method is to use a tapped transformer.

A battery may be charged at around 5 amperes by connecting it to the rectifier output, and placing an electric iron in series with the 110-volt lines on the input—though such is hardly economical, because the iron gets most of the watt hours. The service man, however, may have enough batteries to connect in series and charge directly from the 110 supply.

The polarity of the output must be checked each time the rectifier is started up. The reason is that the rotor of the motor does not always pull into step with the a.c. in the same relative position. A reversing switch should be put in some portion of the circuit, for in-

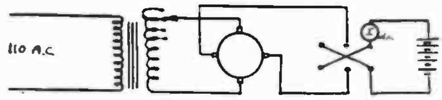



*Fig. 5. Circuit Diagram with Reversing Switch*

stance as drawn in Fig. 5. With a d.c. voltmeter the polarity of the rectifier can easily be determined, and correction made if necessary, before closing the charging switch. An a.c. voltmeter can be used by closing one side only of the charging switch. The voltage of both battery and rectifier in series is then read across the other open side of the switch, and that polarity of the rectifier which gives the smaller reading is correct for charging.

It is a simple matter to make a shunt for a milliammeter so that it will read the d.c. charging current, and by doing so it will aid materially in the operation of the sync. The meter in the picture was a Jewell, pattern 54, 0-100 d.c. milliammeter. A shunt of 17⅜" of No. 14 tinned bus wire converted it into a 20-ampere meter. If a standard ammeter is temporarily available it is only a matter of minutes to find the size and length of wire necessary to give any desired ammeter scale on a milliammeter.

The overall efficiency of any a.c. to d.c. unit is something that is seldom mentioned. Figures for such range from 50 to 5 per cent. With this outfit the input to the motor on the sync was 220 watts. If no resistances are used for charging-rate regulation, that figure may be taken as representative of practically the total power loss of the system. The more power put through the rectifier into the output circuit, the less is the cost per unit of output.

As stated before, the rectifier may be used for a 3000-volt transmitter supply. Actually it has been used to rectify 3300 r.m.s. or 4650 peak volts, when supplying 150 milliamperes to a c.w. transmitter.

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Any a.c. hum from a filter circuit may best be reduced by increasing the capacities of the second and third condenser so as to by-pass the a.c. component of the rectified current. Humless operation requires that this component be less than 0.1 per cent. With a load of 75 milliamperes, 4 mfd. each in the second and third condensers give 0.07 per cent of hum, whereas 2 mfd. condensers give 0.3 per cent. When an eliminator is intended to supply more than 85 milliamperes a condenser block of 2-6-6 mfd. is desirable as such a great current drain increases the tendency to hum.

# A Complete Tube Testing Set

*By* CLINTON OSBORNE

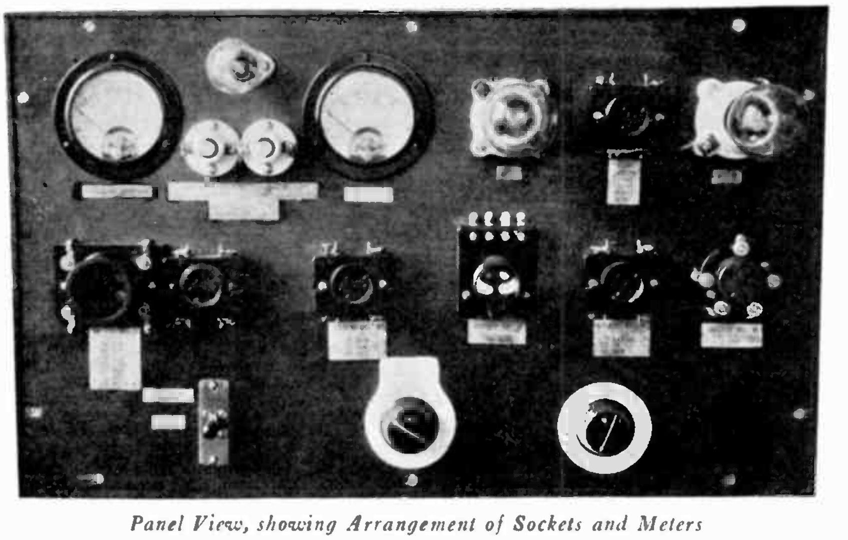
WHILE a number of tube testers have been described in past issues of RADIO, there have been none so complete in the number of possible tests which can be made, as the one described herewith. This tester was made up from suggestions contained in a tube data book recently published by E. T. Cunningham, Inc., and with it, the service man, experimenter or tube salesman can tell practically everything necessary about the condition of any of the standard tubes.

The tester is shown in the picture, and the circuit is shown in Fig. 1. The set has been designed to test all types of tubes, both a.c. and d.c. with the exception of the 374 glow tube, the 376 resistance lamp and the 300-A detector. It will give an accurate indication of the condition of the elements and, if the tube is operative, will also indicate the efficiency of the filament. Above all, it is inexpensive to construct.

The necessary materials for construction are given in the list of parts. The work is simple inasmuch as there are no complicated circuit arrangements; the meters, sockets, rheostats, etc., may be conveniently mounted on a bakelite or wooden panel, with a cabinet to conceal the wiring, or can be laid out on a baseboard. The actual layout and constructional details are left to the judgment of the builder, as it is thought that the circuit diagram and picture will furnish sufficient data for all practical purposes.

In building the test set, the variable rheostat should be of the 10-ohm size, capable of carrying 1½ amperes under continuous load. The fixed resistance *R* should be exactly 6 ohms, and is placed in the negative *A* lead from the No. 2 and 3 sockets to the 4-volt line of the battery. The switchboard key must be connected so that in its normal position it will indicate short circuits. If this connection is reversed so that the emission reading is taken first, the meters or the tube may be damaged, if the tube elements are shorted together.

To place the set in operation, turn the rheostat on slightly and set the switch *A* to the point indicating the corresponding socket number or numbers, these figures indicating which tubes may be tested in the correspondingly numbered socket. For example if switch is on contact *2-3,* type '99s, 220s, or 322s in socket No. 2 may be tested, and '99s in socket No. 3 may be tested. If switch is on contact *4,* C-11s, 12s and 326s may be tested in socket No. 4 and so on: the tube to be tested is then inserted into its proper socket.



*Panel View, showing Arrangement of Sockets and Meters*

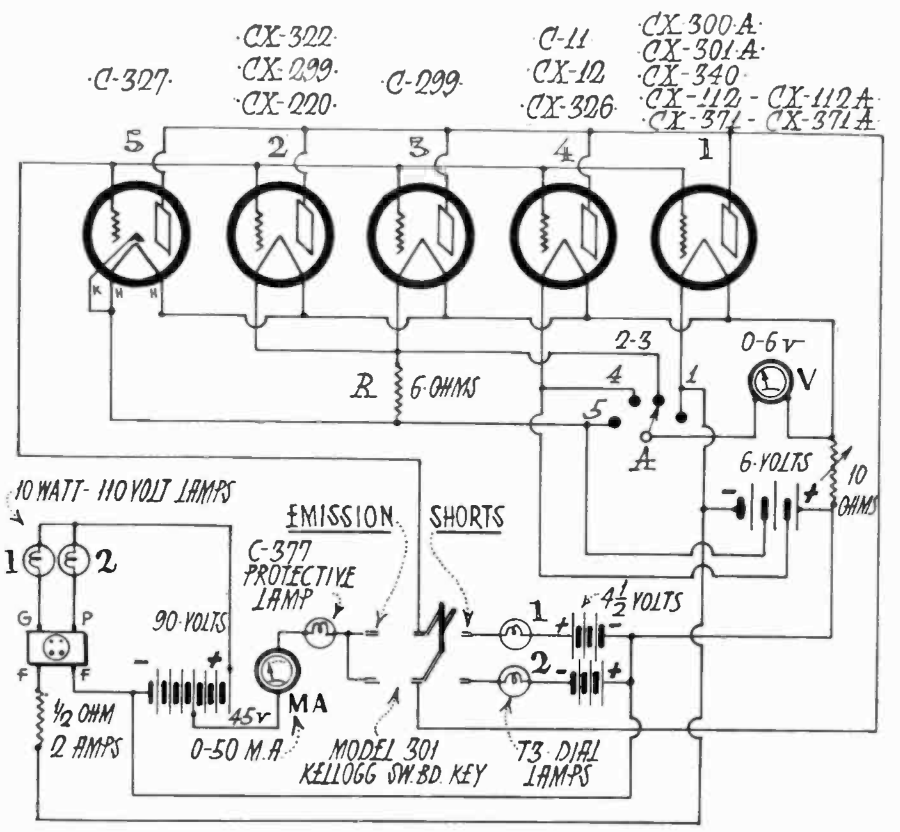



*Fig. 1. Circuit Diagram of Complete Tube Tester*

Note very carefully whether the dial lamps Nos. 1 and 2 are lighted, or even very faintly glowing. If they are, it is an indication that two or more elements within the tube are shorted, or that the filament is open and resting against the grid. To determine if the latter is the case, turn the rheostat up and if no regulation of voltage is possible, an open filament is indicated. If lamp No. 1 lights, a short between filament and grid is indicated; if No. 2 lights, it indicates a short between filament and plate; if Nos. 1 and 2 light, it indicates a short between grid and plate.

If neither lamp lights, then the elements are free from short circuits and the rheostat should be turned up until the voltmeter shows that exactly the proper voltage, as given in the accompanying chart on voltage and emission limits, is being applied to the filament. If the rheostat has no effect on the filament voltage it indicates an open filament, either broken or burned out. When the voltage is correct, *momentarily* press the switch indicating the emission current.

(Continued on Page 50)

# The Marshall Short-Wave Receiver

## A New Short-Wave Circuit Developed for the Navy and Using Screen-Grid Tubes

*By* S. R. WINTERS

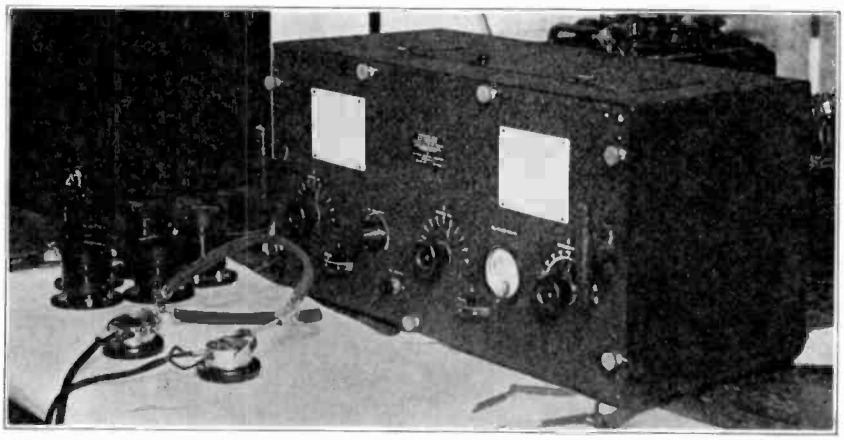
A NEW high-frequency receiving set designed and built at the Bellevue Naval Research Laboratory incorporates the screened-grid or four-element electron tube. This receiver, intended for use on battleships and other floating units as well as at shore stations of the United States Navy, marks the introduction of a push-pull, screened-grid type of receiving set in the Government service—a type of amplifier already popularized by broadcast listeners and radio amateurs. However, this novel circuit is said to be the most sensitive yet developed by the Navy for high frequencies.

This high-frequency receiver is described as a single-stage tuned radio-frequency amplifier, preceding an autodyne detector and two stages of audio-frequency amplification. It is a six-tube unit, including two four-element tubes, connected for push-pull operation, as well as two detector tubes. A frequency range from 4,000 to 25,000 kilocycles is embraced—this extensive wavelength range requiring the use of five inductance coils of varying sizes. Thomas A. Marshall—then a student and research worker in electron tubes at the Bellevue Naval Research Laboratory—designed this receiver.

The so-called "Marshall Receiver" employs two tubes of the '22 type in the radio-frequency circuit—each of these tubes having two grid elements and being wired for push-pull operation. These two four-element tubes operate on 3.3 volts for the filaments, 120 volts for the plates, and 60 volts for the plate screens.

The two detector and two audio-frequency tubes are the '01A type and require 5 volts on the filaments. Forty-five volts are impressed on the plates of the detector tubes but this potential may be varied by use of a potentiometer. The two audio-frequency tubes use only 60 volts on their plates as the sole negative bias available for the grid elements is a one-volt drop in the filament rheostat. The batteries necessary for the entire power supply are a 6-volt, 100-ampere-hour storage battery for the *A* supply, and a 120-volt *B* battery with 45- and 60-volt taps.

The antenna circuit of this novel short-wave Naval receiver consists of a small antenna coupling condenser, connected through a series inductance to the ground. This series inductance coil is coupled to the tuned input-inductance of the amplifier. These two inductance units are wound on a plug-in coil system. When the latter is plugged into the receiver, the tuned-input inductance is connected across the tuning condenser or series inductance. A compensating condenser is employed across the tuning condenser to compensate the extra residual capacity which is present in the tuned detector circuit. This effects a dial alignment of the two circuits, thus insuring a similarity of dial readings for both the radio-frequency and detector variable condensers. The tuned circuit of the radio-frequency amplifier tuning condenser and the radio-frequency amplifier grid-circuit inductance feeds to the grids of the two push-pull tubes through two grid-coupling condensers.



*Marshall Short-Wave Receiver, as Used by Navy*

The tuning condenser comprises two series halves with a rotor member common to both. The rotor is connected to the filaments and virtually is at ground potential. This is intended to eliminate hand or body capacity effect. Likewise, this series connection affords a relatively low capacity value—a minimum of approximately 8 mmfd. and a maximum of 57 mmfd. This gives a ratio of about 7.1 to 1, and yet the maximum capacity is quite small—resulting in a relatively high ratio of inductance to capacity. This is essential to effective amplification. The radio-frequency amplifier grids obtain their direct-current bias through 1-megohm grid leaks, which are connected to the junction between two filament-control resistances, thus affording a negative bias of 1.7 volts. The plate screens are maintained at plus 60 volts with respect to the filaments.

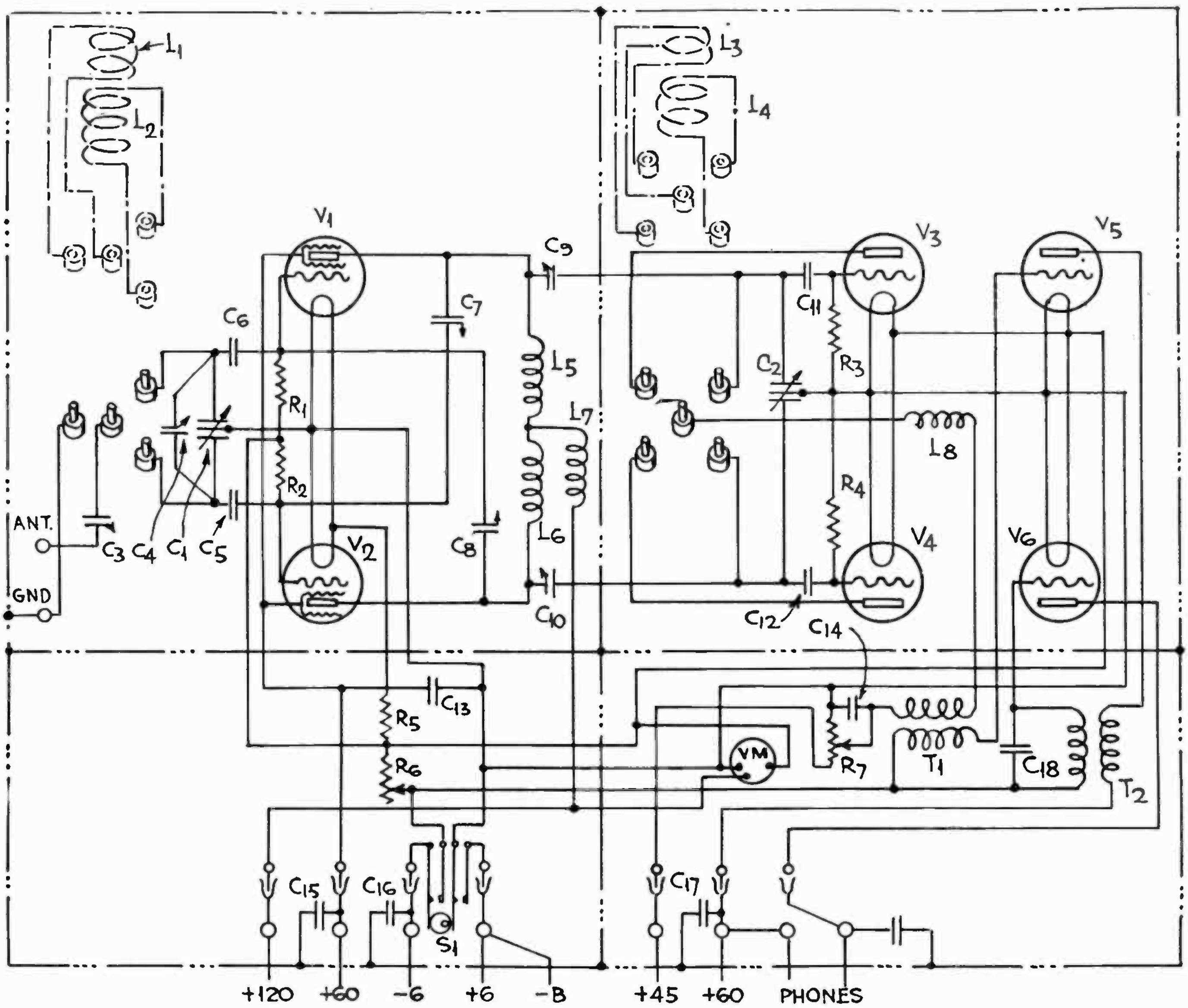
"In all amplifier work," emphasizes the Bellevue Naval Research Laboratory, "it is essential for greatest amplification that the external plate circuit impedance be kept relatively higher than that of the internal tube output impedance. This could, in a receiver of limited tuning range, be accomplished by adding a plate-circuit tuning control. But as simplicity of control, and a minimum of parts and space, is a general and important requirement in Naval service receivers, attempt has been made to employ fixed chokes for this purpose."

Therefore, in the "Marshall Receiver," two high-inductance, low-capacity chokes are employed throughout the frequency range of 4,000 to 25,000 kilocycles. A third and similar choke has been positioned at the junction of the two plate chokes and in series with the *B* battery lead-wire. The latter choke coil serves the function of barring radio-frequency currents from the *B*-battery circuit. This additional or third choke likewise serves the purpose of isolating the junction of the two plate chokes from the ground potential. This permits of the chokes finding their own electrical center, which may be different from that of the apparent center, due to electrical irregularities in the two tube and choke circuits. This arrangement is an aid in the preservation of symmetry, which is essential to efficient and stable operation of the receiver at the ultra-high frequencies.

The detector circuit and the radio-frequency amplifier are in individual shielded compartments. The two are coupled by two fixed condensers, small enough to prevent reaction of the amplifying circuit on the oscillating detector circuit. The capacity values of these two condensers, however, are not detrimentally low—that is, they do not cause a loss of signal in so far as ear tests can determine.

The tuned detector circuit employs a "plug-in" inductance system similar to that used in the antenna circuit. This, labelled "Detector Coil," includes the grid inductance and the tickler feed-back inductance. The tuning condenser in the detector circuit is similar to that employed in the amplifier circuit. The push-pull performance of the two detector tubes again gives practical application to the sound engineering principle of a large inductance in relation to capacity. This insures a greater amount of inductance with which to couple the inductive tickler feed-back than any single-tube circuit. Furthermore, we are assured by the Navy Department, this combination gives a circuit that oscillates with ease throughout the entire frequency range from 4,000 to 25,000 kilocycles.

The tickler feed-back inductance coil is tapped in the center—the two ends being associated with their respective plates and the center to the plus-*B* battery through a radio-frequency choke and the primary winding of the first audio-frequency transformer to the regenerative-control potentiometer slider. This, in turn, is connected across 45 volts. Regeneration or oscillation control is effected by varying the direct-current voltage on the plate elements of the two detector tubes, using the potentiometer for varying the potential. The potentiometer slides, operated by manipulation of a knob on front of the radio-receiver panel labelled "Regeneration Control," is by-passed to shield or ground through a 2-microfarad condenser.




*Circuit Diagram of Marshall Short-Wave Set*

$V_1$ $V_2$—Radio-frequency amplifier tubes, type UX-222.

$V_3$ $V_4$—Detector tubes, type UX-201-A.

$V_5$ $V_6$—Audio Amplifier tubes, type UX-201-A

$L_1$—Antenna Coupling Inductance.

$L_2$—Radio-frequency amplifier grid circuit inductance (Both $L_1$ and $L_2$ wound on r.f. amplifier coil form).

$L_3$—Tickler feed-back inductance. (Wound on "DET" coil form).

$L_4$—Detector grid circuit inductance. (Wound on "DET" coil form).

$L_5$ $L_6$—Low distributed capacity 250 m.h. plate chokes in r.f. plate circuits.

$L_7$ $L_8$—Low distributed capacity 250 m.h. plate chokes in battery leads.

$C_1$—R.F. amplifier tuning condenser.

$C_2$—Detector circuit tuning condenser.

$C_3$—Antenna coupling condenser.

$C_4$—Compensating condenser to assist in dial alignment of r.f. and "DET" tuning condenser.

$C_5$ $C_6$—Grid coupling condensers from tuned r.f. circuit.

$C_7$ $C_8$—Balancing condensers to balance out reaction of amplifier on autodyne circuit.

$C_9$ $C_{10}$—Coupling condenser from r.f. stage to autodyne circuit.

$C_{11}$ $C_{12}$—Detector grid condensers.

$C_{13}$—Bypass condenser on plate screen voltage lead.

$C_{14}$—Bypass condenser on oscillation control resistance.

$C_{15}$ $C_{16}$ $C_{17}$—Bypass condenser on battery leads.

$C_{18}$—Tuning condensers on second audio transformer to cut out audio oscillation.

$R_1$ $R_2$—Grid closure resistances to establish proper bias on amplifier tubes.

$R_3$ $R_4$—Grid leak resistances for detector tubes.

$R_5$—Fixed resistance in series with $R_6$ giving 3.3 volts on amplifier tube filaments.

$R_6$—Variable filament control resistance.

$R_7$—Potentiometer 100,000 ohms on 45-volt detector plate battery for oscillation control.

$S_1$—Filament switch that also disconnects $R_7$ from circuit.

$T_1$ $T_2$—Audio-frequency transformer type CAY 4342.

The first audio-frequency tube is fed from the secondary winding of a transformer — type CAY4342 — while this tube's plate circuit feeds into the primary winding of another transformer, of the same type as the first. The primary winding of the second transformer is slightly tuned with a .0001-microfarad by-pass condenser on the oscillation-control resistance. This, in effect, cuts down the amplification of the higher audio-frequencies, above 1,500 cycles, and correspondingly reinforces the lower frequencies. The secondary winding of this transformer feeds the second audio-frequency tube, while the plate circuit of the latter extends to the telephone connection and through the head telephones to the 60-volt *B*-battery terminal.

The controls on the front of the receiver panel, reading from left to right, are the radio-frequency tuning condenser for bringing into resonance the radio-frequency amplifying stage, the autodyne-detector-circuit tuning condenser, and the regeneration control. An "on" and "off" filament switch is located centrally and near the bottom of the front panel. This switch opens both sides of the filament battery and at the same time opens the potentiometer across the 45-volt supply, thus preventing the *B*-battery from discharging when the receiving set is not in operation.

A voltmeter gives indication of the filament voltage on the '01A type tubes. When the voltmeter-push-button switch is pressed the maximum *B* voltage as applied to the two screened-grid tubes is indicated. These four-element tubes require a filament voltage of 3.3 volts and this current is supplied when the voltmeter reads 5 for the 'A tubes. A single filament rheostat is supplied for the *A* battery control. The screened-grid tubes are fed with energy through the latter resistance unit and through an additional series resistance. The latter should afford a drop of 1.7 volts as required for the efficient operation of the receiver.

The receiver is 22¼ in. long, 10¾ in. high, and 9¼ in. deep. The parts, including diaphragm shielding and wiring, are made secure to the front panel. Withdrawal of the latter displaces completely the receiving set from the box and at the same time automatically disconnects battery, telephone, antenna, and ground leads. These leads, entering the box or receiver container, are permanently fixed to the box fittings. The external connections are made to the receiver circuits through sliding contacts, which close when the panel is secured in place.

The outstanding feature of this new short-wave circuit—its extreme sensitivity—is also its serious limitation. "This receiver has much greater sensitivity at the higher frequencies than any previously supplied to the service," is the unqualified statement of the Navy Department. For this same reason, the set must be mounted on a shock-absorbing pad and the detector tubes inserted in jackets of sponge rubber; otherwise, microphonic noises are so disturbing as to practically defeat the otherwise superior merit of this receiver, namely, ultra-sensitivity.

"The high-frequency receivers as developed in the past," points out the Bellevue Naval Research Laboratory in discussing the theory and operation of this new circuit, "using the customary three-element tubes, have been incapable of giving much amplification over the higher-frequency end of their range and in some cases give a loss above 8,000 kilocycles. With the development of the new four-element tube, which may be called the shielded-plate tube, together with a new circuit arrangement, it is possible to get an appreciable amount of amplification over the entire high-frequency band as now employed.

"The two factors which have previously prevented radio-frequency amplification at the higher frequencies have been the relatively low input impedance of the tube and the low ratio of inductance to capacity, which has existed when using the three-element tube. The low input impedance has resulted from the relatively high grid filament capacity which has under operating conditions been in effect several times the geometrical capacity—being controlled principally by the grid-plate capacity.

"The new circuit employs a push-pull type of radio-frequency amplification, where each of the tube-grid-filament circuits are across but half of the tuned circuit input voltage. This decreases the grid-filament conductance to half for each tube and as the two reactances are in series the total conductance across the tuned circuit is one quarter what it would be for a single-tube-amplifier stage. When the effect of the grid-plate capacity of the three-element tube is considered it is apparent that the push-pull combination with four-element tubes will increase the tube input impedance many times. This improved condition makes it possible to maintain a much higher potential across the tuning-condenser terminals, or the two input grids, than by previous methods. The use of the symmetrical push-pull circuit, which permits a larger ratio of inductance to capacity to prevail, together with the adoption of the four-element tube, has been highly responsible for the improved results at the higher frequencies."

The two screen-grid tubes are equipped with balancing condensers to avoid interplay or disturbing reaction between the stages of radio-frequency amplification and detector. These condensers are located beneath the two holes in the cover which have been blanketed with a butterfly-spring arrangement. Reaction between the different stages in the circuit may be overcome by shifting the vacuum tubes in different sockets. If, however, the trouble persists, the Navy Department indicates that the balancing condensers will accomplish the desired result if this procedure is followed:

The receiver—which may be operated on an antenna only a few feet in length or one several wave-lengths long—is connected to the pickup system and No. 1 inductance coil brought into use. The cover over the adjusting holes in the main cover is removed or loosened and turned 90 degrees, in order to render accessible the condensers with the main cover closed. The lock-screws on these units are loosened.

The receiver circuits are brought in resonance with the detector oscillating. An unbalanced condition is evidenced when the tuning of the radio-frequency circuit through resonance with the detector circuit, when it is barely oscillating, produces a squeal in the head telephones or stops oscillation. This condition is well-nigh ever present, but it is possible to obtain an adjustment where the reaction is not evident when the oscillation control is set one-half of a small division beyond the point where oscillation starts.

The oscillating circuit should be set to this point and the radio-frequency control operated back and forth past the resonance point until the balancing condensers are adjusted. If the receiving set is apparently balanced at the top, middle and bottom of the frequency range of inductance coil No. 1 then it is to be assumed that a satisfactory balance has been assured for the four other inductance coils. For the balancing condenser adjustments a bakelite, fiber or hardwood screwdriver is used, since the presence of metal would defeat any attempts to adjust these balancing condensers.

While the Radio Division of the Bureau of Engineering is prone to classify this new short-wave receiver as still in an experimental stage—due to its tendency to set up microphonic noises when not situated in a shock-absorbing, steadfast position—twelve or fifteen units have been manufactured. Several of these have been introduced to Naval service—both on surface and subsea craft—and when subjected to comparative tests with a standard short-wave set of Navy design the results have been gratifying, in some particulars at least.

For example, while in service on the *Eagle,* a patrol boat for conducting sound and radio experiments, the strength of the signals received by the "Marshall receiver" were stronger than those tuned by the standard Navy short-wave set—though the signals of the latter were more readily tuned and the distant stations more easily located. The selectivity of the "Marshall receiver" was marked and once the stations were logged the dial could be consulted time

(Continued on Page 49)

# TECHNICAL BRIEFS

TRANSATLANTIC radiotelephone service between the United States and Great Britain as well as various cities of Continental Europe, Canada, and Cuba is normally available from 5:30 a. m. to 8:00 p. m., eastern standard time. The British receiving station is at Cupar, Scotland, as far north as conveniently possible so as to reduce interference caused by atmospheric disturbances.

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THE R. C. A. projector system used in long distance radio communication includes both directive transmission and directive reception on short waves. Several receiving antennas, directive in themselves, are spaced so as to eliminate the momentary fading which originally limited the use of short waves.

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RAILWAY radiotelephone equipment has been developed for front-to rear communication on long freight trains. A four-months test of the equipment by the Chesapeake & Ohio Railroad showed that telephonic communication could be maintained between the locomotive and caboose whether the train was standing or in motion and even when the train was broken if the separation did not exceed five miles. A signal system of lower power has been developed for service between the front and rear of long freight trains. One-way telephonic communication with low power equipment may also be maintained between the yardmaster's office and any locomotive in the yards.

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THE demand for quartz crystals for controlling the frequency of radio transmitters is supplied mostly from Brazil. The present price is about $3.00 per lb. To be acceptable to the Naval Research Laboratory at Anacostia, D. C. they must be single crystals weighing at least two pounds and must show growth lines on at least two faces. They must be free from imperfections such as internal fractures and inclusions of foreign matter. They must be absolutely clear when viewed by transmitted light.

THE radio experimenter may find much interest in utilizing the radiated output of a short-wave oscillator to produce luminous discharges through rarefied gases in tubes such as the neon tubes which are now used in electric signs. Whereas a high voltage is necessary to produce a glow when low frequency alternating current is used, relatively low voltages are needed at high frequency.

Thus James and Wilfred Taylor, in a recent issue of *The Wireless Engineer*, London, describe some experiments with a 35,000 k.c. (8.57 meters) oscillator whereby beautiful discharges were produced at 15 volts. In the circuit diagram of Fig. 1 the plate *B* and the grid *D* are connected to two parallel copper wires about 50 in. long and 3 in. apart. A

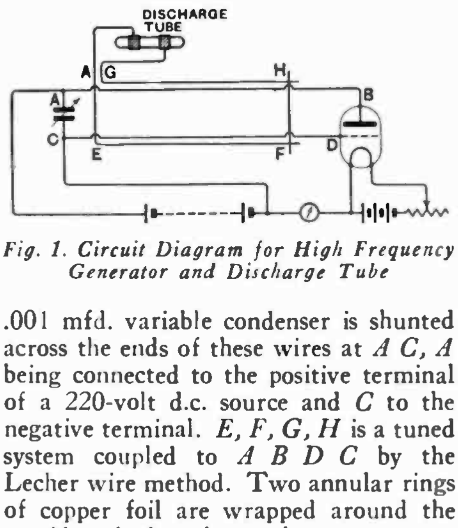


*Fig. 1. Circuit Diagram for High Frequency Generator and Discharge Tube*

.001 mfd. variable condenser is shunted across the ends of these wires at *A C*, *A* being connected to the positive terminal of a 220-volt d.c. source and *C* to the negative terminal. *E, F, G, H* is a tuned system coupled to *A B D C* by the Lecher wire method. Two annular rings of copper foil are wrapped around the outside of the glass tube to serve as electrodes.

Different colors and forms of discharge occur as the gas pressure or gas composition is varied. The experiments were made with air, neon, helium and mercury vapor. The discharges are caused by the motion of the electrons between the electrodes; light is emitted as an electron jumps from an outer to an inner orbit as it collides with a gas molecule.

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THE economically-minded person sometimes objects to the thought of using an apparently wasteful voltage divider to supply 45 and 90 volts to a radio set from a rectifier-filter system which also supplies 180 volts or more for a power tube. But when it is realized that the waste current through the divider not only may improve the voltage regulation or stability of voltage output, but also reduce the strain on the filter condensers, its use is well justified.

A rectifier-filter system is a constant wattage device. The voltage drops as the load or current drain increases, increasing the load resistance decreases the load current. When the current drain is increased from any tap, the voltage output and current supplied from the other taps is correspondingly decreased. Part of the increased load current comes from the rectifier-filter system and part from the voltage divider system, both at the expense of decreased voltages.

These facts are used by the Aerovox Wireless Corporation to explain the advantage of a low resistance voltage divider over a high resistance device, i. e. the advantage of a voltage divider having a relatively high waste current. Tests were made with eliminators having a wide range of regulation curves and with voltage dividers having waste currents of 5, 10, 20 and 30 milliamperes. In all cases the calculated load was assumed to be 20 m.a. at 180 volts, 12 m.a. at 90 volts, and 2 m.a. at 45 volts. The results are tabulated herewith to show the voltage change produced at any tap by increasing or decreasing the load by 1 m.a.

I. 5 MIL VOLTAGE DIVIDER

| Tap | 45V. | 90V. | 180V. |
|---|---|---|---|
| 45V. | 4.25 | 1.85 | negligible |
| 90V. | 2.20 | 3.98 | 1.88 |
| 180V. | 0.53 | 1.40 | 1.25 |

II. 10 MIL VOLTAGE DIVIDER

| Tap | 45V. | 90V. | 180V. |
|---|---|---|---|
| 45V. | 3.02 | 1.37 | negligible |
| 90V. | 1.53 | 2.95 | 1.30 |
| 180V. | .38 | 1.05 | .87 |

III. 20 MIL VOLTAGE DIVIDER

| Tap | 45V. | 90V. | 180V. |
|---|---|---|---|
| 45V. | 2.05 | .96 | negligible |
| 90V. | 1.12 | 2.03 | .93 |
| 180V. | .25 | .73 | .63 |

IV. 30 MIL VOLTAGE DIVIDER

| Tap | 45V. | 90V. | 180V. |
|---|---|---|---|
| 45V. | 1.75 | 0.56 | negligible |
| 90V. | .92 | 1.17 | 0.77 |
| 180V. | .21 | .50 | .50 |

Thus it is shown that an increase in the load resistance at the 45-volt tap of a 5 m.a. divider so as to produce a decrease of 1 m.a. at that tap, will cause increases of 4.25 volts at the 45-volt tap, 2.2 volts at the 90-volt tap, and 0.53 volts at the 180-volt tap, as compared to 1.75, .92 and .21 volts respectively when using a 30 m.a. divider. A decrease in the load resistance to produce a 1 m.a. increase in current causes voltage drops of corresponding values. The 90-volt tap is evidently the most easily and greatly disturbed, and the 180-volt tap, which feeds without passing through the divider, the least disturbed by any change in the load. As the 45-volt tap is very sensitive to changes of load at 45 volts, many eliminators do not work satisfactorily when feeding a set which has a large 45-volt load, like a superheterodyne.

It is evident that voltage variations due to variable loads may be minimized by using as heavy a waste current as possible. Furthermore the rise in voltage due to removing the load is thus minimized.

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THE general theory of sound picture reproduction which was recently explained in these columns, was based upon the Vitaphone and Movietone systems, which record the sound waves on phonograph records, or film respectively, in the form of parallel lines. A third system was inadvertently omitted, this being known to the trade as the Photophone system. The latter is similar to the Movietone in that the sound waves are recorded photographically on the same film with the picture, but these waves are in the form of a single, jagged heavy line that looks like a cross-section of a mountain range. Its width varies in accordance with the frequencies recorded. A photoelectric cell and aperture somewhat like the Movietone system converts this solid black strip into sound, to be amplified and projected into the theatre by means of loud speakers.

Many of the latest types of motion picture projectors are equipped with special fittings so that any of the three systems of sound reproduction can be used by changing the aperture plates, projection lenses, and making minor adjustments requiring only a few minutes. The size of the picture on the Photophone film is somewhat smaller than for ordinary silent pictures, so as to allow a greater width for sound recording, but the picture is rectangular in shape instead of square as for the Movietone system shown in the September issue. This requires a different set of lenses, and a smaller aperture for the picture, but the change is quickly made, and hence no inconvenience is caused by the different systems. Probably the first radio movies which will eventually be made available to the general public will use this system.

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AN exhaustive series of measurements of the amplification and selectivity of sixteen different types of r.f. coils, by Alfred J. Daniels of Aero Products, Inc., shows that in the conventional r.f. circuit the most efficient practical type of those coils tested has its primary wound to occupy ½ in. inside and opposite the low potential end of the secondary. But by means of a special circuit, herein described as the "Chronophase," still better results with screen-grid tubes were secured from an autotransformer whose primary is a portion of the secondary, the low potential ends being common.

All of the coils were of the type shown in Fig. 1, being air-spaced wound to approximately the ideal shape-factor

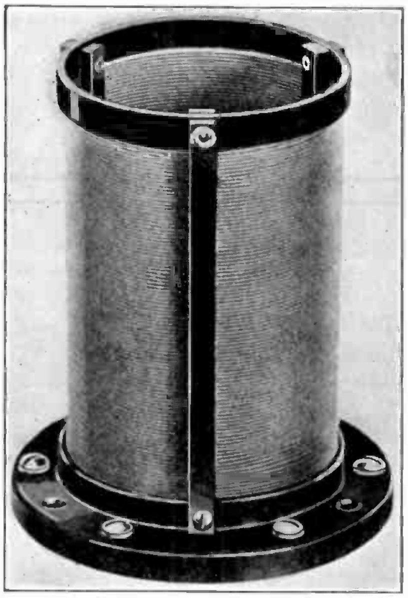


*Fig. 1. Type of Coils Tested*

and supported by a skeleton bakelite frame to minimize insulation losses. Each type had various numbers of primary turns and, where possible, was tested with variable coupling. The secondaries, measured independent of the primaries, had an inductance of 167.4 microhenries and an r.f. resistance of from 3.85 ohms at 550 meters to 9.6 ohms at 200 meters. These figures are changed by the presence of a primary.

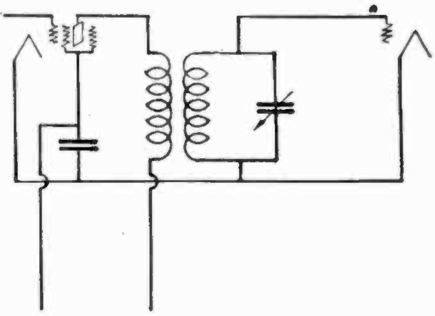



*Fig. 3. a. R. F. Circuit Connections for Screen-Grid Tube with Conventional Transformers*

The coils under test were supplied with a constant input signal at various frequencies in the broadcast spectrum, and the output was measured with a

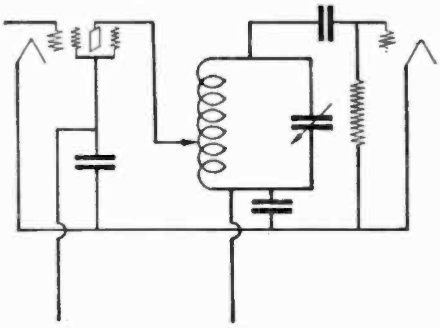



*Fig. 3. b. R. F. Circuit Connections for Screen-Grid Tube with Autoformer*

vacuum tube voltmeter. The test conditions were nearly identical with those surrounding a coil in an actual receiver.

Fig. 2 shows the amplification curves obtained with the autotransformer and

(Continued on Page 56)

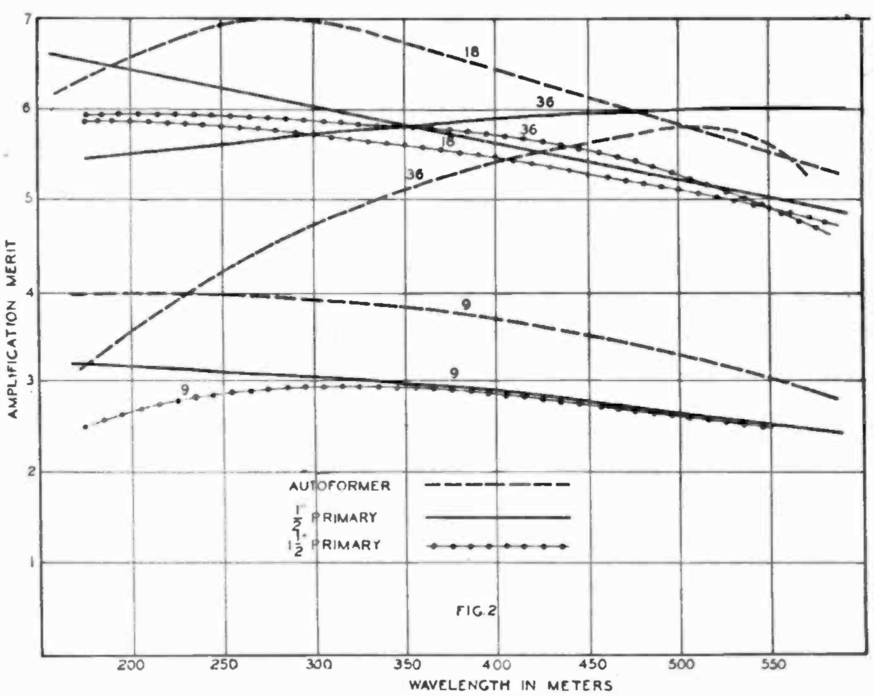
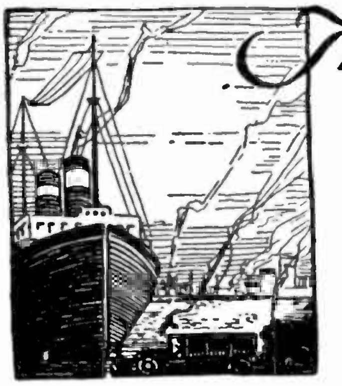
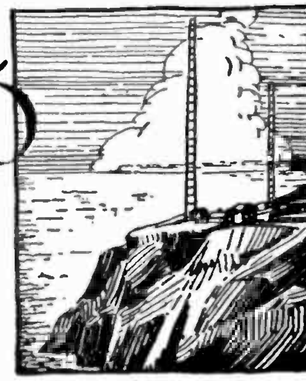



*Fig. 2. Amplification Curves for Three Types of Coils with Varied Number of Turns*



# The COMMERCIAL BRASSPOUNDER

## A Department for the Operator at Sea and Ashore



*Edited by* P. S. LUCAS
R. O. COOK, *Assistant*

A LETTER from Fred M. Winckel comments upon L. W. Gillis' article in June RADIO. Mr. Gillis, you remember, pointed out several reasons why radio operating conditions seem to be going from bad to worse, and made a few suggestions which might help remedy the situation.

Mr. Winckel believes that the only way to improve matters is to go right down to the bottom of things and attack the existing radio laws. No doubt he is right; but, as he goes on to say, the radio operator alone is not in a position to approach the radio commission or the senate committee on such a subject. He feels that the idea of an association of sea-going operators is still good, even if it has failed on several attempts. That is a subject that is always open for debate.

Even if we had an association of radio operators; even if we were solidly organized; where would it get us? Our strength would serve as a threat, but would the threat scare anyone into improving conditions for us? It would certainly antagonize the steamship companies, the radio companies and even the ill-informed public. "Radio operators imperil many lives." We can see the newspaper headlines—and the general public thinks we are having a lovely time of it.

No, radio operating is a profession, and strikes always belittle a profession. The world as a whole is drifting away from such methods of improving conditions; conditions are improving themselves. Employers are acquiring educations; they are learning, through the advancement of psychology, that it is to their advantage to show a little consideration to their employees.

We'll agree with you that our theorizing sounds very nice, but that it does *not* apply to our situation. Why? Are we so different from all other professions?

Well, here's our theory; and this is open to argument. We may be on the wrong track entirely. Anyway, it is our humble opinion that the great majority of operators take life too easily. It is difficult for a man to go onto a job, boss of his own time and unwatched by any authority, without falling into easy going habits. It is extremely difficult when the operator knows full well that he can do all that is required of him in three or four hours a day. If he can handle his job in four hours of concentrated effort, why shouldn't he do so? That's reasonable logic. But here's the reason why he shouldn't; the reason why he should *find* enough work to keep him busy for at least eight hours a day as regularly as any man on the crew.

The general impression is abroad that the wireless operator has an easy time of it. This starts with the other officers immediately associated with the op. It spreads to the crew, to the marine offices, to the higher officials. Not one man in a thousand gives the radio operator credit for doing a good day's work in all his existence. And here we have it. The officials require very little from an operator; and pay him what the fulfillment of those requirements are worth to them. The operator works about as hard as he is paid for; the report gets out that the operator has an easy life; the officials—etc., etc. It goes around in circles.

Now what can we suggest as a remedy for this peculiar condition? In the first place the operator, every operator, must make up his mind to putting in a good, full eight-hour day. He should make out a schedule for himself and, figuratively speaking, "punch the clock." He should win the captain and the mates to his side by voluntarily giving them every available aid to navigation. He should insist that that is a part of his work and he is paid for doing it. (Fingers crossed). If the engineers ask for any aid on their generators he should jump at this opportunity of winning their friendship. While listening in for "roll-calls" and other signals he should not only keep his log up to date, but file away in his head, every bit of information possible so that if anyone asks him any questions he might be able to give the impression that he is well informed. In brief, he must consider his job more important than his officials consider it, and organize it accordingly. How long, under such conditions, would it take for a vastly different sort of "underground telegraph" message to be buzzing in the ears of the officials?

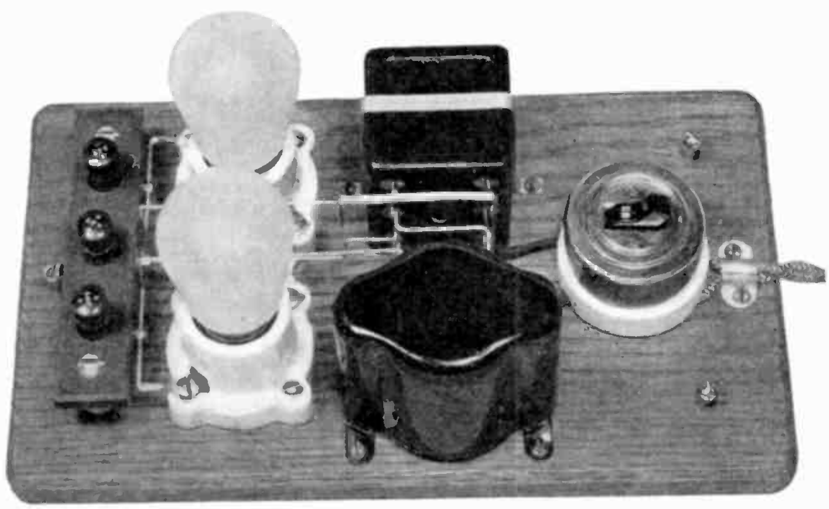
This should be the one great object of an organization: to so enthuse the mass of operators with the possibilities of improving conditions ashore and afloat that they will carry out the suggestions just made. Let the organization be formed to promote the member's interest in his work. Every operator must feel his responsibility in this matter or the situation will be worse twenty years from now than it is today.

And one parting shot to the man who intends to take one trip or spend one year, then quit. You will get a whole lot more out of your trip or your year, you will have more to look back upon, and you will equip yourself for a more successful future if you will play the game as if it were to be your life's work. While you are in it feel yourself a part of our development program. Men, it's up to you.

## A PRACTICAL "B" ELIMINATOR FOR SHIP USE

By R. M. HUGHES

Many sea captains, as well as mates, engineers and radio operators, have their own broadcast receivers aboard ship. Yet few of them use a *B* eliminator, although there is no place where local conditions are better suited for its use. The ship dynamo supplies direct current at about 110 volts. This contains a commutator ripple which must be filtered out before it is suitable for use as the plate supply for a radio set.

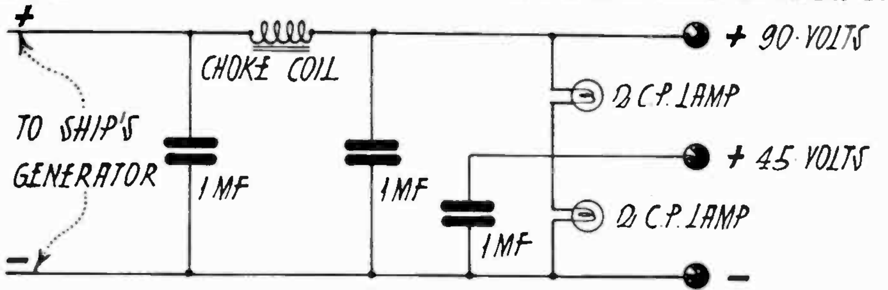


*"B" Eliminator for D.C. Supply*

All that is needed to make the satisfactory battery eliminator shown in the picture and circuit diagram herewith, can be bought at a chain store for less than four dollars, or for slightly more if purchased from a regular dealer in radio parts. This equipment can be quickly and easily assembled on a baseboard and will furnish hum-free current at 45 and 90 volts.

An ordinary snap-switch is used to turn the current on and off. The choke coil has an inductance of about 20 henries. Each of the three condensers has a capacity of 1 mfd. and should withstand 200 volts. The voltage dividing circuit consists of two 2 c.p. lamps connected in series, one being connected directly to the negative side of the ship's generator and other through the choke coil to the positive side of the line. The center tap gives 45 volts.

As a ship's power system is not grounded, a necessary precaution requires a 2 mfd. condenser in the ground-lead of the receiver. This does not interfere with the receiver's r.f. ground, but does prevent shorting the ship generator.




*Circuit Diagram for Eliminator*

All of the parts can be assembled on a baseboard 6 by 10 by ⅝ in. The condensers can be stacked on top of one another and held in place by a small strip of brass. This device has proven to be satisfactory with many different receivers in many locations.

## TRANSLATION OF ESSENTIAL WORDS USED IN XDA WEATHER

*By* Paul Otto

Several operators have asked me where I got the impression that XDA weather is easy to translate! Here is a list of twenty words that chiefly constitute the construction of these weather reports. Of the twenty, there are only eight whose meaning in English is not self-evident. Judge them for yourself.

From experience I have found that the weather contained in the number groups, from coast towns, is the most desired.

In the first group the first three figures are the barometer in centimeters. The fourth is the wind direction, and the fifth the wind force. In the second group the first figure is the state of the weather, and the third is the sky report. These figures can be very easily decoded by referring to a copy of "Radio Aids to Navigation," which can be purchased for seventy-five cents at any store that carries hydrographic publications.

Here are the words:

| ENGLISH | SPANISH |
|---|---|
| Somewhat | Algo |
| Lower | Baja |
| Cape | Cabo |
| Coast | Costa |
| Of | De |
| Light | Debil |
| Of the | Del |
| The | El, or La |
| East | Este |
| Strong | Fuerte |
| Gulf | Golfo |
| As far as, or to | Hasta |
| Moderate | Moderado |
| Very | Muy |
| North | Norte |
| West | Occidental, or Occ. |
| East | Oeste |
| Shifting, or changing | Rolando |
| South | Sur |
| Winds | Vientos |
| Northeast | Noreste |
| Northwest | Noroeste |
| Southeast | Sureste |
| Southwest | Suroeste |

## CCA, ANTOFAGASTA, CHILI

*By* Charles F. Stewart

Having read pleas for South American material in the Commercial Brasspounder, I decided to take advantage of a stop-over in Antofagasta last May to check up on Station CCA.

CCA is a naval station and handles Government business only, on 1800 and 2800 meters. It is intended, however, to install a 600-meter spark, with which to handle commercial ship to shore traffic. Perhaps this service has already been inaugurated.

I was cordially met by the chief operator of CCA, Mr. Stienbacher, who kindly showed me the installation and later introduced me about the town, even throwing a party for me. He told me that I was the first American operator he had met and asked that I extend the invitation to any other operators who might come to Antofagasta, which I hereby do. Take him up if you ever drop your hook in Antofagasta; you will not be sorry.

Now for the station: CCA is housed in a three-story building. Mr. Stienbacher and family live on the first floor where the power supply is also located. On the second floor are the living quarters of the three assistant operators, while on the third floor are the receiving apparatus, control room and land line.

There are two receivers, one Marconi, the other made by Telefunken. The transmitter is on the ground floor near the generators, and is a 10 kw Marconi outfit, with 10 1 kw tubes. The transmitter occupies a room to itself and is surrounded by a brass rail, only the tubes and rheostats being mounted on a panel.

Although the soil is extremely dry a ground is used for transmission and reception. I asked Mr. Stienbacher about the possibilities of a counterpoise, but he had never heard of one and was quite interested when I explained it to him. A Marconi engineer made the installation and I cannot understand why he didn't install a counterpoise.

The Chilean Navy was experimenting with short waves at that time, and was sending its operators small booklets on that subject. It might be well to mention that all stations in Chili are under the control of either the Chilean Army or Navy. The Navy maintains a school in Valparaiso, where its operators are trained. English equipment predominates, although a few Telefunken tubes and receivers are used.

To listen to a Chilean coast station handling commercial traffic you would think the operators and equipment very poor, but the stations handling government traffic have first-class equipment and operators. Only men with a high rating are used for this type of service. It is easier to understand this when it is known that the Chileans believe the Army and Navy to be the most important elements of their country's organization.

Mr. Stienbacher speaks excellent English and is very anxious to get acquainted with American operators. As we said before, if you want to be well received, drop in on CCA.

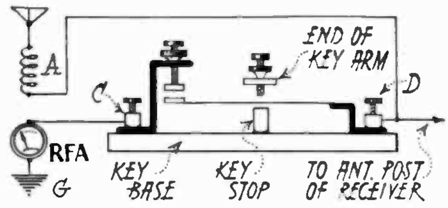
## AN EASILY CONSTRUCTED BREAK-IN

*By* J. A. Bender, *S. S. West Cactus*

A lot of fine machine work can be put in on a break-in, but when the all-important consideration is cash there is just one item, outside of efficiency, to be discussed, and that is simplicity. Therefore, if you are interested, read about the one you can make out of parts retrieved from your junk-box.

Delve into the aforementioned curio shop and bring out the following trinkets:

1 piece of bakelite panel 5"x3".
1 piece of bakelite strip 3"x½".
1 piece of heavy brass strip 3"x½".
1 piece of heavy brass strip 1½"x½".
1 piece of spring brass strip 2"x½".
2 binding posts.
1 8/32 screw about 2" long with nut.
1 brass bushing about ½" long, tapped on one end to an 8/32 thread and on the other end to same thread as on the key contacts named below.
1 piece of brass bushing about ¼" long tapped 8/32 thread for key stop.
2 key contacts.




*View of the After End of the Key Base*

First, mount the key on the piece of panel so that about 3 in. of the base extends out in back of the key proper.

Second, drill three holes in the panel about ¼ in. from the end; the two outer holes being about ⅛ in. from the edges of the panel and the center hole in line with the adjusting screw of the key proper. All the holes must be in line.

Third, take the brass ¼ in. bushing and screw it into the center hole.

Fourth, take the piece of strip bakelite and drill a hole in each end, tapping one hole with the same thread as the adjusting screw on the key. Remove the back adjusting screw from the key arm and bolt the bakelite strip to the arm, using the hole from which the screw was taken. Now screw the adjustment screw into the tapped hole of the bakelite strip.

Fifth, drill and tap one hole on the long strip of brass and bend the strip to right-angles about ¾ in. from the end, using an 8/32 tap to tap the hole.

Sixth, drill a hole in the other end and bend in the opposite way about ¼ in. from the end. Screw the long 8/32 in. screw into the tapped hole, leaving the nut on the screw, and screw the key contact to it, using the ½ in. bushing. Now take the finished piece and bolt to one side of the panel, using a binding post.

Seventh, take the brass spring, drill a hole in each end and screw the other key contact to it. Take the short brass strip and drill a hole in each end, then bend it at right-angles about ½ in. back from each end, reversing directions. Bolt the spring to the strip and bolt the whole thing to the panel.

Eighth, replace the arm of the key and you have the break-in completed. Not much to look at, but it surely does the work.

In hooking up the break-in, disconnect the transmitter from the r.f. ammeter, at *A*. Run a lead from the ammeter to the binding post *C* on the break-in. Run a lead from the binding post *D* to the antenna binding post on the receiver, also to the transmitter at *A*.

(Continued on Page 48)

# With the Amateur Operators

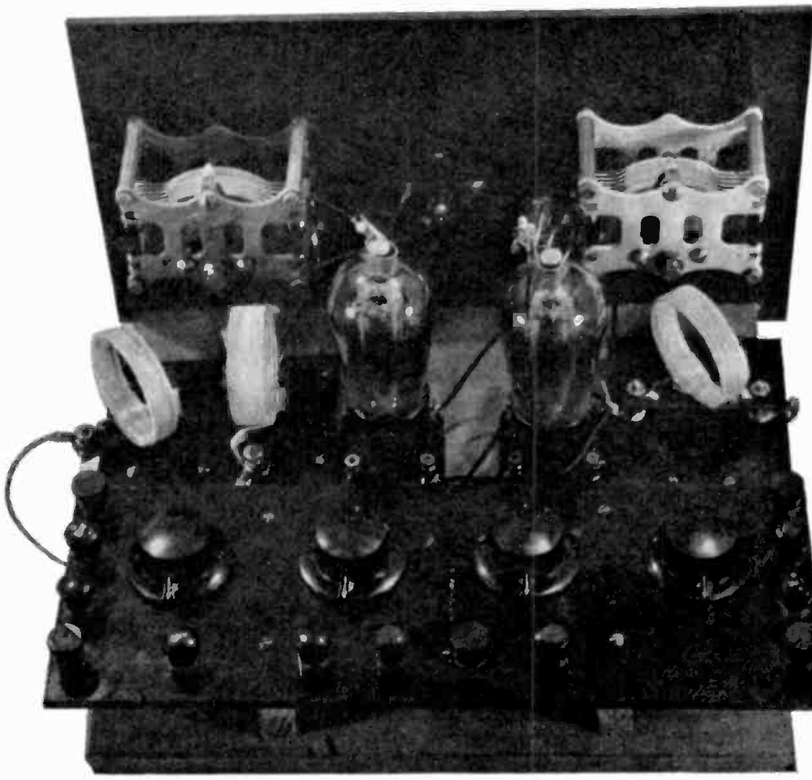
## AN ALL-SHORT-WAVE RECEIVER

*By* A. BINNEWEG, JR.

UNLESS particular attention is given to station design for 1929 conditions, amateurs may have difficulty in working at the higher frequencies. The experimenter will use the 10-meter and 5-meter bands with reflectors. Those who will use the 20 and 40-meter bands must use special care and apparatus.

The usual 40 and 20-meter receiver will not also operate at 5 and 10 meters, as the parts are too large. To satisfy 1929 requirements, the set must tune sharply over a narrow band, which means that midget condensers will be used. Many amateurs will leave the narrow bands and experiment with the much wider 10-meter one which has exceptional possibilities. The writer has developed a receiver which covers efficiently the 5 and 10-meter bands and meets the 1929 requirements for the 20 and 40-meter ones.

The receiver is constructed in two sections: a two-stage screen grid amplifier in one and a regenerative detector and two-stage audio amplifier in the other. The r.f. amplifier section is especially useful for the higher frequencies as the amplification falls off. It may be added to any short-wave receiver. By proper circuit design and parts placement, it is possible to operate the amplifier without any great amount of skidding, a grounded copper sheet between the two tubes usually being sufficient to prevent oscillation at 5 and 10 meters. Fig. 1 shows the complete circuit diagram.



*Short-Wave R.F. Amplifier with Screen-Grid Tubes*

The r.f. amplifier coils must be of small diameter to limit the field and minimize inductive feed-back. For 40 meters, 2-in. coils with 12 turns are about right, and at 20 meters 4 turns will do, the exact size depending upon the range of the tuning condensers. The antenna coil and its associated secondary are mounted on a 3 by 4-in. piece of bakelite placed directly below the condenser so that the wiring is short and direct. The plate coil of the first stage is mounted in a similar manner. A 10 by 11-in. baseboard provides ample space between the parts.

Separate batteries can be used for each stage. Separate binding posts are provided for each *A* and *B* battery supply and two posts are left free for the leads of the output coupling coil.

Filament current for each r.f. amplifier stage is supplied through two rheostats connected in series. One is variable for filament regulation. The other is fixed as regards filament voltage, but is adjustable so as to give the best grid-bias. This bias adjustment is secured through a lead from the movable arm to a separate post. The four rheostats and binding posts are mounted on a 4 by 11-in. piece of bakelite, which is separated above the baseboard by two wooden uprights.

The second r.f. stage requires a .0002 mfd. grid condenser and 1 or 2 meg. leak. This amplifier will operate well at 40 meters without by-pass condensers. For shorter wave work .002 or .003 mfd. will serve.

The clips for the control grids consist of trimmed fahnestock clips to which the leads are soldered.

The main panel measures 7 by 12 in. and shows two 100-degree dials and a filament switch between. The ground post is mounted on the small panel, with the antenna coil, which is fitted with a strip of bakelite and a G. R. plug; this rotates in a jack which can change the coupling. A flexible lead to the antenna coil connects to the antenna post at the rear of the set. The small panels supporting the plug-in coils are fastened to wooden supports and clear the baseboard about ½ in.

The tuning of the amplifier is not sharp at any frequency so that one can tune somewhere near the band, and the receiver is then the usual two-control affair. The input tuned-circuit to the amplifier has the most effect on the overall amplification.

The construction of the regenerative detector and audio section is almost self-evident from the circuit diagram and picture.

For reception at 5 meters, both 100 pfd. midget shunt condensers are set at minimum, the 2-turn secondary is used, and tuning is as easy as usual. The shunt condensers are adjusted for a certain minimum capacity which is desirable in the secondary circuit,

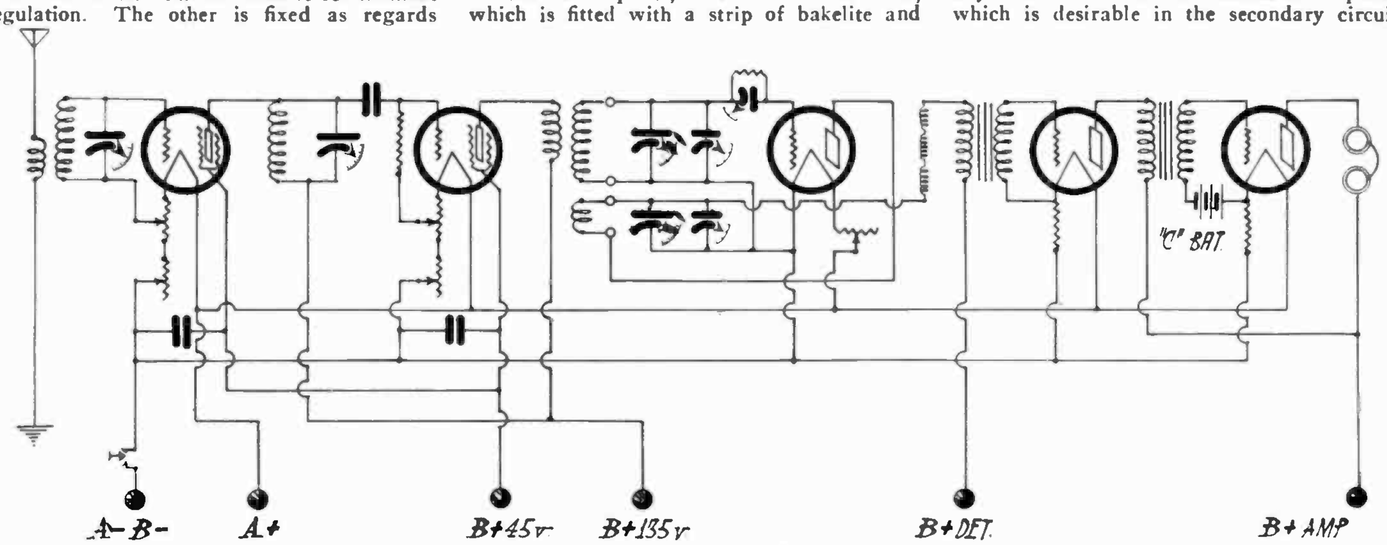



*Fig. 1. Circuit Diagram for All-Short-Wave Receiver with Screen-Grid R.F. Amplifier*

for the throttle-control has a large detuning effect when the total secondary capacity is near that of the tube capacities.

To operate at 10 meters, simply plug in the next coil and listen anywhere between 5 and 10 meters. The secondary shunt condenser is used to shift to a new band.

To operate at 20 or 40 meters, a large inductance can be used, or else the shunt condenser can be set somewhere near maximum and a smaller coil employed.

It is interesting to compare receiving conditions with the different *LC* ratios possible. Any size of inductance, within reason, is all right, as adjustment is made with the shunt condenser. When the proper position is once located, the knob-setting is noted, and rapid wave-changing is then possible. It certainly is a relief to have a receiver which will operate efficiently at the lower wavelengths also.

For 5 and 10 meters, the plug-in coils are self-supporting and are mounted in '99 bases; for 20 and 40 meters, the larger bases may be used with the coils wound directly on them.

If desired, celluloid-supported coils may be mounted horizontally on these bases. A good tube socket should be used for the plug-in coils; by a simple test, at even 10 meters, the capacity between the socket terminals (and what little wiring there is) alone, is sufficient so that the operation of one condenser has some effect on the other. The socket is mounted on a block between the condensers and the leads are thus short.

The throttle-control is a 100 pfd. midget which is sufficient for the shorter wave-bands. For the higher wave-bands, the other 100 pfd. midget, shunt condenser, is utilized and the receiver can thus cover a very large range without changing coils. It is important to adjust the tickler so that good regeneration-control is secured with the condenser near a maximum setting, so that detuning of the secondary circuit will be negligible.

The midgets are mounted on small brass angles; some midgets already have these. Extension handles are used, which allows efficient reception at the highest frequencies without any body effects. A half-inch wooden panel, screwed to two uprights, to which the sub-panel is screwed, makes a sturdy set. To properly center the extension handles, the condensers are first mounted in place and the handles extended to the panel, which is then marked and drilled. Large holes are drilled half way through the panel for the vernier-dial screws, and smaller ones the rest of the way. Often the advantage of a good vernier dial is lost by motion at the bottom; if two brass wood screws fitted with washers are used to hold it here, no trouble will be had. A small dial or knob is used on the regeneration control.

A good choke, which will cover the 5 and 10-meter bands also, consists of several small windings in series on a ¼-in. dowel; these windings consist of 20, 40, 60, 80 and 100 turns, bunch-wound, and are spaced about ¼-in. apart. Basket-weave coils may be used if desired.

| LIST OF PARTS FOR ALL SHORT-WAVE RECEIVER |
|---|
| 4 100-mmfd. Midget variable condensers |
| 1 15-mmfd. Midget variable condenser |
| Tube bases for coils |
| 2 sockets for amplifier tubes. |
| 5-meg. grid leak |
| 1 filament switch |
| 1 detector rheostat |
| 112 detector tube |
| 2 amplifying tubes |
| 2 peaked audio amplifying transformers |
| 2 fixed filament resistors |
| 2 extension handles |
| Wire for coils (No. 12 and No. 20); wire for chokes (No. 36), bakelite (7 by 12 and 7 by 7 suggested); baseboard and uprights, screws for same, etc. |

The capacity of the grid condenser has considerable effect on the operation of a receiver of this type. If too large, considerable effect of one control on the other occurs through the tube capacities. For "all-wave" use, it is preferable to use a variable condenser so that best values may be selected in different bands. A midget having a maximum of 100 pfd. gives good results. At 5 and 10 meters, this condenser is turned down

(Continued on Page 52)

*All-Short-Wave Receiver*

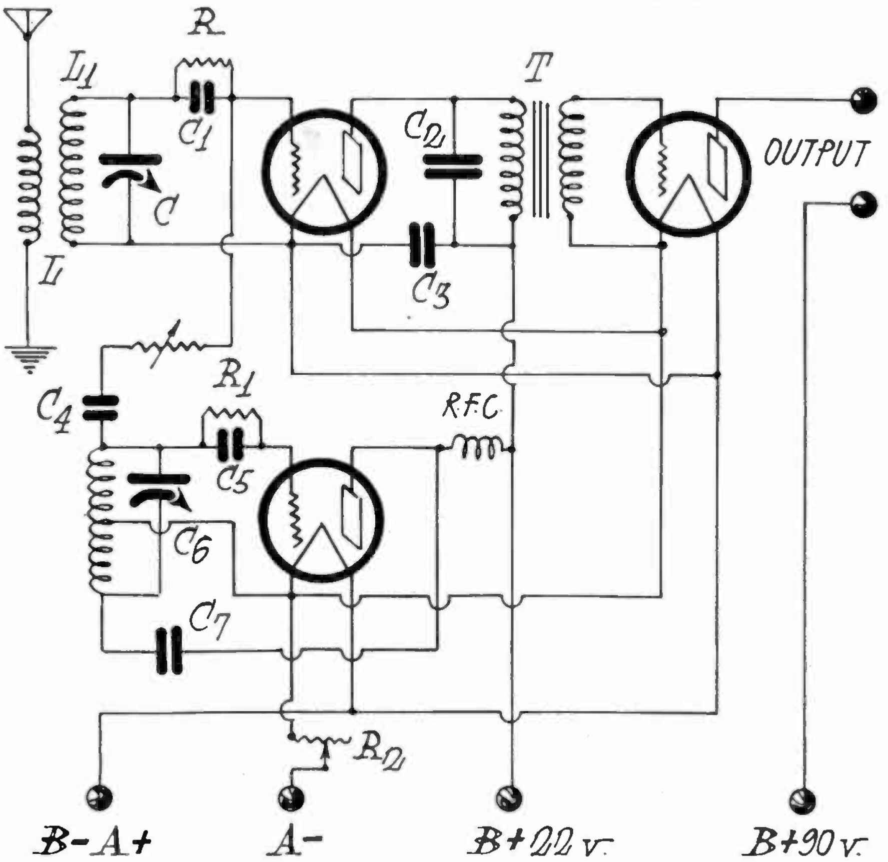
## A SELECTIVE SHORT-WAVE RECEIVER

By R. Wm. Tanner

The selectivity of the usual regenerative short-wave receiver can be greatly improved by adding a Hartley oscillator and removing the tickler coil as shown in the accompanying circuit diagram. The oscillator control has no tuning effect on the detector. The pitch of the signal is not changed when the secondary condenser is varied after a signal is tuned in. This is in marked contrast to the detuning of the grid or secondary circuit which occurs when the tickler is varied in the usual form of regenerative receiver. If the tickler coil is retained when the oscillator is added, greater sensitivity is possible, but another control is added thereby.

While complete shielding is desirable, it is not necessary if the oscillator harmonics are used to produce beats. A slight rushing noise is heard when one of the harmonics crosses the wave of the detector. Although this set is a little harder to tune than a straight regenerative receiver, the results are more than worth it. $R_1$ is a 1 megohm clarostat used in place of a pick-up coil.

The antenna coupling coil *L* has 5 turns




*Circuit Diagram for Selective Short-Wave Receiver with Oscillator*

of No. 18 enamel wire and may well be variable so that close coupling can be used on weak signals and loose coupling on strong signals. The secondary plug-in coils $L_1$, are space-wound with No. 18 enamel wire on a 3-in. form. They have 19, 8 and 3 turns respectively for the 80, 40 and 20-meter bands, being tuned by a .00014 mfd. condenser *C*. The detector grid condenser $C_1$ is .00015 mfd. and the grid leak *R* 6 megohms.

The oscillator coil $L_2$ has a wavelength range of about 180 to 400 meters when tuned with a .00025 mfd. condenser $C_6$. A high ratio vernier dial must be used on this condenser. The coil consists of 50 turns of No. 26 d.c.c. wire on a 3½-in. bakelite form, with a filament connection tap at the 25th turn.

(Continued on Page 54)

# Inside Stories of Factory Built Receivers

## III. Freshman Model Q-15

This is the first factory-built a.c. receiver to use a screen-grid tube as an r.f. amplifier. The other tubes in this four-tube set are a '27 tube as a detector, a '26 tube as a first audio amplifier, and a '71 tube in the second audio stage. Filament current at 3.1, 2.25, 1.4, and 4.8 volts, respectively, is supplied through a stepdown multiple-tapped transformer from a 110-volt a.c. source. Plate voltages are supplied through a full-wave rectifier-filter system using an '80 tube. The entire receiver, including the power supply equipment, is compactly assembled on a steel chassis.

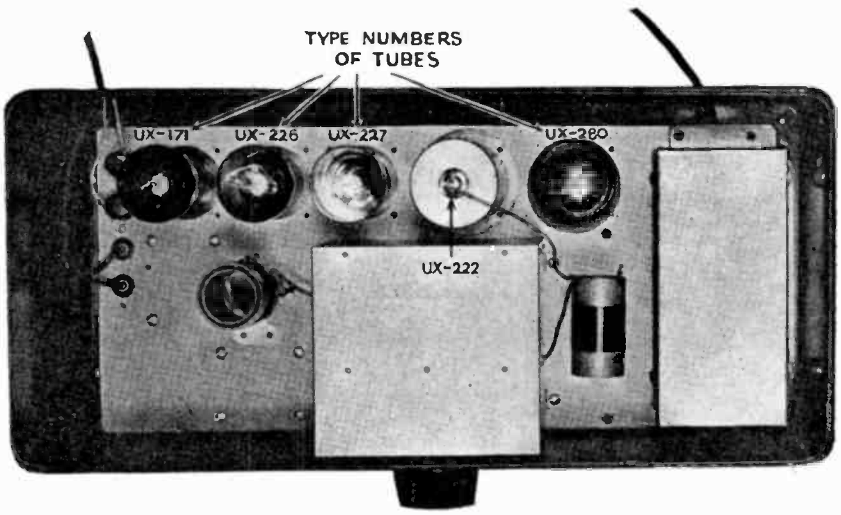
The set has four controls: a 190 to 570 meter tuning dial which operates a two-gang .00036 mfd. condenser, a vernier .00004 mfd. condenser which adjusts for fine selectivity and sensitivity, a volume control, wherein a rheostat varies the antenna current, and an "on-and-off" switch. It uses an outside antenna and ground.

The tuning condenser and power plant are in separately shielded compartments. The screen-grid tube is also shielded.

The r.f. amplification from the screen-grid tube and its associated transformer is claimed to be from 25 to 40, despite the limitations imposed by operating the filament on raw a.c. Such amplification is as good or better than is secured with the usual two stages of r.f. amplification. One of the secrets of its performance is the use of a high grid bias to prevent a.c. modulation.

A small amount of regeneration is ingeniously introduced into the detector circuit to more than compensate for the slight reduction in shield-grid tube gain. This is automatically maintained well below the oscillating point so as to avoid distortion.

Most of the circuit constants for the receiver and power plant are shown in the accompanying circuit diagram. The general construction and arrangement of the chassis may be seen in the picture thereof.




*Freshman Model Q-15 Chassis*

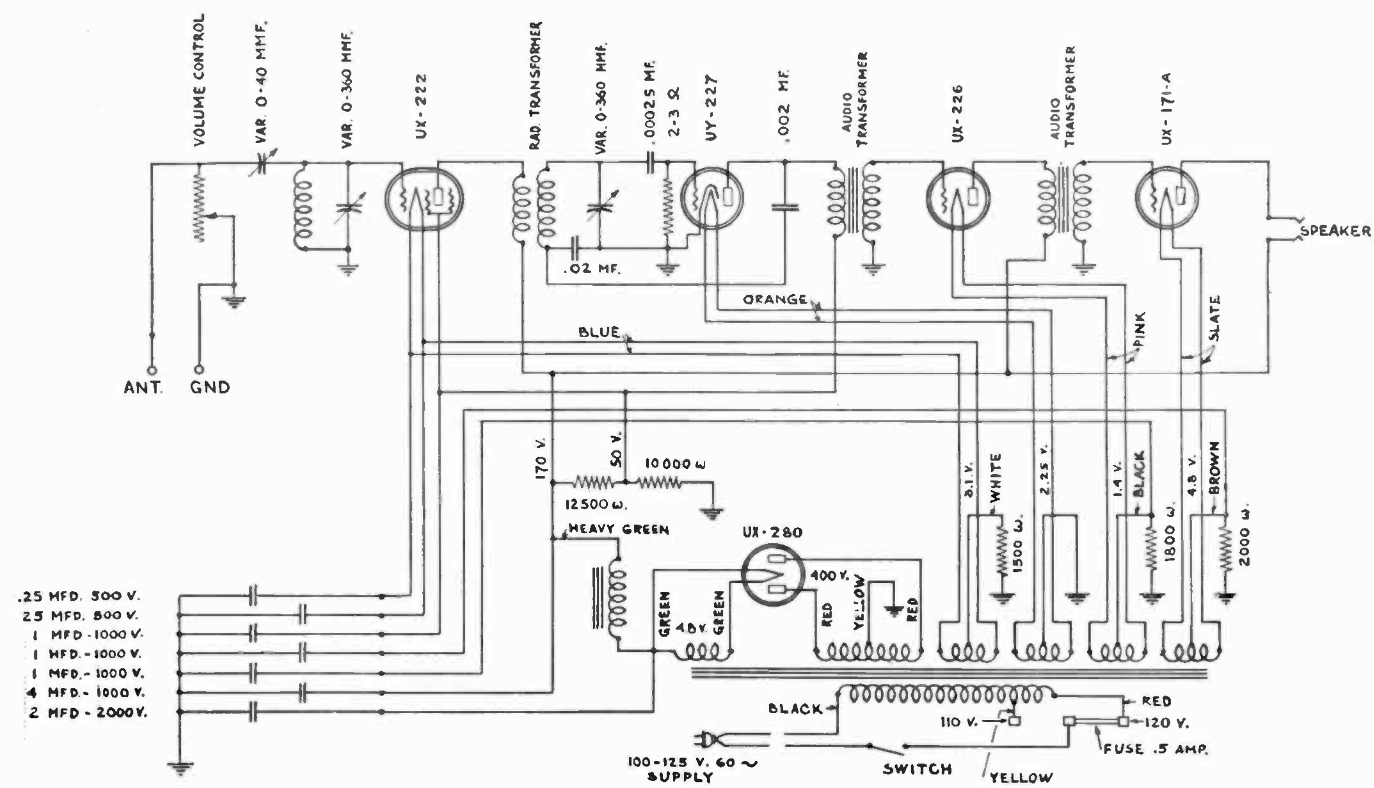
### NEW RADIO CATALOGS

Radio Insulators of all types are illustrated and described in a pamphlet from Knox Porcelain Corp., Knoxville, Tenn., which also shows such antenna accessories as wire, lead-ins, and lightning arresters.

A new bulletin on socket power condensers from the Dubilier Condenser Corporation of New York City shows a complete line of paper dielectric condenser blocks as designed for use with various standard transformers. Dry "A" 2000 mfd. condensers are also listed and described.

Publication No. 84 from the U. S. Bureau of Standards is a Standard Time Conversion Chart which gives a direct reading for the standard time at any desired longitude corresponding to the time at a given place. The chart is printed on heavy Bristol board and consists of two concentric circles, one of which can be revolved. This can be secured from the U. S. Government Printing Office for ten cents.

Scientific Paper No. 568 from the U. S. Bureau of Standards contains "Methods, Formulas and Tables for the Calculation of Antenna Capacity," by Frederick W. Grover. This information is of value to an amateur transmitter who is designing an antenna system whose fundamental wavelength he desires to know.




*Circuit Diagram of Freshman Model Q-15 Receiver*

# Radio Kit Reviews

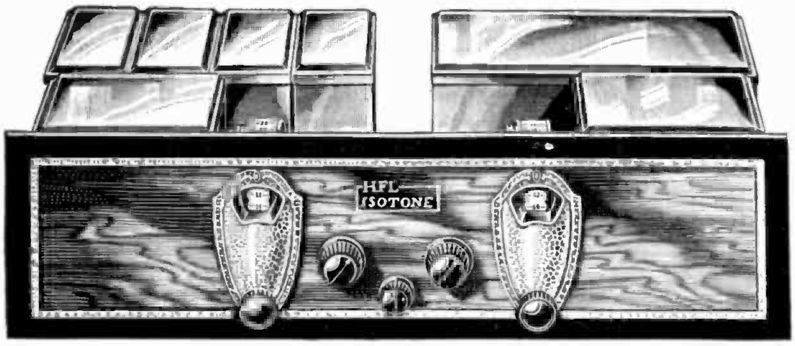
## HFL MODEL 10 ISOTONE

The HFL Model 10 Isotone is a standard screen-grid superheterodyne, utilizing nine d.c. tubes as a radio receiver, with a tenth tube available as an extra stage of audio amplification for phonograph reproduction. It incorporates several new features, including a radiophone control switch on the panel. When this switch is turned to the phonograph side the oscillator, detectors and i.f. amplifiers are completely disconnected from the circuit, leaving three stages of a.f. amplification with '12A tubes for the first two stages and two '71As in push-pull for the third. This a.f. amplifier may be used in connection with any external detector, short wave or broadcast, by plugging the latter into the tip jacks designed for the phonograph pickup. When the switch is turned to "radio" one stage of audio is disconnected, and the other tubes thrown back into the circuit.

Either a loop or an outside antenna may be used. In the case of the latter, the phone tips hanging from the antenna coupler are plugged into the tip jacks marked for the loop. The oscillator and first detector use '01A tubes, the three i.f. stages use '22 type, the second detector and first two stages of a.f. use '12A type, and the last stage of push-pull audio '71A tubes.

The i.f. transformers are peaked at 450 k.c. so as to give one-spot tuning. It will be noticed that a 25 mmf variable condenser is shunted across each of the larger .0001 secondary condensers, allowing each i.f. circuit to be separately tuned. This compensates for variations in the internal capacities of the tubes, making it possible to maintain the utmost selectivity of the amplifier at all times. The sensitivity of the i.f. amplifier is controlled by variation of the voltage applied to the screen grid. Each stage is said to have a radio-frequency gain of 65.

In the tuning unit a small trimmer condenser, shunted across the oscillator coils, makes it possible to adjust the oscillator and antenna tuning dials so that they read alike. In balancing the instrument for best results it is necessary to leave all the shield cans covered with the exception of the one to be balanced. Once the intermediate amplifier is balanced it should be left that way until such time as any of the screen grid tubes have to be replaced. The only remaining variable control is the small trimmer condenser in the antenna tuning stage. This is non-critical in adjustment and does not usually have to be touched. It is possible, however, to make the receiver oscillate by tightening this condenser. All units are thoroughly shielded.



*HFL Model 10 Isotone*

The kit comes in four parts; namely the base pan, the front control unit, the i.f. amplifier unit and the a.f. unit. All are fastened to a metal sub-base drilled for speedy mounting. Six bakelite strips protrude through the bottom of the base pan and the terminals thereon are easily hooked up with nickel-plated connecting strips. The whole job of assembly can be done in less than an hour; each unit fitted into place and made fast, bottom connecting strips screwed on, panel and knobs mounted on front, tubes put into their sockets and covered with the individual shield cans. The panel is 7 x 26 in. in size, of walnut grained Micarta.

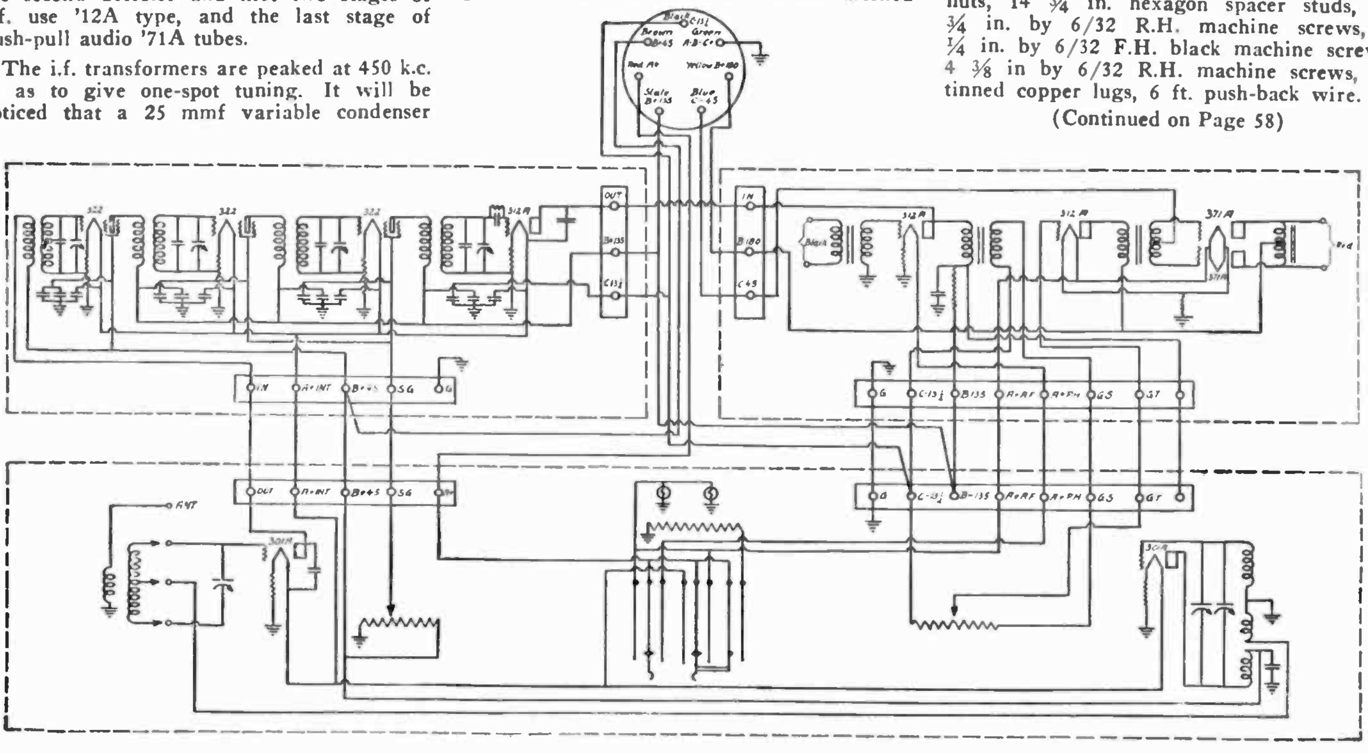
The manufacturers of the HFL Isotone have also designed a power pack which furnishes all of the required voltages to the receiver. This is sold completely assembled and wired and provides the following currents and voltages: *A* current, 2½ amperes at 6 volts; *C* voltages variable 0-15 and fixed 45 volts; *B* voltages 45 (variable 0-90), 135 and 180 volts. There is a variable resistor in the *A* supply circuit which allows the filament voltage to be increased or decreased. Oversize condenser sections and heavy chokes eliminate all tendency toward motor boating and voltage fluctuation. The instrument uses dry rectifiers and condensers throughout and the plate current is furnished by means of a 280 rectifier tube.

When using the power pack on the a.f. amplifier alone, i.e., on phonograph reproduction, with the filaments of the six unused tubes turned off, it was found necessary to use a compensating resistance. This is incorporated in the set.

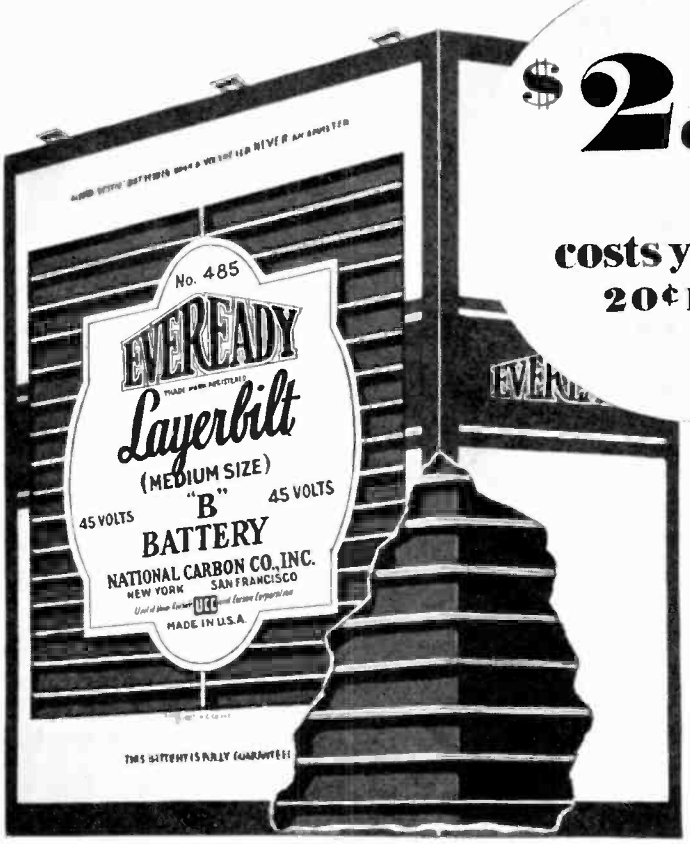
The parts in the kit are:

1 HFL Isotone assembled and wired tuning unit, 1 HFL Isotone assembled and wired screened grid amplifier, 1 HFL Isotone assembled and wired audio amplifier, 8 HFL Isotone shield cans with tops, 1 base assembly plate, 1 drilled and engraved front panel, 1 seven-wire cable and plug, 2 gold escutcheons with knobs (attached), 2 dial lights (inside of drums), 2 large walnut control knobs, 1 small walnut switch knob, 2 steel panel supporting brackets, 12 plate connecting strips, 55 6/32 hexagon brass nuts, 14 ¾ in. hexagon spacer studs, 14 ¾ in. by 6/32 R.H. machine screws, 6 ¼ in. by 6/32 F.H. black machine screws, 4 ⅜ in by 6/32 R.H. machine screws, 11 tinned copper lugs, 6 ft. push-back wire.

(Continued on Page 58)



*Circuit Diagram of HFL Model 10 Isotone*




**$2.95**
**costs you only 20¢ more**

*This is the Medium Size Eveready Layerbilt "B" Battery No. 485. 3¼ inches thick. 45 volts, $2.95.*

If you use the medium size, you can buy the Eveready Medium Size "B" Battery No. 772, for $2.75. It's a fine battery of its type—cylindrical cell. BUT, just add 20 cents to your price, and get the Eveready *Layerbilt* Medium Size "B" Battery No. 485. Same outside size as the older battery, but more active materials inside, and so you buy 25% longer life with your 20 extra cents. Another great battery bargain!

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SEE AND HEAR THE NEW EVEREADY RADIO SETS

## RADIO AIDS AIR RACES

(Continued from Page 30)

Here they come! There they go! Zoom! Zoom! That was a close one. He didn't miss the pylon very far that time! And we're inside, too. Here comes one that whines like a siren. After it passes, an observer calls:

"Operator! Plane number 159 fouled pylon! Sixth lap."

The operator grabs the key.

"6EMF 6EMF 6——"

He doesn't complete the third set of call letters before headquarters station, 6EMF, answers, using the "break-in" system.

"6EMI DE 6EMF GA (Go ahead)," says 6EMF.

6EMI: "QFP (Foul pylon) NR 159 SIXTH LAP K."

6EMF answers: "OK QRX." (O. K., stand by.)

In a few seconds come the signals from 6EMF again: "6EMI DE 6EMF NR 159 DISQUALIFIED AND SIGNALLED QSU (Will call you later.)"

The whole operation hardly took over thirty seconds! Before the plane could reach the field, flying well over 100 miles an hour, the judges knew what had happened at Pylon Number 3. Plane Number 159 is flagged out and is saved from going around several useless laps.

Even more important than "QFP" was QRR. This signal in amateur radio corresponds to the "SOS" of commercial radio. At the air races it was used as the signal for a crash, and we are glad to say that its use was seldom required.

One day, a plane failed to appear at Pylon Number 3 after three laps. 6EMI advised 6EMF, and the latter made an immediate investigation. It was found that the plane had completed three laps at Pylons 1 and 3, and had passed Pylon Number 2 on its fourth lap. The plane was therefore between 2 and 3. A search was made by a scout plane and it was found only a few minutes after it had made a forced landing because of minor trouble.

On another occasion one of the pylons reported a grass fire in the vicinity. A scouting plane was dispatched to the scene and an accurate report of the blaze was made to firemen within a very short time, thus aiding them materially in handling the situation.

It was one thing to tap out a few orders and acknowledgements at the key from time to time, but it was another thing to continue this work from hour to hour and from day to day. It was also quite a job to make five complete installations and then remove them after the races. Sometimes during the day there was considerable time between races. The most you had and the least you wanted was dust and heat! Ice cream sodas at a dollar each would be cheap! But the boys stuck it out to the last day with perfect scores.

As a reward for their services they received the sincere thanks and appreciation of the race officials and the satisfaction that they had contributed, in no small way, to a good cause. They had saved the management some thousands of dollars. They had eliminated a large amount of worry for the officials. They received not a cent of money, as this is against the amateur's code of ethics and the rules of his license.

The boys operating the stations during the races were: Bert Fox (6DY), Charles A. Hill (6BRO-6DRO), Charles Lundblad (6CYX), William Breuer (6BZR), Charles A. Nichols (6ASM), Donald Champion (6FA), and Bob Parrish (6QF-6PS-6XC).

## PHONOGRAPH PICK-UP UNITS

(Continued from Page 24)

rise on the low frequencies to compensate for the drop in the phonograph records. This may be accomplished by using an audio transformer in the first stage which has the primary circuit resonated at a low frequency, somewhere between 40 and 80 cycles per second. There are available on the market at least three varieties of transformers which have a resonant primary, generally with the condenser and *B* battery feed resistance, mounted inside of the transformer case. Such a transformer will give a decided peak on the very low notes when the unit is connected across it and the volume control is simply a variable resistance in shunt. With this arrangement much better music is available from phonographs than is available from most broadcast stations.

## BOOK REVIEW

"Practical Radio," by James A. Moyer and John F. Wostrel, third edition, 378 pages, 5 by 7½ in. Published by McGraw-Hill Book Co., New York City. Price, $2.50.

This text provides a simple answer to the question of what is radio and how is it transmitted and received. In an elementary manner it describes the circuits and parts ordinarily used in radio telephony and telegraphy. Its discussion of vacuum tubes is especially helpful to the novice. As part of a section devoted to the testing of sets is printed a trouble chart which shows at a glance the probable cause and remedy for the common troubles to which a set is liable. It also includes a somewhat sketchy treatment of a.c. filament tubes, rectifiers and loudspeakers. As a whole, it provides a good introduction to the serious study of the subject of radio stripped from its mathematical technicalities.

A low voltage filament is used in the '26 type of a.c. tube because thereby the a.c. hum is reduced. The lower voltage allows the use of a heavier filament and greater current with consequent smaller change in filament temperature and emission. The lower voltage also causes a smaller electro-static field and consequent tendency to hum.

## CONSTRUCTED BREAK-IN

(Continued from Page 40)

When the key is up you are receiving through the secondary of the transmitter's oscillation transformer. When the key is pressed the receiver is grounded out and the ground circuit of the transmitter is closed.

Be sure to adjust the contacts of the break-in so that they close just a fraction of a second before the main power contacts of the key close. In other words, the receiver must be grounded *before* the power goes into the transmitter for full protection. It is advisable to put a safety gap across the antenna and ground posts of the receiver as an added precaution; that is, if the receiver is not already so equipped.

## AMATEUR RADIO RESEARCH CLUB BANQUET

*By* Wallace S. Wiggins

The largest amateur radio banquet in two years for Southern California took place in the Chamber of Commerce Building, September 12, 1928, sponsored by the Amateur Radio Research Club of Los Angeles. Over 115 enthusiasts of "brass pounding" were present in the banquet hall, which echoed and re-echoed with shrill whistles in true "ham" style.

A. H. Babcock, A. R. R. L. director, described the situation at Washington with regard to the status of the amateur, and stressed the importance of keeping up with the times in the design of transmitters and receivers for efficient operation in the new kilocycle bands. He also spoke of operation in channels other than the amateur bands, explaining the "American Eagle Channel," for the Army and Naval Reserve Units.

"Bob" Parrish, 6QF, president of the A. R. R. C., and chairman of the banquet committee, introduced the speakers. "Jimmie" Warner of KHAB, the "Southern Cross," first plane to fly from Oakland to Australia, modestly described part of the flight in a short speech, saying that the trip was "uneventful," but that he appreciated the cooperation of the amateur operators. Bob Hutchings, 6AKF, related a most interesting story of a trip to Siberia and China on which they took portable receiving and transmitting equipment. The big "kick" of the evening came when Hutchings said that although reception was none too good, the strongest signals from the United States came from 6CUT. As the owner and operator of that station was present, he was called upon to describe his supposedly super-high powered transmitter for the benefit of those unfortunates who lacked the cash to purchase high-powered stuff. He was introduced as Homer F. Beal, Jr., of Riverside, Calif. The surprise and wonder of the assembly can well be imagined when Beal said he was using a 7½-watt tube with 1000 volts on the plate through a 30-henry choke. He explained further, however, that a zeppelin antenna, constructed with the greatest care, was being used. This probably accounted for a large share of the success of his strong signals in Siberia.

"Wally" Wiggins, 6CHZ, explained the operations at the National Air Races in connection with the club's activities in providing communication. Bert Fox, 6DY, supplemented this with an explanation of the details of installation and operation. It was announced that over 2400 messages had been handled, free of charge, for patrons of the recent radio show in Los Angeles.

## MARSHALL SHORT-WAVE RECEIVER

(Continued from Page 36)

after time without any variation in the dial readings or numbers. Reception on 8000, 12,000 and 16,000 kilocycles was effected without interference. A temporary removal of one of the shielded-grid tubes, however, cut down the signal strength appreciably.

Using this receiver, the *Eagle* picked up signals in the daytime with regularity from Washington, D. C.; Key West, Fla.; New Orleans, La.; and Guantanamo, Cuba, while cruising in the Panama Canal Zone. However, the signals from stations northward from Louisiana to the Great Lakes were intercepted with the greatest clarity while the *Eagle* was located in the Panama Canal waters. Amateur stations on the Atlantic seaboard were also heard satisfactorily. The comparative tests between this receiver and a standard navy outfit were conducted with both receivers connected to the same antenna—using the so-called "coupled tube" arrangement of the Bellevue Naval Research Laboratory.

Tests on a submarine were restricted by the usual limiting factor of submerging radio in salt water, namely, at a depth of 20 feet there is a sudden and complete extinction of the received radio signal. However, this receiving set oscillated and was as easily controlled while submerged as when on the surface of the water. Furthermore, when using a loop or coil of wire as pick-up system on this submarine the distant signals—from Rocky Point and other transmitting stations—were nearly as loud as when employing the conventional high-frequency antenna on the *Eagle*. The use of one-half of the loop antenna on the submarine caused a material sacrifice in signal strength. When the submarine was resting on the surface of the water, this new receiver appeared to function most advantageously when receiving signals from distant stations on a frequency of 18,000 kilocycles.

## IMPROVEMENTS IN CRYSTAL CONTROL

AMATEURS should take particular note of the improvements which are being incorporated into many of the broadcasting stations, in the form of crystal control. Several of the stations have two crystals, either of which may be used as the main control, and these crystals are cut so accurately as to be within 100 cycles of each other. To maintain accurateness of frequency, each crystal is heated electrically to a certain fixed temperature, at which it is calibrated.

With the coming limitations of the amateur bands, there will undoubtedly be an increased use of crystal control on the short waves. By the installation of a simple heating system and ther-

(Continued on Page 51)

## TUBE TESTING SET

(Continued from Page 33)

The reading should then be compared with the nominal limits as indicated on the accompanying table. If the emission

**POWER AND RECTIFIER TUBE TESTS**

*Indication for Good Tube*

| | | |
|---|---|---|
| CX 310 | No. 1 | Dull red |
| | No. 2 | Dull orange |
| CX 313 | No. 1 / No. 2 | Dull orange |
| CX 316B | No. 1 | Dark |
| | No. 2 | Dull orange |
| CX 350 | No. 1 | Dull red |
| | No. 2 | Dull orange |
| CX 380 | No. 1 / No. 2 | Dull orange |
| CX 381 | No. 1 | Dark |
| | No. 2 | Dull orange |

reading is below these figures it indicates, as a rule, that the tube has been overloaded due to excessive filament or plate voltage, or both, or that there has not been sufficient *C* battery voltage provided.

To take an emission reading on a 322, the screened grid amplifier, it is necessary to connect the two grids together; this may be easily done by arranging an X base socket on an X tube base, connecting a flexible wire with a clip on it to the grid terminal of the socket, inserting the 322 into this adapter, placing the whole assembly into the proper socket in the test set. If no short circuits are shown on the lamps, connect the clip to the top contact on the 322 and then press the emission key momentarily. To test the C-11 it will be necessary to use an adapter to accommodate the special arrangement of contact pins to the C-12 socket.

Type 300-A gas filled detector tubes require a special test for sensitivity, and can only be tested for short circuits and filament emission in this test set.

The testing of 310, 313, 316-B, 350 and 381 tubes is extremely simple, it being only necessary to place the tube in the socket with the switch in position No. 1, the condition of the tube being indicated by the glowing of the lamps. Make certain before placing the tube in the socket that there is no short circuit between the elements. A low emission tube usually indicates abuse resulting from too high filament voltage, too high plate voltage, or insufficient grid voltage. A gassy tube may cause the lamps to glow as if O. K., but of course, is de-



| | C11 CX12 | C-CX 299 | CX 220 | CX 301A | CX 300A | CX 340 | CX 112 | CX 112A | CX 371 | CX 371A | CX 326 | C 327 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Filament Voltage | 1.1 | 3.3 | 3.3 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 1.5 | 2.5 |
| (Min. MA) Emission | 6.0 | 5.5 | 13.0 | 20.0 | 14.0 | 14.0 | 45.0 | 45.0 | 40.0 | 40.0 | 35.0 | 35.0 |

fective. Make certain that there is no decided blue glow surrounding the filament. A faint glow on the 380s, 381s and 350s is the normal condition and does not indicate a defect.

LIST OF PARTS FOR TEST SET

- 1 Panel 12 x 20 in.
- 4 X base sockets
- 1 Navy type socket
- 2 Dial lamp sockets (Edison Min. base)
- 2 110-volt lamp sockets, Standard type
- 1 Socket for 327 a.c. tubes
- 1 Socket for old style 99 tubes
- 1 Socket for 377 protective lamp, Bayonet type
- 2 10-watt, 110-volt Mazda lamps
- 1 6-ohm, ¼-amp. fixed resistor
- 1 7-wire cable, 5 ft. long
- 1 Kellogg Model 301 Key
- 1 10-ohm rheostat, 1½ amps. load
- 1 0-6 V. voltmeter
- 1 0-50 M. A. milliammeter
- 1 4-contact switch
- 1 ½-ohm 2-amp. resistor (6 in. No. 22 Nichrome wire)
- 2 Dial lamps, 6 volts

The thoriated tungsten filament tubes may be reactivated if the overload has not been too severe. The coated type of filament cannot be reactivated due to its design, and any attempt will result in its immediate burnout. The tubes which may be reactivated are as follows: 99, 220, 322, 300-A, 301-A, 340, 371, 310, 313 and 316-B.

In reading the tables accompanying this description, it is well to keep in mind the following notes:

If the dial lamps light, it indicates a short circuit; do not then attempt to take an emission reading or you will damage the meters.

Lighting of lamp No. 1 indicates a grid to filament short; lamp No. 2 indicates a plate to filament short; both lamps indicate grid to plate short.

An open or burned out filament may fall against the grid or plate, causing the lamps to light. This may be determined by turning the rheostat up and if voltage regulation is impossible, the filament is open; such tubes are called open filaments, either broken or burned out, according to the results of the inspection at the service station.

## IMPROVEMENTS IN CRYSTAL CONTROL

(Continued from Page 49)

mometer as an indicator, the amateur can maintain an absolutely dependable constant frequency of transmission. By placing the crystal with its associated tube, inductance and condenser in a closed box or compartment, together with a 25 or 40-watt mazda lamp contiolled by a rheostat, a control of the temperature can easily be had, at little or no additional expense.

The broadcast stations are commencing to use an enclosed automatic heating unit and crystal which is supplied by the Western Electric Co. But an amateur does not need the automatic feature if he watches the thermometer.

## ALL-SHORT-WAVE RECEIVER

(Continued from Page 42)

to a low value and the setting noted. A pair of grid-leak clips are mounted on it and a variable grid leak is best, although 5 megohms is the usual value.

A 112 used as detector oscillates easily at the highest frequencies. No tube-socket is used, since different tubes change things so much. The set ought to be built around the particular type of tube employed. Holes are drilled through the bakelite and the leads are soldered in place. Should another tube be necessary, the 112 is easily removed as it is at the rear of the set.

No short-wave receiver should be without a filament switch, as best oscillation is always secured at some particular filament-setting. These tubes usually work best with very low filament and about 67½ volts on the plate; other tubes will sometimes require comparatively large values of tickler turns and often higher plate voltages. The correct adjustment of the set, for the higher frequencies, is important and will require some experimentation for values giving best results.

The arrangement of apparatus is convenient for the experimenter as the filament rheostat and switch, phone jack and audio amplifier are mounted on a separate panel. All parts are arranged so that they can be used separately.

The whole set is mounted on a heavy baseboard and is supported above it. The 4½-volt *C* battery is mounted underneath. Dry cell tubes can be used and the set made semi-portable; it is a simple matter to mount the layout on the seat of the car and study the 5 or 10-meter signals at a distance from the station.

The audio transformers peak at 1000 cycles and the set therefore gives best response at this audio frequency. There are still AC signals on the air so that a very selective audio amplifier would hardly be desirable yet, especially for all-wave use. In this amplifier, the better signals are received with excellent results and extraneous noises are greatly reduced. Often one can "tune" an audio transformer to about the correct value by using condensers across the windings; some transformers are designed for peaks in the audio range.

The selection of proper midget condensers is important, as many types are not so good. If these are of the one-bearing type, this bearing should be well-constructed and about this the amateur knows. These condensers will eventually replace the larger sizes for most short-wave uses. Almost a whole set of these may be obtained for the price of the usual large instrument. They are as good electrically, if not better, than the larger sizes, especially at the higher frequencies as shown by repeated tests at 5 and 10 meters.

The coils can be celluloid-supported and No. 20 wire is about right for the well-spaced turns. The 5-meter coil consists of about 2 heavy turns on a 1-in. diameter, and the 10-meter one is about double that; at 40 meters, 18 or 20 spaced turns is about right, but the values are not critical because the shunt condenser will compensate. Large coil diameters for 5 and 10 meters should be avoided as movement of the body then has considerable effect on regeneration.

Fixed filament resistors are used in the audio amplifier. To use the set without r.f. amplifier, the antenna is connected directly to a lug on the secondary condenser through a small midget. The output of the r.f. amplifier may be similarly connected; it is perhaps better to use separate batteries for the r.f. amplifier but one will work all right with the same batteries for the whole layout. Often the tube will oscillate much better if the filament leads to the detector are reversed.

The actual wave-change caused by supposedly small effects is too large. In the usual amateur wavemeter employing a flashlamp indicator, the wave may be changed as much as ½ meter at 40 meters by simply changing lamps or shorting a given lamp in or out. Such changes are too large for 1929 conditions. There are perhaps only two arrangements which are practical for average amateur use.

One of these consists of the tuned circuit described above to which is coupled a 2-turn loop (at 40 meters) including a flashlamp in series. Some flashlamps give very broad tuning, but tests show that the 1.25-volt type ("S" filament) is about the best to use, as the filament cools rapidly and gives a sensitive indication. If the main inductance consists of about 18 turns on a 2-in. tube, this 2-turn loop should be set at about ¾ in. from it. Indications will be quite sharp, and with loose coupling, the effect of the lamp circuit causes very little tuning effect. The lamp when turned into, or out of, the socket will have a small effect on the wave, but if left in place, will give good results and tuning will be sharp.

*Wavemeter with Neon Tube Indicator*

An accurate wavemeter is necessary for calibrating the set. The picture and circuit diagram in Fig. 2 show one using a neon lamp as a resonance indicator. It uses a 15 mmfd. midget tuning condenser cut down to three plates and a 20-turn coil, which is wound on a threaded length of 2 in. bakelite tubing. A 50 mmfd. midget condenser is shunted across the tuned circuit.

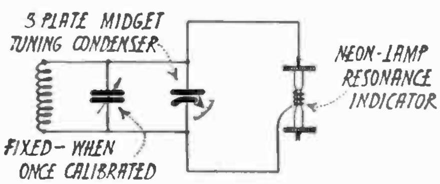


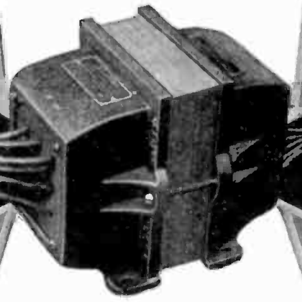

*Fig. 2. Wavemeter Circuit Diagram*

The condensers are mounted on a hard rubber strip which, together with the panel supporting the vernier dial, is securely fastened to heavy baseboard blocks. A small extension handle eliminates the necessity of shielding. The threaded tubing is secured to the baseboard by small metal angles at the base. Heavy copper wire is used for connections.

The neon lamp should be of 5-watt size or larger. It is somewhat more sensitive if one terminal is left open and a length of copper wire, wound around the middle, is used as the other. The lamp is securely fastened to a bakelite piece and is held by a piece of wire passed around the lamp and through holes.

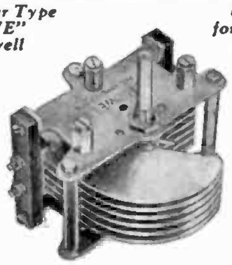
For accuracy, it is best to have a separate instrument for the 40-meter band. The small condensers are economical and at small expense accurate instruments can be constructed for 20 and 40 meters. The 10-meter band is wide and accuracy is not as important.

To calibrate the wavemeter accurately, the transmitter can be operated without an











antenna with a very small input, and so a harmonic falls exactly on the wave of a broadcast station which has been carefully tuned in with any ordinary nearby regenerative, broadcast receiver. By using different stations, various points on the wavemeter calibration-curve are easily obtained. The wavemeter in each case is checked with the wave of the transmitter, the wavelength of which is calculated from the broadcast frequency by dividing by the proper whole number.

Operation is simplified by using a sensitive grid d.c. milliammeter in the transmitter in series with the grid leak. For a 210 tube, this meter ought to be about a 0/25 size. Resonance is denoted by the dip of the grid meter. Several check points should be used and the average curve taken.

The transmitter must also receive special attention for 1929 conditions. It should be sharply tuned and not "modulated" by a poor plate supply, giving the usual broad wave. Good d.c. plate supply will help considerably. Many amateurs may desire to operate with small "99" transmitters. These are quite cheaply constructed and give exceptional results in these days of sensitive, screen-grid r.f. receiving systems, like the one described.

The average amateur transmitter is too closely coupled to the antenna. A broad interfering wave is caused and operation in two frequencies, close together. With loose coupling, the wave is sharpened, transmission is on only one frequency, the note is improved, and the antenna system has less effect on the oscillating circuit, reducing considerably, any "wobbling" effects. One should use a large capacity in the oscillating circuit, which usually eliminates "creeping." If the tubes are run cool, this effect is greatly reduced. Any circuit, when properly adjusted, gives a good constant oscillating frequency.

Since bringing up a tuned antenna circuit to the primary changes the plate current and therefore the tube temperature, the value of coupling will have some effect on the frequency of the transmitter. The coupling depends on so many factors that a general rule cannot be given; if one adjusts the coupling so that 85 or 90 per cent of the antenna current is obtained with close coupling, good results will be secured. The note should be studied near the set and is affected to some extent by antenna tuning. In general, any change in the transmitter which changes the plate current value will have an effect on the frequency and any such will have less chance, if a low $L$ $C$ ratio is used.

If all amateurs in the 40-meter band would use direct current plate supply, operation would be improved because of the sharp waves. The high-pitched notes would encourage the use of peaked audio amplifier systems, thus reducing other interference and amplifying, to a maximum degree, the proper signal. A surprising number of such stations could operate without interference if both the transmitting and receiving systems were sharply tuned. The all-short-wave receiver here described is a step in that direction.

## SELECTIVE SHORT-WAVE RECEIVER

(Continued from Page 42)

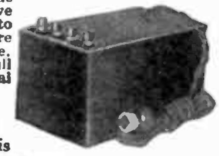
The r.f. choke consists of 300 turns of No. 36 wire, scramble-wound on a 1-in. core. A .00025 mfd. oscillator grid condenser $C_6$ and 1 megohm grid leak $R_1$ lowers the plate current somewhat. The condenser $C_7$ is of .002 mfd. capacity, $C_2$ .0005 mfd., $C_3$ 1 mfd. and $C_4$ .0005 mfd.

The filaments are all controlled by one 6 ohm rheostat $R_2$. Sockets are mounted on sponge rubber cushions to prevent microphonic noises. All parts are mounted on a 7 by 18-in. panel.









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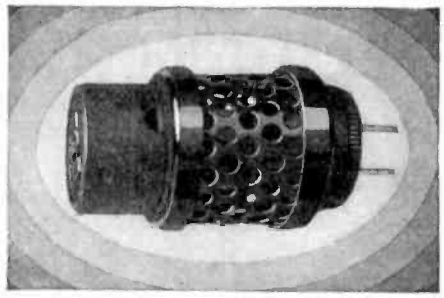

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## TECHNICAL BRIEFS

(Continued from Page 38)

with transformers having ½-in. and 1½-in. primaries, for 9, 18 and 36 turns each. The screen-grid tube circuit connections for each type are shown in Fig. 3, *a* showing the transformers and *b* the autoformer.

The 1½-in. primary type is that generally advocated for use with a shield-grid tube when a tuned impedance is not employed. It will be noticed that there is little gain in amplification when more

and a consequently greater overall amplification. As the number of turns is increased in the portion of the secondary which acts as a primary, the amplification on the higher frequencies is reduced because the two currents in this portion of the coil are in quadrature, and the voltage in the grid of the next tube is consequently lower. This can also be used in a multi-stage amplifier to secure uniform amplification over the entire spectrum without so greatly impairing the selectivity.

The selectivity curves for these three

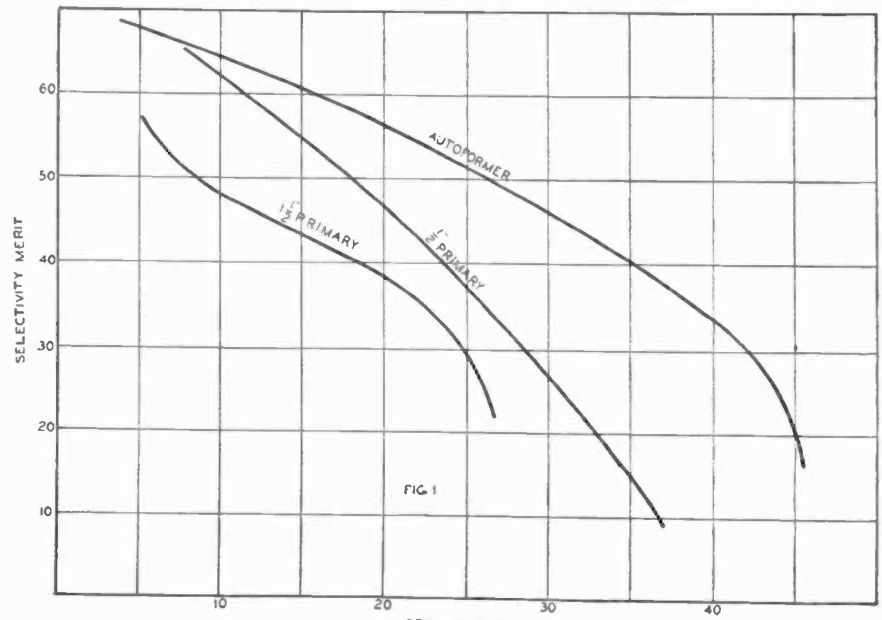



*Fig. 4. Selectivity Curves for Three Types of Transformers*

than 18 turns are used, thus impairing its possibilities for selectivity.

With the ½-in. primary a variation in the number of turns changes the point where maximum amplification is secured. Hence with a multi-stage cascade amplifier uniform amplification can be secured over the whole band by adjusting the number of turns in the primary of each transformer, although this may result in sacrificing the selectivity of one or two stages.

As the inductive coupling is much greater with an autotransformer, a few turns will give a high primary impedance

types of transformers, are shown in Fig. 4. The figure of merit considers the inverse ratio of amplification obtained at the mean of frequencies 50 k.c. distant from the oscillator frequency, plotted against a percentage cutoff at seven-tenths of the maximum. A selectivity factor of 50 is fair, 55 is good, and 60 gives an extremely desirable point. It will be noticed that at 350 meters, for example, this selectivity figure can be obtained with the autoformer circuit with an amplification figure of 5.7, whereas the corresponding ½-in. primary is secured with an amplification

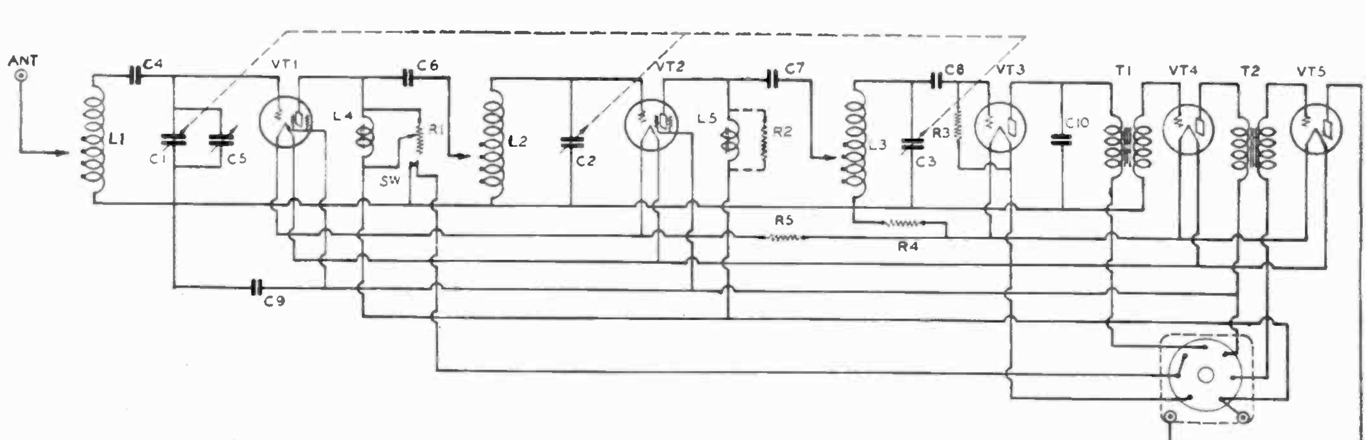
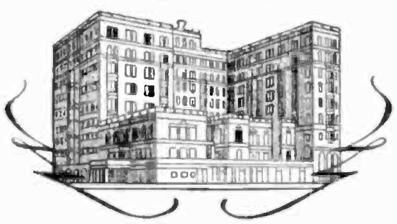



*Fig. 6. Chronophase Circuit with Two Screen-Grid R. F. Stages*







of only 3.6, or about 65 %. In this particuler instance the superiority of the autoformer type is outstanding.

Oscillation was frequently encountered, even in connection with the supposedly non-oscillating shield-grid tube, unless some means were taken to prevent it. The best results were obtained by shifting the phase angle of the currents in various stages by the method illustrated in Fig. 5.

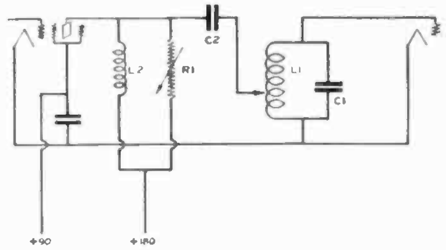



*Fig. 5. Chronophase Circuit*

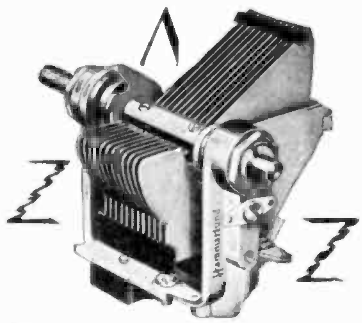
An inductance $L_2$ of comparatively low d.c. resistance was shunted around the resistance $R_1$, maintaining a maximum static value of plate voltage at the tube, while offering a very high impedance to r.f. currents. The resistance $R_1$ can be varied without affecting the static value of the plate voltage and will be found to serve as an oscillation control. If provision is made so that it can be reduced to a low value, so as to effectively short-circuit $C_2$, it can also be employed as a volume control.

In a circuit containing two stages of radio-frequency amplification, it will rarely be found necessary to employ more than one such resistance, as sufficient adjustment of the time relation can be obtained to avoid oscillation while still maintaining the satisfactory value of overall amplification. Maximum results, regardless of the type of tube used, can be obtained by varying the proportion of $L_1$ which is used in the plate circuit of the preceding tube. Little trouble was experienced from inductive coupling between coils.

Shielding always introduces certain losses in the coil, due to linking a portion of the coil's field, and also complicates the mechanical construction of the receiver. It will be seen from the curve that the necessity of shielding is mitigated as far as interstage coupling effects go, while the diameter of the coil is so small that direct pick-up from local stations is reduced to a minimum, as has been demonstrated in practice.

One such receiver using two stages of tuned radio-frequency amplification with shield-grid tubes, employing the "Chronophase" system, has been given an exceedingly thorough tryout. On a 25-ft. aerial located on the shore of Lake Michigan, in the heart of the most congested mass of broadcasting stations in the world, it has been possible to cut through locals and secure good loud speaker reception of stations a thousand miles distant.







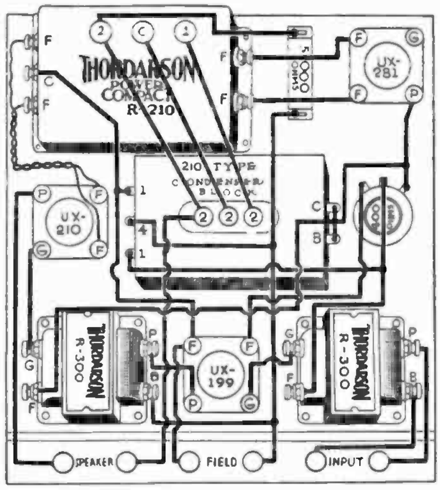
# RADIO KIT REVIEWS

(Continued from Page 44)

## THORDARSON PHONOGRAPH AMPLIFIER

This two-stage all-electric amplifier using a 210 power tube, converts an old style mechanical phonograph into a modern high quality electrical reproducing machine. In addition to the revolving turntable and electrically recorded records, it requires only a good pick-up unit and the easily assembled equipment listed in this kit to get faithful reproduction of audio frequencies from any good radio speaker.

The amplifier is operated completely from alternating current and is so constructed that it is readily portable. It is exceedingly compact, being 10x10-in. and may be placed in one of the compartments or in the tone chamber of the phonograph so that no unsightly or difficult connections to the radio receiver are necessary.




*Pictorial Wiring Diagram of Thordarson Phonograph Amplifier*

The power transformers and filter chokes are completely housed in the Thordarson R-210 Power Compact. This unit furnishes power for the high voltage supply to the plate of the 281 rectifier tube, power for the filament of the same tube, as well as power for the filament of the 210 power tube. The rectifier and filter circuits are conventional, and furnish to the voltage divider, direct current free from hum.

Filament current for the first audio-frequency tube is supplied by the current flowing through the voltage divider. When the 100-volt field of the dynamic speaker is connected to the terminals marked "Field," about 60 milliamperes will flow through the field windings of the dynamic speaker and will be available for heating the filament of the 199 tube.

The plate voltage applied to the plate of the 210 power tube is 385 volts, secured through the voltage drop of the 5000-ohm resistor and the field of the dynamic speaker.

**LIST OF PARTS**

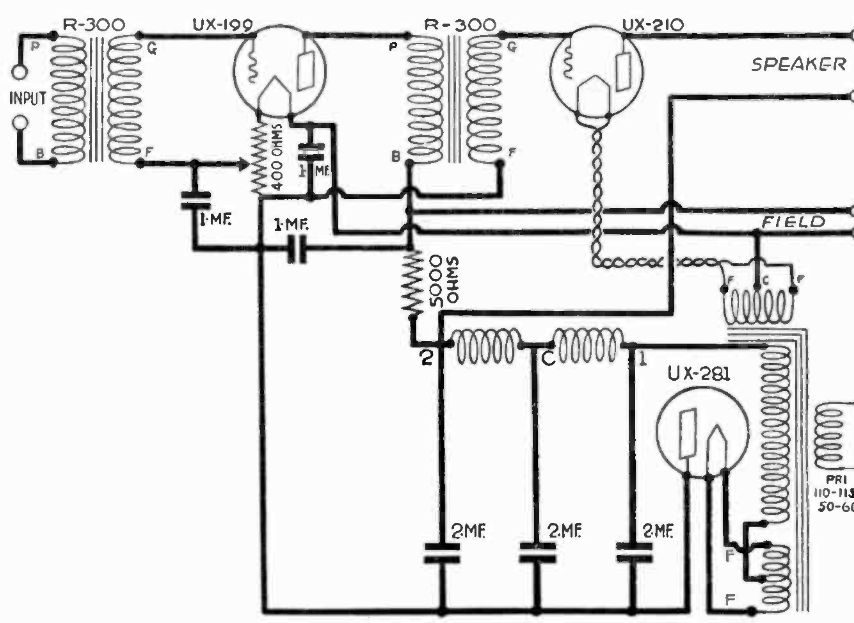
- 1 Thordarson R-210 Power Compact
- 2 Thordarson R-300 Audio Transformers.
- 1 210 Condenser Block (Dubilier, Tobe, Potter, Acme, Aerovox, Fast, Splitdorf).
- 1 Electrad Fixed Resistor, 5000 ohms, Type B.
- 1 Yaxley 400-ohm Potentiometer.
- 3 Benjamin Sockets (Sub-panel).
- 6 Binding Posts, 2 Input, 2 Speaker, 1 Pos., 1 Neg.
- 3 Benjamin Sub-panel Brackets.
- 1 Pc. Bakelite 10" x 10" x 1/4".
- 1 Pc. Bakelite 10" x 2" x 3/16".

**TUBES**

- 1 UX-281 Rectifier.
- 1 UX-210 Power Amplifier.
- 1 UX-199 Amplifier.

The grid bias of 25 volts is secured through the voltage drop through the filament of the 199 tube and the 400-ohm potentiometer. The plate potential for the 199 tube is taken from the high voltage side of the power field of the dynamic speaker, about 125 volts. The grid bias for the 199 tube is obtained from the voltage drop between the filament side of the 400-ohm potentiometer and the movable arm. The arm should be adjusted for best results. The undistorted output of the 210 power tube operating under the above conditions is about 1200 milliwatts.

In view of the fact that dynamic speakers have incorporated in their assembly an output transformer, none is needed in the amplifier itself. It is to be noted at this point




*Circuit Diagram of Thordarson Phonograph Amplifier* that the type of dynamic speaker used must be of the high-voltage field type.

If for any reason it is desired to use this amplifier with other than the dynamic type of speaker it will be necessary to use an output transformer, for the current output of the 210 tube is apt to burn out the fine wire windings of the speaker. The primary of this transformer should be connected to the two terminals marked "Speaker" and the loud speaker should be connected directly to the secondary of this transformer. It will also be necessary to compensate for the field current of the dynamic speaker. This may be done easily by inserting a 2500-ohm resistor in place of the field, that is, connect the resistor to the two terminals marked "Field."

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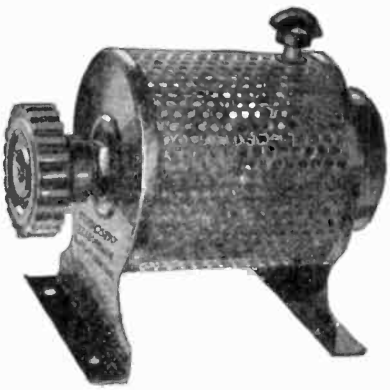
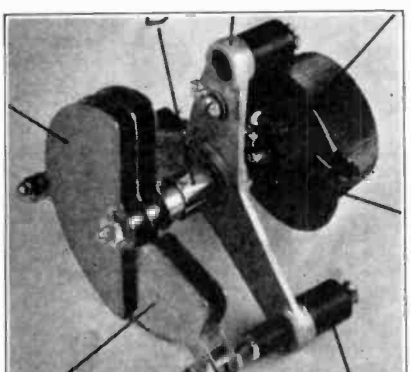
**The Television Clarostat** comprises a special power type clarostat, together with a short-circuiting push-button, contained in a sturdy, ventilated, metal housing with mounting feet. The device has a resistance range of from 25 to 500 ohms, or sufficient for the



required range of speed. It dissipates up to 80 watts, and is capable of controlling either a universal or a condenser type motor, on a.c. or d.c., up to 1/8th horsepower.

---

The new REL variable condensers for use in short-wave receivers and wavemeters, as well as low-power transmitters, are ruggedly constructed with heavy brass plates and have a rigid three-point mounting which eliminates vibrations. They can be mounted on a metal panel without necessarily grounding either the stator or rotor plates. The rotor shaft is immersed in a pool of mercury inside the one-piece bearing, thus giving positive contact. The stator plates are shaped so as to prevent an increase in capacity when the rotor plates pass the point at which the stators are joined together. These condensers are made in various capacities, depending upon the number of plates. The three-plate



model illustrated has a maximum capacity of 54 mmfd. The capacity of the two-plate model may be regulated by moving the stator plate, thus giving a widespread tuning range.

JEWELL

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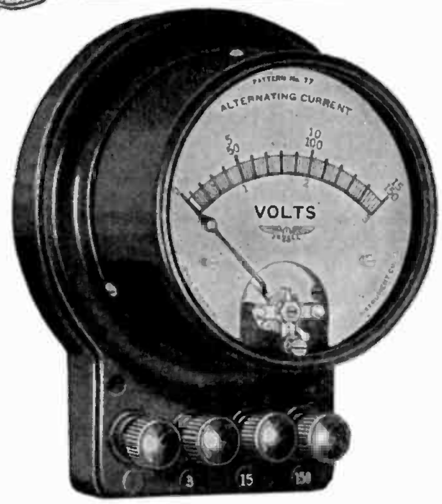


*Pattern No. 77*

One of the chief troubles in the new A. C. sets using either A. C. tubes or D. C. tubes in series is paralysis or damage to the tubes due to incorrect filament voltage. This invariably can be traced to line voltage, which in some localities varies considerably throughout a twenty-four hour period. In the sets using the new A. C. four and five prong tubes it is very important that the filament voltage is right, as it is sometimes found that a particular filament setting is necessary to eliminate hum.

All of the above troubles call for some definite method of adjustment and this can be best accomplished by a suitable A. C. voltmeter having ranges which cover the trouble expected.

Such an instrument and one used by many service men in their work is the Jewell Pattern 77 triple range portable A. C. voltmeter. It is a very desirable instrument for the set owner as it enables him to operate his set at safe filament voltages at all times. The combination range is 0-3-15-150 volts. The scale is silver etched with black characters, and the movement is mounted in a metal case on a bakelite base.

Every owner of an A. C. operated set should have one. Write for descriptive circular No. 1145.

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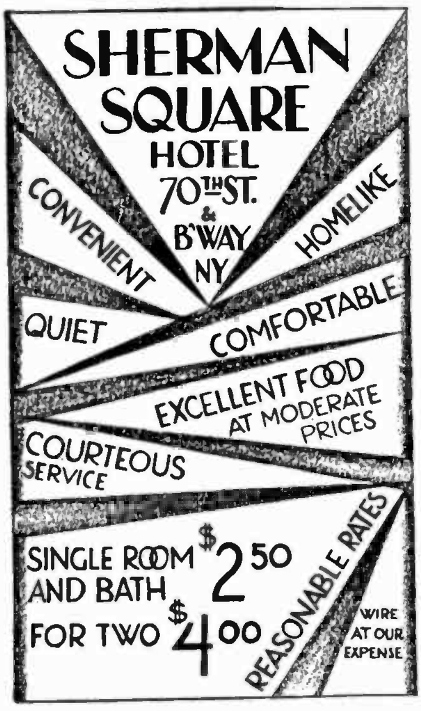


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MAKE MONEY WITH PATENTS! We offer patents with money-making possibilities; circular free. Floyd Clymer, Denver, Colo. (3T)

IMAGINE AN ORGANIZATION of radio "nuts" with over 3000 clients scattered throughout the world, hundreds of them hams, all of them radiowise—dealers, builders, experimenters. Over $40,000 stock of high-grade receiving and transmitting parts only, no sets. Spend over $5,000 yearly on our own experimenting, carry nothing until it passes our tests. 25c will bring prepaid over four pounds, catalog, circuits, data, etc. Weekly data sheets for experimenters and builders (more reliable data than all radio magazines together)—20 weeks, $1.00, 52 weeks, $2.50. Full dealer's discounts to licensed hams, and radiowise builders. We carry approved items advertised in "RADIO." Kladag Radio Laboratories. Established 1920, Kent, Ohio. (6T)

WANTED—Men to work with National Radio Service organization. No selling scheme. Radio Doctors, Inc., Dept. R, Essex St., Salem, Mass.

DEFECTIVE AUDIO TRANSFORMERS Reclaimed Using Factory Windings, Original Guarantee—$0.90. Reclaimed transformers for sale, most makes, $10.00. Inquiries invited. TRANSFORMER RECLAIMING SERVICE, 9 South Reed Ave., Mobile, Alabama.

CHILLICOTHE WALNUT CABINETS. 7x26 inches and 11 inches deep. Genuine walnut with full length piano hinge. Several of these are in stock. Never used. Originally purchased for editorial photographing. Retail price $30.00. We will sell these while they last for $12.50, express charges collect. Eight on hand. Publishers of "RADIO," Pacific Building, San Francisco, Calif.

ELECTRICAL BARGAINS. — New ¼-HP Westinghouse 110 volt, 60 cycle, 1750 speed alternating motors with pulleys, $8.75. Variable speed motors for television 110 volt alternating current, $7.00. Also other sizes motors and generators. Electrical Surplus Co., Dept. 1, 1911 Chicago Ave., Chicago.

FOR SALE.—Latest model Best's Shielded Grid Super without cabinet. Perfect condition. $100. Address Owner, 1129 Mandana Blvd., Oakland, Cal.

NAVY SURPLUS offered at fraction of original cost. General Electric 24/1500, 24/750, 12/350 volt. Holtzer-Cabot 12/500, Westinghouse 10/350. Battery driven also adapted for external drive. 500 and 900 cycle generators. All ball bearing. Literature. Henry Kienzle, 501 East 84th Street, New York. (2T)

KENNEDY TUNER, 200-3600 meters; Magnavox 2-stage amplifier, tubes; Magnavox dynamic horn. Lot $25.00. Roy Strong, Manteca, Calif.

FOR SALE!—Gerald Best's "Modernized" 45-KC super exactly as described in the editorial columns of October "RADIO." This receiver was built by G. M. Best for use in gathering editorial material for the story, and the publishers of "RADIO" will sell the receiver, as illustrated, for $75.00. A fine genuine walnut cabinet with piano hinge is included in the price. In perfect condition and accurately matched and balanced. First money order for $75.00 takes it. Set will be shipped to you express charges collect. PUBLISHERS OF "RADIO," 433 Pacific Bldg., San Francisco, Calif.

BIG PAY.—South American work. American firms pay fare, expenses. South American Service Bureau, 14,600 Alma, Detroit, Mich.

RADIO STATION stamps bought, sold and exchanged. Chas. A. Phildius, 510 East 120th St., New York, N. Y. (4T)

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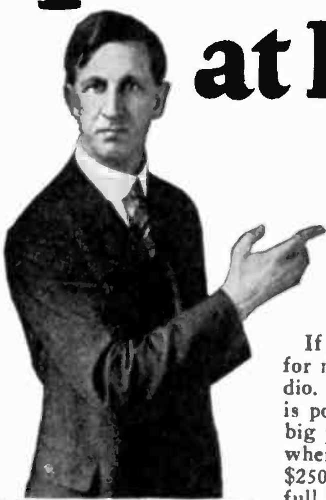
**USE THE CLASSIFIED ADS IN "RADIO"**

***They Bring Results***

**Mail Your "Ad" Now**



# I Will Train You at Home to Fill a Big-Pay Radio Job

If you are earning a penny less than $50 a week, send for my book of information on the opportunities in Radio. It's FREE. Clip the coupon NOW. A flood of gold is pouring into this new business, creating hundreds of big pay jobs. Why go along at $25, $30 or $45 a week when the good jobs in Radio pay $50, $75 and up to $250 a week? My book "Rich Rewards in Radio" gives full information on these big jobs and explains how you can quickly become a Radio Expert through my easy, practical home-study training.

### Salaries of $50 to $250 a week not unusual

Get into this live-wire profession of quick success. Radio needs trained men. The amazing growth of the Radio business has astounded the world. In a few short years three hundred thousand jobs have been created. And the biggest growth of Radio is still to come. That's why salaries of $50 to $250 a week are not unusual. Radio simply hasn't got nearly the number of thoroughly trained men it needs. Study Radio and after only a short time land yourself a REAL job with a REAL future.

### You Can Learn Quickly and Easily in Spare Time

Hundreds of N.R.I. trained men are today making big money—holding down big jobs—in the Radio field. Men just like you—their only advantage is training. You, too, can become a Radio Expert just as they did by our new practical methods. Our tested, clear training makes it easy for you to learn. You can stay home, hold your job, and learn quickly in your spare time. Lack of education or experience is no drawback. You can read and write. That's enough.

### Many Earn $15, $20, $30 Weekly on the Side While Learning

My Radio course is the famous course "that pays for itself." I teach you to begin making money almost the day you enroll. My new practical method makes this possible. I give you SIX BIG OUTFITS of Radio parts with my course. You are taught to build practically every type of receiving set known. M. E. Sullivan, 412 73rd Street, Brooklyn, N. Y., writes: "I made $720 while studying." Earle Cummings, 18 Webster Street, Haverhill, Mass., "I made $375 in one month." G. W. Page, 1807 21st Ave., Nashville, Tenn., "I picked up $935 in my spare time while studying."

### Your Money Back if Not Satisfied

I'll give you just the training you need to get into the Radio business. My course fits you for all lines—manufacturing, selling, servicing sets, in business for yourself, operating on board ship or in a broadcasting station—and many others. I back up my training with a signed agreement to refund every penny of your money if, after completion, you are not satisfied with the course I give you.

### ACT NOW—64-page Book is FREE

Send for this big book of Radio information. It won't cost you a penny. It has put hundreds of fellows on the road to bigger pay and success. Get it. Investigate. See what Radio has to offer you, and how my Employment Department helps you get into Radio after you graduate. Clip or tear out the coupon and mail it RIGHT NOW.

J. E. SMITH, President,
Dept. 33-R,
National Radio Institute
Washington, D. C.

**RADIO NEEDS TRAINED MEN!**

## *Here's the* PROOF

**Made $185 in Three Weeks Spare Time**

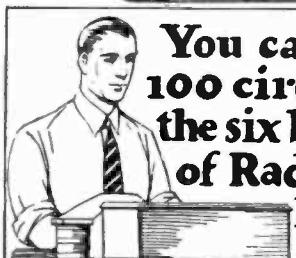
"I have met with continued success. For instance, recently I realized a profit of $185 in three weeks, $1.50 an hour. I have been making good money almost from the time I enrolled. The N. R. I. has put me on the solid road to success."—Peter J. Dunn, 901 N. Monroe St., Baltimore, Md.

**Made $588 in One Month**

"The training I received from you has done me a world of good. Some time ago during one of our busy months I made $588. I am servicing all makes of Radio receiving sets. My boss is highly pleased with my work since I have been able to handle our entire output of sets here alone."—Herbert Reese, 2215 So. E St., Elwood, Indiana.

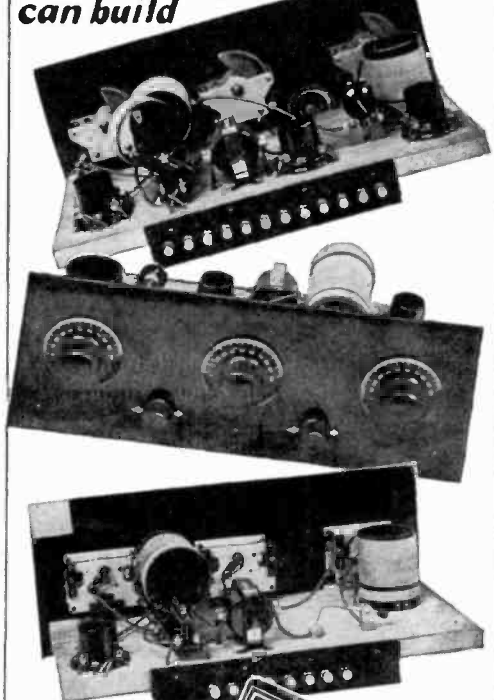
**Earns Price of Course in One Week Spare Time**

"I have been so busy with Radio work that I have not had time to study. The other week, in spare time, I earned enough to pay for my course. I have more work than I can do. Recently I made enough money in one month spare time to pay for a $375 beautiful console all-electric Radio. When I enrolled I did not know the difference between a rheostat and a coil. Now I am making all kinds of money."—Earle Cummings, 18 Webster St., Haverhill, Mass.



**You can build 100 circuits with the six big outfits of Radio parts I give you**

*3 of the 100 you can build*



*Find out quick about this practical way to big pay*


**Mail This FREE COUPON Today**

J. E. SMITH, President,
Dept. 33-R, National Radio Institute,
Washington, D. C.

Dear Mr. Smith: Kindly send me your big book "Rich Rewards in Radio," giving information on the big-money opportunities in Radio and your practical method of teaching with six big outfits. I understand this book is free, and that this places me under no obligation whatever.

Name.................................................Age..................
Address..........................................................................
City...................................................State.....................
Occupation......................................................................

## *Employment Service to all Graduates*

**Originators of Radio Home Study Training**


TOBE
A manufacturer can have no greater faith in his products than to guarantee their faithful operation and with such guarantee TOBE products are sold.
Tobe Type 250 B-Block
B BLOCKS—Model 760
VACUUM TIPON LEAKS
TOBE 1300 Line Hi-Voltage SURGPROOF Condensers
TOBE A-Condenser
TINYTOBE Condensers
TOBE A-Filter
Radio Interference Filter No. 1
5 WATT VERITAS FITS ALL STANDARD MOUNTS
TAPPED SECONDARY VOLTAGE CONTROL
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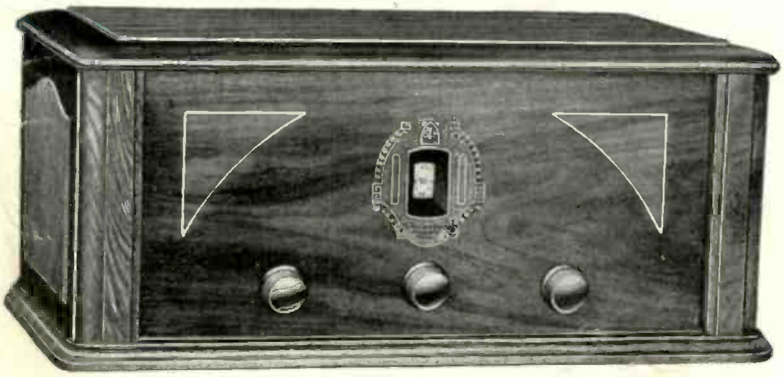
POWER SUPPLY
SPECIAL PENDANT CONTROL SWITCH
The New Tobe A Supply
ELECTRICAL OUTLET
BINDING POSTS CONNECT TO GROUND OR ANTENNA OF SET
WALL SOCKET
PRICE $2.00
4-PURPOSE LIGHT SOCKET AERIAL
The test of the manufacturer's faith in his products is how long will he guarantee them. Tobe apparatus is unconditionally guaranteed for one year.
1000 Volt & 2000 Volt Transmitting Condenser
FILTER CONDENSERS
TOBE By-Pass Filter Condenser New Model
TOBE DEUTSCHMANN CO.
CANTON, MASS.
NEW YORK CANTON, MASS. CHICAGO

# THE MECHANICAL MASTERPIECE

## NEW 1929 *Browning-Drake* EIGHT IN LINE

Eight tubes in line—aluminum construction throughout—all power equipment an integral part of chassis—this year's masterpiece of mechanical precision.



Special Browning-Drake circuit, famous for tone quality and distance—cabinet of selected walnut with hand-rubbed Duco finish. List $135.00.

In radio sets, as in most everything else, you get about what you pay for. The cheapest is never the best.

Your customers are willing to pay a little more and get a Browning-Drake.

Refinements, which make for beauty, power, and tone quality, are obtained through precision assembly, rather than mass production. Among those who appreciate and require the best, Browning-Drake is the outstanding choice.

Quality never fails to satisfy.

# BROWNING DRAKE

TRADE MARK

*Press of*
THE JAMES H. BARRY COMPANY
SAN FRANCISCO, U. S. A.

OCTOBER, 1928 25 CENTS

# RADIO

(REG. U. S. PATENT OFF.)

RADIO PICTURES
*By* JOHN P. ARNOLD

REVAMPING 45 K.C. SUPER
*By* G. M. BEST

A MAGAZINE OF NATIONAL CIRCULATION — COVERING THE ENTIRE FIELD

# MAGNAVOX "*Dynamic*" SPEAKERS


*The Cordova*

110 volt, 60 cycle AC. Combining rectifier and power amplifier. Takes place of last audio stage in set. Handsome walnut cabinet. *List $175.*

*The Beverly*

Gracefully proportioned cabinet finished in light mahogany.

*For A-Battery Operation* . . . . $55

*For AC Operation* . . . . . . . . $70

*Units only; DC $35; AC $50.*

"FIRST SPEAKER FIRST DYNAMIC"

DYNAMIC

*Only a dynamic speaker* can give you studio realism . . . the rich, full, undistorted beauty of music . . . with power volume.

Credit Magnavox for this advance in radio. Magnavox created and sponsored the Dynamic. Half a million owners now enjoy Magnavox speakers. Leading set manufacturers use them as built-in equipment. Let these facts guide you.

THE MAGNAVOX COMPANY

Oakland, California  Chicago, Illinois

# FADA
*Radio*

# THE FADA 10 RECEIVER
# *and* THE FADA 4 SPEAKER

## *Using The Indirect Heater Tube*

They do more than receive—they deliver—*and how!*

These are the leaders of the big radio parade. In a purchaser's home they deliver the four radio essentials—*tone quality, distance, selectivity* and *reliability*. These are the points the consuming public is looking for in a radio set of today.
Fada radios deliver permanent radio satisfaction to their owners and—

### *DELIVER PROFITS TO FADA DEALERS*

It is the combination of dollar for dollar value with the utmost in radio results which gives Fada dealers radio profits and Fada owners the utmost lasting satisfaction.

## F. A. D. ANDREA, Inc.
Jackson Avenue, Orchard and Queens Streets
LONG ISLAND CITY, N. Y.

CHICAGO SAN FRANCISCO

*Prices Slightly Less East of the Rockies*

THE FADA 10

Operated from A.C. light socket (90 to 130 volts, 25 or 60 cycle) single dial, illuminated station finder, adjustment for long or short antenna, rejector, phonograph attachment jack, with improved circuit and volume control, self-contained in a beautiful metal velvetex cabinet in two tones of gold and brown.

Price $115

THE FADA 4 CONE SPEAKER

*Mantel Clock Type*

A seven-inch completely encased cone, balanced armature with extra large chrome steel magnet with improved bobbin winding and simplified direct drive.

Price $32.50

# RADIO

Established 1917

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GERALD M. BEST, *Technical Editor* — A. I. RIVETT, *Draughtsman*

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Pacific Building, San Francisco, California

VOL. X — OCTOBER, 1928 — NO. 10

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### FORECAST FOR NOVEMBER ISSUE

G. M. Best exposes some interesting facts about so-called underground antennas in "When Is An Antenna Not An Antenna?" L. W. Hatry discusses the grid condenser and leak in modern dress. John P. Arnold has a wealth of information regarding progress in transmission and reception of radio pictures. R. Wm. Tanner describes the construction of a short-wave superheterodyne. Clinton Osborne gives details regarding the construction and use of a vacuum-tube tester which tells more about a tube than any device yet described. Glenn L. Browning presents the results of his study of r.f. choke coils. Arthur Hobart works out a great simplification in the formulas for reactance. G. F. Lampkin tells how to charge a battery with a synchronous rectifier. A. Binneweg, Jr., describes the practical construction of equipment for the 1929 amateur station.

# *In the Sets Designed by Leading Engineers*

Faradon Capacitors are specified as standard equipment where electrostatic condenser long life and durability is essential.

Faradon Capacitor marks quality. Keep this in mind when considering a new set, kit or replacement parts.

WIRELESS SPECIALTY APPARATUS CO.
Jamaica Plain, Boston, Mass., U. S. A.
Established 1907

**Faradon**

**Electrostatic Condensers for All Purposes**

2202

# Lost Music Captured

## BY THE *Remler* Power *Amplifier*

ATTACH the Remler Power Amplifier to **your** set. Let it capture and bring to your ears the music you've been missing.

Resonance of bass viol and tuba, life and vigor from piccolo and flute, blend with added overtones from the "middle range" instruments to produce a richness of tone quality such as you never expected to hear from your set.

Designed—not for **louder** music, but for **more** music—it brings orchestra details to your ears just as field glasses bring landscape details to your eyes. It balances the instruments, calling in the bass and treble notes to their proper volume.

Three principles guided the Remler engineers in perfecting this marvelous amplifier. First, no tubes were to be "crowded." Only by keeping amplification well below maximum could tone perfection be realized.

Second, transformers must be specially designed to handle all frequencies smoothly, without performance "peaks."

And, third, a reliable source of plate and grid voltage supply should be available for the whole set as well as for the amplifier.

Months of concentration on these problems resulted in their solution. Now this power amplifier and "B" supply may be attached to practically any good set with vastly improved results. Full directions accompany each unit.

If you do not care to assemble it yourself the nearest radio dealer or professional set-builder can do it for you at negligible cost. Just show him this ad.

The coupon will bring you details on this and other Remler products.

## *Remler Radio Leadership*

The Power Amplifier is the latest addition to a line of radio parts which for ten years have made the name, "Remler" stand for "radio reliability."

These other parts are in constant demand by set-builders who know that they can rely on Remler items.

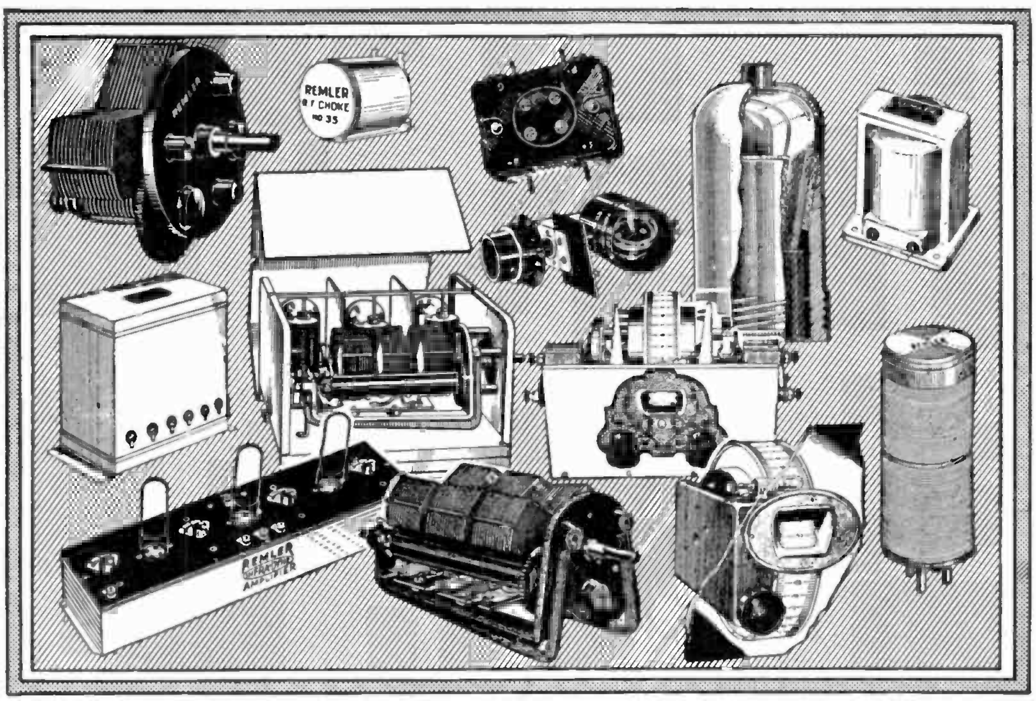
The Twin Rotor Condenser, and the two and three gang condensers built on the same principle, are favorites that grow in popularity from year to year. The Drum Dial is a necessity to the builder who is competing with factory-made products. The new Audio-Transformers raise reproduction to new standards of efficiency.

If you want to know the details of the entire Remler line, check the coupon for the 20 page catalog folder.

### Remler Power Amplifier and Plate Supply

*Power Tube:* CX 350 (UX 250)
*Rectifier Tubes:* Two CX 381 (UX 281) Half-Wave Rectifiers
*Voltage Regulator Tube:* CX 374 (UX 874)
*Power Supply:* 110-volt Electric Light Mains
*Over-All Dimensions:* 10⅛" wide by 20" long; total height, with cover, 8½"
*Wiring:* Semi-complete. Blueprint and wire supplied with Foundation Kit
*"B" Eliminator:* Will supply ample plate current for any receiver. Continuously variable voltage adjustments. Wire-wound resistors
*Power Transformer:* Tapped for various line voltages

**Parts, less tubes, $112.50**




**REMLER**
*Division of*
GRAY & DANIELSON MFG. COMPANY
**260 First Street, San Francisco**

NEW YORK CHICAGO

REMLER DIVISION, GRAY & DANIELSON MANUFACTURING CO.
260 First Street, San Francisco, California.

Gentlemen: Please send me:

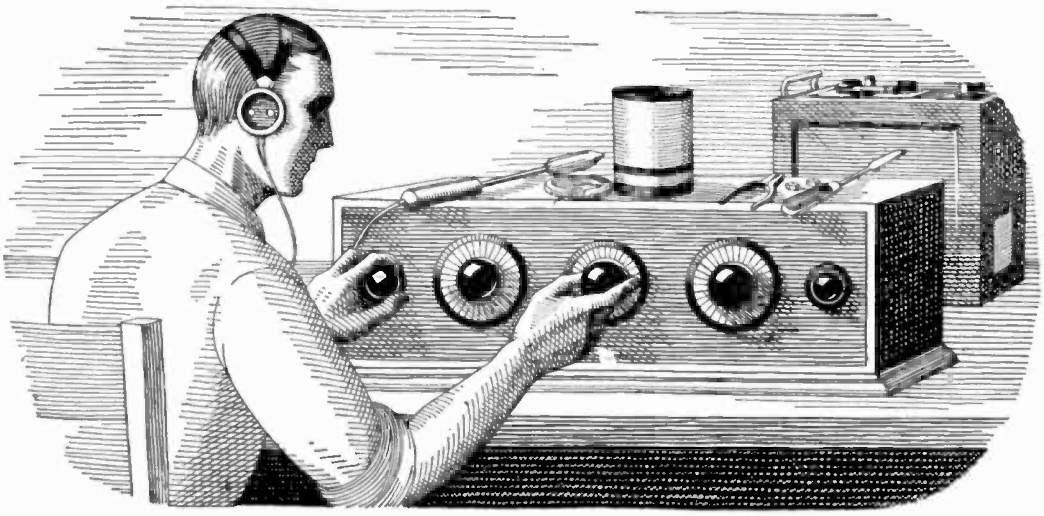
☐ All the "dope" on the Power Amplifier. ☐ Bulletin Service for Professional Set Builders. ☐ Twenty-page Catalog.

*Name*............................ *Address*............................

*City*............................ *State*............................

Do you build and sell sets?............................

RADIO-10



*If all the Radio sets I've "fooled" with in my time were piled on top of each other, they'd reach about halfway to Mars. The trouble with me was that I thought I knew so much about Radio that I really didn't know the first thing. I thought Radio was a plaything—that was all I could see in it for me.*

# I Thought Radio Was a Plaything

## *But Now My Eyes Are Opened, And I'm Making Over $100 a Week!*

$50 a week! Man alive, just one year ago a salary that big would have been the height of my ambition.

Twelve months ago I was scrimping along on starvation wages, just barely making both ends meet. It was the same old story—a little job, a salary just as small as the job while I myself had been dragging along in the rut so long I couldn't see over the sides.

If you'd told me a year ago that in twelve months' time I would be making $100 and more every week in the Radio business—whew! I know I'd have thought you were crazy. But that's the sort of money I'm pulling down right now—and in the future I expect even more. Why only today—

But I'm getting ahead of my story. I was hard up a year ago because I was kidding myself, that's all—not becuase I had to be. I could have been holding then the same sort of job I'm holding now, if I'd only been wise to myself. If you've fooled around with Radio, but never thought of it as a serious business, maybe you're in just the same boat I was. If so, you'll want to read how my eyes were opened for me.

---

When broadcasting first became the rage, several years ago, I first began my dabbling with the new art of Radio. I was "nuts" about the subject, like many thousands of other fellows all over the country. And no wonder! There's a fascination—something that grabs hold of a fellow—about twirling a little knob and suddenly listening to a voice speaking a thousand miles away. Twirling it a little more and listening to the mysterious dots and dashes of steamers far at sea. Even today I get a thrill from this strange force. In those days, many times I stayed up almost the whole night trying for DX. Many times I missed supper because I couldn't be dragged away from the latest circuit I was trying out.

I never seemed to get very far with it, though. I used to read the Radio magazines and occasionally a Radio book, but I never understood the subject very clearly, and lots of things I didn't see through at all.

So, up to a year ago, I was just a dabbler—I thought Radio was a plaything. I never realized what an enormous, fast growing industry Radio had come to be—employing thousands and thousands of trained men. I usually stayed home in the evenings after work, because I didn't make enough money to go out very much. And generally during the evening I'd tinker a little with Radio—a set of my own or some friend's. I even made a little spare change this way, which helped a lot, but I didn't know enough to go very far with such work.

And as for the idea that a splendid Radio job might be mine, if I made a little effort to prepare for it—such an idea never entered my mind. When a friend suggested it to me one year ago, I laughed at him.

"You're kidding me," I said.

"I'm not," he replied. "Take a look at this ad."

He pointed to a page ad in a magazine, an advertisement I'd seen many times but just passed up without thinking, never dreaming it applied to me. This time I read the ad carefully. It told of many big opportunities for trained men to succeed in the great new Radio field. With the advertisement was a coupon offering a big free book full of information. I sent the coupon in, and in a few days received a handsome 64-page book, printed in two colors, telling all about the opportunities in the Radio field and how a man can prepare quickly and easily at home to take advantage of these opportunities. Well, it was a revelation to me. I read the book carefully, and when I finished it I made my decision.

What's happened in the twelve months since that day, as I've already told you, seems almost like a dream to me now. For ten of those twelve months, I've had a Radio business of my own. At first, of course, I started it as a little proposition on the side, under the guidance of the National Radio Institute, the outfit that gave me my Radio training. It wasn't long before I was getting so much to do in the Radio line that I quit my measly little clerical job, and devoted my full time to my Radio business.

Since that time I've gone right on up, always under the watchful guidance of my friends at the National Radio Institute. They would have given me just as much help, too, if I had wanted to follow some other line of Radio besides building my own retail business—such as broadcasting, manufacturing, experimenting, sea operating, or any one of the score of lines they prepare you for. And to think that until that day I sent for their eye-opening book, I'd been wailing "I never had a chance!"

Now I'm making, as I told you before, over $100 a week. And I know the future holds even more, for Radio is one of the most progressive, fastest-growing businesses in the world today. And it's work that I like—work a man can get interested in.

Here's a real tip. You may not be as bad off as I was. But think it over—are you satisfied? Are you making enough money, at work that you like? Would you sign a contract to stay where you are now for the next ten years—making the same money? If not, you'd better be doing something about it instead of drifting.

This new Radio game is a live-wire field of golden rewards. The work, in any of the 20 different lines of Radio, is fascinating, absorbing, well paid. The National Radio Institute—oldest and largest Radio home-study school in the world—will train you inexpensively in your own home to know Radio from A to Z and to increase your earnings in the Radio field.

Take another tip—no matter what your plans are, no matter how much or how little you know about Radio—clip the coupon below and look their free book over. It is filled with interesting facts, figures, and photos, and the information it will give you is worth a few minutes of anybody's time. You will place yourself under no obligation—the book is free, and is gladly sent to any one who wants to know about Radio. Just address J. E. Smith, President, National Radio Institute, Dept. 22-R, Washington, D. C.

J. E. SMITH, President,
National Radio Institute,
Dept. 22-R, Washington, D. C.

Dear Mr. Smith:

Please send me your 64-page free book, printed in two colors, giving all information about the opportunities in Radio and how I can learn quickly and easily at home to take advantage of them. I understand this request places me under no obligation, and that no salesman will call on me.

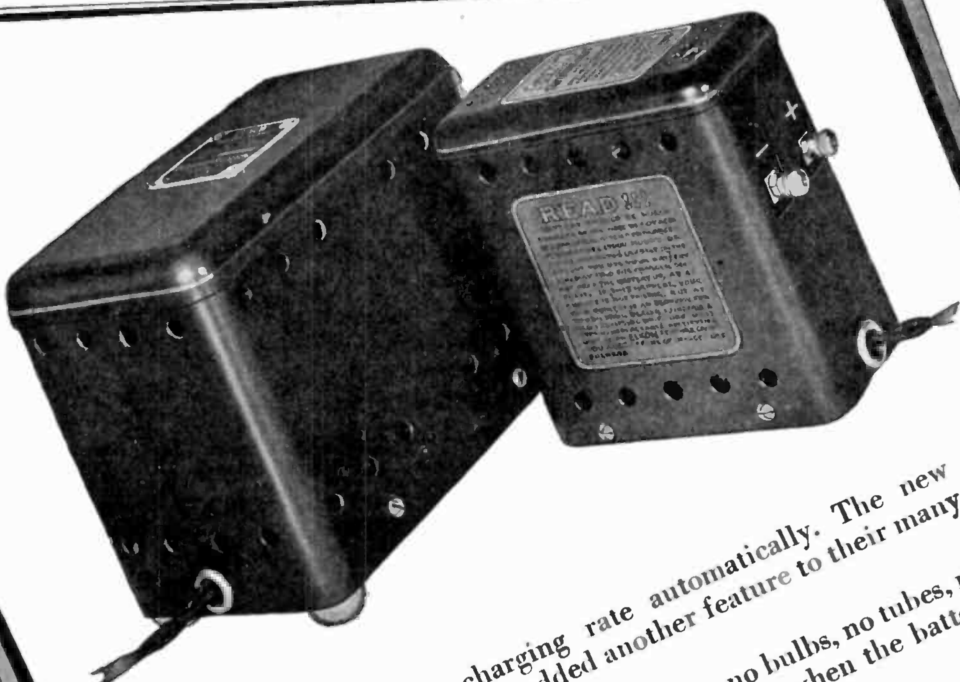
Name........................................

Address........................................

Town.................... State....................

Occupation........................................

# THE NEW TAPERING CHARGERS



TAPERING the charging rate automatically. The new Elkon Chargers have added another feature to their many advantages:—

Dry—no acids, no water, no corrosion, no bulbs, no tubes, no noise, no moving parts, high charging rate when the battery is low, low charging rate when the battery is high.

The Tapering Charger, 1 Ampere, maximum charging rate is the ideal power supply for the storage battery. Leave it on all the time, without interfering with reception and without injuring the battery. Long life. Instructions and Guarantee printed on container.

The 3 Ampere Tapering Charger is ideal for the rapid charging of either radio or automobile batteries. Has all the advantages of the smaller charger.

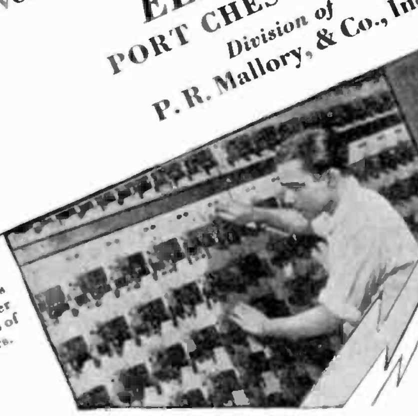
No attention needed—just plug them in and forget them. Elkon Rectifiers are self-healing! They are not affected by accidental overloading or line surges!

**ELKON, INC.**
**PORT CHESTER, N. Y.**
*Division of*
**P. R. Mallory, & Co., Inc.**

## ELKON Replacement Rectifiers

This exclusive feature of the Elkon Rectifiers is saving customers millions of dollars! After a long time—5000 hours for battery chargers—a year or so for "A" Eliminators, renewing the rectifier will prove to be an economy. The old rectifier may be slipped out and the new one put in—only a minute required—and the unit is as good as new.

If you have a power unit using a dry rectifier, ask your dealer about the Elkon Replacement Units. Remember Elkon is the only unit authorized by Fansteel to replace the acid jars in the Balkite power units.

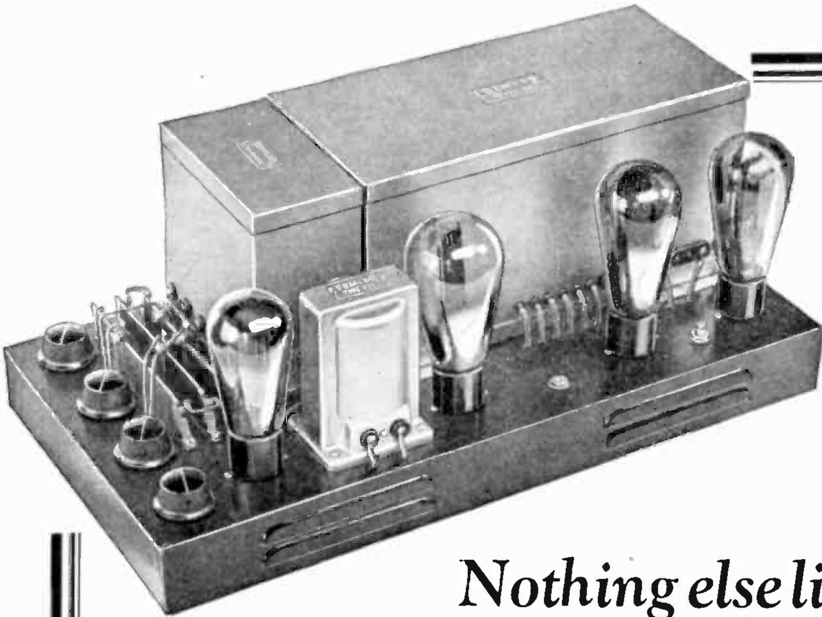


Row upon Row of Elkon Rectifiers seasoned under the careful eyes of skilled workers.

Radio Department, ELKON, INC.
260 Fox Island Road, Port Chester, N. Y.
Send me complete information on the Elkon Radio Products.

Name.........................................

Address.........................................



# Here is a Real DYNAMIC Speaker Amplifier

## *Nothing else like it on the market*

## Remler Audio Transformers are Different

### Because They are Designed for Dynamic Speakers

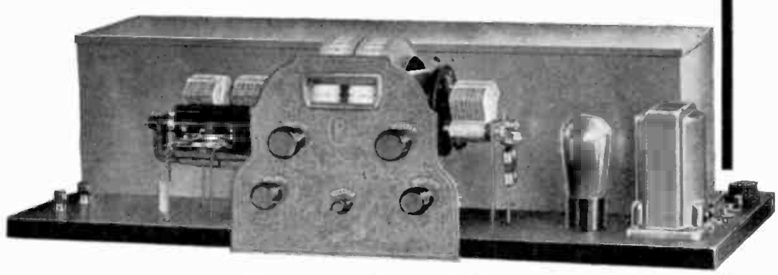
NO HUM from this super power amplifier and *B* eliminator—even with the husky "250" power tube. Remler has so thoroughly engineered this power amplifier that the hum is eliminated. By scientific placing of parts and by skillful engineering Remler makes it so simple for you to assemble this amplifier that you are assured in advance of complete success. The new Remler audio transformer in the last stage—designed especially for the dynamic loud speaker and the new Remler output transformer—the only one of its kind available—allows you to get the most out of a dynamic speaker for the FIRST time. There is no other output transformer like it on the market. Nothing just as good. It's a brute in size and a surefire performer. It delivers better and purer tonal qualities to the loud speaker than any other known amplifying device. You will marvel at the fidelity of reproduction. You have never heard anything like it before. Only Remler gives you this modern up to date equipment. This amplifier is known as the No. 950. The metal base goes with the kit. Everything is included—even the screws, nuts, wire and a simple diagram of connections.

**Price for All Parts—Less Tubes, $114.00**

## *The New* REMLER 29

A RECEIVER that looks as good as it works. Finished in beautiful lacquered copper. Screen grid amplifier unit with individual compartment shields. The entire unit is assembled, wired and laboratory matched and balanced in the Remler factory. Clean cutting 10 KC. selectivity. The new Remler audio transformer gives reproduction such as you have long waited for.

**Price for Complete Kit....$131.25**



### A Professional Job

HERE is a receiver for the most discriminating fan. It can be assembled in a few hours. Simple, explicit wiring charts and instructions make it a pleasure to assemble this new kit—the best of any we have seen this season. Metal chassis with all holes punched. Beautiful escutcheon plate. The illustration fails to do justice to this new "29" Remler SUPER. Acknowledged by engineers as the finest thing in radio for the season.

## Set Builders—Dealers:

ORDER your Remler equipment from us. We make prompt deliveries anywhere. Out of town set builders and dealers can wire us for immediate shipment. Express or parcel post delivery to out of town customers. Over-the-counter deliveries to local trade. We carry a complete stock of the best known national lines. Get your tubes, batteries, speakers, eliminators and other supplies from us. Let us convince you that our service is better than ordinary. Usual discounts allowed to set builders and dealers.

**UNITED RADIO SUPPLIES CO.**
1062A Howard Street, San Francisco, Calif.

*THIS COUPON SAVES TIME*

UNITED RADIO SUPPLIES CO.
1062A Howard St., San Francisco, Calif.

Per your ad in "RADIO" send me at once the following new REMLER items, for which remittance of $50.00 is enclosed, balance to be paid by me C.O.D.

........................................................................

........................................................................

........................................................................

Name........................................................................

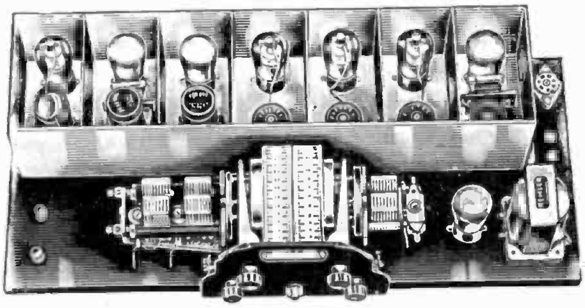
Street and No........................................................................

City and State........................................................................

**REMLER** NEWARK ELECTRIC CO. **FROST**

# The Sensational Set of the Season

# *New* REMLER "29"



## LIST OF PARTS REQUIRED

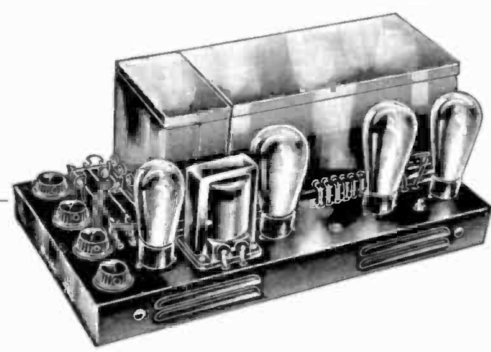
| | |
|---|---|
| 1 Remler No. 712 Shield Grid Selector and Amplifier, including all wiring | $70.00 |
| 1 Remler No. 752 Foundation Kit | 15.00 |
| 1 Remler No. 920 First Stage Transformer | 12.00 |
| 2 Remler No. 110 Universal Drum Dials | 9.00 |
| 1 Remler No. 632 Two-in-line Condensers | 12.00 |
| 1 Remler No. 638 Twin-Rotor Condensers | 5.00 |
| 1 Frost No. 1895 500,000 Ohm Volume Control | 2.00 |
| 1 Frost No. 1896 2,000 Ohm Sensitivity Control | 2.25 |
| 1 Frost No. S1910 10 Ohm Gem Switch Rheostat | 1.00 |
| 1 Frost No. 780 Cable Plug | 2.25 |
| 1 Frost No. 782 Cable Plug Socket | .75 |
| Complete Kit List Price | $131.25 |

## Complete Parts In Stock--Ready To Ship

AFTER you have read the amazing story of this newest and greatest receiver you will naturally want to build one for your own use. You can easily duplicate the remarkable selectivity, the ease of control, the extreme volume on distant stations and the wonderful tone quality of the original laboratory receiver. No other circuit with such wonderful performance has ever been offered to the public that could be built by the Listener in just a few hours' time. Simple two dial tuning control permits razor edge selectivity. Perfection of tone quality assured with the new Remler Audio Transformers. And just as this new circuit is the logical one for you to build, so also, is the Newark Electric Company the logical place for you to secure your parts. Complete stocks of all parts exactly as recommended—always in stock ready for immediate shipment. Dealers and Set Builders should write at once for schedule of discounts.

# REMLER No. 950 POWER AMPLIFIER and "B" Supply

TONE quality has already become the most important feature of radio receiver design. The new Remler power amplifier designed especially for use with the new Remler "29" receiver reproduces the full range of musical frequencies with a vividness and coloring which seems to bring the broadcasting artists into your own home. Many months of engineering research backed by the years of experience in specialized manufacture have brought the new Remler Audio Transformers to a degree of perfection which we feel will make them the first choice of those who truthfully appreciate perfection of tone. The new Amplifier is easily built by anyone in a few hours' time by following the simple blue prints furnished. Complete kits of parts always in stock ready for immediate shipment. Dealers and Set Builders should write immediately for discounts.



## LIST OF PARTS REQUIRED

| | |
|---|---|
| 1 Remler Transformer and Choke | $45.00 |
| 1 Remler No. 952 Foundation Kit | 12.00 |
| 1 Remler No. 921 Audio Transformer | 12.00 |
| 1 Remler No. 923 Output Transformer | 20.00 |
| 1 Frost No. 300 Resistance Kit | 9.00 |
| 3 Frost No. 1405, 2 Mfd. Filter Condensers | 12.00 |
| 2 No. 1104 Frost By-Pass Condensers | 2.50 |
| Complete List Price | $114.00 |

**NEWARK ELECTRIC CO.**

*"Nothing but Radio"*

**FROST** 226 WEST MADISON STREET CHICAGO, ILLINOIS **FROST**

# OUT-SELLING ALL

*Single Dial Control*
*Verniers for long distance tuning*

## "De Luxe Model"

## SARGENT-RAYMENT SEVEN

**Uses Four Screen Grid Tubes, Detector, and Two Audio**

### *A Station for Every Dial Degree*

THAT is the average performance of the Sargent-Rayment Seven over the entire dial. Tuning from slightly over 200 meters up to 550 meters, this receiver will, under average night-time conditions, receive 100 stations per evening.

The outstanding performance of this receiver is due to very careful design throughout. Four stages of screen grid tube amplification are used. Each stage is completely isolated by heavy aluminum shielding. Lap Shield joints are used to insure against any possibility of having the slightest leakage from stage to stage. Each screen grid, plate and filament wire is by-passed and nine radio frequency chokes are used to prevent inter-coupling. As a result, the set is not critical to operate and does not oscillate at any wave length. Even with the full power turned on at 200 meters the receiver is fully stable.

### THE ANTENNA CIRCUIT

An entirely new type of antenna circuit is used. This input circuit at once assures fine selectivity and good sensitivity, and at the same time it is so connected that antenna capacity does not affect the setting of the gang condenser. Thus, although the antenna is sharply tuned, it is not necessary to compensate for changes in wave length. This is a special feature released for the first time in this set.

The full power of four screen grid tubes gives a degree of sensitivity that has never before been attained in anything that has been placed on the radio market. No suppressors or other counteracting devices are used to prevent oscillation, so that the full amplification of each tube becomes useful. As a result, the receiver will produce a louder signal on a distant station than any other set that can be put up against it, and the selectivity, which is 10 kilocycle in most cases, enables the owner to get long distance reception during the early evening hours when all the local stations are on.

### A Guarantee by the Designers

Some very broad claims have been made in our advertising of the Sargent-Rayment Seven. Were it not for the fact that this set is unique in design these claims could not rightly be made. The Sargent-Rayment Seven has been thoroughly tested under the most adverse conditions and is unconditionally guaranteed to do everything claimed in our advertising. In case anyone desiring to purchase one of these sets is in doubt about this point, we will be glad to arrange so that that person can obtain the set on a ten day money back trial basis.

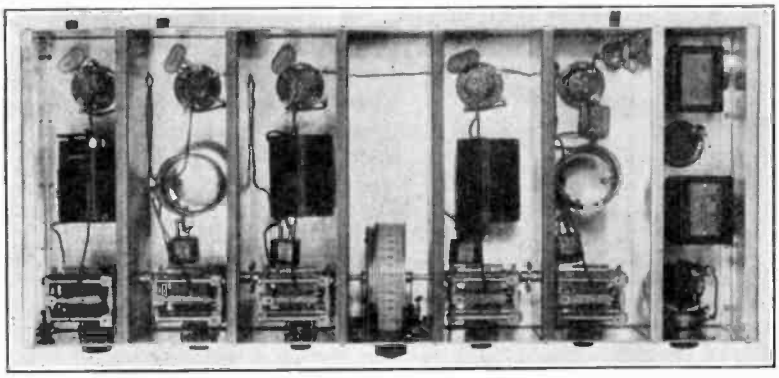
We are perfectly willing to stake our professional reputations as radio designers on this circuit and will leave it to the judgment of the radio fans at the end of the season whether or not any misleading statements have been made.

*(Signed)* E. M. SARGENT, L. C. RAYMENT

### Seven Outstanding Features

1. Ten kilocycle selectivity all over the wave band.
2. More power, more amplification, more sensitivity than ever before available in any receiver.
3. All present distance records smashed. Sets a new standard.
4. Efficient all over the wave band. Plenty of power on the long waves.
5. Tone quality unsurpassed. Uses the latest audio transformers. 210 or 250 tube can be used in last stage if desired.
6. Tuning controlled by handsome, illuminated revolving drum. Only one control for master selector. Fine tuning verniers available for use when wanted.
7. Requires no cabinet. Finished in grained aluminum with black and white trimmings, or in brown, crackle, crystalline lacquer.

# THE OTHER KITS!



"Built Like a Battleship"

## NOTE THE CONSTRUCTION

The above illustrates a top view of the receiver with the cover removed, giving an idea of how substantially this set is built. It shows the complete isolation of each radio frequency stage, the single drum control on gang condensers and the spacing and angling of the coils to prevent feed back. This is a triumph in radio set construction and at the Radio Shows at which it has been exhibited it has attracted widespread attention and comment.

## THE AUDIO SYSTEM

The audio system employed in the Sargent-Rayment Seven is noted for its clearness of tone. The small-sized Clough transformers Nos. 255, 256 and 251 have been purposely selected because they do not over-emphasize the base notes at the expense of the high ones. More powerful transformers could have been selected, but as the set contains plenty of radio frequency power a distinct gain was made by choosing the less powerful but clearer small transformers.

## WHAT FINISH DO YOU LIKE?

The Sargent-Rayment Seven is supplied in two finishes. For the dyed-in-the-wool radio fan there is a standard grained aluminum finish, while for those who prefer a darker set which will better harmonize with living room furnishings we are prepared to supply the usual brown, crackle, crystalline finish. The set can be obtained either built up or in kit form, with finish desired at the prices given below. The models are identical in every respect except for the finish.

The De Luxe model is put out exclusively by Radio Constructors Corporation and can only be bought from us or from jobbers listed on this page. All parts are manufactured by Silver-Marshall and the De Luxe Finish is applied by us.

We especially recommend this model. It is unexcelled in appearance and harmonizes with all furnishings.

### PRICES—FOR THE COMPLETE KIT

The SM-710 Sargent-Rayment Seven Kit is complete in every respect. All parts are inspected at the Silver-Marshall factory for both electrical and mechanical defects and are fully guaranteed by both Silver-Marshall and by Radio Constructors Corporation to be in first-class condition. Everything is carefully packed to withstand shipment. Complete instructions for assembling and wiring the kit are included. These instructions are so explicit and so well illustrated that the novice will have no difficulty in following them.

All hardware, screws, nuts, washers, brackets—everything necessary to build the set—is included. There is nothing additional to be bought. The kit includes even the "cabinet."

No. 710 Standard Model, Grained Aluminum Finish, Code Word "Mercury" ....$130.00
No. 810 De Luxe Model, Brown, Crackle Crystalline Finish, Code Word "Venus" ....$140.00

### FOR THE BUILT-UP SET

The completely built, wired, and tested Sargent-Rayment Seven receiver is carefully packed in a specially cushioned packing case. It exceeds the parcel post size limits and hence must be shipped by express. Full instructions for connecting the set to the power supply and operating it are included.

No. 711 Standard Model, Code Word "Neptune" ....$150.00
No. 811 De Luxe Model, Code Word "Jupiter" ....$160.00

IMMEDIATE DELIVERY

## RADIO CONSTRUCTORS CORPORATION

357 Twelfth Street — Oakland, Calif.

## Dealers

These jobbers can supply you with either the kit or built-up set

### WASHINGTON

WEDEL CO.,
520 Second Ave., Seattle, Wash.
HARPER-MEGGEE, Inc.,
4th at Blanchard St., Seattle, Wash.
INLAND RADIO CO.,
922 West First, Spokane, Wash.
HARPER MEGGEE & CO., INC.,
4th and Blanchard Sts., Seattle, Wash.
HARPER MEGGEE & CO., INC.,
South 214 Howard St., Spokane, Wash.

### OREGON

STUBBS ELECTRIC CO.,
75 6th St., Portland, Ore.
UNIVERSAL SPECIALTIES CO.,
40 N. Ninth St., Portland, Ore.

### SOUTHERN CALIFORNIA

HERBERT H. HORN CO.,
1629 S. Hill St., Los Angeles, Calif.
C. C. LAWTON,
1125 Wall St., Los Angeles, Calif.
RADIO SUPPLY CO.,
912 S. Broadway, Los Angeles, Calif.
RADIO MFRS. SUPPLY CO.,
1000 S. Broadway, Los Angeles, Calif.
MODERN ELECTRIC CO.,
308 West Center St., Anaheim, Calif.
SUNSET ELECTRIC CO.,
1141 1st St., San Diego, Calif.
WILLIAMS AND KLENTZ,
409 5th St., Santa Ana, Calif.

### NORTHERN CALIFORNIA

ELECTRIC SUPPLY CO.,
370 11th St., Oakland, Calif.
COAST RADIO SUPPLY CO.,
648 Howard St., San Francisco, Calif.
GILSON ELEC. SUPPLY CO.,
1106 Madison St., Oakland, Calif.
KIMBALL-UPSON CO.,
607 K St., Sacramento, Calif.
OFFENBACH ELECTRIC CO.,
1452 Market St., San Francisco, Calif.
PACIFIC RADIO SALES CO.,
357 Twelfth St., Oakland, Calif.

### COLORADO

VREELAND RADIO CORP.,
1639 Tremont St., Denver, Colo.

### NEW MEXICO

PACKARD SERVICE STATION,
417 West Gold Ave., Albuquerque, N. M.

### UTAH

LUND RADIO CO.,
Fairview, Utah.

### NEVADA

RENO MOTOR SUPPLY CO.,
Reno, Nevada.

### DEALERS—SET BUILDERS

Get established now in your community as headquarters for the Sargent-Rayment Seven. Fill in the attached coupon and send it to us for full information.

Radio Constructors Corporation,
357 Twelfth Street,
Oakland, Calif.

Please send me at once full details regarding the Sargent-Rayment Seven. I am a dealer or professional set builder and buy my supplies from the jobbers listed below.

Name ....................

Address ....................

City and State ....................

Name of Jobber ....................

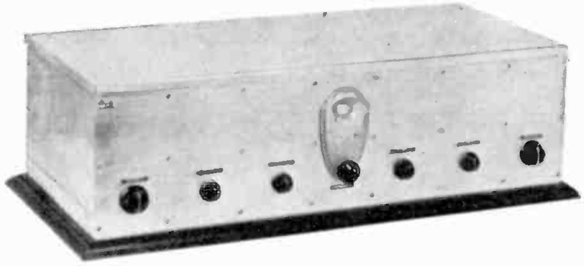
Name of Jobber ....................

# Dealers! *We Specialize on this Receiver*

# SARGENT-RAYMENT SHIELD GRID "7"----

*"Beats Them All"*

ORDER your Sargent-Rayment "7" now. Protect yourself against further delays. A tremendous demand for this remarkable receiver has taxed the capacity of the factory but we can still make prompt deliveries if you send us your order right now. Within a few weeks it will be impossible to promise quick deliveries. This receiver is taking the country by storm. It's a knockout. Sold either in kit form or completely built and wired.



*The cabinet goes with the kit at $130.00. Aluminum, grained, finish. Brown crackle lacquer finish $10.00 additional.*

ONLY receiver on the market with the 7 exclusive features. New Clough audio transformers. Marvelous tone and great volume on "DX" stations. So selective that you can bring in two stations within one degree of the dial setting. Not critical—very easy to tune and absolutely stable in operation. In all our history of radio merchandise we have never heard the equal of this Sargent-Rayment "7." Get your kit or built up set TODAY.

RADIO DEALERS SUPPLY SERVICE
Wholesale Division of
OFFENBACH ELECTRIC COMPANY
1452 Market Street,
San Francisco, Calif.

Send me

V ..................SM-710 Sargent-Rayment Kit, unwired, List $130.00.

V ..................SM-710 Sargent-Rayment Set, completely, wired, List $150.00.

for which I attach a deposit of $40.00, the balance to be paid for C. O. D. upon receipt of shipment.

Name..................................................

Street and Number..................................................

City..................................................State..................

## SET BUILDERS AND DEALERS—

Send the coupon now for your Sargent-Rayment Seven kit, or completely wired receiver. Telegraph orders promptly filled. Mail order service to all parts of the world. All tubes and accessories can be purchased from us at regular dealer discounts.

ORDER DIRECT FROM
*Radio Dealers Supply Service*
*Wholesale Division of*

OFFENBACH ELECTRIC COMPANY

*"The House of a Million Radio Parts"*

1452 Market Street     San Francisco, California

## EASTERN MAIL ORDER

and

## Wholesale Distributors

Specializing on

Sargent-Rayment 710 (7 tube kit)

Silver-Marshall 720-730-740

KITS AND POWER EQUIPMENT

*Dealers and Set Builders*

Write the Largest New England Distributors for

*DISCOUNTS AND LITERATURE*

or

Send your order to be shipped C. O. D. subject to Maximum Discount

SM

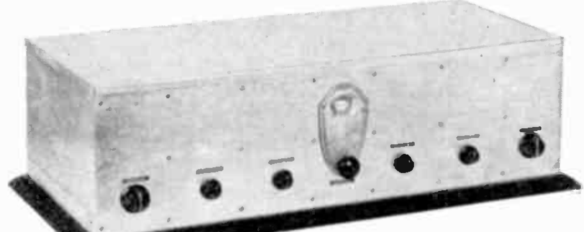
**H. JAPPE COMPANY**
46 Cornhill
BOSTON, MASS.

SM

## ANNOUNCING

Mail Order Service From the Best Known Radio House in New York

*All Popular Kits* , *Immediate Shipment*



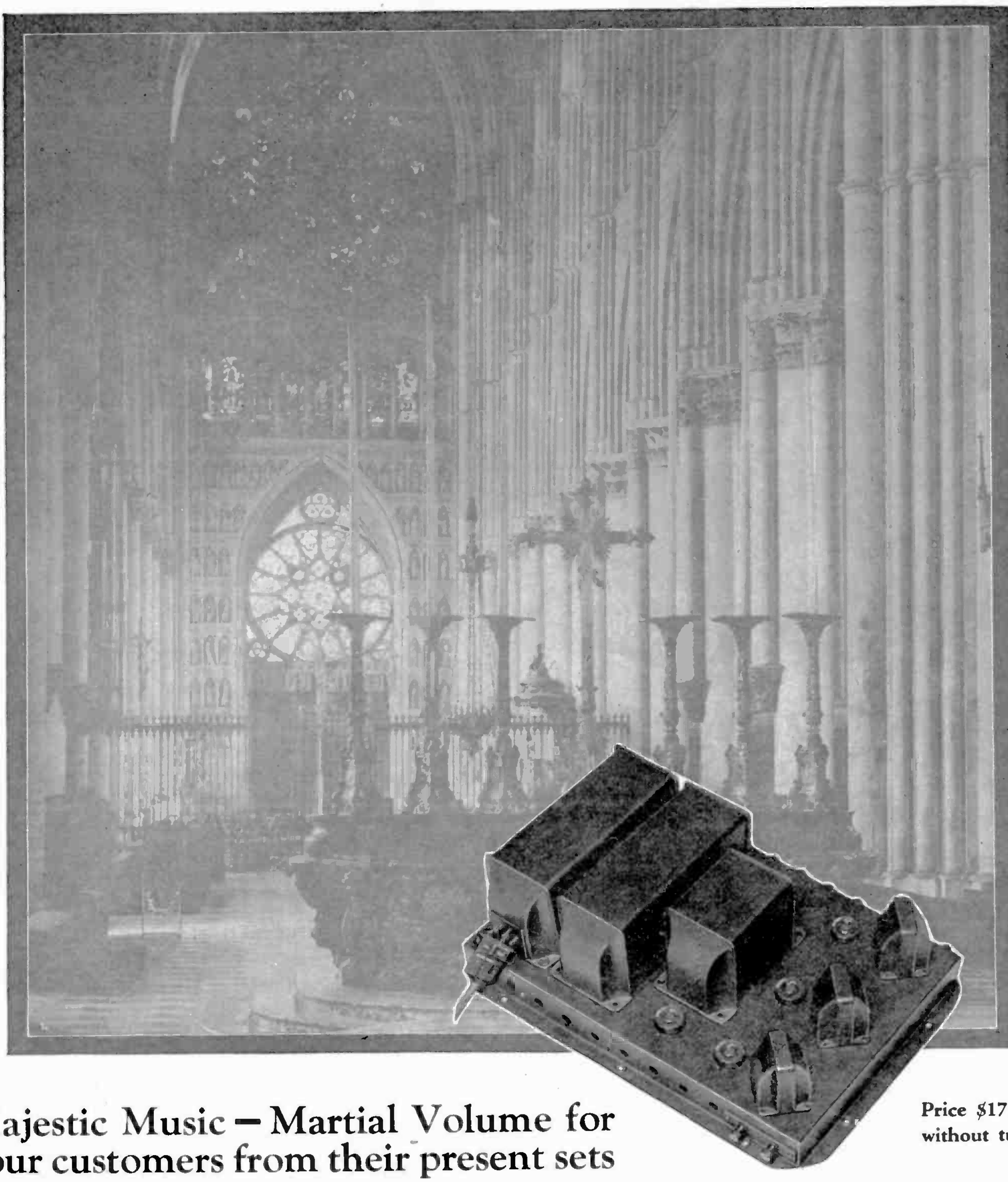
S-M 720 Screen Grid Six     S-M 740 Coast to Coast Four
S-M 710 Sargent-Rayment Seven
S-M 730 Round the World Four
All Other S-M Kits and Parts

We are pleased to announce the addition of a complete mail order department, to better serve the interests of the dealers and set-builders of the entire United States and Canada, to whom quick and reliable service is a dire necessity.

Our large buying resources and a complete up-to-date stock, allow immediate shipment of all S-M kits and parts and other popular kits.

Send for our free mail order catalog at once, and become acquainted with the excellent service we can give you.

**Royal-Eastern Electrical Supply Co.**
16 West 22nd Street , , New York, N. Y.



# Majestic Music — Martial Volume for your customers from their present sets

**Price $175.00 without tubes**

equal to the coronation music of Rheims Cathedral, can be obtained by adding a Samson PAC2 which will also eliminate all A, B and C batteries with their attendant care and replacement.

Rich bass notes, remarkable clarity and a volume which can be controlled from a whisper to dance hall proportions can be obtained. The PAC2 will operate 1 to 16 loud speakers or 500 to 700 headsets.

The Samson PAC2 Power Amplifier and ABC Eliminator are designed to meet AIEE Standards and Underwriters' Requirements. The Amplifier is of the two stage transformer coupled type using a 227 tube in first stage and two 210's in push pull for second stage. Compensation is provided for 105 to 120 volt, 50-60 cycle current. External voltages are 45, 90 and 135B, —4½ C, and AC filament current for two 227 and five 226 tubes. An 874 regulator tube is used to maintain constant B voltages.
PAC2 Amplifiers, when used in conjunction with tuning units, are ideal for supplying music or instruction to schools, hospitals, apartments, clubs, etc. They will modernize the many battery operated sets in your neighborhood or greatly increase the resale value of your traded-in sets.
Send for folder R.R. describing this unit and many others.

*Main Office:* **Canton, Mass.**
**Manufacturers Since 1882**

**Samson Electric Co.**

MEMBER R.M.A

**Factories at Canton and Watertown, Mass.**


# THORDARSON R-300 AUDIO TRANSFORMER

SUPREME in musical performance, the new Thordarson R-300 Audio Transformer brings a greater realism to radio reproduction. Introducing a new core material, "DX-Metal" (a product of the Thordarson Laboratory), the amplification range has been extended still further into the lower register, so that even the deepest tones now may be reproduced with amazing fidelity.

The amplification curve of this transformer is practically a straight line from 30 cycles to 8,000 cycles. A high frequency cut-off is provided at 8,000 cycles to confine the amplification to useful frequencies only, and to eliminate undesirable scratch that may reach the audio transformer.

When you hear the R-300 you will appreciate the popularity of Thordarson transformers among the leading receiving set manufacturers. The R-300 retails for $8.00.

**THORDARSON ELECTRIC MANUFACTURING CO.**
*Transformer Specialists Since 1895*
**WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS**
*Huron and Kingsbury Streets — Chicago, Ill. U.S.A.*

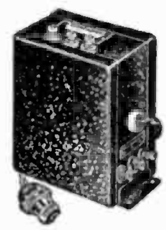
### Power Supply Transformers

These transformers supply full wave rectifiers using two UX-281 tubes, for power amplifiers using either 210 or 250 types power amplifying tubes as follows: T-2098 for two 210 power tubes, $20.00; T-2900 for single 250 power tube, $20.00; T-2950 for two 250 tubes, $29.50.

### Double Choke Units

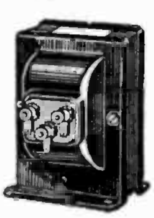
Consist of two 30 henry chokes in one case. T-2099 for use with power supply transformer T-2098, $14; T-3099 for use with transformer T-2900, $16; T-3100 for use with transformer T-2950, $18.

### Power Compacts



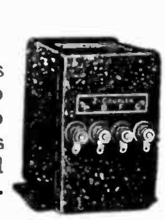
A very efficient and compact form of power supply unit. Power transformer and filter chokes all in one case. Type R-171 for Raytheon rectifier and 171 type power tube, $15.00; Type R-210 for UX-281 rectifier and 210 power tube, $20.00; Type R-280 for UX-280 rectifier and 171 power tube, $17.00.

### Speaker Coupling Transformers



A complete line of transformers to couple either single or push-pull 171, 210 or 250 power tubes into either high impedance or dynamic speakers. Prices from $6.00 to $12.00.

### Screen Grid Audio Coupler



The Thordarson Z-Coupler T-2909 is a special impedance unit designed to couple a screen grid tube in the audio amplifier into a power tube. Produces excellent base note reproduction and amplification vastly in excess of ordinary systems. Price, $12.00.

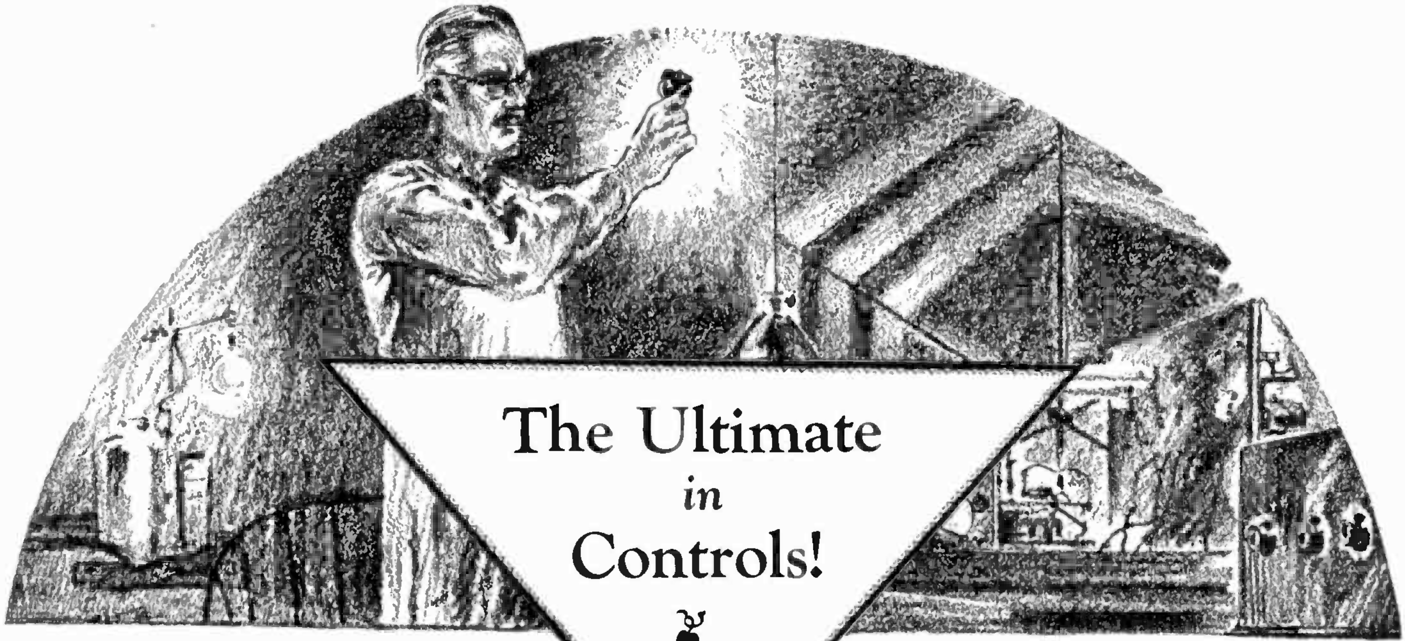
THORDARSON ELECTRIC MFG. CO.
500 W. Huron St., Chicago, Ill. 3583-G

Gentlemen: Please send me your constructional booklets on your power amplifiers. I am especially interested in amplifiers using........................tubes.

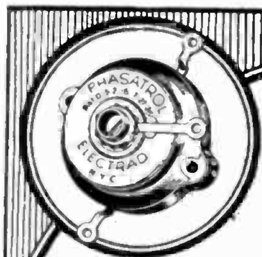
*Name*.......................................................................

*Street and No*..........................................................

*Town*....................................................*State*.................



# The Ultimate *in* Controls!



Licensed by Rider Radio Corporation.

Patented 5-2-'16; 7-27-'26. Pats. Pending.

## PHASATROL

Reg. U. S. Pat. Off.

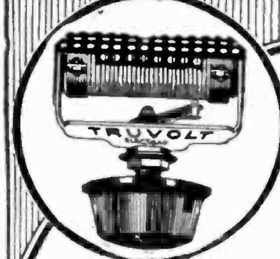
### A True Balancing Device for Radio Frequency Amplifiers

Phasatrol is an unusually efficient device for controlling radio frequency oscillations and thus eliminating the disturbances to reception which they cause. Adapted to any type of receiver using R.F. amplification. A wonderful improvement for the new A.C. circuits where the elimination of noise is often a problem. Price $2.75 each.

ELECTRAD Resistances are specifically designed to assist the builder of eliminators and receivers in solving the important problem of control in all its phases.

They are constructed in the most approved designs according to the highest standards of quality and workmanship. Exhaustive tests for mechanical and electrical exactness assure the unsurpassed accuracy and dependability of these units.

Electrad Specializes in a Full Line of Resistances for All Radio Purposes.



## TRUVOLT ALL-WIRE Resistances

U. S. Patent 1,676,869 and Patents Pending

Truvolt Variables simplify B-Eliminator construction by eliminating difficult calculation and making all adjustments easy. 22 Stock Sizes $3.50 each.

Truvolt Fixed resistances are adjustable to different set values by the use of sliding clip taps—an exclusive Truvolt feature!

*Tear out and Mail Coupon for Full Information.*

# ELECTRAD Inc.

ELECTRAD, INC.,
Dept. H-10, 175 Varick St.,
New York.

Please send me descriptive circulars on the following products and put me on your mailing list for similar literature.

..........General Circular
..........Tonatrol Volume Controls
..........Phasatrols
..........Royalty Variable Resistors
..........“Electrad Control Manual” (Enclose 10c for mailing)
..........“What B Eliminator Shall I Build?” (Enclose 10c for mailing)
..........Truvolt Divider Manual

I am particularly interested in..........

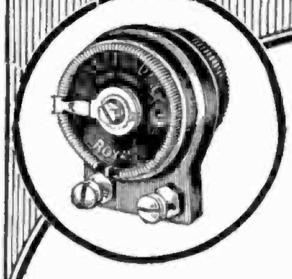
Name..........

Address..........

*Pacific Coast Offices:*

**905 Mission Street**

SAN FRANCISCO, CALIFORNIA



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## ROYALTY VARIABLE HIGH RESISTANCES

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# RADIO

VOLUME X — OCTOBER, 1928 — No. 10


## Radiotorial Comment

AN ADVERTISEMENT of an "eight tube radio" which is equipped with seven amplifying tubes and one rectifying tube prompts the question, "when is a tube not a tube?" Should a set having two r.f. stages, detector, and two a.f. stages be called an eight tube set because its plate voltage is supplied by two rectifiers and controlled by a glow tube? A technical answer might be yes, but in the generally accepted meaning it should be no. A positive answer involves a species of misrepresentation and fraud. Popularly, a tube is not a tube when it is a rectifier.

* * *

IN THEORY, it is possible for several stations to broadcast the same program simultaneously on the same wavelength. This theory has been proved practical by two widely separated stations. And now the Columbia Broadcasting System announces that it will try to synchronize all the stations on its chain.

These tests, if successful, could pave the way for relieving the present congestion in the broadcast spectrum. Instead of tying up half the available channels for the transmission of one program, as has frequently been the case, all the stations in a chain could use one channel and leave the other channels open for the use of other stations or chains. This is made possible by the use of quartz crystals which hold the radiation to one constant frequency without deviation.

A great deal of experimental work yet remains to be done. The expense to the stations would be tremendous. Many of them would be loath to surrender the wavelengths that they are now using. But none of these objections should prove insurmountable. However it is to be hoped that the Radio Commission will not continue to postpone action until the engineer has solved these problems.

THE ultimate success of the efforts to perfect radio moving pictures is assured by the indomitable spirit of the scientist. This spirit finds characteristic expression in a confession of Professor Albert A. Michelson who is quoted as saying: "My greatest inspiration is a challenge to attempt the impossible."

* * *

RADIO advertising is raw when overdone, thus differing from meat and other edibles. Subdued publicity, which may be a builder of goodwill, is so rare nowadays that many listeners purposely avoid tuning in programs which are known offenders.

* * *

MATHEMATICAL analysis of the problem of atmospheric interference to radio reception as published by John R. Carson, noted telephone engineer, in the July I. R. E. Proceedings, forces the conclusion that static, like the the poor, will always be with us. He finds that a directional antenna will afford some relief when the predominant atmospheric interferences come from a direction other than that of the desired signal. He also concludes that no arrangement for balancing out the static by means of an auxiliary circuit can lessen the interference—signal ratio for radiotelephony, though such methods offer a slight theoretical possibility for reducing static interference to telegraph signals.

The practical answer to the problem has been found in using more power at the transmitter. Thereby the desired signal can be made stronger than the undesired static. But wherever and whenever the static impulses are stronger than the signal impulses, the latter are obliterated. Thus does science confute the claims of static-eliminator inventors.

* * *

MUSIC has two mechanistic elements, rhythm and tone. The poorest radio set will reproduce rhythm, the beat which stimulates such bodily activities as marching and dancing. But it requires a fine set to give fidelity of tonal reproduction. This is the reason for the popularity of transformers with a uniform response curve, power tubes with the reserve energy needed to bring out the low notes, and dynamic speakers.

The appeal of jazz to the untutored mind comes from its rhythm. But its monotony soon tires the cultured mind which derives greater pleasure from a more flexible varying rhythm, as in the waltz.

Good music is characterized not only by rhythm, but also harmony of tone. Tone consciousness gives the appreciation of good music which is innately possessed by most people, regardless of their musical education. A fine radio set is a versatile musical instrument which stimulates tone consciousness. As such it should be in every home.

* * *

PRODUCTION schedules of radio manufacturers provide for an output of about two million complete sets during the present season. More than half of these are to be made and sold by five manufacturers. Over forty per cent of them are console models, most of which are equipped with loudspeakers. Of the probable loudspeaker output, about sixty per cent are of the electro-magnetic type and forty per cent of the electro-dynamic type.

These are the models which are being shown at the Fall radio shows. Most of them represent an improvement in design which is reflected as an improvement in quality of reception, particularly of the low notes which for years were the lost chord of radio.

It is estimated that nearly ninety per cent of the output will use raw a.c. for filament supply. This represents a corresponding drop in the probable sale of battery charging equipment and batteries. Battery-operated sets are still made for isolated districts where alternating current is not available or for sets employing shield-grid or other special types of d.c. tubes.

The shield-grid tube, by the way, has not yet been adopted by the standard manufacturers. So its advantages are available only in custom or home-built sets. It is being subjected to rigid laboratory experiments and with a.c. filament supply may be the great new feature of the 1930 models.

One noticeable feature in some of the new sets is the use of a high-voltage detector voltage output so that it is possible to secure sufficient grid swing to actuate one final audio stage with one or two power tubes. This not only eliminates the cost of one transformer and tube, but also removes one possible source for the introduction of distortion.

Because of improvements and refinements, prices are still on the up-grade. There are notable exceptions to this general trend, but the average complete receiving set of today costs about three times as much as the average set of five years ago. But it is much more than three times as good.

Claims for long-distance reception are conspicuous by their scarcity. Emphasis is placed upon fidelity of tone reproduction from local stations. Thus is a radio set becoming more and more a musical instrument which happens to be actuated electrically rather than an electrical instrument which happens to perform musically.

* * *

WHY the a.c. hum is not always heard in some of the lower priced sets which use a.c. filament tubes is a question which has sometimes puzzled those who are trying to clear up such trouble in sets that they or others have built. The answer to this question usually is found in the use of an audio frequency amplifying system which does not reproduce the low notes.

It is relatively easy to design transformers and speakers which suppress the very low notes. In fact the great difficulty is to bring them to life. Yet the casual listener does not notice the absence of notes below 120 cycles if the low notes above this frequency are strongly accented. So if the a.c. hum is not heard there may be a reasonable suspicion that no other 60 or 120 cycle notes can be heard.

Another expedient which helps to solve the difficulty is the use of a heater type instead of a filament type of a.c. tube. With a good filter-rectifier system for plate voltage supply, and with heater tubes throughout, it is possible to greatly minimize the hum. But the expense of doing this must be reflected in the price of the set.

# Canada's Arctic Radio Stations

*By* JAMES MONTAGNES

A SEA ROUTE from the Canadian West is to be opened in 1930, via the Hudson Bay and the Hudson Straits to the Atlantic Ocean. A railway is nearing completion, running northeast from Winnipeg to Fort Churchill; an aerial survey of weather conditions and ice traffic is being made, and this summer four permanent radio stations were installed in this district, which lies directly south of the Arctic Circle.

To cut the cost of grain transportation to Europe this new sea route has been deemed necessary. It is now in its final stages of completion. Radio has and will play a big part in its use, a large force of government operators and the latest equipment for ship to shore communication having gone to the Far North this summer.

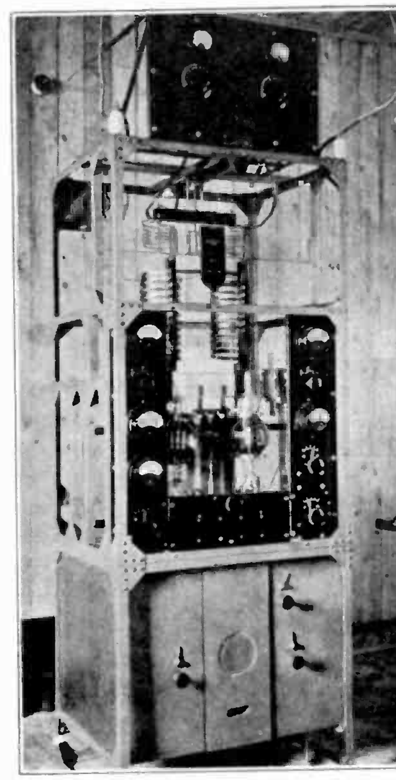
Three temporary stations along the Hudson Straits were installed in 1927, when the aerial survey went north. They have kept in constant touch with Ottawa, sending valuable information on the daily surveys made from the air. The stations were situated at Port Burwell at the southeastern extremity of the Straits, at Wakeham Bay near Ungava Bay on the south shore of the Straits, and at Nottingham Island at the western entrance to the Straits.

The station at Wakeham Bay, being between the other two, was the control station. It was in daily touch with Ottawa. This station and the one at Port Burwell are being closed, having served their purpose, and two new stations will replace them, one at Cape Hope's Advance, near Wakeham Bay, and the other on Resolution Island at the northeastern end of the Straits, opposite Port Burwell. The station at Nottingham Island is being made into a permanent installation and a fourth station will be at Fort Churchill on the western shore of the Hudson Bay at the end of the railway from Winnipeg.

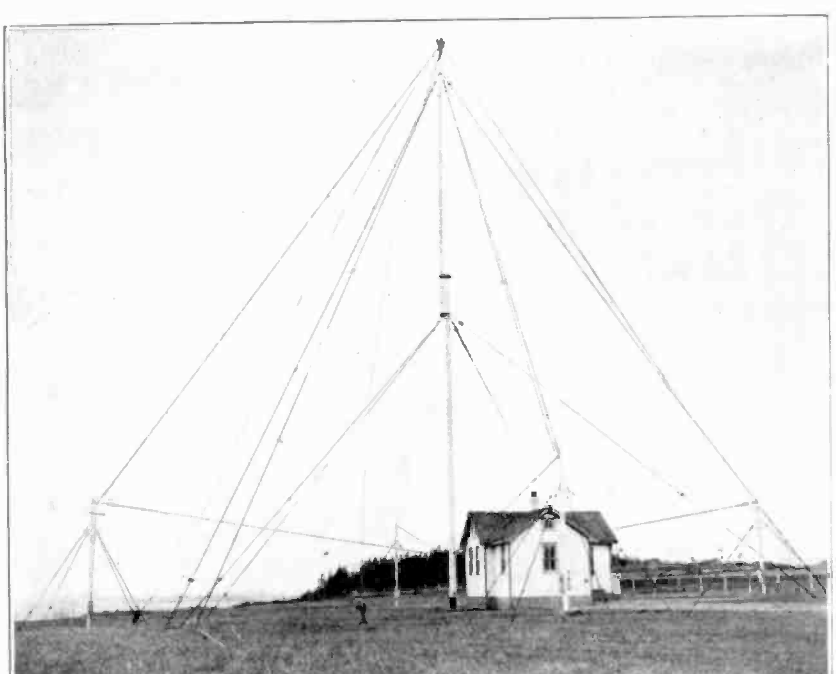
*Radio Station on Nottingham Island, Hudson Bay*

It is significant that each of these stations, in addition to its regular equipment, will be equipped with direction finding apparatus. This follows the Canadian Government's policy to equip its shore stations with this latest means of guiding mariners. The apparatus will be similar to that installed at the various stations on the Canadian Atlantic and Pacific coasts.

At each station along the Straits there will be a 500-watt C. W. and I. C. W. long wave transmitter, operating on 600, 800, 1700 and 2100 meters. The station at Resolution Island, the farthest east station of the chain, and the new control station, will also be equipped with short wave apparatus for direct communication with Ottawa. Power and wavelengths to be used on the short wave have not yet been chosen. The call letters at this station will be VAW, at Nottingham Island, VCB, and at Cape Hope's Advance, VAY.



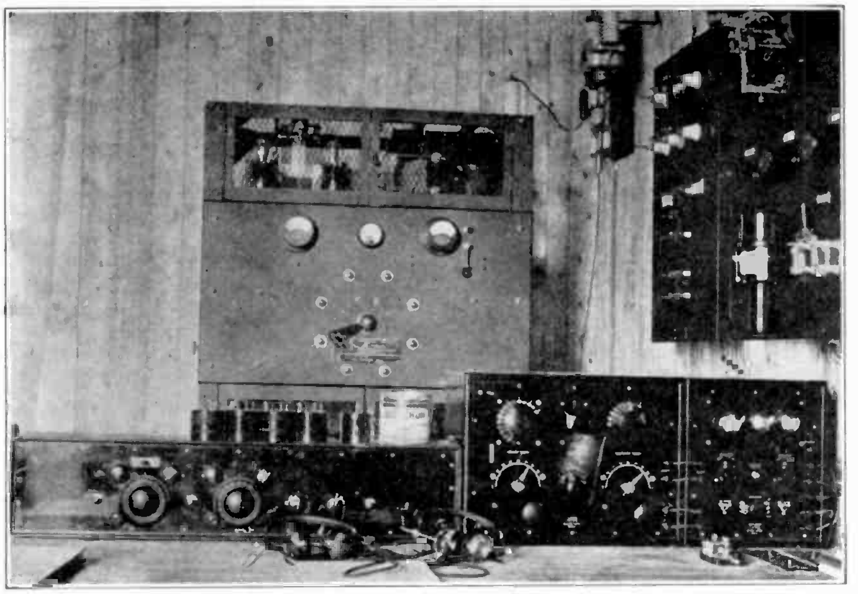
*Short-Wave Transmitter at Wakeham Bay*



*Direction Finding Station at St. John, N. B., Showing Type for Hudson Straits District*

The station at Fort Churchill, VBY, will be the most powerful of the group. A 1600-watt C. W. and I. C. W. set is being installed for long wave work. A 500-watt set for short wave transmission and a 100-watt radiotelephone equipment will be installed in addition to the direction finder. It will use the same wavelengths as the three other stations, and will be able to communicate by means of the short wave apparatus with Winnipeg and Ottawa.

An officer-in-charge and three operators will be stationed at each post. These will be relieved every year. They will communicate with ships coming in and going out in the same way that shore operators in more civilized waters are accustomed to do. Most of the apparatus and the majority of the men left during July for their places at Canada's most northerly stations. The stations will be on the air in the near future as everything must run smoothly when navigation opens in the spring of 1930.



*Receivers and Long-Wave Transmitter at Wakeham Bay*

## NEON TUBES

Neon is an inert gas which is obtained by the fractional distillation of liquid air. There is about one part of neon in 200,000 parts of air. It is used in glow tubes to give a constant 90 volt output from a rectifier filter system and it is used in television to convert variations in electric current to variations in light.

Its use in a voltage regulator tube depends upon the fact that the tube gives a constant voltage drop averaging 90 volts across the tube for any current flow from 10 to 50 milliamperes. Two of these tubes may be placed in series to give 180 volts, with a center tap between them to provide 90 volts. It is necessary to limit the maximum current to 50 milliamperes by means of a series resistance. In normal operation one of these tubes draws from 10 to 15 milliamperes so that it cannot be used in with a 65 m.a. rectifier which is supplying more than 50 m.a. to a set at specified voltages. It also acts as a condenser across the output, bypassing the a.c. component of the rectified output.

Its use in television depends upon the fact that its brilliancy varies with the amount of current fed to it. Its brilliancy is low for small voltages and high for large voltages. Thus all the contrasting lights and shadows of a broadcast picture can be registered on a receiver screen.

# Chain Broadcasts on One Wavelength

*By* S. R. WINTERS

THE feasibility of assigning a single frequency to a chain of broadcasting stations, as suggested by Dr. J. H. Dellinger, technical advisor to the Federal Radio Commission, and the practical demonstration of operating a station at St. Louis, Missouri, and one at Columbus, Ohio, on the same wavelength, are developments fraught with hopeful possibilities in unraveling the tangled skein of broadcasting. Dr. Dellinger, believes in "the possibility of the use of special piezo-oscillators in broadcasting stations, which hold the frequency so close that several such stations can operate simultaneously without heterodyne interference on the same frequency."

The Columbia Broadcasting System will attempt synchronization of the individual stations comprising its chain. This far-reaching and elaborate test will have for its guidance the experience of a similar experiment conducted by WAIU of Columbus, and KMOX of St. Louis, links in the Columbia broadcasting chain. This synchronization experiment is still in progress and the methods employed and results obtained are described in a communication to the Federal Radio Commission from H. V. Ackerberg, chief engineer of the Columbus station. His detailed report follows:

"The WAIU transmitter during these experiments is not crystal-controlled, the usual crystal-oscillator being replaced by a manually-controlled master-oscillator completely shielded, and accurate in maintenance to frequency to within 15 cycles over a period of five hours. KMOX employs a standard Western Electric 4-A transmitter which has been found to be accurate within 25 cycles over a like period of time. We determine their variation of frequency by the usual method of beating their carrier with a constant frequency oscillator located in Columbus. During the actual synchronization we use a calibrated local oscillator at the transmitter. This oscillator is absolutely accurate at 1000 kilocycles. We beat our carrier against this local 1000 kilocycle oscillator instead of against KMOX at St. Louis.

"Our observers give us the correction before the program starts. This correction, usually in the neighborhood from 100 to 500 cycles, is easily made at the transmitter—the local constant-frequency oscillator corrected accordingly and the program continued. At intervals during the program the observers give us additional corrections. These corrections are made at once at the transmitter.

"We find that there is an entire absence of heterodyning and the only problem that we have not yet quite overcome is that of cross talking during announcements. We have worked out a plan whereby we are dividing the announcing time—each station utilizing half of the 15-second intervals allotted by the chain for our local announcements. We are very carefully studying the distortion factor. As yet we have experienced no serious distortion of audio-frequencies due to time lag, or due to either one of the two transmitters being slightly out of phase.

"We would very much like to carry on these experimental tests, employing thermostatically-controlled crystals. For your information, we have been successful in beating two thermostatically-controlled crystal oscillators for a period of seven days, with the result of no more than a 5-cycle deviation over this period of time.

"It is my opinion that this method could be very successfully applied to the synchronization of two stations—another noteworthy factor in the ability to hold our transmitter to a given frequency continually is an unusual type of antenna design. We are using at the present time, and have found it by far the least susceptible to frequency changes due to variation of capacity, atmospheric changes, etc., a system comprising two 40-ft. 8-in. diameter, 6-wire horizontal cages.

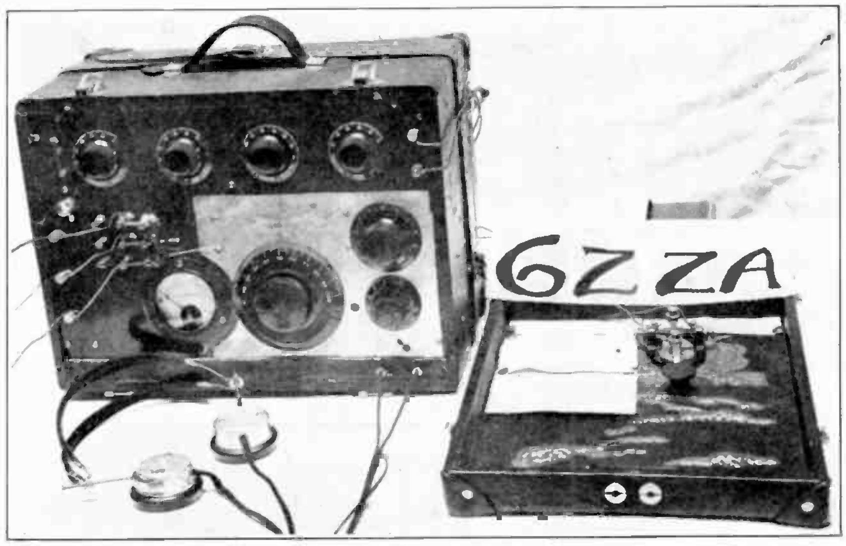
"These cages are suspended between towers 200 feet high. They are tightly stretched between the towers, this tension being maintained by an automatic compensator. The down lead is composed of a 50-ft. 4-in. 6-wire cage at the upper end. At the bottom of this vertical cage the six wires are bunched, continuing 130 ft. straight down to the coupling house. This so-called 'rat tail

(Continued on Page 44)

# Home Contacts for the Traveling Man

## Provided by a Portable Short Wave Radio Transmitter and Receiver Which Is Here Described

*By* DON C. WALLACE




*Complete Set Ready for Operation*

BY means of a small transmitter and receiver, which is carried in a hand satchel, the writer has been able to telegraph to his wife from distant hotel rooms for an hour or so each evening for several months. After a concentrated two week's course in code practice Mrs. 6AM passed the examination for an operator's license and qualified to operate the short-wave transmitter at 6AM, Long Beach, California.

During his long trips Mr. 6AM carried the outfit here illustrated, using a portable Zepplin antenna on 40 meters. At 500 miles range the average audibility of the portable transmitter was R-8 at 7 p. m. and R-7 at noon.

Half wave self-rectified current is used to supply the plate of the transmitting tube. AC is used on the filaments. It has been found that the same transformer cannot be used for both filament and plate, because of the unsteadiness. Consequently the lightest available toy transformer was used here. It has a variable voltage tap, which allows proper filament voltage to be used regardless of the line voltage. This also allows the *B* eliminator transformer to be rewired so as to deliver 800 volts, from what is really a 600-volt transformer.

The method of securing this voltage is shown in Fig. 2. The two filament windings are connected in series to give 13 volts; this 13-volt winding is then connected in series with the 110-volt winding so as to reverse the flux caused in the core by the 110-volt winding.

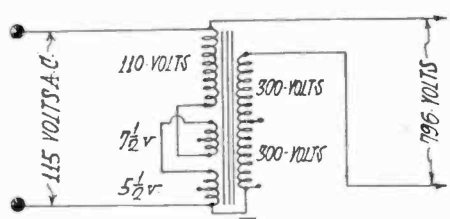



*Fig. 2. Method of Securing 800 Volts from 600 Volt Transformer*

This actually will reduce the turn ratio 13/110, giving a like increase in output of the same ratio, i.e. adding 71 volts onto the 600 already secured from the transformer (300 volts on each side of the mid tap). Then this total of 671 volts is connected in series with the 110-volt line voltage which is usually 115, giving a total of 796 volts or approximately 800 volts.

This has proved to be just the correct voltage for the CX 310 tube used for transmission, inasmuch at that voltage it does not heat, runs steadily, and shows

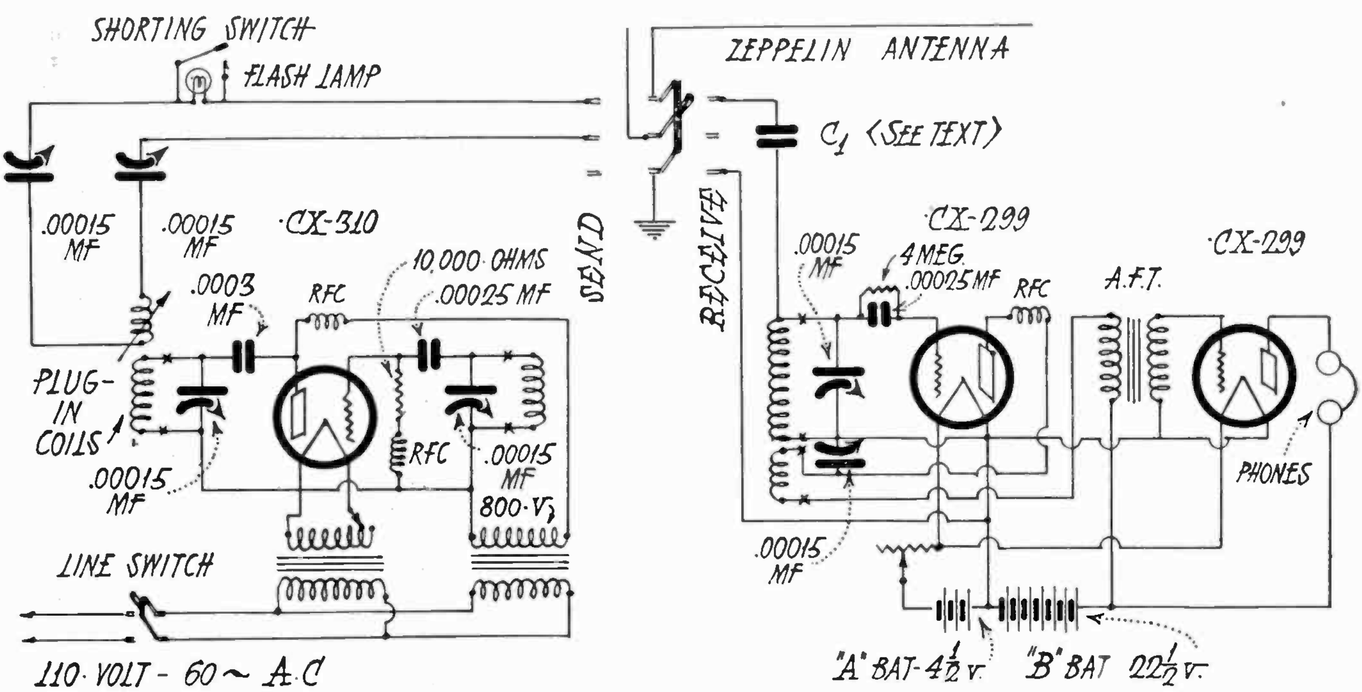



*Fig. 1. Circuit Diagram of Portable Transmitter*

good output. The wave becomes unsteady around 1000 volts, and with 600 volts the output is considerably less. With a heavy duty transformer the overload, especially with intermittent service such as in keying, will not hurt the transformer. In this way, standard apparatus can be used, doing away with the necessity of having to wind a special transformer.

All the receiving condensers used as plate-blocking condensers promptly blew, so finally an old UC 1015 RCA condenser was installed, doing away with trouble from that source. The .00025 mfd. condenser used for the grid is one of the new midget type mica condensers.

Ordinary sockets caused trouble so one of the old RCA porcelain UR 541 sockets was used. All the transmitting condensers are the Midget type, equipped with 2-in. rheostat knobs to conserve space.

The r.f. chokes, coil mountings, and coils are of standard makes, the coils being 1⅜ in. in diameter, wound with No. 14 wire on a celluloid form. Rather than paint the coil with dope, the wire was heated until it meshed into the celluloid. The result is a highly efficient and durable transmitting coil which takes little space. Coils for both 20 and 40 meters can thus be taken along as the space requirements are slight. Coil dimensions and data for both the transmitter and the receiver are given in the accompanying table.

The receiver was originally designed with but one tube, whereby communication with 6AM was very easy from San Francisco and Oakland, 500 miles away. Body capacity was bad, due to the headphones in the plate circuit of the detector tube. To do away with this required shielding, and an audio stage made signals much more pleasant to copy. With the one tube only, amateur signals from Uruguay, New Zealand, Australia and Tahiti were all heard during the space of ten minutes listening while at a hotel in Oakland. The Uruguay station, by the way, was using voice transmission, and could be made out quite well on this single 199 tube.

Lynch resistors are used in both the receiving and transmitting portion of the set. The receiving is a 4 meg metalized resistor, and the transmitting a 10,000-ohm 10-watt type.

The receiving batteries are very light, the *B* being the smallest size, and the *A* being an ordinary *C* battery. The entire set is light enough to be easily carried.

The small condenser $C_1$ is the capacity formed by twisting two pieces of rubber-covered hookup wire, for a distance of 2 in. Space and weight are thus secured, retaining the necessary rigidity.

Inasmuch as the transmitter and receiver are so close to each other, both sides of the 110-volt AC line must be opened, or else there is a bad inductive hum in the receiver. This switch is made from the smallest knife switch material found on the market, and the entire switch is mounted right in the cord, at a convenient arm's length from the receiver.

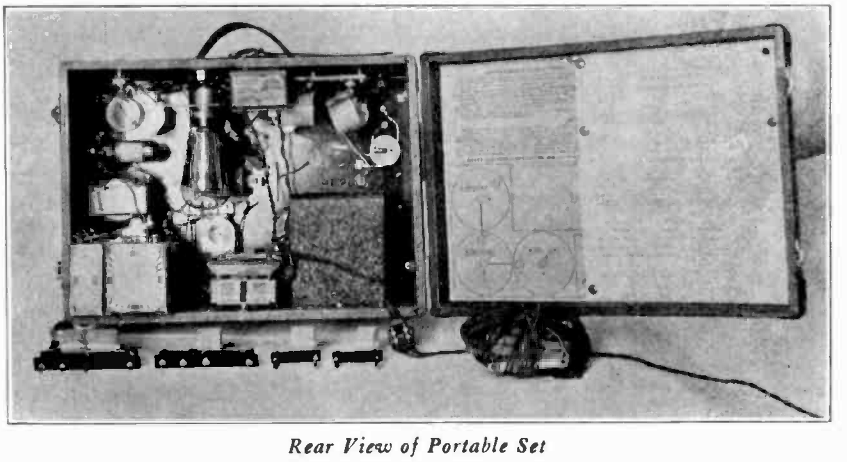
The entire box is reinforced with brass angle irons, bolted inside the corners of the main box and on the lid. The key is mounted right in the corner, and is arranged to fit closely into the panel with the lid in place.

The antennas most successful for hotel use have been zepplin type, using two r.f. feed lines spaced each 3 ft. with small dowel sticks 3 in. long, boiled in paraffin, and held in place with rubber bands for simplicity and convenience. The forty-meter antenna is 66 ft. long (made with loop wire), and the feeder wires each 35 ft. long. The twenty-meter antenna is just half this size, i.e., 33 ft. for the antenna and 17 ft. for the feeder wires.

In testing out this set with its own antennas at 6AM, communication was established with Japan, Call AJ-1AW, using the 20-meter portable zepp out the window and about 3 ft. over the roof of a one-story bungalow, held in place with string. String, by the way, is always used, as string is good temporary insulation, and a ball of it can be dropped or thrown out most anywhere to put up an antenna in a hurry. When it is desired to take down the antenna, a quick jerk does it nicely. Ten minutes is often all that is necessary for the complete set-up, including antenna installation and tuning in of distant 6AM.

Other tests at 6AM indicated that the 40-meter antenna strung over the back yard at a height of 3 ft., would give R-8 signals at points over 500 miles, and in one such half-hour test two or three stations reported R-8. In addition, several East Coast, Mid-West, and Western stations were "worked."

The ease and convenience of the whole arrangement is really delightful, and it just goes to show how easily even now, the portable sending and receiving set may be built and used.



*Rear View of Portable Set*

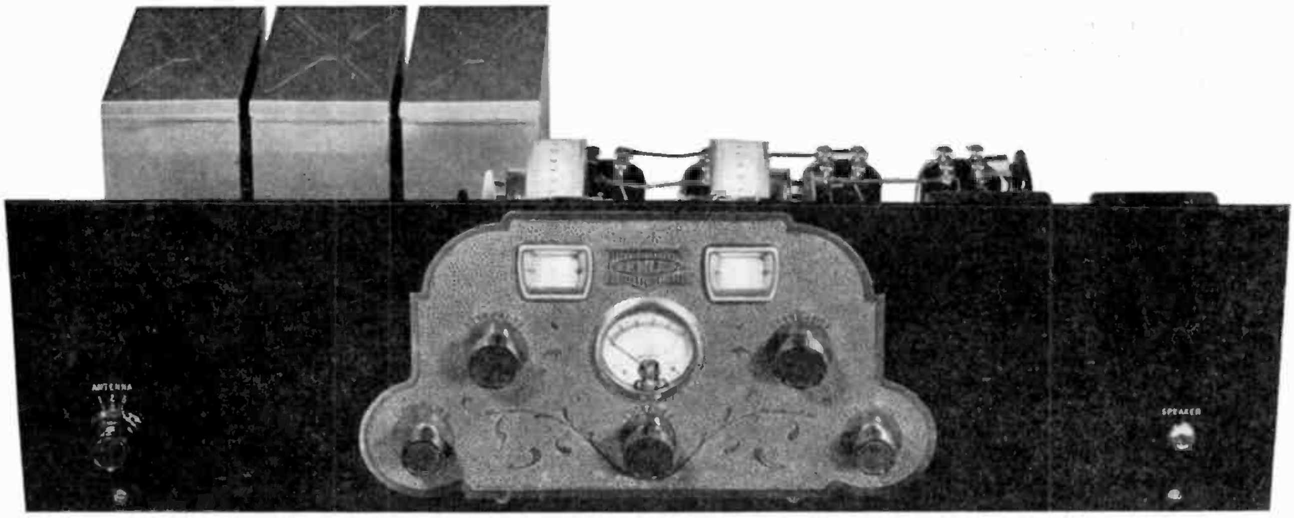
## COIL DIMENSIONS AND DATA

### RECEIVING COIL DATA

| *Wave* | *Turns Secondary* | *Spacing* | *Turns Tickler* | *Diameter* | *Size of Wire Spaced* |
|---|---|---|---|---|---|
| 18-26 | 13 | ⅛" | 10 | 1⅜" | No. 20 SCC |
| 26-37 | 15 | ⅛" | 15 | 1⅜" | No. 28 SCC |
| 36-47 | 26 | ⅜" | 24 | 1⅜" | No. 28 SCC |

### TRANSMITTING COIL DATA

| *Wave Band* | *Plate Turns* | *Grid Turns* | *Turns* | *Diameter* | *Size of Wire Spaced* |
|---|---|---|---|---|---|
| 18.7-21.4 | 8 | 6 | | 1⅜" | No. 14 SCC |
| 37.5-42.8 | 12 | 12 | | 1⅜" | No. 14 SCC |
| *Antenna Coil* | | | 13 | 1⅜" | No. 20 SCC |



*Panel View, Showing Brass Escutcheon Plate*

# Revamping the 45 Kilocycle Superheterodyne

## How to Add a Stage of R.F. Amplification with Shield-Grid Tube So As To Minimize Heterodyne Interference

*By* G. M. Best

Four years does not seem like a long time to most of us, but that period in the radio industry represents a lifetime for the average radio receiver. With very few exceptions, receiving sets which were built during 1924 are now hopelessly obsolete, since they are usually unselective, have poor tone quality based on present-day standards, and have too many controls.

The most popular radio receiver, judging from the number of kits sold, and inquiries received, during 1924 was the 45 kilocycle superheterodyne which was first described in May 1924 Radio. This circuit was subsequently copied by nearly every parts manufacturer in business, and the number of circuits which appeared in the columns of our contemporaries under different names were legion. Based on reliable estimates, there must be several hundred thousand of these receivers in existence today.

The original model used a three-tap regenerative loop, with eight dry cell tubes. It had two controls, was easily constructed and, strange to say, usually worked as soon as the tubes were placed in their sockets and the batteries connected, which is more than can be said for some of the popular circuits of later years.

This set today, in the region of the large broadcasting centers, where there are many stations on the air at one time, is not selective enough to cut out these local stations and receive distant ones like it did in 1924, because the locals are invariably sending out many times the power they did four years ago, are more numerous, and are closer together in frequency assignment. For the latter reason, the set is often afflicted with interference between local stations, due to the fact that the two settings of the oscillator dial conflict with each other, and hence some of the local stations are heard only with the heterodyne whistle from another local superimposed on it. This is a very unsatisfactory condition, and the method by which the old model can be rebuilt into a selective, modern receiver, using as many of the old parts as possible, will undoubtedly be of great interest to many of our readers.

The design which was found to be most satisfactory is shown in the pictures, and the circuit in schematic form is shown in Fig. 1. A stage of completely shielded r.f. amplification with shield grid tube, a shielded oscillator and first detector, are followed by a three-stage intermediate amplifier, second detector, and two stages of transformer coupled audio amplification. This requires one more tube than was needed in the original set, but does not take up any more baseboard or panel space, except that the panel is made 7 in. high instead of 6 in.

The loop antenna is not used, since an exposed loop is no longer popular,

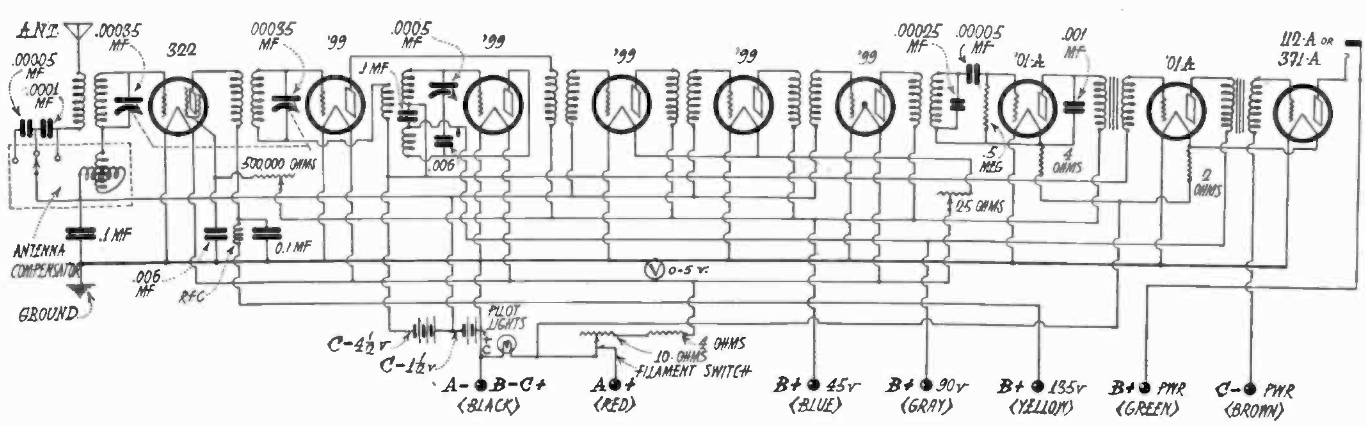



*Fig. 1. Schematic Wiring Diagram of 45 K.C. Superheterodyne*

is difficult to tune in connection with gang control of the condensers, and is unsightly. In its place is an aperiodic antenna coil, loosely coupled to the secondary coil, with two series condensers arranged for easy connection by means of a switch located on the front panel. This switch is a part of the antenna compensator; an inductive type of trimmer used successfully in such circuits as the infradyne and the 115 k.c. superheterodyne, and if this control is not desired, the right size of fixed condenser can be permanently connected at the time the set is adjusted.

The r.f. and oscillator coils are placed in individual compartments of copper, 3 x 5½ x 5¾ in., the same as are used for the 115 k.c. superheterodyne recently described in RADIO. They can be obtained ready-made, in knock-down form, or they can be made from sheet copper or brass in the dimensions given above. The three r.f. coils are all wound on 1½-in. bakelite forms, 4 in. long, and the bottoms of the coils are equipped with bases identical with that of the standard X base vacuum tube, so that they may be plugged into a vacuum tube socket.

The antenna coil primary consists of 20 turns of No. 28 silk wound in bundle fashion on a 1¼-in. diameter, and placed inside the secondary coil at the bottom. The secondary consists of 110 turns of No. 25 double silk wire, wound on the 1½-in. form. The r.f. transformer has a secondary of 114 turns of No. 25 double silk wire, on the 1½-in. form, with primary of 100 turns of No. 30 cotton covered wire wound on a ½-in. spool, and placed at the bottom of the secondary. The oscillator coil has two stator windings of 49 turns each of No. 25 double silk wire, for the grid and plate coils, and the coupling coil consists of 18 turns of No. 25 double silk on a 1¼-in. tube, placed inside the two stator coils.

Connection of these coils to the tube bases used to plug into the coil-mounting sockets is as follows: The antenna coil primary is connected to the two small prongs of the tube base, so as to connect to the *G* and *P* terminals of the socket. The secondary coil is connected to the two thick prongs of the tube base, with the top end of the secondary used as the grid terminal, and connected to the negative filament terminal of the tube socket used as the coil mounting. The r.f. transformer primary is connected to the two small prongs of its base, and the secondary to the two thick prongs the same as for the antenna coil. In the case of the oscillator, the plate coil is connected to the two thin prongs, and the grid coil to the two thick prongs. The coupling coil is brought out to two switch points fastened on the sides of the 1½-in. tube, at the bottom, and so arranged as to touch two springs which are mounted on the coil socket, as can

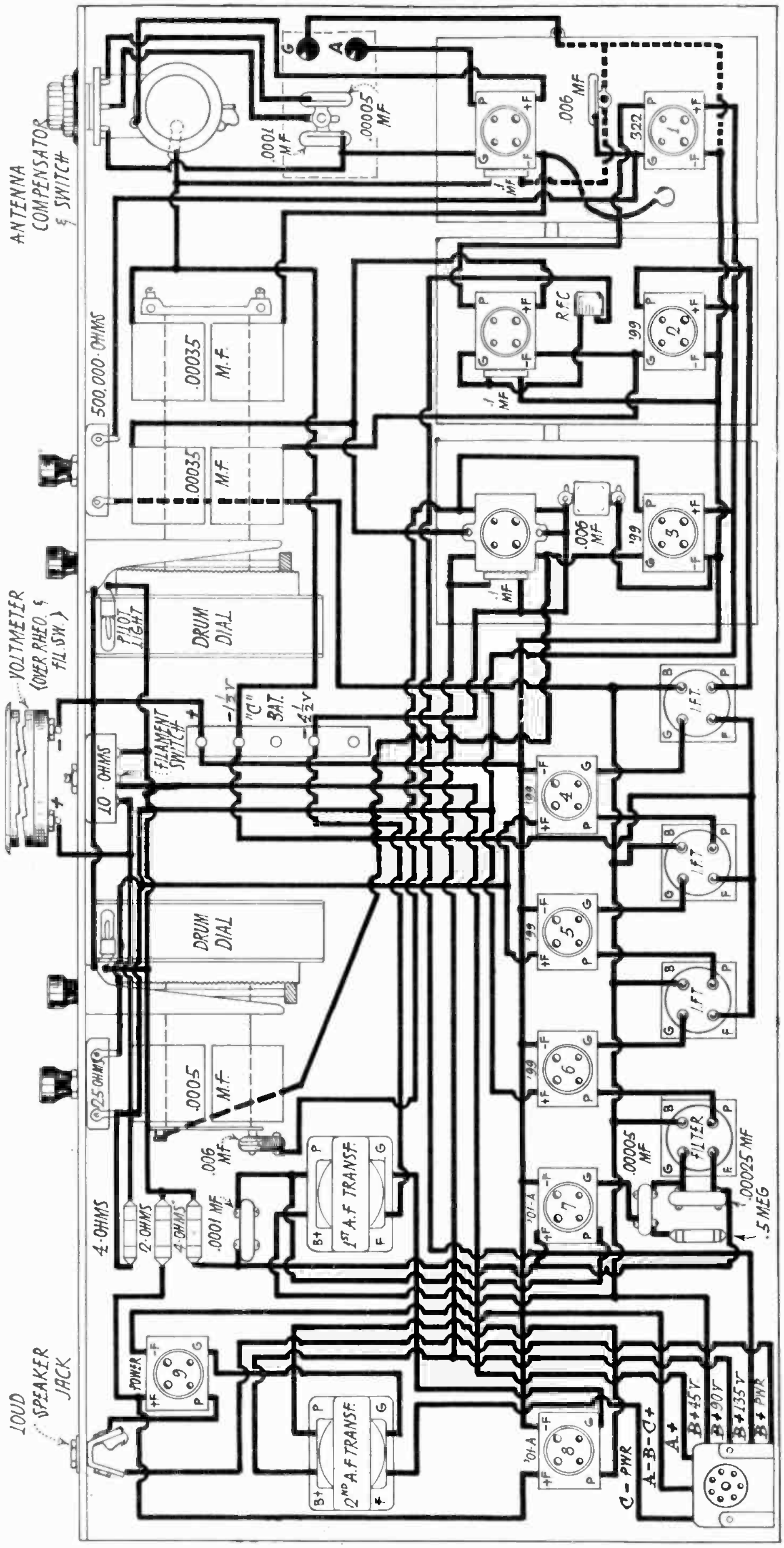
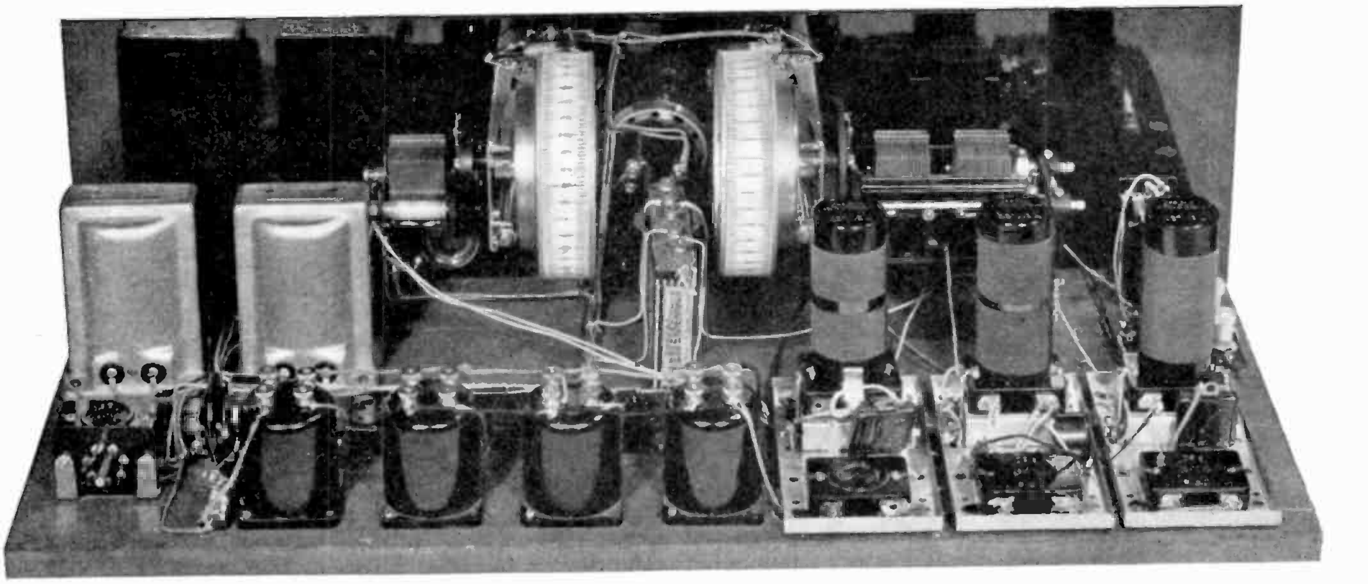



*Fig. 2. Actual Assembly and Wiring of Receiver*

be seen from the pictorial diagram, Fig. 2. The detailed connections of these coils can be followed from this diagram, which shows the actual connections to all the parts. Ready-made coils such as were used in the 115 k.c.



*The Revamped 45 K.C. Superheterodyne*

super can be used equally as well, the inductance units being the same design except that only one r.f. transformer is used instead of two.

The three shield cans are mounted on the rear of the baseboard, at the right, and a slot is cut in the baseboard, 1½ in. from the right-hand rear corner, to permit passing the connecting wires between the shield bases, underneath them. This slot is 5 in. wide, and 9 in. long, with a ⅝-in. margin along the back edge of the baseboard. As can be seen from the picture, these bases are placed about ¼ in. apart, and the three tube sockets are mounted at the rear end of each base, while the sockets for the inductance coils are placed on small brass brackets 1⅛ in. high, which raise the sockets above the shield base sufficiently to place a .1 mfd. bypass condenser underneath the socket. The factory-made shields have these brackets included along with the necessary mounting screws.

The three i.f. transformers and the filter are mounted in a row along the back edge of the baseboard, with about ¾-in. spacing between transformers. The three i.f., second detector and first audio tube sockets are placed in a row in front of the i.f. transformers, and at the left-hand rear end of the baseboard, a cable plug terminal is mounted. The two audio transformers are placed as shown in the picture, and between these transformers and the front panel the power tube socket, and the fixed filament resistances are mounted.

The front panel, which is 7 x 26 x 3/16 in., supports two illuminated drum dials, one for the .0005 mfd. oscillator condenser, and the other for the two-gang condenser controlling the r.f. amplifier circuit. Between these two dials the panel voltmeter is placed, and below the latter, a 10-ohm rheostat-switch is mounted. Looking at the picture of the front panel, the antenna-compensator

PARTS REQUIRED

2 Drum Dials.
1 Escutcheon Plate for Panel.
1 Two Gang condenser with insulated rotors and stators—.00035 mfd.
1 .0005 mfd. variable condenser.
3 Shield cans 3 x 5½ x 5¾ in.
12 Tube sockets—(at least 3 UX base for coils).
3 No. 600 i.f. transformers from old 45 k.c. super.
1 No. 610 filter transformer from old 45 k.c. super.
2 Audio transformers.
1 Voltmeter—0-5 volts.
1 500,000 ohm variable resistance.
1 10 ohm rheostat-switch.
1 25 ohm variable resistance.
2 4 ohm fixed resistances.
1 2 ohm fixed resistance.
3 .1 mfd. by-pass condensers.
3 .006 mfd. fixed mica condensers.
1 .001 mfd. fixed mica condenser.
1 .00025 mfd. fixed mica condenser for filter transformer.
2 .00005 mfd. fixed mica condensers.
1 .0001 mfd. fixed mica condenser.
1 Antenna Compensator.
2 R.F. coils (see text).
1 Oscillator coil (see text).
1 R.F. choke (at least 1 millihenry).
1 Battery cable with terminal connector.
1 C battery—7½ volts with taps each 1½ volts.
1 Single circuit jack.
1 Panel 7 x 26 x 3/16 in.
1 Baseboard 11 x 25 x ¾ in.

and series-condenser switch is seen at the left-hand end, and at the right is the speaker jack. To dress up the panel and give it that "factory-built" appearance, a brass plate, as shown in the picture, was used, and as this plate is already drilled and embossed for the two drum dials, voltmeter, and the rheostats, it is only necessary to lay the plate on the panel and mark out the holes to be drilled through it for the various pieces of panel apparatus.

The main volume control is the 25-ohm rheostat mounted at the right of the rheostat-switch, and at the left is the 500,000-ohm variable resistance used to control the gain of the shield grid tube. Between the drum dials, on the baseboard, is a 7½-volt *C* battery used to furnish 1½ volts negative for the i.f. amplifier tubes, and the shield grid tube, and 4½ volts negative for the oscillator, first detector and first audio tubes. If extra wires are run in the battery cable, this *C* battery can be located externally, or a *C* battery eliminator associated with the *B* power plant can be used. The 7½-volt size battery is used, as it is the only one on the market which has a 1½-volt tap; the remaining 3 volts above the 4½ volts required are not used.

From the above data, and the pictures, it can be seen that the material which can be salvaged from the old set consists of the i.f. transformers and filter, the oscillator condenser, tube sockets, audio transformers, volt meter, and some of the miscellaneous resistances and bypass condensers. If the audio transformers are several years old, they are probably obsolete, and should be replaced with new ones which have a better frequency characteristic. This is a matter for the set-owner to decide, as some transformers which are two or three years old are still excellent as compared with some of the 1928 models. The shield grid tube will require an X base socket, and if the old style sockets used in the 1924 model sets have loose springs, they should be replaced with X base sockets. Note that the grid condenser and leak in the second detector circuit have different values than customarily used, to improve the output of the second detector at the higher frequencies, as described in more detail in the "Technical Briefs" column in this issue.

All wiring in this set was done with solid insulated wire of the "push-bak" variety, as this wire is quite flexible, is easily cabled, and the insulation at the ends can be pushed back with the fingers to expose a portion of the tinned wire for the soldered connection. The filament leads, positive *B* and negative *C* battery wires were cabled together, but all grid and plate leads were run by the shortest route and were kept out of the cable form. The two oscillator condenser leads were run directly from the oscillator shield base to the condenser terminals, these leads being at an angle with nearby wires so as to avoid paralleling the i.f. amplifier wiring as much as possible. The coupling coil between the oscillator and first detector circuits is placed in the filament end of the first detector grid return, a .006 mfd. bypass condenser being connected between the *C* battery end of this coil, and the filament of the first detector to prevent coupling through the *C* battery. The old oscillator coil used in the original model can be used if the coupling coil shaft is cut off, but it makes a very tight fit into the shield can, and a larger can will be required. The oscillator coil used in the rebuilt model was designed for a 115 k.c. circuit when used with a .00035 mfd. tuning condenser, so that by using the old .0005 mfd. condenser, the coil will oscillate over a band of frequencies suitable for a 45 k.c. circuit.

There should be little difficulty in lining up this set after it is rebuilt, as the i.f. amplifier and audio circuit is practically the same as the original circuit, the only difference being in the front-end amplifier. The antenna compensator is used as the trimmer adjustment for the end section of the two gang condenser, so that after the two dials have been roughly logged, a station around 400 meters should be located on the oscillator dial, and the r.f. dial set at maximum volume for that station. Then, if no adjustment of the antenna compensator knob produces a sharply defined maximum in the sound, the variable mica trimmer associated with the variable condenser shunted across the r.f. transformer secondary should be adjusted until moving the antenna compensator knob produces a maximum at about the center of its swing.

Local and distant stations should be free from heterodyne whistles caused by harmonics of the oscillator, and while there will be two settings of the oscillator dial for any given station, these settings should not interfere with reception of other stations. Once adjusted, the amplification control of the shield grid tube, which is the 500,000-ohm variable resistor, should not require further attention, and the volume can be controlled by the 25-ohm rheostat in the i.f. amplifier filament circuit. The power tube used depends on the amount of volume required. If the '71-A tube with more than 135 volts plate is used, an output transformer will be required; as most electrodynamic speakers have an output transformer already built into the speaker, it may not be necessary to purchase an output transformer for the set.

# Finding Buried Treasure by Radio

*By* SAMUEL G. MCMEEN

WE SHRINK at the somewhat sensational title to this writing, but it expresses what we have to say. So why apologize? By the term "treasure" is meant anything that is metallic. Pearls and diamonds barred. One of the purposes of the device here described is the location of natural deposits of metals.

The great Faraday used to say, when confronted by a new phenomenon brought to him for observation, "Tell me what to observe." This for fear that his mind might be drawn off into some channel other than the right one for the purpose in hand, even though the diversion might be of vastly greater import than the original. Accordingly, please

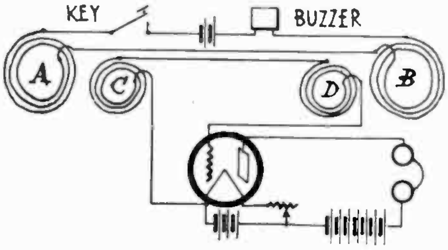



*Fig. 1 Balance and Amplifier*

observe that in Fig. 1 there are four coils, lettered *A, B, C,* and *D,* and that coils *A* and *B* are serially connected in company with a battery and a buzzer. As long as this connection is maintained and the battery holds out, the buzzer will operate. These two coils, *A* and *B*, are connected to each other in such a manner that their windings oppose each other in direction.

The coils *C* and *D*, similar in form to *A* and *B*, are connected so that when the buzzer is operated there is no sound —or little sound—in the telephones operated by the amplifier. For the rest of the rig is simply that, with the output of the coils *C* and *D* connected to the grid and filament, and the head set and *B* battery connected to the plate and *A* battery, a very faint train of impulses in the balance is made plainly audible.

The coil *C* lies horizontally above the horizontal coil *A*, and similarly *D* over


*Fig. 2 Actual Relation of Coils*

*B*, all as shown in Fig. 2. This relation should be made adjustable, so that by varying it, the required condition of no sound in the telephones may be attained when there is no metal near either coil *A* or coil *B*. By varying the separation of one pair of coils while the other is stationary this condition of least sound may be attained.

The ability of the device is of this order: when a conductor of any kind lies in the neighborhood of one pair of coils and there is no exactly similar conductor in the neighborhood of the other pair of coils, a sound will be heard in the head set. This is the fact to the degree that if a good coin be placed near one pair of coils and a counterfeit imitation of it near the other pair (and exactly the same distance from it) a sound will be heard because of the difference in the conductivities of the noble and base metals.

For practical use as a metal finder, the pairs of coils should be mounted on wood supports about 15 ft. long, so as to get the two coils well apart and so to accentuate the difference in field caused by the nearness of the sought metal. This wood structure should also carry the batteries and the amplifier. The whole outfit is then carried over the region in which the metal is hoped for, listening while this search progresses. It will be found that the searched-for metal lies directly below the point of loudest response in the telephones.

Care should be exercised not to expose the ears to the maximum response from the balance, as it is sometimes very strong. In regular use, however, the sound swells from nothing to louder gradually, so that there is ample notice of the approach of the dangerous condition.

Each of the coils *A, B, C,* and *D* should carry about 300 turns of No. 32 wire.

It is important to omit from the wood structure all metals, such as bolts, nuts, nails and screws. Lashings of thongs or cords should be used instead of such metallic fastenings.

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The voltage drop caused by a resistor connected in series in a circuit is equal to the product of the resistance in ohms and the current in amperes. Conversely the required resistance value in ohms is equal to the quotient of the voltage drop by the current. Thus to find the size of the resistor necessary to reduce a 6-volt supply to the 5 volts necessary for the operation of six '01A tubes, each requiring .025 amperes, first find the voltage drop, 6—5=1, then find the current in amperes, 6 × 0.25 = 1.5, then divide 1 by 1.5=.66 ohms. Likewise to find the resistor size to reduce a 6-volt supply to the 3 volts necessary for the operation of seven '99 tubes each taking .06 amperes: 6—3=3 volts drop, 7×.06=.42 amperes, 3÷.06=50 ohms.

# Radio Picture Transmission and Reception

## Photoelectric Equipment and Methods for Visual Communication

*By* JOHN P. ARNOLD, *Departmental Editor*

THE transmission and reception of moving pictures by wire and radio was demonstrated on August 8 in the laboratories of the Westinghouse Electric and Manufacturing Company. The pictures were sent over two miles of wire from the laboratories in East Pittsburgh to Station KDKA, and the radio wave was picked up on a receiver in another part of the laboratory building.

The system devised by the Westinghouse engineers may be considered as a combination of both phototelegraphy and television, since it solves some of the most serious problems of television by methods employed in "still" picture communication. It has been a by-word of experimenters in this field that the reception of moving pictures in the home will be developed before the transmission of images of natural moving scenes is perfected. The present demonstration indicates that this is likely to be the case, as the results which were obtained are said to be much more satisfactory, as far as the quality of the received pictures is concerned, than the more difficult problem of actual television.

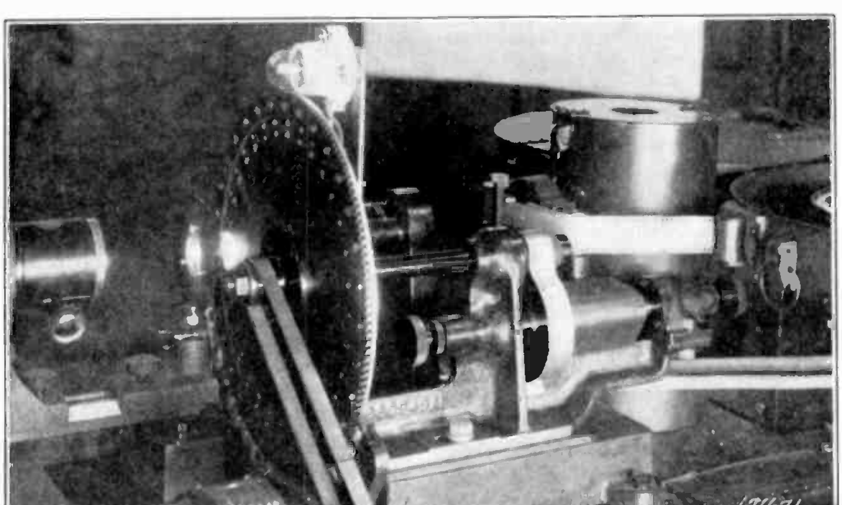
*Radio Movie Projector as Operated by Frank Conrad*

Although it is difficult to present a technical description from the information at hand, some of the most interesting features of the system may be gathered from the pictures and data presented here. At the transmitter, the subject, which is a standard moving picture film, is scanned by a beam of light passing through the usual Nipkow disc and the film, and subsequently falling on the cathode of a caesium photoelectric cell. The intensity of the light varies in accordance with the density of each small area of the film to which the beam is directed by the rotation of the scanning disc. These varying intensities produce, in the output of the photoelectric cell, a current which is proportional to the light and shade of the film.

The advantage of such a transmitting system lies in the fact that extremely powerful lamps may be used in scanning a film which would be intolerable if the subject happened to be a human being. Again, the fact that the photoelectric cells are not required to collect the reflected light from the scene is another point gained. The resultant efficiency of such an optical system removes the necessity of employing a tremendous amplification of the photoelectric current.

In this system the efficiency of the scanning disc is increased by the use of square instead of circular holes arranged in the conventional spiral around the disc. Each small picture of the film is scanned by one revolution of the disc and the film is moved before the disc at the rate of sixteen pictures per second.

The caesium photoelectric cell is not used as often for practical engineering work as is the potassium hydride, gas-filled cell. Caesium, an alkali metal, is much more difficult to prepare than potassium, due mostly to its lower melting point. A cell of pure caesium is more sensitive, especially to the longer wavelengths of light, than potassium; but potassium can be readily sensitized by converting it to a hydride and filling the bulb with an inert gas such as argon. Some investigators report that cells of caesium hydride are not particularly successful, and it is likely that a pure metal cell was used for this demonstration.



*Close-up of Westinghouse Radio Movie Transmitter*

The picture signals embrace a frequency range of from 500 to 60,000 cycles, since 16 pictures per second of a definition comparable with the 60-line screen of photo-engraving processes are transmitted. The quality of such pictures is much better than the usual television results where the pictures are composed of 20 or 30 lines to the inch instead of sixty. It is also possible that it was not necessary to transmit the highest frequencies involved without causing distortion, as was found in the case of the Bell demonstrations. It would seem, however, that frequencies lower than 500 cycles might be involved.

The signals are picked up on a radio receiver and control the intensity of a mercury arc lamp which varies in brightness in accordance with the light or shade of the moving picture at the transmitter. Another scanning disc distributes these light values to their proper place in order to reproduce the picture which is thrown on a ground-glass screen.

Both scanning discs are turned over at the same speed, so that each hole in the receiving disc is in exactly the same relative position as the corresponding hole in the transmitting disc. For this purpose a 5000-cycle signal is produced by a tuning fork and transmitted over a separate channel from that used for the picture signals. This signal is received on a special receiver and controls the synchronous motors which drive the scanning discs at both stations.

A neon lamp is also used as a part of the synchronizing system. It is located above the scanning disc in the pictures shown here. Whether it is used as a part of the control system or as merely an indicator is not apparent from the information at hand, although the thought occurs that the Westinghouse engineers may have taken advantage of the peculiar property of the neon lamp to oscillate at a frequency determined by capacity of a condenser in parallel with the electrodes of the lamp and a resistance or inductance placed in series with the source of supply. This property of the neon lamp will be described in a forthcoming issue of the magazine in the connection with a neon lamp stroboscope.

The development of this system was undertaken by Dr. Frank Conrad, of the Westinghouse laboratories, and within two months' time had advanced far enough to give a practical demonstation of the work. Although the moving pictures were only transmitted over a total distance of four miles, the range in the case of radio transmission is of course limited only by the distance at which the signals may be received without serious fading, interference or atmospheric disturbance.

The officials of the company have announced that the regular transmission of motion pictures from KDKA would begin within a few weeks time and that commercial receivers are to be sold through the Radio Corporation of America.

## "B" in Phototelegraphy

The late Edgar Saltus remarked that greater writers almost invariably have surnames of two syllables with the accent on the first. In an idle moment we note that the names connected with picture communication begin with a "B"—witness Bain, Bakewell, Bidwell, Baird, Berjonneau, Belin and Baker; the Bell and Bartlane systems. Should this discovery enable any one to prove anything we shall be happy to be so informed.

## PREMATURE PUBLICITY

The writer of these pages has been guilty of many crimes (none of them trivial, thank goodness), but never has he failed to give the devil his due. *In re* this television furor, which has fluttered our tympanic membrane these many moons, our attitude has been as light and flippant as a chorus girl's opinion of third marriages. While we confess to a total inability to get excited over the immediate prospect of a practical form of television descending among us, we have not intended to create the impression that we mean to slight the endeavors of serious investigators of this problem. Rather than do that, we would chuck this word-mill out the window and go to work.

The thought has occurred that our readers require of us (plurals are used throughout this writing to discourage attempts of assault and battery) some explanation of our gay treatment of serious topics. In order that the misunderstanding may not be mutual, we hasten to exclaim that we admire greatly all earnest workers of scientific miracles and that we do not give three whoops down the neck of a twenty-foot horn for publicity seekers. To elucidate—probably at length—is our dire purpose.

Back in the good old days lived a clever fellow named Archimedes, a very absent-minded man, as another scribe rather casually reports. One day he rose from the bath and, in dishabille (it couldn't have been completer), he dashed through the streets of Syracuse shouting "Eureka!" What he had discovered was specific gravity—whether it was found in the water or in good King Hiero's golden crown the deponent knoweth not. Now, after clothing himself in a tunic or it may have been a blanket, did the modest Archimedes sit himself down in the portico (or is it the frieze?) of the temple and tell every passerby that they could now have specific gravity right in their homes? No, sir, he just explained that what he had discovered was after all only experimental specific gravity and the people would have to wait a little while before it would be suitable for every-day use.

We have not, unfortunately, any record of how the newspapers of that day proceeded to write up this discovery, but dimes to doughnuts the headlines read: *Archimedes Solves Specific Gravity; System Soon Available in Every Home.* Yet we all know from our classical studies that it took many years of concentrated effort for the perfection of specific gravity and all the people of Syracuse had to be satisfied with the ordinary kind of gravity, although they were disappointed many times by premature announcements that all the problems had been solved.

We return with dignified haste to the present and to the subject of television. In this day and age we find men working among their retorts and alembics and, no matter whether their immediate object is gain or fame, they are deserving of respectful attention and the utmost sympathy if the outcome of their efforts makes life brighter or more interesting for the rest of us. As a criterion of their labors we ask nothing more of them than that, when they make a new and important discovery, they tell us truthfully, without obscuring the issue, just what they have really succeeded in doing and, where possible, demonstrate, in order that we may judge for ourselves what has been accomplished. Whom we do distrust is the creature who pokes his head out of a laboratory, hollers his "Eureka" and then tells a wild yarn to the newspaper boys.

It may not be understood by our wide audience (as wide, we hope, as this effusion is long) the advantages of doing what is commonly—and how commonly!—known as "shooting off the mouth." Do you know why folks fly the Atlantic, fly the Pacific, fly a kite? No? Well, for the sake of publicity. Furthermore, publicity is unpaid-for advertising; advertising is said to pay, and you can tell this cross-grained world it does. In more and other words, you get something for nothing, and no one ever quibbles over the means of obtaining that. Without drawing the parallel finer, is it necessary to indicate why, in the case of television, it is profitable to howl about something you haven't got or to exaggerate the value of what you have?

For this reason we have been somewhat light-hearted in the matter of television; because, in lieu of proof, we have been fed the sauce of apples. There has been but one *bona fide* demonstration in recent years of its possibilities. Moreover, the actual results were published for the world to read. Nothing more could be asked. In addition, this demonstration made clear that a practical system of television has not yet been developed for reception in the home. Who shall say—certainly not this prognosticator—when this time will arrive. Furthermore we do not expect that television will come from the hands of the self-advertisers.

## DARK SAYINGS

One does not begin to appreciate the vast potentialities of language in matters of lucidity and excellence until it becomes necessary to study the literature of patents. Among treasured gleanings from this storehouse comes the magnificent description of "an apparatus comprising an electron emitting cathode, a grid and plate in *thermionic cooperative array.*" Others less gifted than a patent attorney would hardly recognize the UX 201A under this bristling disguise.

## TELEVISION IN THE OPEN

Engineers of Bell Telephone Laboratories recently disclosed the further progress which they have made by demonstrating a new transmitting device which is capable of putting outdoor scenes upon a television circuit. On the roof of the laboratories actors boxed, danced, swung baseball bats and tennis rackets which appeared in brightly illuminated pictures in another part of the building.

The present apparatus differs radically from that of the first demonstration when the scene to be transmitted was illuminated by a powerful artificial light and only the actor's head and shoulders appeared in transmission. With the improved apparatus the scene is illuminated by ordinary sunlight and covers the area occupied by two men engaged in a boxing match.

In the first form of apparatus demonstrated in April, 1927, the scene was illuminated by a rapidly oscillating beam from a powerful arc light and that limited the scene to be transmitted to a very small area. The new development frees television from one of its limitations.

The scene or event to be transmitted is reduced to the form of an image by a large lens, this image being scanned by a rapidly rotating disc similar to that previously employed but much larger. The lens serves somewhat the same purpose in the television apparatus as the large lens of an astronomical telescope, and like the latter, it should be larger to gather as much light as possible.

The experiments show that moving persons and objects can be successfully scanned although at a considerable distance from the lens and therefore in such a position that the focus of the lens does not require changing from moment to moment. Light passing through the lens and scanning disc is made to actuate a photoelectric cell and generate an electric current which, after amplification, may be transmitted either by wire or radio.

This development in television is due to Drs. Frank Gray and Herbert E. Ives. They illustrate the progress of the telephone engineers in the problems of television, but the engineers themselves refused to prophesy as to future developments or applications. They pointed out that the improvement was in the television transmitter and that its use required no fundamental change in the two types of receiving equipment for use by either single individuals or larger audiences, which were developed and demonstrated a year ago.

## PICTURE RECEIVING METHODS

### III. Miscellaneous Devices

To conclude this review of picture receiving methods we have yet to describe those instruments whose most prominent characteristic is a high frequency of response. Hence these are usually more suitable for television than for phototelegraphy, but they have been proposed or employed at one time or another for still picture transmission and should therefore be considered at least for the sake of completeness. The neon lamp, the cathode ray oscillograph and the several types of Kerr cells are those which we will describe. In phototelegraphic systems these instruments are used with photographic methods of recording. Considering the expense of the oscillograph tube and the inconvenience of working with the neon lamp, the Kerr cells alone are the most adaptable for this purpose; but for television, as we approach the problem today, nothing appears to be more satisfactory than the neon lamp or the cathode ray oscillograph.

The Kerr cell, as employed by Rignoux and Fournier in their television experiments, consists of two Nichol prisms between which is placed a tube containing carbon bisulphide, a liquid which changes its refractive index (that is the ratio of the speed of light in air to the speed in any other medium) under the influence of electrostatic or magnetic fields. In Fig. 1, $L$ is a source of monochromatic light, $N$ and $N'$, Nichol prisms, and $CB$ a tube containing carbon bisulphide, around which is wound a coil of wire. If the Nichol prisms are set at the polarizing angle, no light falls on the receiving cylinder on which has been placed a photographic film. When a current passes through the coil of wire corresponding to the tone values of the original picture, the amount of light falling on the film will vary with the current, since this changes the refractive index of the carbon bisulphide and hence the angle of polarization.

The Karolus cell, which was also developed for a television system, is an instrument of this type, differing only

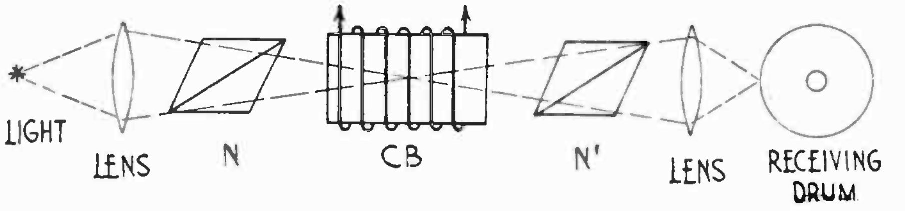



*Fig. 1. Kerr Cell*

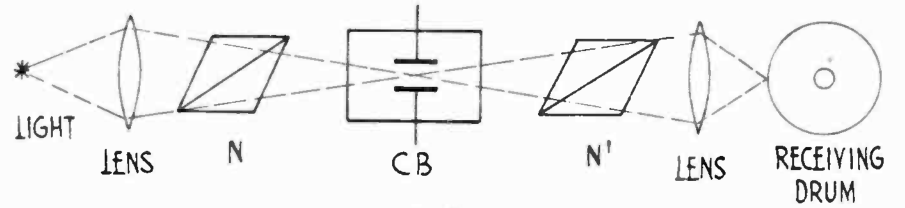
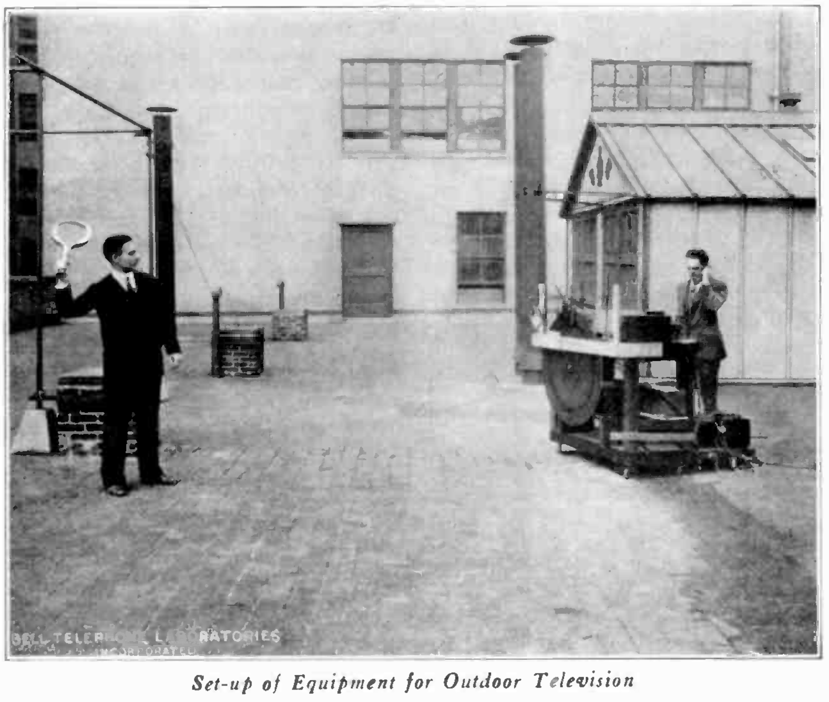



*Fig. 2. The Karolus Cell*



*Set-up of Equipment for Outdoor Television* in that instead of wrapping a coil of wire around the tube, two plates forming a small condenser are immersed in a liquid which is then subjected to an electrostatic instead of a magnetic field, (Fig. 2). Further information regarding such electro-optical shutters may be found in a paper by J. W. Beams in the *Journal* of the Optical Society of America, (Vol. 13, p. 597; Nov., 1926).

The neon lamp is too well known to require an extensive description since few have failed to observe the characteristic pink glow that winks at us from many advertising signs. For the purpose of television, for which it is generally used, the brightness of the lamp varies with the received image currents. The observer looks directly at the plate of the neon tube through a scanning disc which rearranges the lights and shades of the original scene in the correct order. It is hardly worth while to employ the neon lamp in still picture transmission due to the low intensity of the light and the color, which is not very satisfactory for photographic recording.

Alexanderson discusses the merits of the Karolus cell and the neon lamp for television as follows: "The first choice to be made was to select a source of light. This choice was soon narrowed down to two alternatives—the light-control developed by Professor Karolus of Leipzig and the neon lamp developed by D. McFarlan Moore of the Edison Lamp Works of the General Electric Company. Tests of these two sources of light for television soon convinced us that each has its own distinct field of usefulness. When a large volume of light is needed for projection on a screen, the Karolus system is preferable. . . . While the neon lamp does not compare with the Karolus light in brilliancy, it is more sensitive and easier to operate."

The Braun tube or cathode ray oscillograph is an instrument which may be used either for phototelegraphy or television. In its most suitable form (Fig. 3) the tube contains a filament in a highly exhausted bulb supplying a stream of electrons which are directed upon a fluorescent screen (crystals of zinc sulphide, zinc silicate, calcium tungstate, etc.) which is rendered luminous by the impact of the electrons. By the use of coils or plates, as in the case of the Kerr cells, the movement of the spot of light on the fluorescent screen can be controlled by the application of magnetic or electric fields controlled by the picture currents. The size and intensity of the luminous spot can also be varied by adjusting the filament and anode voltage. Possessing little or no inertia the cathode ray oscillograph is quite likely to have a prominent place in the development of television, since it will respond to the high frequencies necessary for this form of visual communication.

This description of the various methods of receiving has preceded any attempt to describe a complete phototelegraphic receiver suitable for working on radio communication channels; chiefly for the reason, as has been pointed out elsewhere in this department, that the design of such a receiver is largely governed by the transmitting system and, until it is known just what type of equipment the broadcasters will install, construction articles are practically worthless. As soon as picture broadcasting becomes well established, these essential facts will be published; but in the meantime it is advantageous to become familiar with some of the various methods of receiving for the experimenter can often adapt several of these to the particular apparatus which he has installed.

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Newspaper reports have it that another system of picture transmission has been demonstrated in London. From meager descriptions reaching this side of the Atlantic, this system, designed by Captain Otto Fulton and called the "Fultograph," is somewhat reminiscent of the earlier systems of phototelegraphy. It appears that a photo-engraving is made on copper (presumably using insulating material such as fish glue) and this is placed on a revolving metallic drum. At the receiving station, the picture is printed by passing a current through chemically treated paper. Synchronism is carried out "electromagnetically." The system can be used either for wire communication or for radio, and the receiver is to be placed on the market for amateur use.

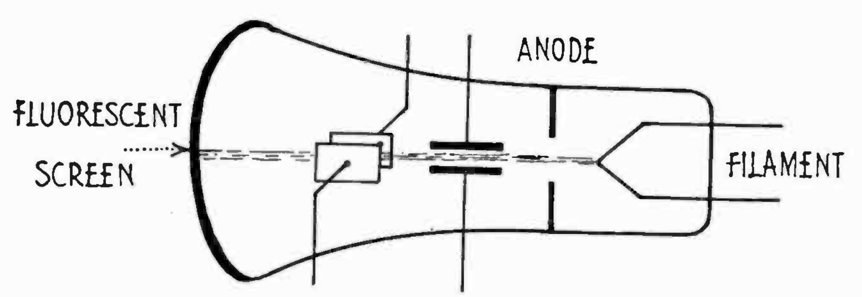
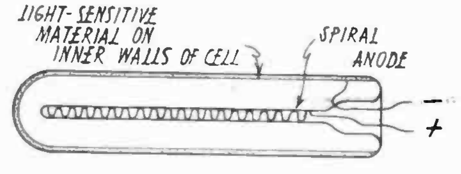



*Fig. 3. Braun Tube or Cathode Ray Oscillograph*

## III. LIGHT SENSITIVE CELLS

The alkali metal photoelectric cell shown here is one of the few cells which have been especially designed for television. It was developed by Dr. Herbert E. Ives and three of them were used in parallel in the transmitting apparatus demonstrated by the Bell Laboratories. These cells differ from the conventional type in that they have an exceptionally large area (40 square inches) of light-sensitive material and have an aperture of 120 square inches to collect the reflected light from the subject to




*The Ives Photoelectric Cell*

be transmitted. The cells, which are 14½ inches long and 3½ inches in diameter, are probably the largest that have ever been made. The cathode material, deposited on the inner walls of the glass bulb, is potassium hydride and is contained in an atmosphere of argon to increase the current output by ionization of the gas. The anode consists of a spiral of wire extending down the center of the bulb. The necessity for such large cells is due to the fact that they must be operated from the diffused light reflected from the scene or object to be transmitted and at the same time "generate" a current large enough to override the noise level in vacuum tube amplifiers.

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The Federal Radio Commission has approved of several applications to operate or to construct stations for the experimental work and the actual transmission of television signals. These stations have been assigned 100 kilocycle bands between about 47 and 125 meters. The authorizations were granted the following:

8XI. Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. 63.83 to 62.5 meters and 19.86 to 19.73 meters. 20,000 watts. This wavelength will be shared with 2XBW of the Radio Corporation of America.

6XC. Robert B. Parris, Los Angeles, Calif. 4500 to 4600 kilocycles, (66.7—65.2 meters). 15 kilowatts.

2XBU. Harold E. Smith, Beacon, N. Y., 4800 to 4900 kilocycles, (62.5—61.22 meters). 100 watts.

1XAY. J. Smith Dodge, Lexington, Mass. 4800 to 4900 kilocycles, (62.5—61.22 meters). 500 watts.

3XK. J. Francis Jenkins, Washington, D. C. 4900 to 5000 kilocycles, (61.22—60 meters). Also 6420 kilocycles (46.72 meters). 5 kilowatts.

4XA. Station WREC, Inc., White Haven, Tenn. 2400 to 2500 kilocycles (125 to 120 meters). 5 kilowatts.

# An A. C. Screen-Grid Five Receiver

## Some Interesting Suggestions for the Experimenter

*By* FRANK C. JONES

THE advent of the a.c. screen-grid tubes makes possible the design of receivers having exceptionally high amplification for a given number of tubes. They are similar in characteristics to the d.c. models and are of several types. The main difference seems to be in the filaments, one type using a heavy round filament operating on 1 volt like the UX 226 amplifier tubes. Another type has a 15-volt heater with cathode grounded to one side, while the tubes used in this receiver have filament characteristics similar to a UY 227. This last type of tube may have the filaments wired in parallel to the UY 227 detector tube, providing the filament power supply transformer will deliver sufficient current without overheating.

An experimental receiver, shown in the photographs, was designated with several points in mind. First, it was desirable to have a great deal of amplification without using more than two screen-grid tubes.

Second, lack of selectivity, which is troublesome with ordinary circuits using screen-grid tubes, was a real problem to overcome. The circuit shown in Fig. 1 works out very well, as will be shown later.

Third, was the problem of selectivity without too much audio distortion due to side band cutting in the radio frequency amplifier and detector circuits. This can be solved by using a large number of tuned circuits, in which case the overall resonance curve is more nearly square in shape. Four tuned circuits are used here, since with less the loss of high audio frequencies due to side band cutting was noticeable. This occurs when more regeneration is used in order to obtain the same apparent selectivity—the resonance curve is more peaked.

The fourth problem was the use of an audio amplifier system which would give good quality reproduction and still not make the a.c. hum bothersome. If an audio amplifier is used in which the transformers will efficiently repeat 60 cycles, the a.c. hum in a good dynamic speaker is objectionable. Most of the 60 cycle a.c. hum, audible as 60 cycle and higher harmonics in the speaker, originates in the detector circuit, with perhaps a little in the r.f. amplifier. So an audio amplifier should be designed to cut off above 60 cycles if the residual hum in the speaker is to be minimized.

Most commercial a.c. tube receivers use audio amplifiers which are "down in the mud" on low frequencies in order to minimize the a.c. hum. The same thing has been done in this receiver except that the cut-off is sharper than in most a.c. receivers. This allows better low frequency amplification down to, say 100 cycles per second. The cut-off was made sharper and more complete by resonating the primary of the first transformer with a 0.1 mfd. condenser, $C_{16}$, Fig. 1. This condenser resonates at about 100 cycles per second with the primary of the first audio transformer,

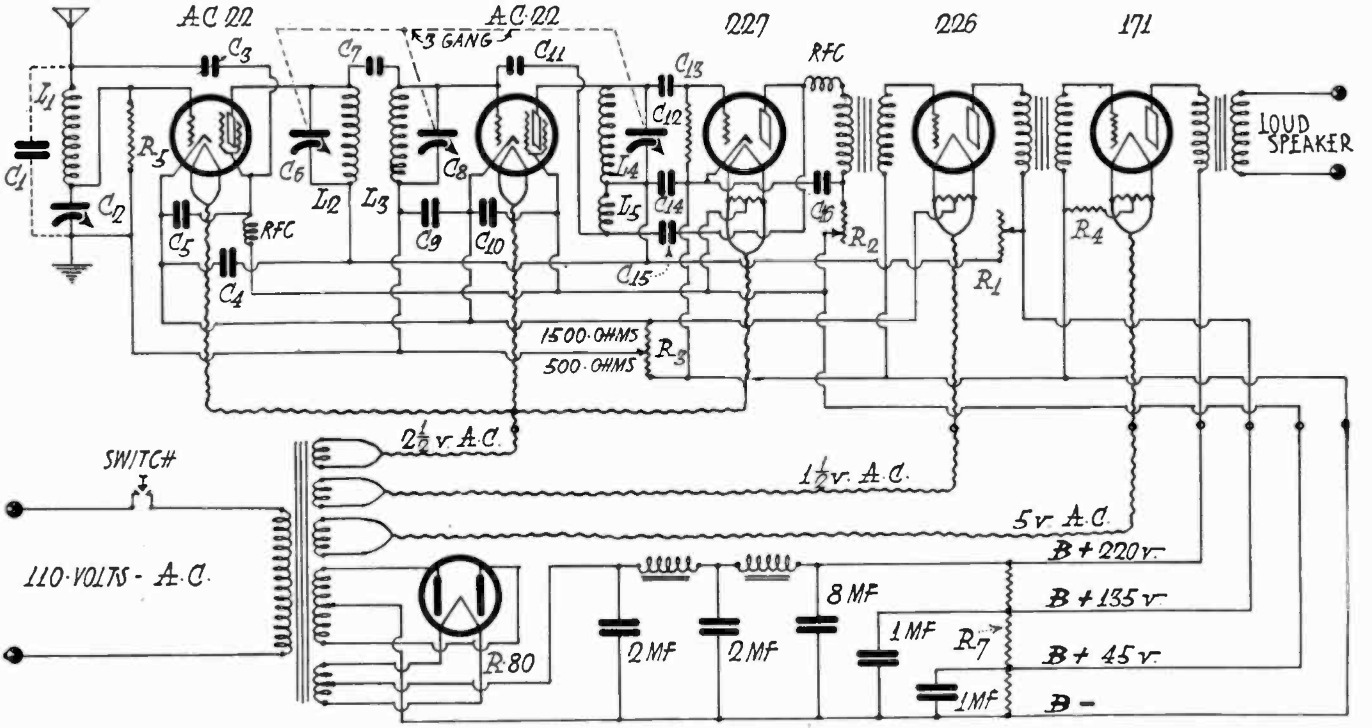
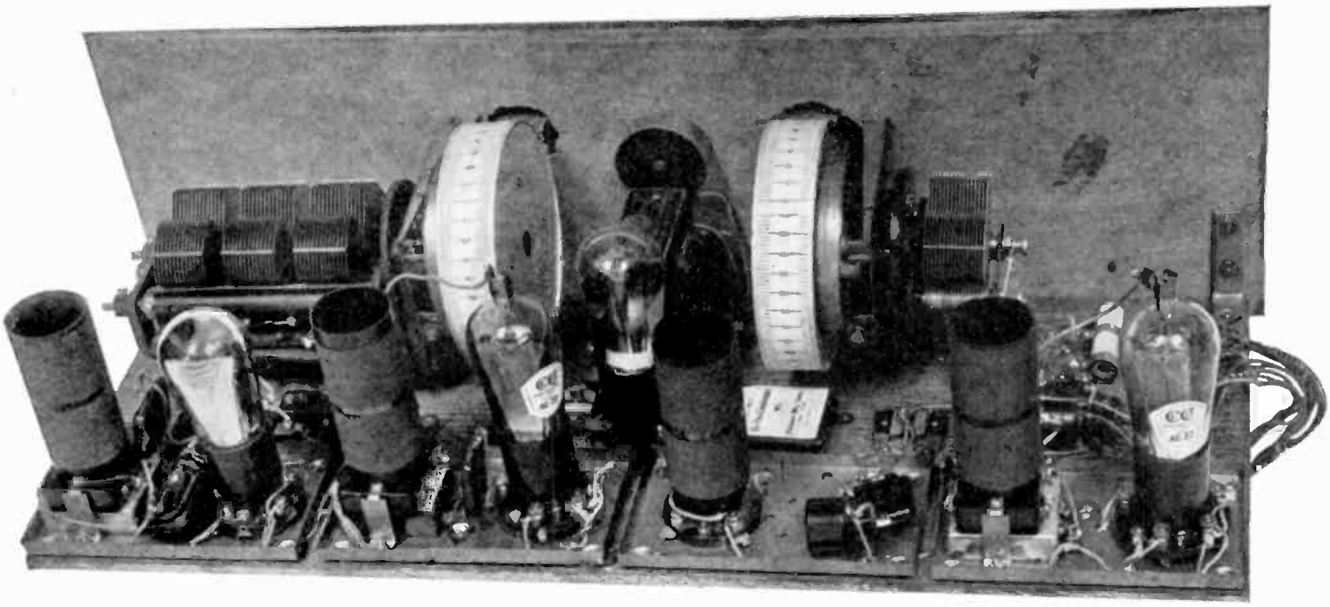



*Fig. 1. Circuit Diagram of A.C. Screen-Grid Receiver and Power Plant*

$C_1$ = .001 mfd.
$C_2$ = .0005 mfd. max. variable.
$C_3$ = .0001 mfd. max. semi-variable (feedback)
$C_4$ = 1. mfd.
$C_5$ = .00025 mfd.
$C_6$, $C_8$, $C_{12}$ = 3 gang variable condenser .00035 mfd. max.
$C_7$ = 2 to 20 mmfd. semi-variable condenser. (coupling).
$C_9$ = .01 mfd.
$C_{10}$ = 1. mfd.
$C_{11}$ = 2 to 20 mmfd. semi-variable condenser. (neutralizing).
$C_{13}$ = .00025.
$C_{14}$ = 1 mfd.
$C_{15}$ = .0005.
$C_{16}$ = 0.1 mfd.
$R_1$ = 0-500,000 ohm variable resistance.
$R_2$ = 0-500,000 ohm variable resistance.
$R_3$ = 2000 ohm grid bias resistor tapped at 500 ohms.
$R_4$ = 2000 ohm grid bias resistor tapped at 500 ohms.
$R_5$ = 0.1 megohms.
$R_6$ = 2. megohms.
$R_7$ = 25,000 ohms. (25 watt size).
$L_1$, $L_2$, $L_3$, $L_4$ = Tuning inductances for broadcast range.
$L_5$ = Feed-back coil = 20 or 30 turns.
R.F.C. = 1⅛ millihenries.
Audio Transformers = 3:1 ratio.
Output Transformers = 1:1 ratio.
Tubes = 2 AC 222—r.f.
1 Type 227—r.f.
1 Type 226—1st audio.
1 Type 171—Power.
1 Type 80—Rectifier.



*Rear View of A.C. Screen-Grid Receiver*

which gives increased amplification there and much less down towards 60 cycles. The resonance effect is not very great, since the detector plate impedance is part of the series resonant circuit. However, it is enough to make the amplifier better.

The variable resistance $R_2$, Fig. 1, acts as a regeneration control for the r.f. transformer primary through the condenser $C_{17}$. This resistance was made large enough so that even with the detector tube nearly oscillating, over 100,000 ohms resistance is still in the circuit.

The amplifier has several unique features. The first part of the circuit consists of a tuned antenna system with the control grid of the tube across the tuning condenser. The screen-grid feeds back through the condenser $C_8$ to the antenna coil in the familiar modified Colpitts' oscillator circuit in order to obtain some regeneration. Regeneration makes this circuit tune more sharply and, since energy is fed back to the control grid circuit, greater signal response is obtained. The by-pass condenser $C_5$ shunts most of the screen-grid r.f. energy to ground, so that only a small portion is fed back to the control grid through $C_3$ and the antenna coil.

The plate circuit of the first tube consists of a tuned impedance and is coupled to the next tuned circuit through the very small coupling condenser $C_7$. This arrangement greatly improves the selectivity, since it adds another tuned circuit. The reaction between the two screen-grid tubes is lessened somewhat also. By making $C_7$ large enough, 5 to 15 mmf., a band pass effect is obtained, since a double resonant hump is secured, due to closeness of coupling between the two tuned circuits.

The second screen-grid tube is also connected across tuned circuits, both grid and plate. This stage is neutralized since there is some grid to plate capacity in the tube and between the grid and plate circuit tuning condensers to cause oscillation. Neutralization is accomplished with a condenser $C_{11}$ and a winding coupled to the tuned circuit following this tube. By having this stage neutralized, it is possible to use any amount of regeneration in the detector without throwing the r.f. amplifier into oscillation. The winding can also be used as the tickler feed-back coil for the detector with very little unbalance. This winding is in the proper direction for both purposes when it makes a continuous winding with the tuned circuit coil.

The detector is of the usual grid leak-condenser system with controllable regeneration. The variable resistance $R_2$ controls regeneration, and $R_1$ controls volume. These two are both 0-500,000 ohm variable resistances and are controlled by knobs on the panel. $R_1$ controls the r.f. amplification by change of plate voltage. Since the plate current drain of the two screen-grid tubes is quite small, the change of load on the plate supply unit is negligible. The detector, and the two tuned circuits preceding it, are tuned by means of a three-gang condenser so that there are only two tuning controls in the form of two drum dials.

As shown in the pictures, the experimental receiver was made up in two units, one including the r.f. amplifiers, detector and first audio stage; and the other unit, the last stage of audio and the *A, B, C* power unit.

All *C*-biases are obtained by means of resistances in negative *B* leads. The peculiar biasing obtained by means of $R_3$, Fig. 1, is necessary in order to maintain nearly a fixed bias on the grids of the two r.f. tubes. Changing the volume control setting $R_1$ changes the plate current of these two tubes and so changes the current through part of $R_3$, but the percentage change of voltage across $R_3$ is changed very little. This should be nearly constant, since the total drop across $R_3$ provides *C* bias for the first audio tube. The plate current of this audio tube, a type '26, is large so that practically constant *C*-bias voltages are available from the resistance $R_3$. $R_3$ should be a total of about 2000 ohms tapped at 500 ohms from the —*B* lead. The resistance $R_4$ also consists of about 2000 ohms to provide *C* bias for a type '71 power tube.

All plate voltages are obtained from a voltage divider of 25,000 ohms. This resistance is shunted across the power supply, and is tapped at 45 and 135 volts. There is nothing unusual about the power supply unit and amplifier, and it might well be crowded into much less space than the one shown in the picture. The main requirement is that it supply about 220 volts across the voltage divider so that about —40 volts *C* bias and 180 volts *B* supply are available for the type '71 power tube.

The filament winding for the heater-type filament tubes should be capable, without overheating, of supplying 5¼ amperes at 2¼ volts for the two r.f. tubes and detector. A type 80 full-wave rectifier tube was used in preference to a gaseous rectifier because of less voltage drop. This makes it possible to use a power pack with high voltage winding of 220 to 250 volts on each side of the center tap.

Because of the circuit design, it is not necessary to completely shield the r.f. stages and detector. However, it is quite necessary to shield the coils and tubes from each other. Copper cans 3 x 6 x 5½ in. in size were used for each tuned circuit. These cans are made with removable sides and tops, so the job of wiring is quite simple. All wiring is done by means of insulated wire in the most direct fashion possible. Most of

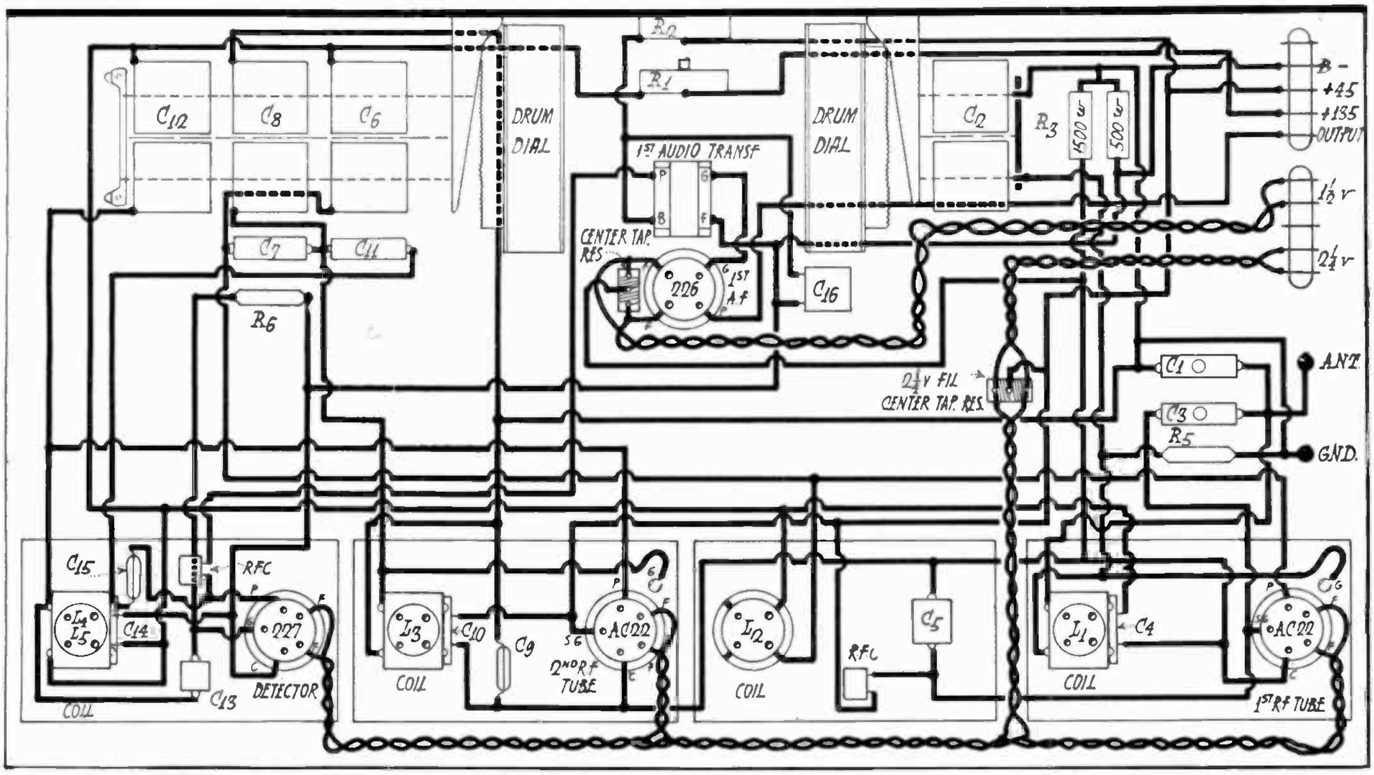



*Fig. 2. Layout of Apparatus for A.C. Screen-Grid Receiver*

the leads are run through holes in the subpanel and run along underneath this panel. All a.c. filament leads are run in twisted pairs, using at least No. 16 gauge wire. All shields, drum dial frames and transformer cases are grounded to —B. The large by-pass condensers are generally mounted underneath the plug-in coil sockets.

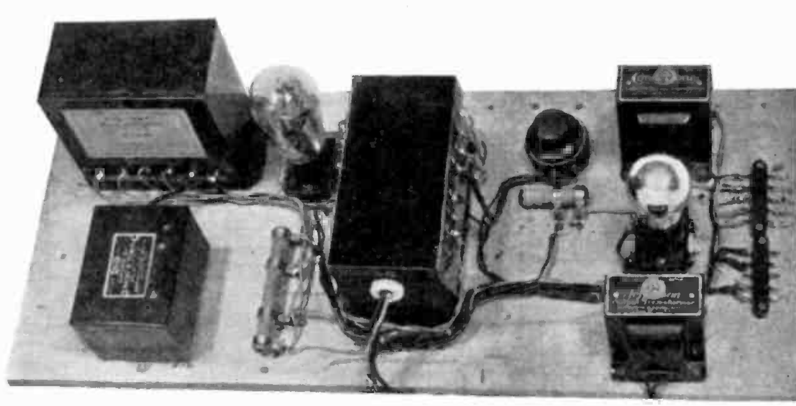
The coils consist of about 120 turns of wire on a 2½-in. tube arranged for plug-in mounting into X sockets. They are wound in two sections with the grid and filament leads coming out at the center instead of the ends. This gives a smaller field and allows the use of the relatively small shielding cans. Any coils suitable for the broadcast range may be used if desired.

The antenna coil may be of the same size as the others, in which case a .001 mfd. condenser $C_1$ will probably have to be shunted from aerial to ground unless a very large antenna is used. This condenser simply increases the antenna effective capacity in case a small antenna is used. Somewhat greater signal strength, and a little less selectivity, will be obtained by omitting it and adding more turns to the antenna coil. The exact number would depend upon the size of antenna used, so that taps should be made every 40 or 50 turns so as to get approximately the correct number. The condenser $C_2$, having a maximum capacity of .0005 mfd., should then cover the broadcast range. Since the condenser $C_2$ isolates the control grid from ground, a grid leak $R_6$ should be used to obtain $C$ bias as shown. $R_5$ should be from .1 up to .5 megohms in value.

The detector feed-back coil should consist of about 20 turns, though this value is not critical. The winding should be in the proper direction so that the detector will oscillate when $R_2$ is decreased in value.

The feed-back condenser $C_3$ should have a maximum value of .0001 mfd. and the corresponding by-pass condenser $C_5$ should be .00025 mfd. The radio frequency chokes may be of any type, since none of them are at very high r.f. potential. The other by-pass condensers, $C_4$, $C_9$, $C_{10}$, $C_{14}$, may be of any value from .1 up to 1 mfd.

The by-pass condenser $C_{16}$ should be .1 for the particular type of transformer used. For other makes of transformers, other values of condensers would be necessary, since a .1 mfd. might resonate at 60 cycles with some other make, causing the a.c. hum to be emphasized instead of diminished.



*Power Plant and Second Audio Stage*

The coupling condenser $C_7$ and neutralizing condenser $C_{11}$ should both be semivariable with a range of from 2 to 20 mmfd. The grid condenser $C_{13}$ and

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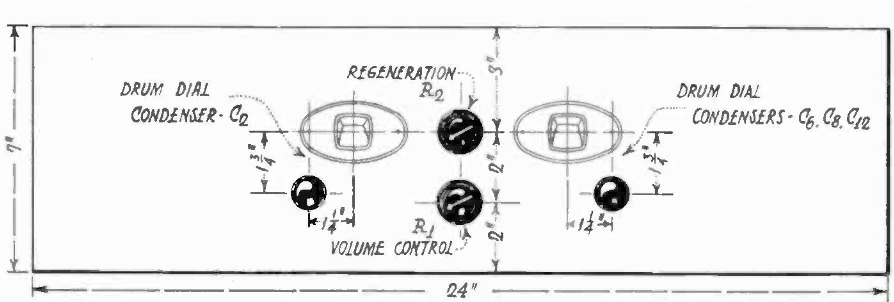



*Fig. 3. Panel Layout*

# A Portable Short-Wave Receiver

*By* CLINTON OSBORNE

WHEN the Commander Byrd expedition to the South Polar regions sailed from the United States in August, one of the many pieces of radio equipment carried along for use after the expedition reached its permanent base was the short-wave receiver shown in the pictures. This receiver, a gift from his business associates and friends to Mr. Joseph Rucker, the official motion-picture photographer of the expedition, is being taken along, not for the purpose of establishing communication with the United States as might be assumed, but for the entertainment of its owner and his companions on the "long winter evenings," when home seems far away, and the phonograph records have worn out.

Short-wave broadcasts from the North American continent and Europe are being picked up nightly in all parts of South America and Oceania, so that it is not beyond the bounds of reason to presume that successful reception of WGY at Schenectady and other short-wave stations will be had in the Antarctic Zone with a regenerative detector and two stages of audio amplification.

*Portable Short-Wave Receiver in Carrying Case*

The first requisite of this set was that it should be compact in size, and the second was lightness in weight. Loaded down with cameras, personal luggage and other equipment, the addition of a forty or fifty pound radio set would be too much of a burden, so that by careful placement of parts and the use of the well-known shelf design, as shown in the picture of the set, the parts were mounted on a 6½ x 14-in. panel, and placed in a cabinet only 6 in. deep.

Naturally, to be portable, the set was dry cell operated throughout, necessitating the use of type '99 tubes. The range could have been increased somewhat by the use of a shield grid tube ahead of the detector, but this type of tube requires 135 volts of *B* battery, and the weight of such a battery, even though small-sized cells were used, would be prohibitive.

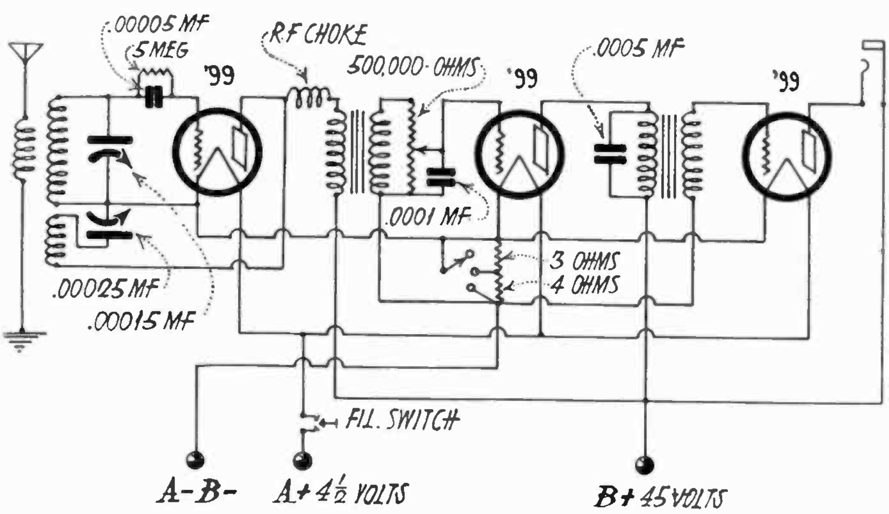
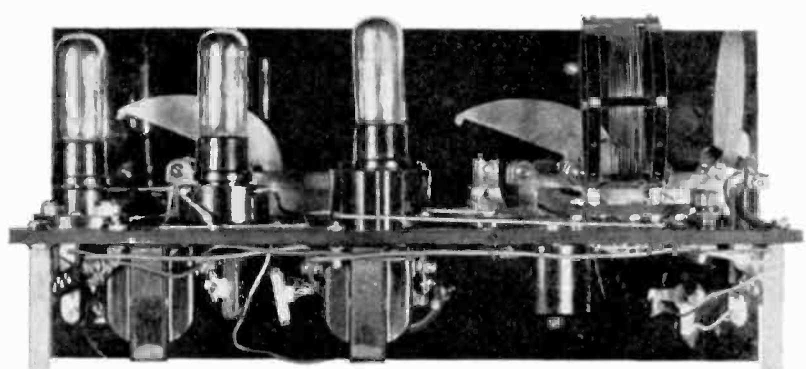



*Fig. 1. Circuit of Portable Short-Wave Receiver*

The circuit is shown in Fig. 1, there being three type '99 tubes in the conventional regenerative detector and two stages of transformer coupled audio amplification. The tuned circuit was made from a standard short-wave plug-in kit of coils, with mounting, so as to cover the waveband from 15 to 125 meters. To cut down on the height of the panel, the hard rubber mounting which came with the kit of coils was dispensed with, and the four-coil jacks were mounted on the bakelite sub-base which supports the tube sockets, chokes and audio transformers. By the use of a pair of alumni-

(Continued on Page 46)



*Rear View Showing Sub-panel Assembly*

# A Portable A. C.-D. C. Test Kit

*By* H. W. Anderson

A COMPLETE outfit for testing a.c. or d.c. radio sets can be assembled at reasonable cost by mounting a 0-1 m.a. milliammeter and an a.c. voltmeter together with suitable resistances and switches on a panel fitted into a carrying case. The milliammeter reads direct current and voltages and the voltmeter indicates a.c. filament and line voltages.

As can be seen from the circuit diagram in Fig. 1, the milliammeter is used as a high resistance voltmeter by employing different sizes of multiplier resistances, so that scales of 100, 250 and 500 volts can be had by installing resistors of 100,000, 200,000 and 500,000 ohms respectively. Accurate resistances with adequate current-carrying capacity are now being made to replace the rather inaccurate lavite resistances which were previously in general use in home-made high resistance voltmeters. By the use of these resistances in connection with a 1 milliampere scale milliammeter, a voltmeter having a resistance of 1000 ohms per volt is thus obtained.

By using shunt resistances across the milliammeter terminals, the range of the meter was increased to values of 50 and 200 milliamperes, and 5 amperes. For practical purposes, a milliammeter can be considered as a voltmeter reading the voltage drop across the resistance in shunt.

*Portable A.C.-D.C. Test Set*

When the resistance of the moving coil, and current necessary to operate the meter are known, it is an easy matter to calculate the resistance of the necessary shunts. To find the voltage necessary to operate the meter, Ohm's Law is used, where the voltage equals the current times the resistance. In this particular test set, a Western Model 301 milliammeter was used, and the resistance of the meter, as given in the catalogue, is 27 ohms. Other makes of meters can be used equally as well, provided that the resistance of the meter is known, or can be determined with fair accuracy. By substituting in the formula, the voltage to operate the meter is .027 volts. (*E* equals *IR* equals .001 mils x .27 ohms equals .027 volts.)

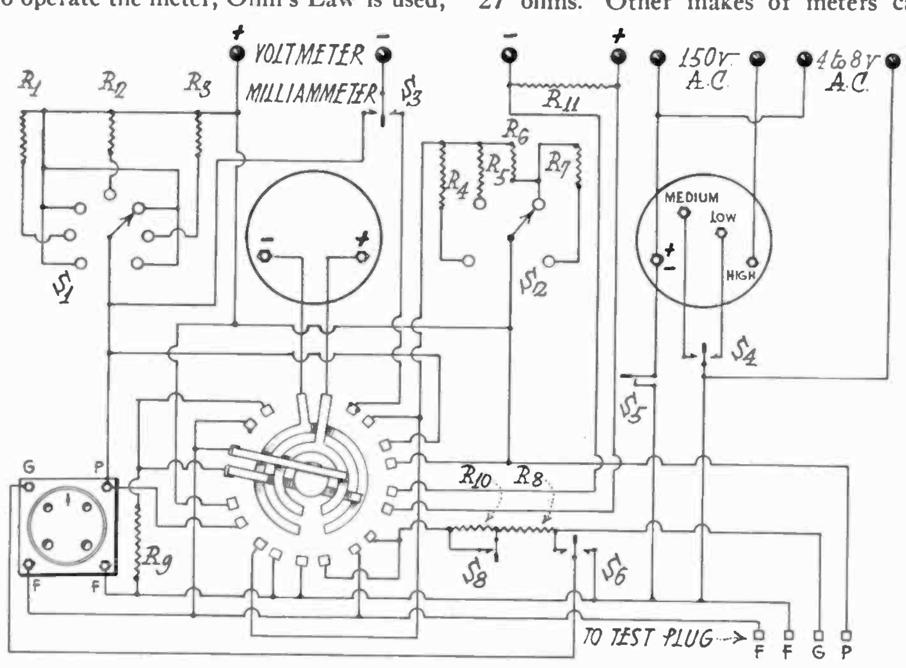




*Fig. 1. Circuit Diagram of Test Set*

For a 10-milliampere shunt the necessary resistance is one which gives a drop of .027 volts. This resistance is found to be 2.7 ohms. The other resistances for 50 mils, 200 mils and 5 amperes are .54, .135, and .0054 ohms, respectively.

The resistances used for shunts for the 10, 50 and 200 milliampere scales were fixed filament resistors of wire-wound type, unwound to the exact values needed. The 5-ampere shunt was made of about 10.3 inches of No. 18 wire. The fixed resistors were mounted on a seven-point inductance switch. Every other point was connected together and then tied to the common side of the shunts so as to place a short across the meter when switching from one scale to another.

While it is possible to calculate the resistance of the shunts it is very necessary that the milliammeter be calibrated with an instrument of known accuracy. Any high school would be willing to do this. The voltmeter range is accurate enough, so that calibration is not absolutely essential, although it is desirable.

A bi-polar switch is convenient to make the various tests. The switch for checking tubes was made from an old filament control jack of the single-pole double-throw variety and was mounted on the panel so that it could be operated by a push button. The pictures show this more clearly. The test plug was made from the X base of an old '99 tube. The cable connecting this plug should have leads sufficiently heavy so as to have no voltage drop through it when testing a.c. tubes.

Since the pictures were taken some improvements have been developed in the test set, and these are shown in the circuit diagram. For this reason the picture of the set panel shows one extra binding post. Also the 50-volt scale was changed to 100 volts.

The toggle switch is for the purpose of shorting out a 50,000-ohm resistance in the grid circuit, giving a choice of 50 volts for normal working conditions and 100 volts for use with the '50 tubes. A suggestion for those who might care to use it, would be to place a reversing switch in the *C* bias test circuit, making it possible to read the space charge voltage on the grid of a '22 tube.

For testing a.c. sets, an a.c. meter was used to cover the filament voltages of the a.c. tubes. Another range was also included in the meter for the checking of house-line voltages. This meter is operated through a switch so that it can be connected across the filament terminals of the socket in the test set.

The test kit was made as compact as possible and is contained in a case 6½ x 10½ x 4½ in. The case used was an old vibrator case, but the constructor may find some other box that will suit his purpose. The apparatus was mounted on the panel to form as symmetrical and convenient a layout as possible. The builder may have ideas of his own as to

LIST OF MATERIAL USED

| | |
|---|---|
| $R_1$ | 3 ohm resistor. |
| $R_2$ | 4/7 ohm resistor. |
| $R_3$ | ¼ ohm resistor. |
| $R_4$ | Super Davohm 10 M Ohm. |
| $R_5$ | Super Davohm 100 M Ohm. |
| $R_6$ | Super Davohm 250 M Ohm. |
| $R_7$ | Super Davohm 250 M Ohm. |
| $R_8$ | Super Davohm 50 M Ohm. |
| $R_9$ | Super Davohm 10 M Ohm. |
| $R_{10}$ | Super Davohm 50 M Ohm. |
| $R_{11}$ | 10.3 in. of No. 18 Wire. |
| 8 | Binding Posts. |
| $S_1$ | 7 point inductance switch. |
| $S_2$ | 4 point inductance switch. |
| $S_3$ | SPDT Switch. |
| $S_4$ | SPDT Switch. |
| $S_5$ | Filament Switch. |
| $S_6$ | Push button S. P. S. T. Switch. |
| $S_7$ | Weston Bi-polar Switch. |
| $S_8$ | Toggle Switch. |
| $M_1$ | Weston Mod. 301 0-1 Milliammeter. |
| $M_2$ | A.C. Voltmeter, 0-4-8-150 volts. |

panel layout and, therefore, no dimensions are given. The pictures and circuit drawing should enable the builder to ascertain the manner in which it was constructed.

The operation of the test set is very simple, requiring the same precautions that would be taken with any laboratory instrument. Take, for example, the testing of any tube being operated with direct current on the filament. First remove the tube from the set and place it in the socket of the test set. Then put the plug in the socket to be tested. Before going any further it is well to see that the voltmeter and milliammeter are on the right scales. When in doubt as to the voltage and current being used in connection with the tube, always use a higher scale and drop back towards the lower scales after you have ascertained what the approximate voltage and current are.

The first position of test on the bipolar switch is *A* voltage. If the meter reads backwards, turn to the next position, which will reverse the voltmeter leads to the socket. Position No. 3 connects the milliammeter in the plate circuit of the tube to be tested. In this position the operator has the choice of three milliampere scales, as previously described. Position No. 4 connects the voltmeter in the plate circuit and again gives the operator the choice of three voltmeter scales. It might be well to warn the operator to always be careful to select the proper voltmeter scale here. Positions No. 5 and 6 are *C* battery and *C* battery with the *A* reversed. This gives a true *C* battery reading.

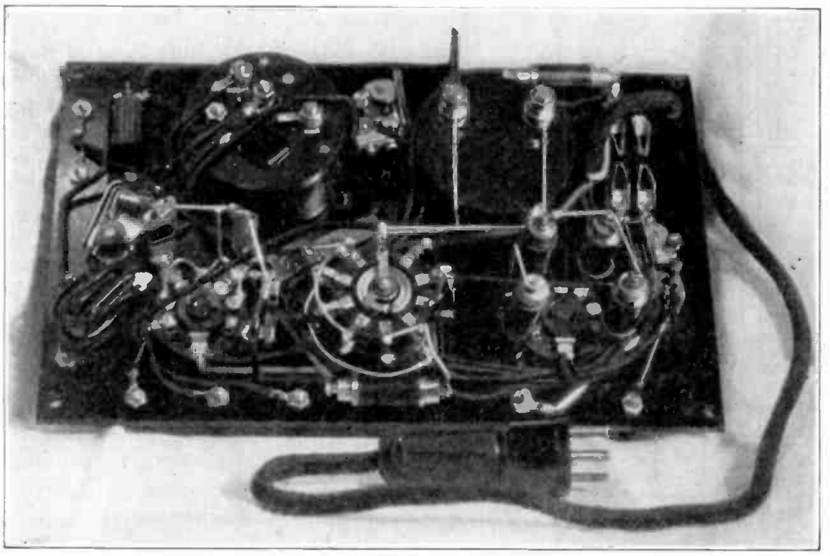
When the tube employs a.c. on the filament the procedure is somewhat different for the *A* circuit, all other tests being the same as the d.c. tube. The switch marked a.c. or d.c. should be set for the former. The switch which selects either the 4 or 8 volt scale should be set to the voltage specified by the tube manufacturer as, for instance, the '26 and '27 tubes will come within the 4 volt range and the power tubes will all come within the 8 volt range.

Suitable adapters will be necessary, adapting the five-prong tube to the four-prong socket or the four-prong test plug to the five-prong socket to be tested. These adapters may be constructed or they may be purchased.

Further operation of the bi-polar switch to position No. 7 gives an ammeter range on a pair of external binding posts for the use of testing various chargers. Position No. 8 of the switch connects the milliammeter to an external binding post with the choice of three milliammeter ranges. In doing this it is necessary to see that the meter switches as are set to the proper position. Position No. 9 connects the voltmeter scales to the same binding post by merely operating the meter switch again. The a.c. meter is also available on external terminals, one pair carrying the 150 volt ranges and the other pair carrying the 4 or 8 volt scales as selected by the 4 and 8 volt switch.

The set will also determine the condition of tubes by inserting the tube in the test set and placing the plug in the socket of the tube to be tested. The bipolar switch is rotated to plate mils and the milliammeter switch is set to the proper range. Now by pressing the button marked *Grid Test* the *C* bias is removed from the grid of the tube and there is a corresponding increase in the plate current if the tube is in good condition. A table of scales showing what the different tubes should test can be obtained by checking a few of the tubes of various styles.

In making these several tests for voltages the set will clear up many problems such as burned-out audio transformers, on both primary and secondary, open grid resistances, open radio frequency transformers, run-down batteries and deactivated tubes.



*Test Set Panel, Showing Assembly of Parts*

# TECHNICAL BRIEFS

THERE seems to be a lack of information on the subject of the testing of tubes, especially the a.c. models, insofar as operating limits are concerned, and so we are presenting the circuit of the tube testing device used in our laboratory, together with a table of limits which will serve for all practical purposes. This test set is primarily intended for measuring the normal plate current, and the filament emission of any of the standard tubes, except the type '50 power tube. More elaborate outfits for measuring the amount of gas present in the tube, its gain in Transmission Units, or its power output, can be constructed, but at a greater expense than is warranted in most home testing outfits. The test circuit is shown in Fig. 1, and the outfit can be built at relatively low cost, with two meters as shown. These can be used for other purposes when the test set is not in use, so that the meter connections can consist of jacks, whereby the meters are temporarily plugged into the circuit.

Two tube sockets are required, one for d.c. tubes, with flexible connector for the grid of the shielded-grid tube, and one for heater type a.c. tubes. The heater of the type '27 a.c. tube is lighted from a battery rather than a.c., to avoid complicated connections, the heater current being limited by the main filament rheostat, which is adjusted so that the filament voltage is 2.25. Three filament rheostats of different values of resistance, as shown in Fig. 1, are connected in series, so as to enable the adjustment of filament voltage on any tube to its proper value, using the same 6-volt battery. The switch *S*, which may be a double pole, double throw jack switch, has two positions, one for measuring the normal plate current, with 3 volts negative grid and 67½ volts plate, and the other for measuring the filament emission, by connecting the grid and plate in parallel, with the same *B* voltage.

The procedure for testing a tube is as follows: for d.c. tubes, insert the tube in its proper socket, first seeing that the filament rheostats are set to maximum resistance. Set the switch *S* to the filament emission test, and cut out resistance in the rheostat group until the plate milliammeter reading is between 3 and 5 milliamperes, depending on the type of tube, as shown in the table below. Read the filament voltage required to produce this emission, and if the voltage is equal to or lower than the corresponding voltage as given in the table, the tube is O. K. If the emission current cannot be made to equal the values given in the table without increasing the filament voltage above the stated limits in the table, then the tube needs reactivating. In the case of the a.c. tubes, reactivation is not possible, so that the above applies only to the d.c. tubes. In testing CX-310 tubes, a special milliammeter having a range of at least 100 m.d. must be used.

Next set the switch *S* to the plate current position, increase the filament voltage to the normal value, and read the plate current on the milliammeter. If the current is not within the limits given in the table, even though the fila-

**TEST LIMITS FOR STANDARD TUBES**

| | EMISSION TEST | | PLATE CURRENT TEST | |
|---|---|---|---|---|
| *Type* | *Emission-current at Fil. volts indicated in next column* | *Fil. Volts* | *Rated fil. voltage* | *For good tubes Plate current should be* |
| CX-310 | 100 m.a. | 6.0 | 7.5 | 11-25 m.a. |
| CX-11 or 12 | 3.0 m.a. | 1.0 | 1.1 | 1-5 m.a. |
| CX-299 | 3.0 | 2.9 | 3.3 | 1-4 |
| CX-220 | 3.0 | 2.8 | 3.3 | 4-10 |
| CX-322 | 3.0*** | 2.8 | | |
| CX-301-A | 5.0 | 3.9 | 5.0 | 1-4 |
| CX-340 | 5.0 | 3.9 | 5.0* | 0.1-1 |
| CX-112-A | 5.0 | 3.5 | 5.0 | 2-8 |
| CX-371-A | 5.0 | 3.7 | 5.0** | 5-15 |
| CX-326 | 5.0 | 1.0 | 1.5 | 2-8 |
| C-327 | -- | -- | 2.5 a.c. | 1-6 |

* Reduce grid bias to zero for CX-340.

** Reduce plate volts to 45 for CX-371-A.

*** Plate, grid and shield connected together.

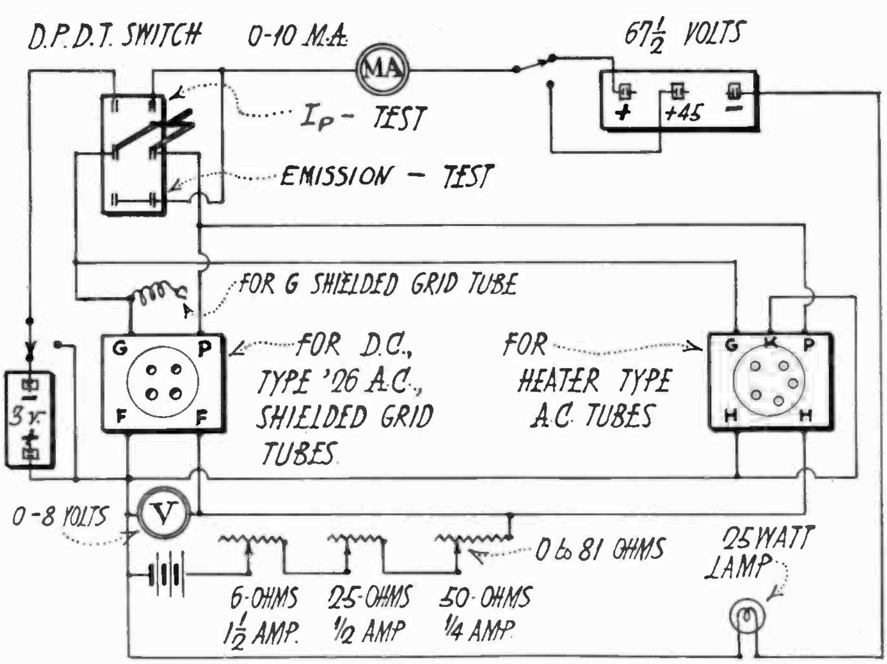



*Fig. 1. Circuit of Tube Tester*

ment emission is good, the tube would probably not be suitable for use as an all-purpose tube.

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THE correct value of grid leak and grid condenser for the detector tube is a much-discussed question. Practically all circuits, including factory-built jobs, use a .00025 mfd. grid condenser, shunted by a 2 megohm leak. Sometimes the grid leak is connected directly between the grid and filament of the tube, thereby shunting the tuned circuit ahead of the detector, as well as the grid condenser, but the effect is the same for all practical purposes.

The size of the grid condenser, as well as the resistance of the grid leak, has a definite effect on the higher frequencies in the audio frequency output of the detector. It has been found that a marked improvement in the output at frequencies above 3000 cycles is obtained by lowering the capacity of the condenser to 50 mmf. (.00005 mfd.) and the grid leak to ½ megohm. This is particularly useful in the case of a superheterodyne, where the use of filters having a frequency band only 3 or 4 k.c. wide cuts off the higher frequencies of the modulated carrier, and in the loud speaker, the high notes are lacking in volume.

By changing the grid condenser and leak to the lower values specified, the detector output at 5000 cycles can be brought up by 5 transmission units or more, while the output at the lower frequencies is not changed appreciably. If the audio frequency amplifier or loud speaker of a tuned r.f. set is deficient at the higher frequencies, this change in the detector circuit may greatly improve the tone quality, without affecting the sensitivity of the receiver enough to be noticeable, even on distant stations.

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MANY of the new models of a.c. sets are provided with automatic control of line voltage. While the ballast lamp, such as has been used in the Radiola models for a number of years, is an excellent voltage-control method, it is suited to only one type of set having a certain power consumption. Hence, it cannot be used with any type of a.c. set.

The most practical type of primary voltage control so far introduced has been a ballast resistance of the exposed type, placed in series with the primary of the power transformer, which is wound to 100 volts instead of 110 or 120. The resistance absorbs the additional 10 or 20 volts which are not required by the transformer, and, being made of iron wire, varies in resistance according to the temperature. So that in case the line voltage rises, the resistance increases as the wire temperature increases, thus smoothing out the fluctuations providing they are not too violent. The control is effective only when the voltage fluctuations are gradual, as the heating of the resistance wire is slow, and the action of the regulation is sluggish. This method permits the service man to take care of local conditions, where the ballast resistor is found to cut down the voltage to a point too low for satisfactory operation of the set, so that turns can be removed from the resistor until the effective voltage across the transformer is the right value.

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ONE of our readers kindly points out an error in the answer to Question 7 of Group 1 of the Questionnaire published in July RADIO. In discussing the difference between the peak, average and effective values of alternating currents, the relation between the instantaneous maximum value of the voltage and the instantaneous value is as follows: $e = E\text{-max} \sin 2\pi ft$, where e is the instantaneous value, E-max is the instantaneous maximum value, the angle $2\pi ft$ is in radians, and t is the time in seconds. If the time of one complete cycle is T, f equals 1/T.

Speaking of this Questionnaire, we are also criticized for calling it a questionnaire for "Radio Engineers." One correspondent stated that he had several "soldering iron experts" at twenty-five dollars a week who could pass the examination satisfactorily, so that he was wondering what the definition "Radio Engineer" comprised. Undoubtedly most college graduates in science or electrical engineering could pass the first group of questions perfectly, but the fact remains that in the radio manufacturing business there are hundreds of men earning good incomes who are fine practical radiomen, experienced in the handling of problems relating to radio frequencies, and with a smattering of knowledge of d.c. and a.c. theory, but who could not pass an examination based on the questions in Group One without consulting a textbook. If the Questionnaire has been of any help to this class of readers then we will feel quite satisfied in having accomplished something worthwhile. As to the definition of Radio Engineer, since no university, to our knowledge, awards a degree of R. E., one answer is as good as another.

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THE question is often asked as to what results will be obtained by the use of shielded grid tubes in place of the type 99 tubes in the intermediate amplifier circuit of the average superheterodyne. On first inspection it might seem that this change could be made by a slight circuit change and the insertion of flexible wires leading to the control terminal on the top of each shield grid tube. While this is quite true, there are other factors which are much more important than changes in the circuit.

In the first place, most intermediate frequency amplifiers in superheterodynes built during the past three or four years are unshielded, and were designed for tubes having a voltage amplification not to exceed 7 or 8, so that by using tubes giving much higher voltage gain, the coupling between stages would be enormous, and the amplifier would oscillate uncontrollably. By completely shielding each stage, the oscillation troubles could be partly cured, but unfortunately, the average intermediate transformer has a turns ratio of 4 or 5 to 1, which is entirely too high for the shielded grid tube at frequencies where most i.f. transformers are peaked. Several experimental amplifiers of this type were tested with shielded grid tubes, and it was found that by using two i.f. stages, carefully shielded, a stable amplifier could be constructed, but due to the enormous amplification, the amplifier was so broad as to be useless when used in a receiver having a loop antenna.

By employing at least two sharply tuned r.f. stages ahead of the first detector, a fair degree of selectivity with high sensitivity was obtained, but by substituting transformers having a higher primary impedance and much lower turns ratio, a more selective set resulted. Hence it can be assumed that it would be a waste of time or money to attempt to use the shield grid tubes with high ratio, iron core intermediate transformers, unless the set is to be located where good selectivity is not an important factor.

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SOME very interesting facts about the screened grid tube were recently brought out by *Experimental Wireless*, in an article on the theory of the screened grid tube. It was found that the residual capacity between the plate and the control grid of the tube is equal to the capacity between the control grid and the screen, divided by the amplification factor of the tube when the screened grid is used as a control grid.

The maximum possible amplification factor of the tube is equal to the product of the "mu" of both the control and screen grids. But whenever there is any secondary emission from the electrodes, the "mu" is lower than the above value. The mutual conductance of a screened grid tube is equal to that of a corresponding three electrode tube, considering the screen grid as an anode, minus a percentage due to the electrons intercepted by the screen grid. Thus, the mutual conductance falls off rapidly as the screen grid mesh is made very close.

Judging by the performance of most screened grid receivers developed in the United States since the tube was introduced, most of the tubes must have a very high secondary emission, as the amplification per stage is very much lower than the theoretical maximum.

# With the Amateur Operators

## A COLPITTS SHORT WAVE TRANSMITTER

*By* WILLIS L. NYE

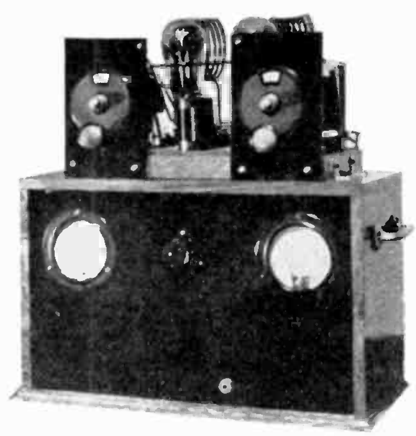
THE favorite system of the transmitting amateur today using short waves resolves itself either to a Hartley or Tuned Grid and Tuned Plate circuit for use in communication. These two circuits are immensely popular with the operators and each has its own apparent advantages. However, another system that combines the two others mentioned is the Hoffman modification of the Colpitts oscillatory circuit.

The Hoffman arrangement of the Colpitts system is known as the Split Colpitts and has proven to be an ideal transmitter for the high frequency wavebands down as low as 5 meters. With a UX-852 tube this system has been proven satisfactory to as low as 1 meter in wavelength. The Hoffman modification splits the inductance of the original system into two separate coils with the plate stopping condenser between them. Around this is built the entire circuit. The chokes are connected to the plate stopping condenser, one going to the plate supply and the other to the grid leak to the filament center tap, which is taken between the two series capacities that are shunted across the two inductances, thus forming the oscillatory circuit.

The modifications Hoffman made in the original Colpitts work out to great advantage to the operator. As the two capacities are in series there are no critical adjustments in frequency. This also enables much greater power to be applied without undue sparking between the plates. The center tap is easily placed between the two tuning condensers and does away with any clipping arrangement. The two sections can be adjusted in relation to each other, thus permitting variable coupling to the antenna and also making the power input variable if the operator so chooses. These modifications all tend to make the circuit extremely simple to operate and once the tubes are lighted the circuit bursts into oscillation immediately and does not require any tuning circuits, etc., to bring it into resonance.

Because all the capacities directly affecting the tube are wired in series, any changes in tube capacities have no effect on the emitted frequency. This helps to steady the wave and the note. If this circuit is run at a constant output that is not overloading the vacuum tube oscillators no trouble from "wobbulation" should be experienced. All the above characteristics of this circuit have a direct bearing on the efficiency of the system as a whole. The note emitted from this type of transmitter is generally superior to notes emitted by other systems using the same forms of plate supply from raw a.c. to d.c. or supply from a high frequency alternator.

The circuit is suitable for use with any type of antenna system, including voltage feed with a single wire feeder line. The antenna is coupled to the system through a



*View of Completed Transmitter*

coil which is placed between the two inductances of the oscillatory circuit. The coupling should be varied for proper output.

Fig. 1 shows how the circuit can be adapted to self-rectification by adding one more special choke, two stopping condensers and one more tube, along with the usual sockets, clips, screws, etc. This will appeal to the builder seeking economy. Of course the note emitted is not equal to a rectified tone but is pleasant to copy, it being 120 cycles in frequency.

The set was built along similar lines to the *"Bumblebee"* transmitter recently described in RADIO. This design is efficient, besides looking well and giving accessibility for adjustments or repair. The set should be wired in accordance with the diagram given. Be sure to place the coils in proper relation as specified.

All the parts are of standard design. The main tuning condensers are double spaced. The gridleak is a heavy resistance capable of carrying 100 watts constantly without heat. The stopping condensers are mica type. The chokes are home-made, as are the 3/16-in. copper tubing inductances. The filament transformer is of 8 volts or 10 volts as desired. The plate transformer is a special built unit made by 6EX at his laboratory. It is tapped from 550 to 850 volts. The set was built with all parts capable of carrying an output of 203-A tubes though the original set uses the new type of heavy construction UX-210 tube.

The chokes are wound on hard rubber tubing, 125 turns being used for the plate chokes and 80 turns for the grid choke. The forms are wound with No. 26 enameled wire. The diameter is 1 in. The small center tapped choke in the grid lead is a 50 turn winding on ½-in. diameter dowel stick. This prevents ultra high frequency oscillations between the two tubes. It is wound with No. 30 wire and center tapped at the 25th turn. All chokes are mounted on small nickel-plated angle clips.

The set is easily adjusted. The coupling to the antenna coils must be very loose and the set must be operated on either a fundamental system antenna or one that requires a coupling coil with double feeders. After the working wave is chosen and the set is loosely coupled, place the antenna into resonance with the transmitter. This will be indicated by a rise in the plate milliammeter reading. Listen in with the receiver and adjust the coupling until the note is as smooth as when the antenna is disconnected. This is the point where the set is functioning cor-

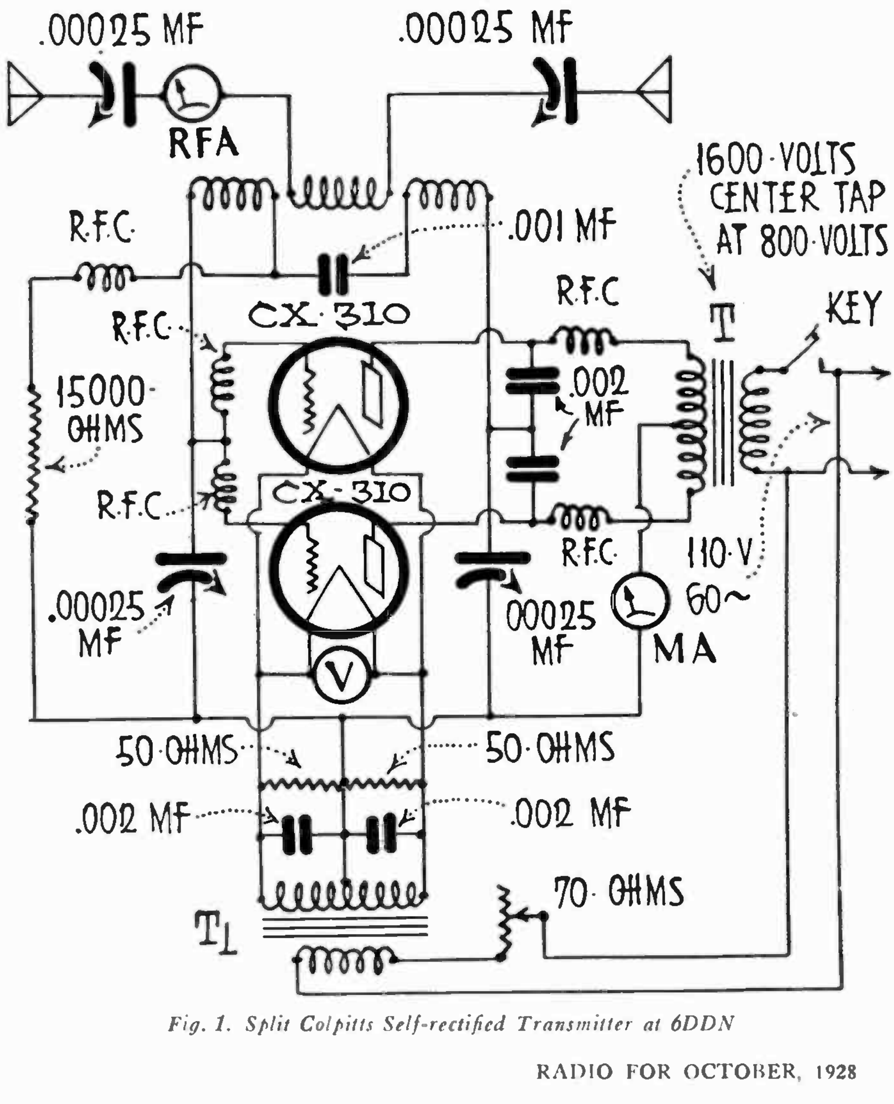



*Fig. 1. Split Colpitts Self-rectified Transmitter at 6DDN*

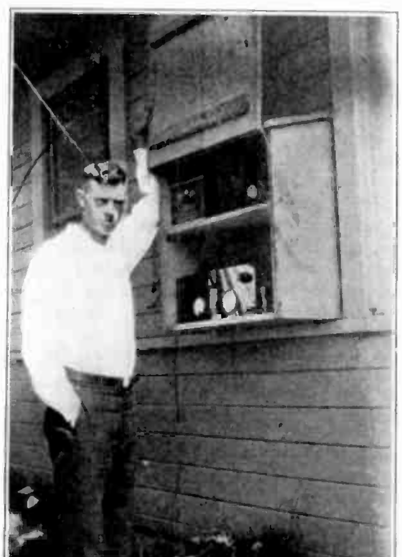
rectly with a good tone. If the set is coupled too close to the antenna the note is rough and the plate current is unsteady. It is advisable to detune the antenna about ten per cent off the point of resonance. Never allow the plates to become red in color as this tends to roughen the note.

Both tuning condensers are set at approximately the same reading on the dials, which should be vernier. The plate milliammeter should read to 200 m.a. and the filament voltmeter to 15 volts. The plate milliammeter is placed in the plate center tap lead. It will record the reading of the two tubes. The coils are wound in the same direction and are 2½ in. in diameter. They should each have 8 turns while the coupling coil would have 7 turns of 2-in. diameter.

The self rectified transmitter in order to produce a good note should have a very low plate current in the tubes. This necessitates a high resistance grid leak in the neighborhood of 15,000 to 17,000 ohms, the last being about the highest value permissible, as beyond that value the tubes become unsteady. With the high resistance leak the plate current is small. The power transformer should be tapped exactly in the center, otherwise the input to each tube is apt to be unequal. The core should be designed so as not to produce distortion of the 60 cycle a.c. line current. The oscillator tubes should be checked for filament emission and for internal capacity so as to be identical.

This set is keyed in the plate primary, thus permitting the use of break-in system, as the filament hum is very sharp with this arrangement. The power variation switch is mounted in the cabinet, as is a double fuse block with 6 ampere plug fuses for protection to the line current. The cabinet is mounted on small countersunk casters, permitting the whole transmitter to slide back and forth easily as the antenna unit is mounted on the window near the lead-in. The filaments are adjusted by a rheostat as shown and properly center-tapped with large by-pass condensers.

The input with 850 volts on the tubes is approximately 54 watts which is about as much as the tubes should be pressed or else the tone will roughen. This set is adaptable to any frequency if the coils are of the plug-in type. This set has proven itself to be well adapted to any make of tube.



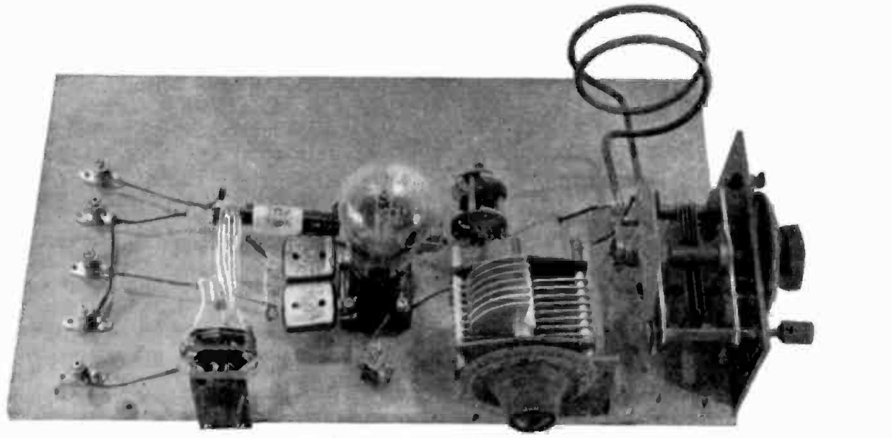
*Outside Transmitter at 6BDR*

## DESIGN AND CONSTRUCTION OF ¾, 5 AND 10-METER TRANSMITTER

*By* A. Binneweg, Jr.

Transmitting arrangements and circuits for use on the shorter waves, below 20 meters, need special design and construction if good results are to be obtained. Effects that are entirely negligible at the lower frequencies become exaggerated and the circuits and layouts must be modified for the new conditions.

In some rough measurements with a "dummy" antenna at 10 meters, on the 10-meter set shown in the illustrations, the output was reduced by using a filament clip, and was increased by using a tuned choke in the plate circuit and small midget stopping condensers, where possible. Bringing the hand up to the oscillating-circuit condenser causes the output to drop to less than half, usually; this is not caused by detuning, for with the hand on the vernier, the original output cannot be restored by retuning the oscillating circuit slightly. It seems that the body either causes increased r.f. resistance or "shunts" some of the energy to earth, or both, causing the decreased input to this antenna.



*10-Meter Transmitter*

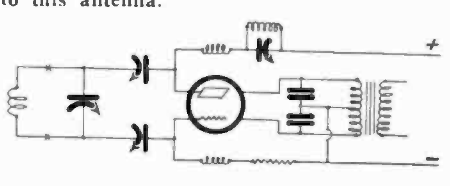


*Fig 1. Circuit Diagram of 10-Meter Transmitter*

For best results, the oscillator should be well away from surrounding, grounded objects and should preferably be hung from the roof of the shack in some convenient manner. It is only by "isolating" the transmitter, that a good fraction of the power will reach the antenna.

The r.f. chokes are quite important and small basket-weave coils may be used to advantage. Since any coil has some distributed capacity, it will have a natural period at which its impedance to the passage of r.f. currents will be high. At some frequencies it will allow the r.f. currents to flow through with little impedance.

It is difficult to wind such a coil having the proper natural period. The best way out is to connect a choke of approximately the right value to the plate of the tube, as shown in Fig. 1, and in series with it, a parallel circuit, the natural period of which can be adjusted so that a high impedance may be obtained anywhere in the wave-band. If the basket-weave choke functions properly, little change in plate current will be noticed when the tuned choke is tuned to the operating frequency.

The tuned choke for 10 meters, should consist of a 15 mmfd. variable midget condenser and a coil of about 3 turns, 3 in. in diameter. The tuned choke can be used to compare the various chokes tried, at this frequency. With a large *L-C* ratio and a small drop across the parallel-circuit, the loss is small and the operation of the transmitter is improved.

The grid choke is not subjected to such high voltages and is less important. A good value to use is 30 turns of fine wire in a 1 in. basket winding for both chokes.

With a high value of inductance and small value of capacity in oscillating circuit, the r.f. drop across it will be large and large sparks can be drawn from the circuit. High values of inductances, however, tend to cause an unsteady wave, when transmitting, because of the small capacity used in the tuning circuit. The capacity used in the tuning circuit, being in parallel with the grid-plate capacity, should be large so that any change in the latter, due to tube-heating, will have little effect. If one uses about two 3-in. turns of copper tubing at 10 meters, good results will be obtained.

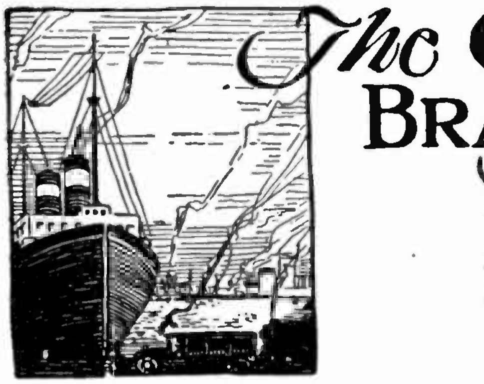
The grid and plate-stopping condensers used in short-wave transmitters are usually much too large and cause a large oscillating current to pass through the tube capacity. This current will depend upon the voltage between grid and plate (across the oscillating circuit, approximately) and this will depend upon the *L-C* ratio used. It is not uncommon for the grid-lead on a 250-watt tube to be burned out in an amateur station, because of this effect.

The amateur ordinarily has no way of determining exact values of small capacity, so the best way is to use small variable condensers here. The plate condenser must have good plate-spacing, but this is not as important in the circuit shown; because no filament clip is used, the total voltage is thus not directly across this condenser. In the set illustrated, a small "midget" was used in the grid.

Both condensers should be reduced in value until oscillations cease and increased somewhat beyond this value, for best re-

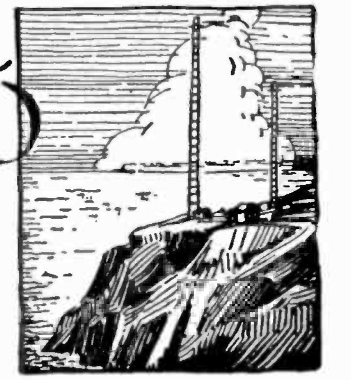
(Continued on Page 56)

A clever scheme for installing a portable short wave transmitter is pictured herewith, being that of 6BDR at Bakersfield, Calif. The 7½ watt transmitter as well as the power transformer and receiver batteries are placed in a box outside the house, and the sending key and receiver on a table just inside. Russell Estep, the owner, is a former ship operator who has learned to make the most of cramped quarters.



# The COMMERCIAL BRASSPOUNDER

## A Department for the Operator at Sea and Ashore



*Edited by* P. S. LUCAS
R. O. COOK, *Assistant*

After reading Radio Service Bulletin Number 135 (June 30, 1928), it seems fitting that something should be said about the changes in call letters effective October 1, as a result of Article 14 of the International Radiotelegraphic Conference of 1927. A glance at the list of revamped call signals shows that the Radio Division has done its usual fine job in handling a very tedious and difficult task. It was extremely wise to revamp the list in time so that the new call signals will appear in the fall edition of the "International List of Radio Telegraph Stations Alphabetically by Call Signals," and the June 30 edition of "Commercial and Government Radio Stations of the United States." FB! It will save many an op the time, trouble and confusion of searching through various bulletins in search of the new four letter call of some ship, or perhaps, the new three letter call of some coastal station! Fortunately, very few PG coastal stations had four letter calls prior to the new assignment. "The Voice of Labor" at Chicago is one of the few to save labor under the new assignment.

It is gratifying to note that some of the steamship lines having large fleets of vessels have obtained a "slice of the alphabet." That is, call letters in alphabetical order. We emphatically call it a step in the right direction! It would even be wise to reserve call letters to assure alphabetical continuity as more ships are added to the various fleets. There are more than enough available call letters to take care of future growth for some years to come anyway. A general call signal should also be assigned to each of the various large fleets, perhaps heading their particular alphabetical list of call letters. Such arrangements could be worked out nicely and then referred to the Radio Division for approval if the Division would sanction such action. In the past, the Radio Division has cooperated along constructive lines, thanks largely to a very capable Chief.

Getting back to general calls—whoever is responsible for the call letters assigned to the Bureau of Lighthouses should be commended for his foresight and ability. The Bureau has WWLH as its general call—a *very* appropriate one. Why not follow the example and have the general call for all coastal stations WCS instead of WTM, all merchant vessels WAMV instead of WKW or WGBG, all U. S. warships NUSW instead of NOB or NERK? General calls would have a chance of serving a very useful purpose if more ops were able to use them fluently. Some don't even know such a thing exists.

For years the op with the cumbersome four letter call has envied his more fortunate brother, but October 1 he can sit back with a smile of satisfaction as he hears many old fists trying to behave while pounding out newly assigned call letters. Some of the new calls have even been changed to start with a K instead of a W, and vice versa. It's a bit hard to imagine a ship like KII signing WMCE, WSN signing WSBN, etc. Still, ships like GFWV have used four letter calls for years. The coastal ops will probably be caused the greatest inconvenience by the new assignments. Some years hence we shall undoubtedly hear them speak of "the good old days when some ships had three letter calls."

We hope that the new assignments will not result in the use of the last two letters of a four letter call rather than the full call. This practice comes under the heading of false signals and will result in trouble as well as confusion if practiced to any extent. It's great to be brief, but don't be lazy OM's.

—R. O. C.

## THE SE-1420 FROM THE INSIDE

*(The following article describes very minutely the 1420 receiver which is in use on a great many United States ships. Although every operator has used one of them at one time or another, very few have seen the insides, or worked out the circuit, due to the fact that the old type apparatus was usually clouded in shrouds of secrecy. Therefore, we feel that for those who occasionally get the urge to build a stage of R. F., an external loading arrangement, or what have you? this article will come in very handy. We hope so, anyway. For business reasons the writer asks to use a nom de plume.)*

The 1420 is intended for reception of signals between 235 and 7500 meters.

The antenna circuit comprises a coil variable in 6 taps, and a variable air condenser .0014MF connected in series between antenna and ground binding posts of the set. The antenna coil has 658 turns of Litz, wound on a threaded form 4" in diameter and 5½" long, coil winding space is about 4¼" long. The form is threaded 36 turns to the inch left, hand turn. It is tapped as follows:

| | | |
|---|---|---|
| First tap | 20 turns | 1 bank wound |
| Second tap | 42 turns | 2 bank wound |
| Third tap | 83 turns | 3 bank wound |
| Fourth tap | 159 turns | 4 bank wound |
| Fifth tap | 312 turns | 5 bank wound |
| Sixth tap | 658 turns | 6 bank wound |

There are a total of 658 turns and a little subtraction will give the number of turns per tap or bank. The antenna condenser is of the double rotor type. Each rotor section has 17 plates and each stator section has 16 plates, making a total of 34 rotor and 32 stator plates.

The secondary circuit comprises a coil variable in 6 taps and a variable air condenser .0007MF connected in parallel between the terminals of the detector system. The secondary condenser has 17 rotor and 16 stator plates.

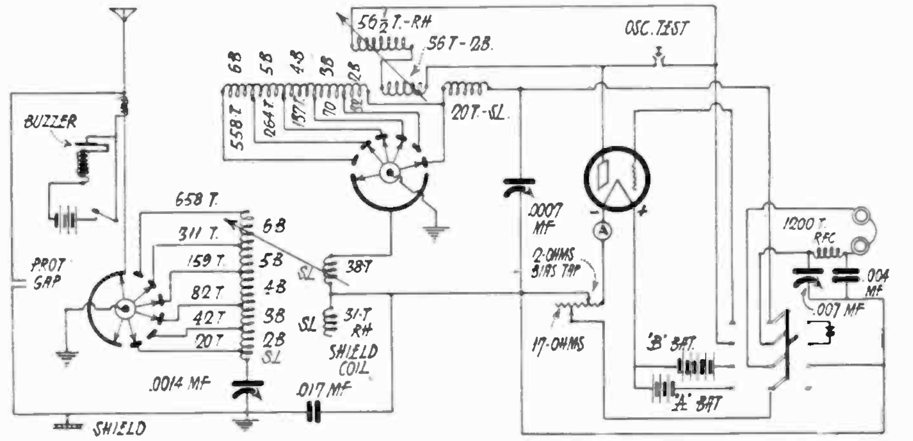
The entire receiver is enclosed in a grounded sheet copper case or lined box (I have seen aluminum used for lining also).

The antenna and secondary circuits are separated by a sheet copper partition. Electrostatic coupling between antenna and secondary is prevented by a shield coil wound over the secondary or coupling coil.

Magnetic coupling between antenna and secondary is obtained by means of a coupling coil connected in series with the secondary coil (sometimes called secondary load coil), and forming part of the first tap. The coupling coil is wound on the rotor of antenna vario-coupler which is of the 45 degree angle mounting type—0° to 180° rotation. The coupling coil is provided with an electrostatic shield to prevent capacity coupling between antenna and secondary circuits. This shield consists of an additional winding placed over the coupling coil, one end of which is connected to ground potential and the other end is left open or dead ended.

The rotor of antenna coupler or coupling

(Continued on Page 49)



*Type 1420 Receiver Circuit Diagram*

# Inside Stories of Factory Built Receivers

## II. The Majestic "70"

The new Majestic receiver is a 7-tube tuned r.f. completely shielded set, with all-metal chassis and separate power supply unit, so designed as to fit into several types of console cabinets of different prices. The receiver, a front view of which is shown in Fig. 1, consists of three stages of tuned r.f. controlled by a four-gang condenser, which can be seen at the right end of the set. The three r.f. tubes, which are of the type '26 a.c. are contained in the cylindrical cans in back of the condensers.

At the left of the chassis are the two audio transformers and the output transformer, which are enclosed in metal cases, in which they are sealed so as to be air-tight. The circuit diagram, shown in Fig. 2, will enable a better understanding of the picture of the under part of the chassis, which is shown in Fig. 3. The three r.f. transformers are placed in individual copper compartments, at the left in Fig. 3, the transformers being of the small diameter, low external field solenoid type, as can be seen in the case of the center r.f. transformer, the shield for which has been removed.

The antenna is connected to the slider of a 10,000 ohm potentiometer, through a piece of shielded wire, the potentiometer shaft being the right hand one in Fig. 3. This serves as the volume control, as can be seen in the diagram, and for long antennas, a .0001 mfd. fixed condenser is placed in series with the slider of the potentiometer to cut down the effective length of the antenna. The antenna coil is mounted at the upper right hand corner of the picture, Fig. 3, it being tuned for the first section of the four-gang condenser.

The trimmer condenser for this tuned circuit consists of a cylindrical shield which fits down over the coil, and is varied by means of the lever arm and shaft at the left end of the panel. The shield as it fits over the coil changes the tuning of this coil slightly, and so adjusts it to resonance with the r.f. transformer secondaries. The effectiveness of this method of volume control and resonance adjustment, as well as the shielding of the set can be attested by the fact that when no antenna or ground is connected, no signals can be heard at the maximum setting of the volume control, even when the set is within a few yards of a powerful station.

(Continued on Page 52)

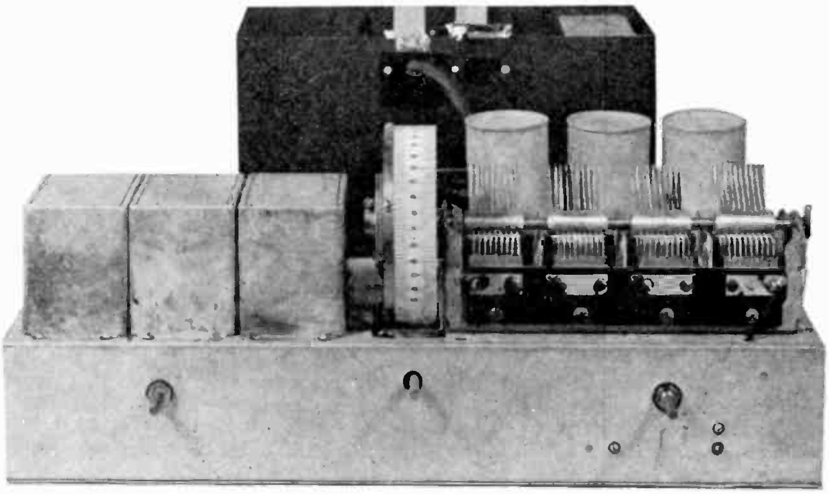


*Fig. 1. Chassis and Power Plant of Majestic "70"*

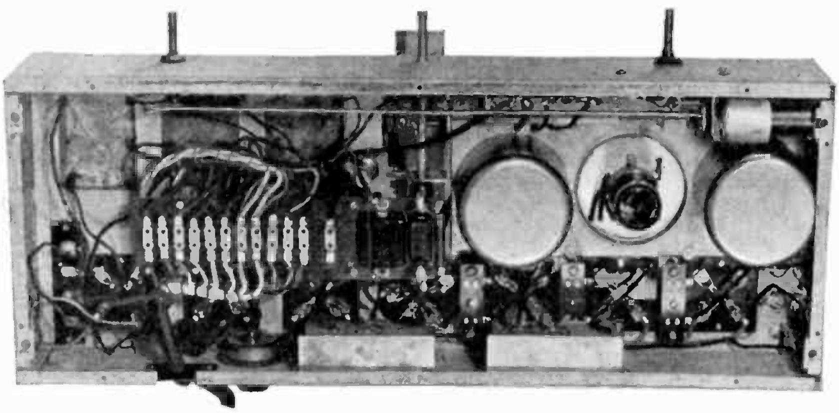


*Fig. 3. Underpart of Chassis*

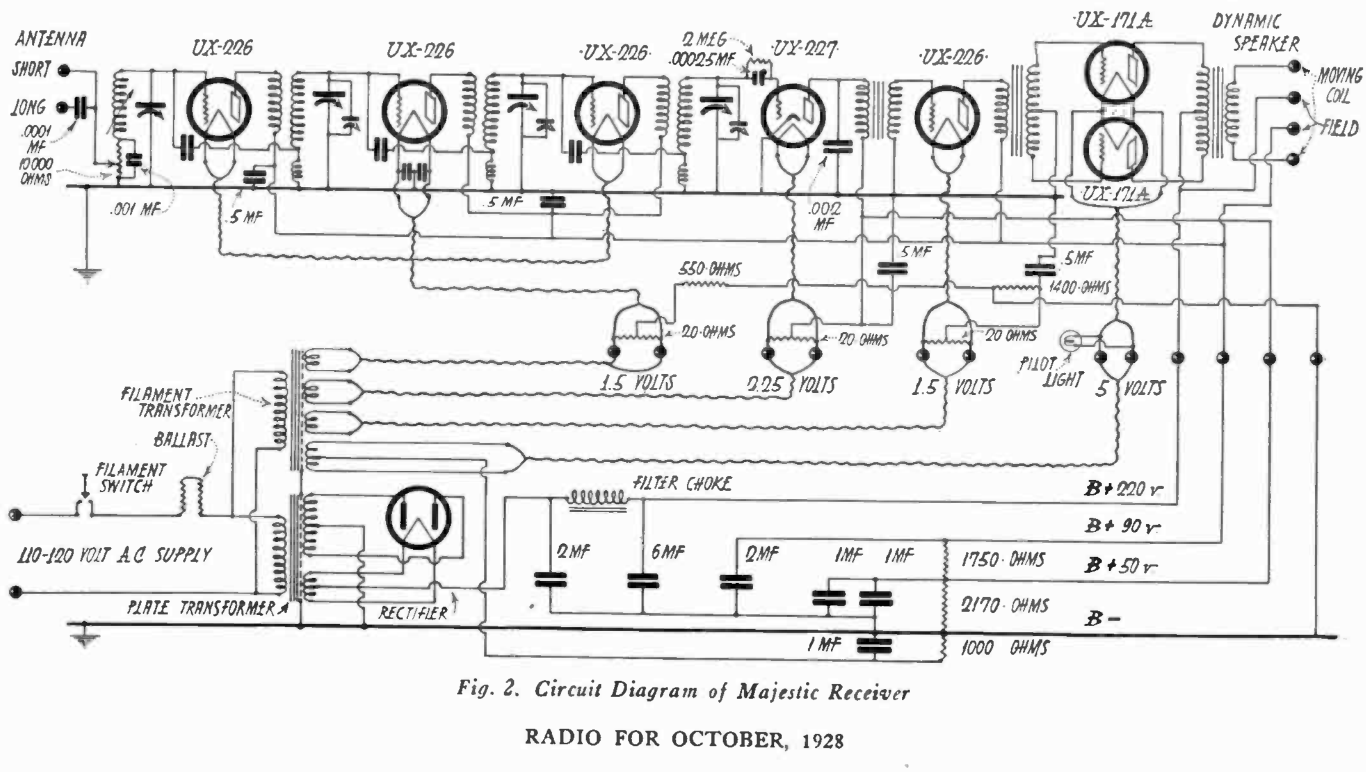



*Fig. 2. Circuit Diagram of Majestic Receiver*

# for just a few cents more

# The EVEREADY LAYERBILT


**Now $2.95** *Eveready Layerbilt Medium Size "B" Battery No. 485. 45 volts. The longest lasting Eveready of its size.*


**Now $4.25** *Eveready Layerbilt "B" Battery No. 486, the original Eveready Layerbilt. 45 volts. For heavy duty. The longest lasting of all Evereadys.*

# lasts weeks and months longer

TO GET a genuine Eveready Layerbilt "B" Battery you need only pay a few cents more than you would for a cylindrical cell Eveready of the same size. The longer life built into the Eveready Layerbilt is worth much more to you than its cost. Every Eveready Layerbilt "B" Battery is built of flat cells, which occupy all available space within the battery case and avoid waste spaces between the cylindrical cells in the older type of battery.

That is why the Eveready Layerbilt lasts much longer than the cylindrical cell type. The added life is far greater than you might suppose from the insignificant extra cost.

There are two Eveready Layerbilts. One is the original No. 486, built for heavy duty, the longest lasting of all Evereadys and the most economical. It costs 25 cents more than a cylindrical cell Eveready of the same size. The other is the newer Medium Size Eveready Layerbilt No. 485, which has the same dimensions as the Eveready No. 772 (cylindrical cells), but which lasts much longer than that battery, though costing only 20 cents more.

When you go to buy new "B" batteries, add just a few cents to what you would pay for a cylindrical cell Eveready, and get Eveready Layerbilts. They will bring you weeks and even months of extra service.

Tuesday night is
Eveready Hour Night

*East of the Rockies*

9 P. M. Eastern Standard Time, through WEAF and associated N. B. C. stations.

*On the Pacific Coast*

8 P. M. Pacific Standard Time, through N. B. C. Pacific Coast network.

**EVEREADY**
**Radio Batteries**

*Layerbilt construction is a patented Eveready feature. Only Eveready makes Layerbilt Batteries.*

NATIONAL CARBON CO., INC.
New York San Francisco
*Unit of Union Carbide* UCC *and Carbon Corporation*

## CHAIN BROADCASTS

(Continued from Page 20)

lead' is composed of six No. 10 enameled copper wires woven together. This lead is also under tension.

"The fundamental wavelength of the antenna system is in the neighborhood of 326 meters. The series condenser is used to work at 1060 kilocycles and 1000 kilocycles. We have found this type antenna indispensable in maintaining an exact frequency. The counterpoise system is used due to very high ground resistance.

"I am working with KMOX at the present time to have them install a temperature controlled crystal so that we may further develop that idea."

The official statement of Dr. Dellinger commits, for the first time, the Bureau of Standards to the feasibility of assigning a single wavelength to a chain of broadcasting stations. The practice of tying up 30 or 40 channels for the transmission of the same program has not only resulted in an extravagant use of half of the available wavelengths allotted for broadcasting, but radio fans have justly condemned the system because of the duplication of tuning from one end of the dial to the other.

Chain broadcasting systems, when confronted with the suggestion of synchronization of a group of stations on one frequency, ordinarily have rebuffed the idea with objections. For example, C. W. Horn, chief broadcast engineer of the Westinghouse Electric & Manufacturing Company, told this writer that the cost of converting a group of stations to a single standard of operation would be relatively large. Other engineers have voiced objections on the grounds of heterodyne interference—though synchronization experiments between the Columbus and St. Louis broadcasting stations disprove this, there being an entire absence of heterodyning. In fact, two stations in Massachusetts—WBZ and WBZA—have been operating on one wavelength for two years or longer.

The special piezo-oscillators to which Dr. Dellinger refers govern the frequency with great precision. For instruments of this type, equipped with temperature control, national and international comparisons have shown that they are reliable to a few parts in 100,000. The Bellevue Naval Research Laboratory, according to claims, has developed a frequency standard that is accurate to a few parts in a million. This is known as the "Navy's primary frequency standard." A similar degree of accuracy has been attained by the Bell Telephone Laboratories, Inc., in the design of frequency standardization instruments.

# STERLING

## SOCKET POWERS

Sterling "A" Power Supply with proper "B" unit, makes a good D.C. tube set completely electric.

R-81 "B" Power

R-81 is one of Sterling's most successful products. It is the most compact "B" Socket Power Supply on the market. Voltage regulation for detector, amplifier and a master control to regulate voltages proportionately. Operates from 115 volt, 50-60 cycle. Size 7½ x 4½ x 5½. **Without tube, $25.00. B. H. Raytheon tube, $4.50.**

R-93-V Dri-A Power

R-93. Used with Sterling "B" Power to make good D.C. tube set completely electric. Voltage regulated: one point control.

**Complete with bulb, $39.50.**

## TESTERS

One lost sale would equal the cost of several Sterling testers.

*R-512 Tube and Set Tester*

**Price $35.00**

R-512 Sterling A.C. Tube and Set Tester for the radio service man. Tests plate current, tests for open grid circuits and "A" and "B" power supply; locates defective tubes and sockets; tests the set wiring, etc.

R-510 A.C. and D.C. Tube Tester; tests all tubes. **Price $35.00.**

R-417 Sterling A.C. Line Voltmeter enables the service man to make correct power adjustment for A.C. tubes. Simply screw the plug into the electric light socket and the true line voltage is obtained at a glance.

*R-417 A.C. Line Voltmeter*

One set of tubes saved by testing more than pays for this device. Pocket size, simple and efficient.

**Price $7.50**

*R-375*

## PRE-AMPLIFIER

*R-375 Sterling Screen Grid Pre-Amplifier* Gives to Old and New Radio Sets the Advantages of the 222 Screen Grid Tube.

**The Pre-Amplifier, using the 222 screen grid tube, may be used on practically all 6-volt D.C. tube sets to obtain more distance, better tone, greater selectivity and less static. The Pre-Amplifier is connected in ahead of the 6-volt D.C. receiver.**

***It is ideal for sections where a radio set must bring in stations hundreds of miles away in order to get really desirable programs.***

**Model R-375 Sterling Pre-Amplifier is equipped with switch and power cable having marked leads. Easy to install. Two tone bronze case. Size 7½ x 4½ x 5½". Shipping weight in lots of 6, 22 lbs.**

**R-375 for 6-volt, without tube ........ $13.00**
**Radiotron UX-222 Screen Grid Tube ........ $6.50**

## DYNAMIC AND VARI-TONE SPEAKERS

**Blind tests—in which the identity of various speakers was unknown—conclusively proved that the new Sterling speakers reproduced tone more faithfully than all others in their price class.**

**The Sterling Manufacturing Co.**
Cleveland, Ohio

PACIFIC COAST DEALERS CAN ORDER DIRECT FROM
*Radio Dealers Supply Service*
*Wholesale Division of*
**OFFENBACH ELECTRIC COMPANY**
*"The House of a Million Radio Parts"*
**1452 Market Street San Francisco, Calif.**

*Makers of Fine Electrical Instruments for 23 Years*

## A PORTABLE SHORT-WAVE RECEIVER

(Continued from Page 34)

num brackets, and a strip of ¼ in. bakelite 2¼ x 14 in. long, apparatus can be mounted on both sides of the strip, thereby cutting the depth of the set in half, as compared with the customary bread-board style of mounting generally used in short wave receivers.

The audio transformers were selected not so much because of their tone quality as for compactness and rugged mechanical construction; for headphone reception, the tone quality on WGY at 3000 miles distance was excellent.

Underneath the subpanel adjacent to the coil mounting, the plate r.f. choke was mounted, and the antenna binding post was placed at the right hand end of the base. Two fixed resistances, one of 3 and the other of 4 ohms, are also mounted on this base, to control the voltage of the 99 tubes. In order to eliminate a voltmeter and panel rheostat, these resistances were selected so as to reduce the voltage across the three filaments from 4½ to 3.3 volts when the dry cells are new, and by means of a flexible wire with clip, the 3 ohm resistance can be cut out when the dry cells have dropped .6 volt. When the cells have dropped to 3.3 volts, the entire resistance group can be cut out, and while this removes the *C* bias from the two audio tubes, it enables getting the last watt out of the batteries, an important consideration when several thousand miles from the nearest source of supply.

The panel apparatus consisted of the two tuning condensers, with vernier dials, a filament switch, volume control resistance, and output jack. The volume control consisted of a 500,000-ohm potentiometer shunted across the secondary of the first audio transformer, and while not absolutely necessary, is a handier control of volume than the tickler condenser.

In the picture of the set installed in the cabinet, the relative size of the outfit can be seen. Below the set, in the box, are three standard size 1½-volt dry cells, and two small 22½-volt *B* batteries. The dry cells for the filament will last for about 150 hours of intermittent use, and the *B* batteries for about the same period, so that with two sets of spares, nearly 500 hours of service is possible with the set. The two stages of audio are designed to give as much amplification as possible for headphone reception, and hence the last audio tube will not operate a loud speaker. If a loud speaker was required, at least 90 volts and 4½-volt negative grid would be needed for the last audio tube for any sort of volume.

The complete set, with batteries, tubes, cabinet, headphones, and three sets of coils, weighs 20½ lbs., of which

(Continued on Page 48)

# Jensen
## DYNAMIC SPEAKER

*The new Jensen cabinet models are in full production in both Jensen factories. Orders, regardless of quantity, are being shipped promptly. Jensen distributors throughout the country have these new models in stock.*

*Above is shown the new Jensen Model 7 Console. List prices range from $75.00 to $90.00 depending upon the type of Jensen Dynamic Speaker unit installed in the cabinet.*

### FULL PATENT PROTECTION

Jensen Dynamic Speakers are manufactured under the patents of the Lektophone Corporation, and also under Electro-dynamic patents which name Peter L. Jensen as co-inventor. Additional patents are allowed and pending covering exclusive Jensen features.

No other dynamic speaker offers such advantages: licensed under Lektophone and Dynamic patents and constructed under additional exclusive Jensen patents.

# SIFTING THE DYNAMIC SPEAKER FIELD

*The new Jensen Model 6 Cabinet (shown above) sets a new vogue in truly artistic and finely finished cabinet design. Prices range from $55 to $70, depending upon type of Jensen Dynamic Speaker Unit installed in cabinet.*

*Jensen Dynamic Speaker Units for installation in radio or phonograph cabinets are priced at $40, $43 and $55. Made in types to operate with 6 to 12 volt D.C., 100 to 120 volt A.C. and 90 to 180 volt D.C.*

*Jensen Dynamic Speakers are fully protected by licenses and patents as follows:*

*Licensed under Lektophone Patents . . Licensed under Magnavox patents . Jensen patents allowed & pending*

DEALERS, jobbers and manufacturers have quickly learned to sift the dynamic speaker field. Jensen continues as the standard of comparison, and Jensen popularity increases each day as the real advantages of a true tone dynamic speaker are understood.

But this steadily increasing leadership is a perfectly logical result for no other dynamic speaker has these five points of excellence—typical Jensen features.

1. Manufactured under both Lektophone and Dynamic patents.
2. Exclusive features in design covered by Jensen patents allowed and pending.
3. In quantity production for over a year with uniform high quality maintained.
4. Selected by leading radio set, cabinet and coin operated phonograph manufacturers as standard equipment.
5. Two factories in full production; deliveries apace with demand for the first time.

Five proven advantages—and the reason for Jensen leadership in the dynamic speaker field.

Write or wire us regarding wholesale or retail distribution in your territory.

**Jensen Radio Manufacturing Company**

212 Ninth St., Oakland, Cal. 338 North Kedzie Ave., Chicago, Ill.

## A PORTABLE SHORT-WAVE RECEIVER

(Continued from Page 46)

the batteries weigh more than half, so that the set can be termed a truly portable outfit. The cabinet was made of cedar, and with the handle weighed less than 2½ lbs., and was provided with a sliding panel at the front, to cover up the dials and front panel, and afford complete enclosure of the set and batteries.

This sort of a receiver would be ideal for a summer camp or automobile trip, where it was desired to keep in touch with events at home, at places where distance reception with an ordinary broadcast receiver would be out of the question. Only a short antenna is required; on this particular model, WGY was received in California with only 10 feet of wire indoors, and with good headphone volume; ample proof that 25 or 30 feet of wire thrown up into a tree, or suspended a few feet above the earth, will be sufficient.

## BYRD EXPEDITION TRANSMITTERS

The Byrd Antarctic Expedition is equipped with three transmitting and receiving sets to be employed on ships and at the base station. Three transmitters of the 500-watt, intermediate-frequency type have been supplied by the Radiomarine Corporation. One is aboard the S. S. *City of New York*, and another aboard the S. S. *Chelsea*. The third is intended for use at the base station of the expedition, which will be established on the ice. Three short-wave receivers have also been supplied, to accompany the transmitters. These will maintain communication at least with stations in South America, New Zealand and Australia. It is also expected that communication will be maintained between the base station and the planes of the expedition.

Commander Byrd has laid out an elaborate system of contact between the various parties of his expedition. He has selected five experienced radio men to accompany him and be responsible for the operation of the radio equipment.

In addition to the stations on the supply ship and at the base, each of the exploring parties, whether flying by airplane or traveling by dog-sled, will have portable short wave transmitters and receivers. Five of these sets, which are alike, have been designed and built by the C. F. Burgess Laboratories, Inc., Madison, Wisconsin.

The transmitters as well as the receivers are powered by dry batteries. To retard any reduction in service due to the low temperatures which may fall to 75° below zero, special battery boxes have been constructed and heat insulated with balsam-wool.

## THE 1420

(Continued from Page 41)

coil is a rubber or bakelite form 2⅞" in diameter and 2" long. This form is slotted or grooved so as to leave a winding space 2¾" in diameter and 1.84" long; it is then threaded 22 threads per inch left hand, and wound with 38 turns of Litz., 36 per inch. Over this form and coil is slipped the shield coil form. This is thin tubing 2¾" inside diameter and 2" long. This tube is threaded 18 threads per inch *right hand* thread and wound with 31 turns of Litz. Owing to the difference in diameters in coil forms and the slot cut in the rotor there is about ⅛" space between coupling and shield coils.

The sec. coil or load coil is wound on a 4" micarta form 6.25" long. The secondary and part of plate coils are both wound on this form. Looking at the set from the rear you will notice that there seem to be 3 windings or sections and that a rotor shaft comes through the tube between the first and second sections of 1.375" from the left hand end of the tube. On the first section, which is about ⅝" long, 20 turns start .55" in from the end, are connected in series with the coupling coil and make the first tap of the secondary. The remainder of the secondary starts 2.25" in from the end and is wound as follows. Litz. 36 turns per inch, left hand:

| | | |
|---|---|---|
| Second tap | 32 turns | 2 bank wound |
| Third tap | 70 turns | 3 bank wound |
| Fourth tap | 137 turns | 4 bank wound |
| Fifth tap | 264 turns | 5 bank wound |
| Sixth tap | 558 turns | 6 bank wound |

Total 558 turns.

Regeneration and oscillation are obtained in the plate circuit by the use of a tickler in the form of a variometer, having a stationary coil wound on the same tube as the secondary, (and between first and second sections of secondary, in series with a rotor coil which is wound on a spherical form mounted inside the secondary. When the movable part is in the 180 degree position its coupling adds to that of the stator coil, when in the zero position its coupling is subtracted from that of the stator and practically neutralizes it. The shaft on the rotor is ¼" in diameter and is 1.375" from end of tube. The stator winding of the tickler is about 7/16" long, starts 1.55" in from the end and has 36 turns, two bank wound 36 turns per inch, left hand. The rotor form is about 3⅝" by 1.84" and shaped like any ball rotor. It is wound with 56½ turns Litz. *right hand* turn.

We can all see the tube socket and squirrel cage rheostat. The latter has 17 ohms, with a 2-ohm bias tap.

The telephone condenser is a high capacity affair connected between the tickler and filament to act as an r.f. by-pass around the phones and *B* battery. It is built up of copper sheets 1.25" in diameter, and .005" thick, and mica sheets 1.50" in diameter and .005" thick. These are tapped as follows: 15 plates, 1 plate, 2, 3, 4, 5, 8 and 7 plates, or a total of 45 copper and 46 mica plates, and giving a fixed capacity of .004 MF and a variable capacity of .007 MF.

A radio frequency choke coil is used to keep the r.f. out of the phones. This is made up of 1200 turns of No. 36 SS enameled copper wire.

A grounding condenser grounds the filament and battery circuit, and is made of 55 copper sheets 1.70" by .40", .005" thick, and 56 mica sheets 1.40" by .60", .0015" thick.

The above data were used in building some of the 1420's during the war, and as it is sort of obsolete in the Navy now, I guess it will be o.k. to use it.

### DEAD-END SWITCHES

The high inductance sections of the antenna and secondary coils are resonant at wavelengths near the operating ranges of the low inductance sections and therefore would weaken signals on lower wavelengths. To overcome this the inductance switches are provided with fine blades, so as to short circuit unused portions of inductance. A pointer driven by the inductance switches indicates, on the proper one of six circles on the condenser dial the wavelength to which the circuit is tuned.

A Federal anti-capacity switch is provided for connecting battery circuit and crystal detector. In the send position the filament and plate batteries are both disconnected. In the Crystal-R.F. positions the detector tube is disconnected so that the tuning circuit can be hooked up to an r.f. amplifier or a crystal detector hooked onto the set. The dials are white metal 4.50" in diameter and 1/16" thick. One half of the dial is engraved 0° to 180° or 0° to 100°, and on the other half are engraved six half circles. These are .25" apart, and wavelengths are engraved on them after the receiver is calibrated.

I would advise anyone interested in building a set similar to this one to get a copy of RADIO for June, 1923, or December, 1922, and read D. B. McGowan's article on a portable receiver for 150 to 5000 meters. The enclosed data were, as I understand, used on the original 1420, and although various improvements have been made, the coils and condensers remain the same.

The shield coil has been disconnected in some, as has the choke coil. Some later models use a grid-leak and condenser instead of the bias tap.

In commercial adaptations of this set the antenna series condenser is a little larger, .0015 MF instead of .0014 MF, and the secondary condenser is .00075 MF instead of .0007 MF. These changes of course allow the set to tune to a higher wavelength. Some sets have binding posts so that external load coils may be attached for longer wavelengths.

## LETTERS TO THE EDITOR

### "Radio Conditions"

Sir: Discussions of the Radio "game" afloat, in this department, have been absorbing—especially the always interesting contributions of Mr. Gillis, comment by the department editor and many others. However, for the instant, look at the job afloat, not as a so-called "game," but as it stands stripped of superfluities—simply a wage earner's occupation beset by supposedly insufferable conditions. (No one but the operator regards it as a "game.")

The occupation carries certain impedimenta of tradition, fascination, mild adventure, some romance, bits of mild egotism and what-not, which collectively cloud facts and befog issues.

The ship operator's job leads him into a cul-de-sac. In strictly ship radio work, promotion is impossible. Amelioration of conditions is limited to a betterment of the local situation on an increase in pay.

Given local conditions, in general, afloat, affect most all ship's officers in practically equal degree. Operators have scant hope of dictating conditions to which other officers are subject.

Increase in pay has been attempted by: (1) individual effort; (2) mistaken efforts to "increase operator's efficiency"; (3) by organization; (4) by strike or (5) through radio companies.

In general, individual efforts to increase salary are nil in result.

"Increase in operator's efficiency," to gain wage increase, is a hollow mockery, and a boomerang. Through radio service contracts, in general, employment of operators, and as actual agents of the steamship company, the radio concerns automatically take care of the "efficiency" of operators—hiring and firing as the service demands. Radio concerns furnish men and conduct operations to the satisfaction of the steamship company. Otherwise radio contracts are either cancelled or not renewed, being placed elsewhere. Gaining the sentiment ($) of shipping companies by "increase in efficiency" of operators is a pretty (and apparently mighty tempting) hallucination in which the uninitiated set great store—but which has been exploded innumerable times since the advent of radio afloat. Sight should not be lost of the fact that demands for "increase in efficiency" of operators pass directly to the radio company—not directly and primarily to operators—at least from the contracting steamship company's point of view. In general, present "efficiency" satisfies shipping companies. Novices should not thrust upon the steamship company what it has not demanded—not expected—neither, in excess of that which it has contracted for, and is paying for.

Of organized efforts to gain greater wages, little has been accomplished. With industries in the hands of corporations, the concrete efforts of employees' organizations along these lines have been doubtful. Witness the boundless evidence of the invalid efforts of craft unions in the United States—except purely locally, or temporarily—or in scattered spots, and—or under extraordinary or unique conditions. Notwithstanding, every industry, every group, every syndicate of employers in the country are organized and more or less interlocked throughout the country—and can so function if business reasons demand. Sadly enough, employees often fail to see benefit in organizations themselves. Organization and interlocking relations both together constitute a fundamental essential of all effort and progress—de facto, a veritable key to the universe, down to the last single electron.

Attempts to force increase in salary, as regards this vocation and many others, remain abortive. Evidence is abundant that strikes in the United States are becoming, more or less, a thing of the past—in general, the effect being futile (perhaps a bitter fact, yet undeniable).

Alliance with radio concerns to effect an increased wage in ship work, also remains abortive. A high official of a world-wide radio concern told the writer: "We would like to see operators afloat obtain reasonable, even high, wages for their highly skilled work. But we must preserve our own scalps. Through contracts we are, in effect, servants of the steamship company—actually a subdepartment. Undesirable or not, as it may be, we are helpless to aid the operators in this direction. The operator must fight his own battles—and keep his slate clean with us." A very comprehensive and final statement.

Some caustic, some futile, some unreasonable, some misleading and some infantile comment appears in publications from time to time regarding conditions and causes for present conditions afloat. True it is that exasperation crops up and with good apparent reason, yet internal strife defeats any common objective. One singularly obnoxious phase of the matter is the derogation of American operators—by American operators. Most of this comes from uninformed sources, or from spur of the moment repartee. American radio communication systems are the premier of the globe, not because we just like to think so, but because traffic handled and men and equipment employed prove it.

Another matter. Amateur and commercial radio telegraphy do not readily mix. The hue and cry for the necessity of amateur radio has a proper and admirable genesis and the amateur has a desirable niche in the scheme of things, but not at sea on merchant ships. The utter essentiality of the amateur's usefulness during the war is often overstressed, especially as regards the Navy. In contrast,

(Continued on Page 54)

# THE MAJESTIC "70"

(Continued from Page 42)

The variable condenser group is also shielded, this shield having been removed when the picture was taken. This group is controlled by a single drum dial, the control shaft being in the center of the chassis. The individual trimmers for these condensers are adjusted at the factory.

The detector is the usual type '27 a.c. tube, and the audio frequency amplifier consists of a type '26 first stage, and a push-pull second stage using type '71 tubes. The output of the set is fed into an electrodynamic cone speaker, the field of which is excited by 90 volts d.c., obtained from the rectifier system in the power plant, which is shown in back of the chassis in Fig. 1. The power plant consists of a type '80 full-wave rectifier, supplying 200 volts d.c. for the *B* and *C* potentials, as well as the field of the loud speaker, and the usual 1½, 2½ and 5-volt windings on the power transformer supply the filaments of the tubes and the pilot lamp on the drum dial.

The voltage divider resistances are indicated on the diagram, as are the values of the filter condensers, and the various *C* biasing resistances in the set itself. *C* bias is obtained by means of the voltage drop across these resistances, which are placed in the negative *B* supply lead. While the electrical center of the filament circuit for the three r.f. tubes is obtained by means of a center-tapped 20-ohm resistance, of a fixed type, the small amount of residual hum in the receiver is balanced out at the time of installation by a 20-ohm potentiometer across the filament of the first audio tube, this resistance being placed on the back of the chassis, so as to be accessible from the rear of the cabinet.

A liberal use of ½ mfd. bypass condensers localize r.f. currents to their proper paths, and r.f. chokes in the grid return circuits of the r.f. amplifier tubes prevent ultra-high frequency oscillations between stages.

In the power plant, a voltage regulator consisting of a resistance bank is placed in the primary circuit of the power transformer, which is especially designed for this resistance. This assures regulation of voltage to the tube filaments, and of the plate supply, for any ordinary line condition. The output voltages of the power plant are run to a set of binding posts, to which the connecting cable is fastened, and the electrodynamic speaker in turn is connected to four terminals on one end of the receiver chassis. Note in the diagram how the speaker field is connected between the positive 90 and 180-volt *B* taps, instead of between the negative and positive 90-volt *B* terminals. The arrangement of the bypass condensers in the r.f. circuit is such that the r.f. currents follow a very short path to ground, instead of passing through a common *B* positive lead for some distance before reaching the proper bypass through a condenser.

# Radio Kit Reviews

## THE AERO INTERNATIONAL

The Aero International kit comprises a complete outfit for the construction of a short-wave broadcast receiver comprising one r.f. stage, detector and two stages of audio. The r.f. stage uses a shield-grid tube and plug-in coils which cover the different short-wave bands used by broadcasters.

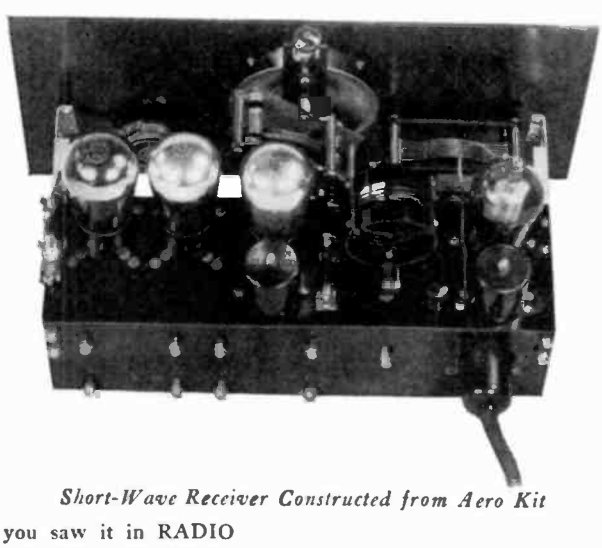
The kit includes bakelite panels, with a completely wired sub-panel so that the unit can be completed by connecting a few wires to the instrument mounted on the front panel. The last audio stage is wired so that either a '71 or a '12 type of tube may be used.

The set has but one tuning control and is non-radiating. It also has a smooth volume control and a filament rheostat, there being but three knobs on the front panel.

KGER of Long Beach, Calif., recently broadcast a unique description of the regatta conducted by the Pacific Southwest Exposition. This was done by means of a portable transmitter on the regatta barge whose radiation was picked up and amplified at a shore receiver and then transmitted by wire to the broadcast studio, whence it was broadcast on 215.7 meters. The portable transmitter, 6XBV operated on a 48.86 meter wavelength.

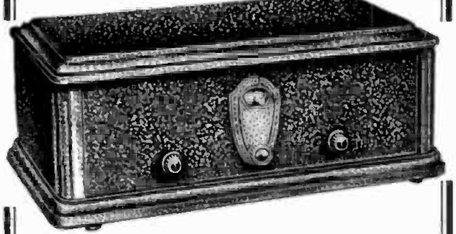
The Polymet Manual from the Polymet Mfg. Co. of New York City presents engineering data on various types of condensers and resistances used in the construction of radio equipment. From these data it is possible to determine the sizes and types necessary for any desired purpose.

Aerovox condensers and resistors are illustrated and described in a catalog from the Aerovox Wireless Corp. of Brooklyn, N. Y. This contains much interesting information about the selection of filter equipment for socket-power devices. This company has also published "Notes on the Design of Filters" in Nos. 6 and 7 of its "Research Worker."



*Short-Wave Receiver Constructed from Aero Kit*

# A Startling New Principle in *Broadcast Reception*



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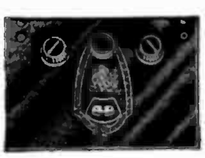

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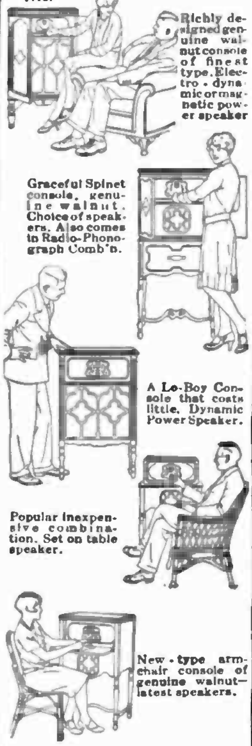

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## LETTERS TO THE EDITOR

(Continued from Page 51)

in the Army, during the war men were taken from the cattle ranches, the mines, from the back areas of "back beyond" and turned into radio men of the first water—men who coolly carried on under battle conditions which might shake the faith and reason of a saint to the very foundation, and these men, priorly, had never dreamed of such instruments as those of radio, nor ever had so much as a sniff of salt water until they set foot on eastbound transports. I retain in a notebook the following entries:

"Carter, John, (excellent operator) formerly cowpuncher—decapitated by shell burst."

"Lines, Joe, (1st class opr.) gold miner, torso riddled, shell burst."

"Haven, Tommy, (1st class opr.) lumberjack, eight shell splinters, chest."

An additional entry is not a casualty—exactly:

"Bront, Jack—Hungry."

Kindliest regards to all,

JACK BRONT.

Truckee-Carson Irrigation District. Electric Power Section, Hazen, Nevada.

---

Dear Eddy: Want to let you know that I follow your interesting department at all times and enjoyed reading E. J. Stenman's amusing recital of his "Curiosity" venture in brasspounding.

Can understand friend Gillis' kick as he wrote in the June number. I used to be a strong amateur myself and started that way in the game. What he says is only too true, though, and I know it is the regret of the more sensible of the "ham" bunch.

Now suppose the wireless companies had an "extra" list, something on the order of the W. U. and Postal Telegraph companies when they used to handle lots of men.

In other words the permanent list of operators for a given outfit would be determined by seniority and ability, each weighing equally. Now then, when a "ham" or a man from a school tried to "buck" the list he would be given a chance and if he didn't stick or was given an unfavorable report by his senior operator on his first trip, he would be relegated to the end of the list and some other would be given his chance; thus gradually eliminating undesirable types from the ranks of commercial B. P.

Then again, suppose an old-timer comes in from a trip and finds his hulk is to be tied up for an indefinite period and he is paid off. He reports in to the "office" and the traffic manager of course tries to give him preference in locating, but actually he is just about as bad off as a new man on the list. It seems to me that such a man in first rate standing should be on such a "permanent list" so that he would rate relieving some chap perhaps just newly on the "extra" list and in this way all ops who had put in time and had acquired relative standing, with the company, through seniority and ability, would be sure of regular berths on some tub or other or shore job. But where the steamship company is paying "Sparks," the telegraph company can't exercise such control over the operators supplied from their office, even though they would like to keep their best men regularly "lined up."

Now what about it, Eddy, wouldn't that system keep out the undesirable newcomer as complained of by Mr. Gillis and take care of the man who wants to feel that he has an employment that he can rely upon to regularly sustain his insides and possibly that of a Mrs.? Of course this is in line with what I had to say as given in the July magazine.

As for the matter of unlicensed men holding down these point-to-point jobs, guess that would have to depend on the employers in such outfits. Rather think in most cases they depend on the recommendations of the traffic managers of the wireless companies; so I found it when getting on the Western Air Express when it first started up.

I understand the tropical outfit is conducted along such lines as suggested and while I never worked for them, I know that the average of ability for the marine operators, not to mention their land station stuff, is high, much higher than that of any other marine radio telegraph organization. I'm trying the C. G. for a spell now; at NGQ. Keep continuous watch on 600 M. So don't miss much of the old stuff at that.

73, W. L. JEPSON.

Yes, something of this sort would probably be a wise and practicable move on the part of the controlling steamship companies. The sad part of it is, however, that the ideas and ideals brought forth in these humble columns do not reach the doorsteps of the aforementioned companies. Why not stir up a circulation of that character? If the men to whom the operators are responsible should get acquainted with operators' ideas by reading these informal discourses, would they not be a little more in sympathy with the desires of their men? Well, then, why not get a little cooperation from you fellows in getting RADIO into the hands of these men? When you see something that your chief or marine superintendent should read, pass it on to him, or send us his name and perhaps we can mail him a complimentary copy. Let's get at the men at the top—acquaint 'em with the operator's point of view—but let's be tactful about it.

## Corrections and Additions to the Inter-Coastal and Gulf Weather Schedules

*By* PAUL OTTO

75th Meridian Time

Arlington.—NAA, 2677, CW, change 10:30 a. m. to 10:00 a. m.

Nassau.—VPN, 600, SPK, 9:15 a. m., local weather.

120th Meridian Time

Mare Island.—NPG, 7006, CW, change 9:00 a. m. to 7:30 a. m.

Marshfield.—KGN, 600, ICW, 8:00 a. m., 12, 4, 8 p. m. local.

Additional word to list used in XDA weather.—Spanish, Decreciendo; English, Decreasing or diminishing.

## CARIBBEAN NOTES

*By* CHARLES H. GRANT, WXE

It may be of interest to the gang on the east coast, as well as those who are running from coast to coast, to know about some ship schedules maintained by the United Fruit liner, *Santa Marta* while in southern waters. During the heavy static season, a majority of the ships in the Caribbean find it rather difficult to clear their traffic, usually meaning an all night grind before the sweating op can pound his ear in peace without worrying about some important message or routine traffic that "should have gone through."

The United Fruit liners are always in touch with the Tropical Radio Company's coast stations, working on hourly schedule, providing expeditious service to the states and Central America. There is no ship relay charge to coast station, providing the coast station is controlled by the Tropical Radio, and the boys surely give service.

The *Santa Marta* (KLG) stands by on 700 meters, CW or spark, answering calls on 750 CW at the following hours, Eastern Standard Time: 2:30, 4:30, 9:30, 10:30 a. m.; 2:30, 4:30, 9:30, 10:30 p. m.

## ¾, 5 AND 10 METER TRANSMITTERS

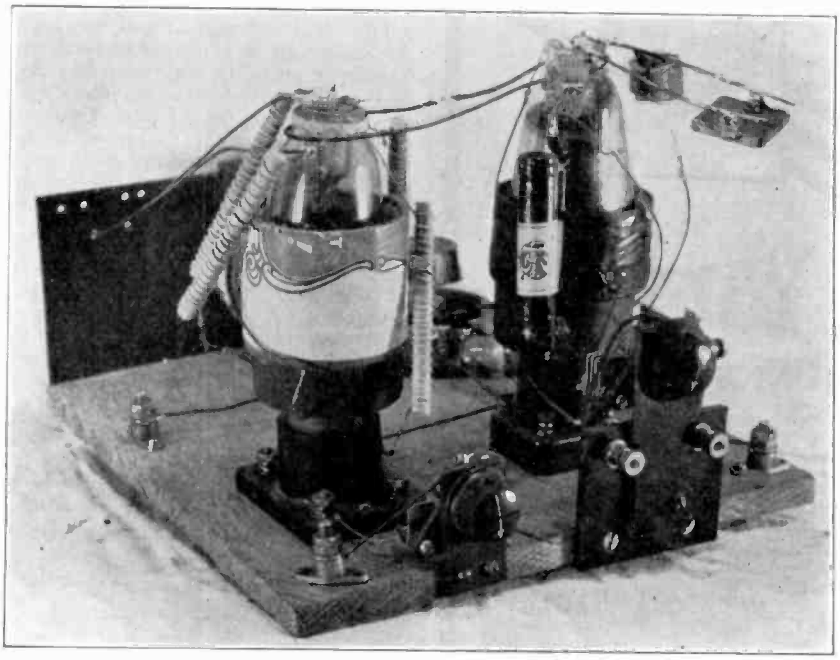
(Continued from Page 40)

sults. Usually an increase in output results when the smaller values are used. At these frequencies, by-pass condensers across the filament have perhaps little merit, but they help some, and are inexpensive; two .001 mfd. mica receiving condensers can be used. A 1500-ohm grid leak is about right for the 310 tube.

The tuned grid and plate circuit operates very well at 5 and 10 meters. The two condensers used should be of the same type, for small changes may throw off the range of one tuned circuit. It is doubtful if any particular transmitting circuit has the advantage over other circuits, if both are properly adjusted. The care used in proper adjustment and arrangement of parts at these frequencies may mean the difference between good and poor results, and this does not necessarily mean to use the shortest possible leads. The circuit in Fig. 1 is perhaps the simplest and may be used at 5 meters with little change. At 5 meters the effects described are more exaggerated than at 10 meters, but with proper adjustment, a transmitter will operate as well here.

For proper transmission, the oscillators should be loosely coupled to the antenna. The "coupling" to the antenna at the higher frequencies consists appreciably of electrostatic coupling also. The tendency is to use too close coupling. The zeppelin antenna is a good one to use, for the radiating part can easily be drawn up into the clear. Small differences in construction will often throw the antenna out of proper balance. One can tell approximately where the voltage loops are on the antenna by using a small input to the transmitter and moving the hand along near the antenna wires. At positions of high voltage, the plate current of the transmitter usually changes. One can adjust the antenna only approximately in this way, for the presence of the body changes the capacity of the antenna somewhat.

The ¾-meter band is of unusual interest to the experimenter. The ordinary power tubes (such as the 310) have such high internal inductance and capacity that they will not oscillate directly at ¾ meters. A master-oscillator power-amplifier arrangement (as shown in Fig. 2) will not only allow one to put power into a telescoped-tubing on ¾ meters, but the output will be quite steady.



*¾-Meter M. O. P. A. Transmitter at 6BX*

In the illustration of the ¾-meter set, the 2¼-meter oscillating circuit is clearly shown. The oscillator operates at about 2¼ meters and is overloaded so as to produce strong harmonics. The 310 can be made to oscillate strongly at this wavelength and this wave is used rather than 1½ meters where it is more difficult to secure proper operation with these tubes. The oscillator is coupled to the amplifier by means of the parallel wires with a loop at each end.

The amplifier is a 5-watt tube which is somewhat better for the purpose. The parallel wires of the oscillating circuit are about 3 inches long and the wavelength is adjusted by sliding the fixed condenser along the wire. This condenser is .00025 mfd.

The plate "tank" of the amplifier consists of a pair of parallel wires which are trimmed to their proper lengths, this changing both the inductance and capacity for a

(Continued on Page 58)

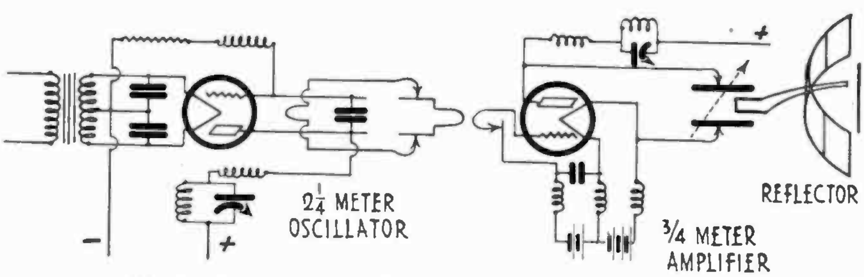



*Fig. 1. Arrangement of Apparatus for ¾-Meter Transmitter*

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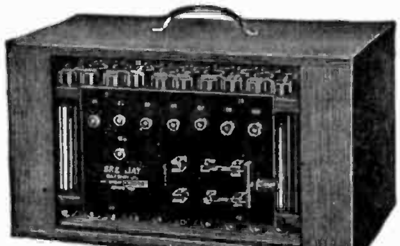

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## ¾, 5 AND 10 METER TRANSMITTERS

(Continued from Page 56)

given spacing. The r.f. transmission line connecting with the reflector is coupled to the parallel wires by means of the holes in the bakelite at the rear of the set.

The chokes shown on the amplifier consist of about 20 turns wound on a ¼-in. dowel. A small tuned choke is used in the plate circuit. A tuned choke is also used in series with the 30-turn basket coil on the oscillator. The bases of both tubes must be removed. Troublesome "shorts" in the base are prevented by bending each lead back over the glass at the "seal" and holding them in place with a few turns of string, wound around the tube. For 2¼ meters, the tuned choke consists of a midget of about 5 plates and a few inches of wire as a coil. The ¾-meter tuned-choke consists of a midget condenser of 2 plates and an inch or so of wire. This choke should be about the same size as the wave meter which includes the ¾-meter band. The wave meter is calibrated from lecher wires which need only be about 5 ft. or so at this wavelength. The wires are spaced rather close together, so a short copper wire shorting-link can be used. Two such parallel wires, if arranged on a support, and provided with a small centimeter scale, will serve as a direct-reading wave meter.

With simple oscillating circuits of this nature, one can use plug-in tubes to change the wavelength. The tubes are provided with complete oscillating circuits which are adjusted for maximum efficiency at the frequency used. Thus when the wavelength is changed, the oscillator will operate immediately and with maximum efficiency.

The bases of the tubes are removed by heating over a gas flame. The tubes are inverted and sealed into a cardboard box. As the oscillator is overloaded and will heat, a heavier sealing compound than parafine should be used. The inverted tube-container is fastened to a wooden base, one end of which is turned down so as to fit into a UX socket. The various tubes can therefore be plugged into the circuit quite readily. Each tube is fitted with its own oscillating circuit, chokes and grid leak and can be adjusted for good results at operating frequency.

By tuning the "transmission line" between the oscillator and amplifier, the correct harmonic can be emphasized, thus giving a predominating ¾-meter wave for the amplifier. The plate circuit of the amplifier is tuned by cutting the wires, the correct length being about 1 ft. long; the exact length depending upon the tube used. The coupling-line can be tuned by varying the distance between the tubes, the length of the line; and is supported by passing it around the bases of the two tubes. The line could also be tuned by using a very small variable condenser. By tuning the wavemeter which is coupled to the plate circuit of the amplifier, the plate current will increase at ¾ meters, if everything is functioning.

Another interesting field for experimentation is to use small parallel circuits in the line to prevent undesired harmonics from reaching the amplifier. These circuits show some impedance at harmonics of their natural frequency but have a very large impedance at their natural frequency.

The ¾-meter set with its reflector was exhibited at the University of California on "Engineer's Day" and proved to be of considerable interest. The ¾-meter reflector used at 6BX is believed to be the first ever used for actual amateur transmission.

## A.C. SCREEN GRID FIVE

(Continued from Page 33)

leak $R_6$ are of the usual sizes, .00025 and 2 megohms. The detector feed-back condenser $C_{16}$ should be about .0005 mfd. in value. The size of this and the tickler turns can best be found by trial; the values given worked satisfactorily in the experimental receiver. The three-gang condenser $C_6$, $C_8$, $C_{12}$ should have trimmer condensers across each section for properly lining up the tuned circuits. The condensers should have a maximum value of .00035 mfd. with the type of coils shown.

Center-tap resistances across the filaments of the 1½, 2¼ and 5-volt tubes may be fixed or variable. A little better balance, less a.c. hum, may be obtained with semivariable resistors.

Fig. 2 shows the apparatus layout in the receiver. This, together with the wiring diagram, Fig 1, and the pictures, should enable anyone to make up a similar receiver. Fig 3 shows the panel layout.

The control grid leads should have small spring clips for connection to the top electrode of the screen-grid tubes. Type UY sockets are necessary for these tubes as well as for the detector. The r.f. chokes may be of some standard type, or may be made by winding 300 or 400 turns of small insulated wire on a spool.

In testing such a receiver it is generally most convenient to test the detector and audio amplifier first. The audio amplifier should have the proper plate voltages of 135 and 180 for the first and second stages, respectively. These voltages, as well as the other plate voltages, should be checked with a high resistance voltmeter when all the tubes are lit. To test the detector and audio amplifier, connect the antenna through the feedback coil to the grid of the detector and some local station may be used to test the quality of the audio system.

Each stage of r.f. may be checked roughly in the same manner if necessary. After the audio system and detector have been checked as described, the whole set may be lined up. Connect the antenna to its regular connecting lug, set the coupling condenser $C_7$ nearly at minimum value, and $R_1$ and $R_2$ at their maximum values of resistance. Then adjust the two tuning controls for some broadcast station and adjust the trimmer condensers for maximum signal strength and selectivity. This may be most easily done by rotating the three-gang condenser back and forth slightly while adjusting each trimmer condenser. Decrease $R_1$ and probably the r.f. amplifier will spill over into oscillation, that is, it will squeal on a broadcast station. The neutralizing condenser should then be increased or decreased in value until the r.f. amplifier will not oscillate even when the detector is thrown into oscillation by decreasing $R_2$, the regeneration control. During these tests the feed-back condenser $C_3$ should be set at a minimum value so that the first r.f. stage does not oscillate when $C_2$ is varied.

It will be found that there is a fairly critical setting of the neutralizing condenser $C_{11}$ which will allow the detector tube to spill over into oscillation smoothly and with $R_2$ control turned around furthest. Increasing $C_{11}$ will mean that the trimmer condenser across $C_8$ will have to be decreased. Fortunately the input capacity of the screen-grid tube is less than the input capacity of the detector tube or of the plate to filament capacity of the preceding screen-grid tube. Because of this, a value of 10 to 15 mmfd. in the neutralizing condenser $C_{11}$ tends to help line up the circuits as well as neutralizing this stage. The detector regeneration can be tested before the circuits are lined up by making sure that this part of the circuit oscillates. It should spill over when $R_2$ is not much more than half cut out if the feed-back coil has enough turns.

After the rest of the circuit is properly lined up the first stage of r.f. may be adjusted for its proper degree of regeneration. The tuning condenser $C_2$ should cover the whole broadcast range. If it does not, the shunt condenser $C_1$ should be changed in value until it does. The feed-back condenser $C_3$ may then be adjusted so that the r.f. amplifier is tuned to about 300 meters and $R_1$ is zero. Regeneration in the first tube tends to sharpen the tuning of $C_2$ and helps to obtain good overall selectivity.

The d.x. possibilities are excellent with, of course, the usual limitations of good or poor location. At a poor location here it was possible to overload the power tube on music from a station 400 miles away.

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SELL.—JEWELL RADIO SET ANALYZER. Pattern 133, Complete, Brand New, $45.00. E. M. Heiser, Route 3, Brecksville, Ohio.

FOR SALE!—Gerald Best's "Modernized" 45-KC super exactly as described in the editorial columns of this issue. This receiver was built by G. M. Best for use in gathering editorial material for the story and the publishers of "RADIO" will sell the receiver, complete with tubes, as illustrated in this issue, for $100.00. A fine genuine walnut cabinet with piano hinge is included in the price. In perfect condition and accurately matched and balanced. First money order for $100.00 takes it. Set will be shipped to you express charges collect. PUBLISHERS OF "RADIO," 433 Pacific Bldg., San Francisco, Calif.

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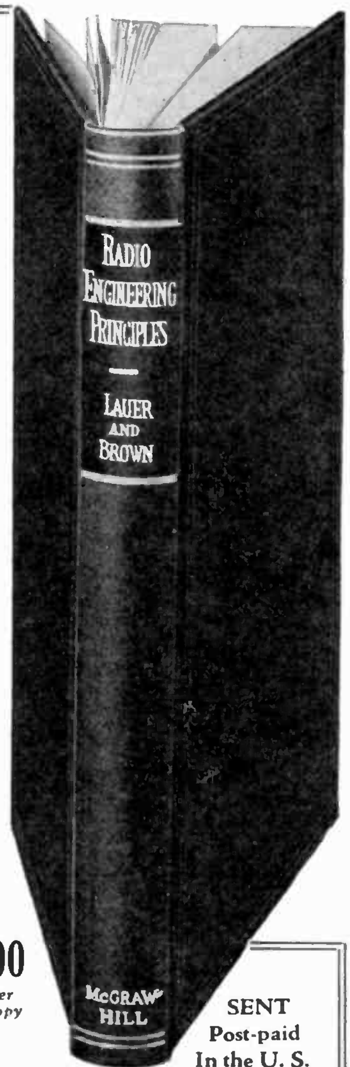


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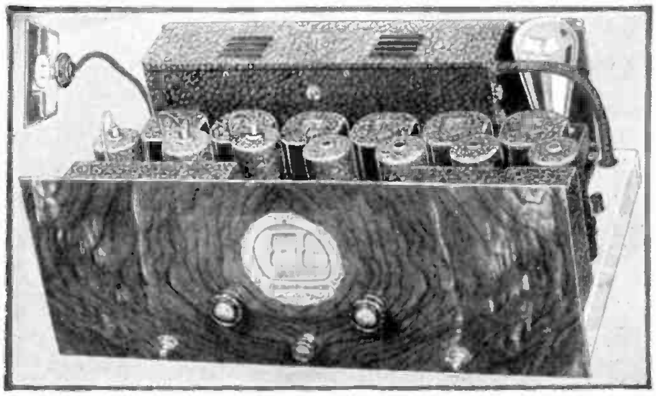
## The pioneers of the Shielded Grid Circuit now introduce advanced features in a new series of A-C and D-C operated Custom Built Shielded Grid Receivers



A FEW short months ago, Tyrman engineers developed and conquered the Shielded Grid Principle in radio circuits. Its introduction was heralded by Set Builders, Engineers and Editors as the greatest advance in radio since broadcasting. Today there is not a receiver using Shielded Grid Tubes which does not bear the ear marks of Tyrman influence.

Now after months of systematic experimenting, backed by unsurpassed working knowledge in Shielded Grid circuits, Tyrman Engineers again conquer principles that reach new peaks in Performance, Tonal Qualities, Beauty and Value in Custom Built Receivers.

Send for free descriptive literature. When you examine the diagrams and layouts you will quickly see why, in the Tyrman Series, you can be assured of hairline selectivity, full, rich tonal quality, unequaled power and distance under most trying conditions.

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Custom-Bilt Shielded Grid

### *For Complete A-C Socket Operation Using A-C Shielded Grid Tubes*

Short Wave Coils • UX250 Amplifying Tube • Phonograph Switch

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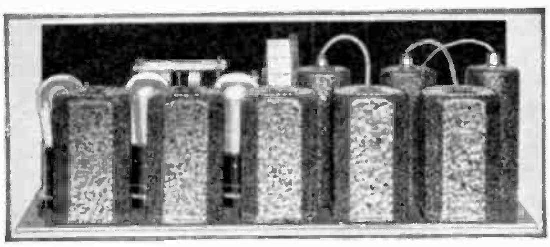

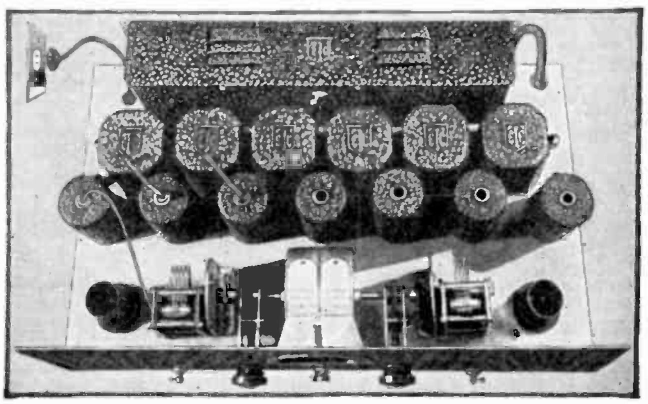

## Tyrman "72"

Custom-Bilt Shielded Grid

### *For Battery or A-C Socket Operation*

The Tyrman "72" can be assembled for battery, eliminator or Complete A-C Socket operation. Even if assembled as a battery set it is a simple matter to convert to complete socket operation. When assembled for A-C Socket Operation uses A-C Power Supply especially designed for the "72" mounted on subpanel platform. The Tyrman Duo System of Amplification, and Tyrman Audio Coupler System assure rich tonal qualities.

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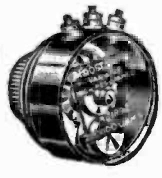

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Offer marvelous control of volume and oscillation. Roller contact arm is practically frictionless. Bakelite case and dust cover. Supplied in a wide range of resistances. $2.00 and $2.25.

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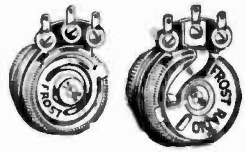
Identical with our larger Resistance Units except in size. The Gem is housed in Bakelite case measuring 1⅜ x ⅝ in., thus saving much space back of panel. $2.25 and $2.50.



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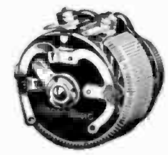

**Frost-Radio Bakelite Rheostat with Switch**

Battery operated sets find wonderful service in these Frost Rheostats with switch mounted on Bakelite panel. Switch has positive "off" position, and springs are German silver with sterling silver contacts, 2 to 75 ohms, $1.35.

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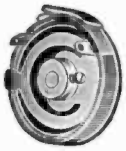

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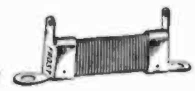

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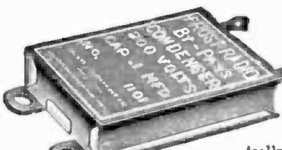


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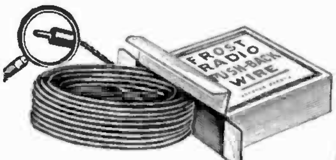


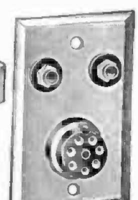

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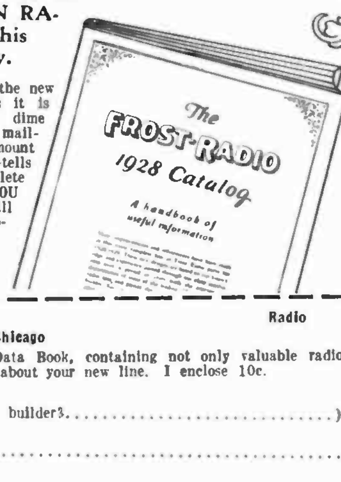


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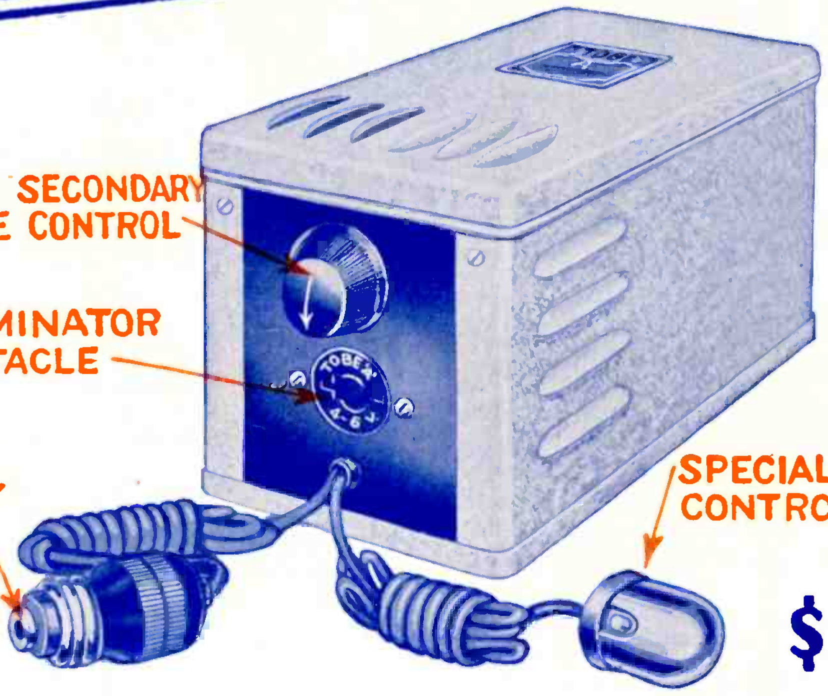

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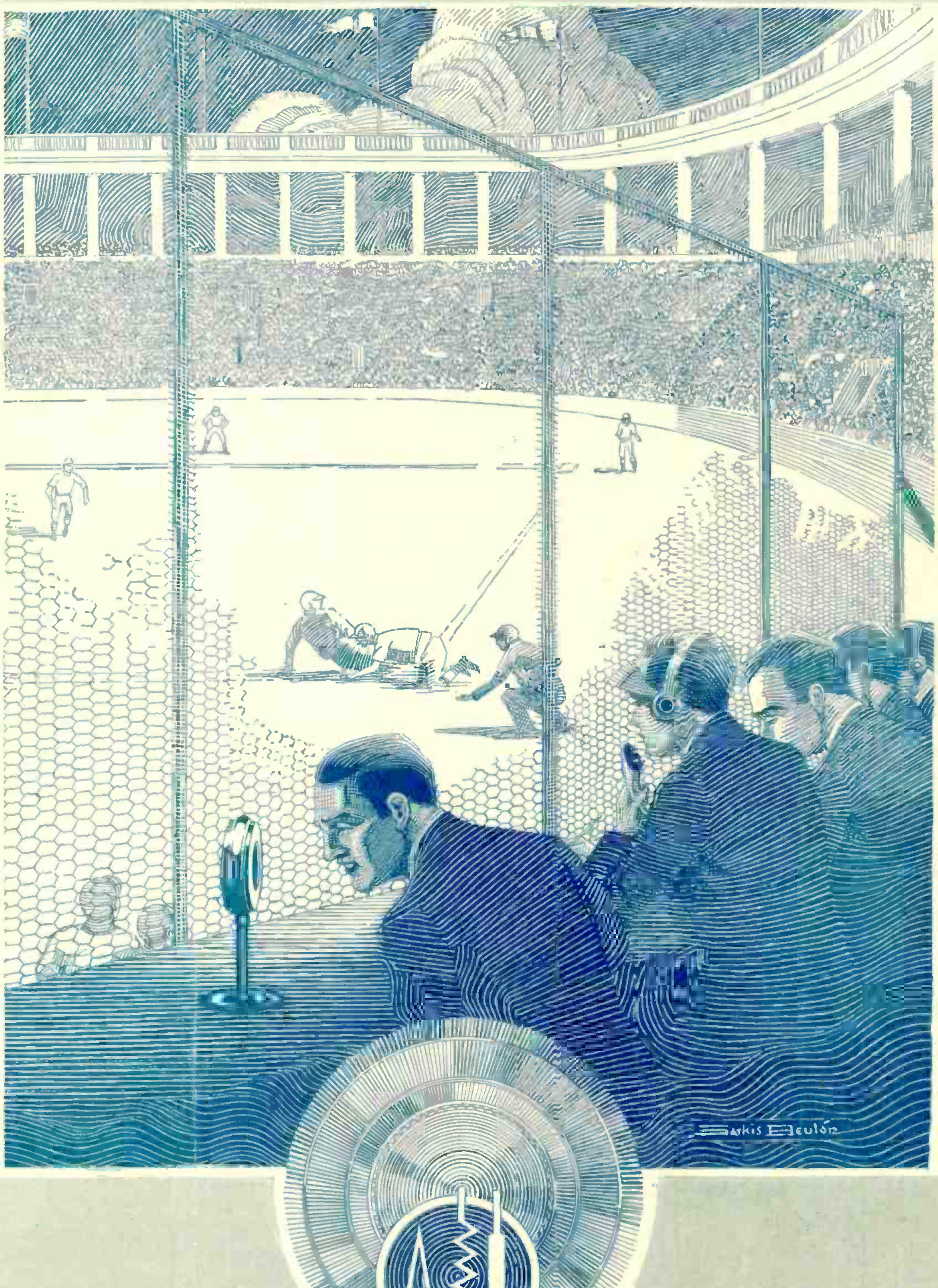

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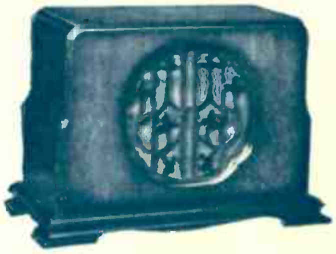

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THE FADA 4 CONE SPEAKER
*Mantel Clock Type*

A seven-inch completely encased cone, balanced armature with extra large chrome steel magnet with improved bobbin winding and simplified direct drive.

Price $32.50

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Operated from A.C. light socket (90 to 130 volts, 25 or 60 cycle) single dial, illuminated station finder, adjustment for long or short antenna, rejector, phonograph attachment jack, with improved circuit and volume control, self-contained in a beautiful metal velvetex cabinet in two tones of gold and brown.

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# RADIO

Established 1917

Published Monthly by the Pacific Radio Publishing Co.

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GERALD M. BEST, *Technical Editor* — A. I. RIVETT, *Draughtsman*

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VOL. X — SEPTEMBER, 1928 — No. 9


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### FORECAST FOR OCTOBER ISSUE

Don C. Wallace interestingly tells how a traveling man keeps in daily touch with his home by means of short-wave radio. G. M. Best describes the rejuvenation of the 45,000-cycle superheterodyne, so as to meet modern conditions. Clinton Osborne illustrates and describes the portable short-wave receiver which is to be used for the Byrd expedition to the South Pole. John P. Arnold discusses the ill-advised publicity about television, describes practical uses of photoelectric cells, and describes miscellaneous devices used in picture reception. Frank C. Jones tells how to build an a.c. screen grid receiver having five tubes. Samuel G. McMeen "finds buried treasure by radio." H. W. Anderson explains the construction of an all-purpose test set. Willis L. Nye has adapted the split Colpitts circuit for use as a short-wave transmitter. R. Wm. Tanner describes a selective short-wave receiver, and A. Binneweg, Jr., discusses the design and construction of ¾, 5 and 10-meter transmitters.


THE New
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"29"
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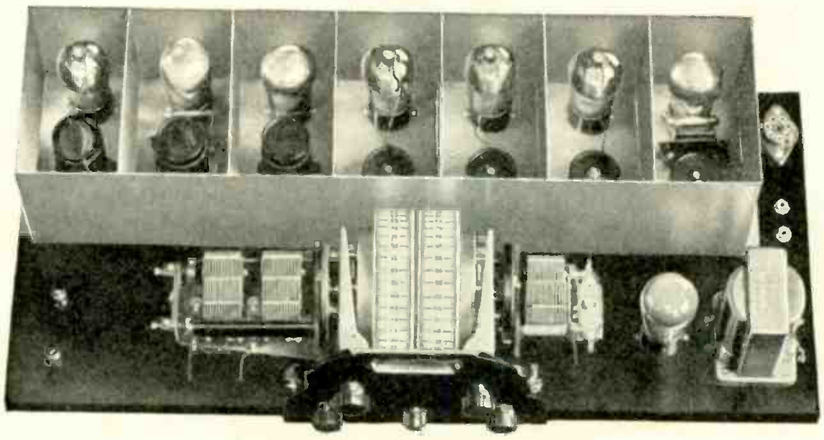


Today there are all sorts and kinds of radio receivers. They range in cost from a few dollars to many hundreds. You will find among them scores of good sets—sets that perform creditably.

BUT if you are experienced in radio, if you are musically critical, you know that you are still looking for the ideal receiver. You realize that circumstances force the makers of factory-built sets into many compromises. You cannot see much difference—except in appearance—between one receiver and another. Now turn to the Remler "29," first shown on August 18, 1928, and make some careful comparisons.

Tone may be your first consideration. In the "29" you find tone range and clarity beyond your highest expectations.

Perhaps you demand knife-edge sharpness of tuning. The "29" gives it in fullest measure. In addition you certainly want a set so sensitive that you will be able to enjoy many programs from far distant stations. Then roam the ether with the Remler "29." Here is the receiver that always does what is expected.

The REM 2

## High Spots

Marvelously Realistic Reproduction . . . Remler Audio System . . . Perfect Control of Volume from Maximum to a Whisper.

All the Selectivity that Could be Desired . . . Clean-Cut Separation of Stations on Adjacent Channels.

Superheterodyne Sensitivity . . . Shield-Grid Amplification.

Easy to build . . . Can be Assembled, Wired and Put into Operation in One Evening. No Special Knowledge or Experience Necessary.

Most of the Wiring Completed and the Circuits Balanced at the Factory . . . Only a Few Wires to be Installed by the Builder in Accordance with Color Code.

Eliminator or Battery Operated.

Combined Power Amplifier and Plate Supply . . . CX 350 (UX 250) Power Tube . . . Full Wave Rectification . . . Voltage Regulator Provided for.

Steel Chassis Amplifier Construction . . . Compact and Rigid.

Power Transformer Primary Tapped for Different Line Voltages.

## UNIT CONSTRUCTION
### *And What It Means*

Until recently the set-builder was compelled to assemble his parts from a large number of different manufacturers. Shopping for these parts was more trouble than putting them together. In the Remler "29" the more difficult assembly and wiring and the more exacting adjustments are completed at the factory. The No. 712 Shield-Grid Selector-Amplifier is a complete and self-contained unit and is the heart of the receiver.

This type of construction means lower costs to the buyer, and insures operation up to the standards of the designer.

# Why a Custom-Built Set . . . . ?

WHILE the majority of people own factory-made sets, the man who thinks for himself and knows what he wants will refuse to follow the crowd and will do his own deciding.

The radio expert fully appreciates the refinements and superlative performance of the custom-built receiver. Now the simplified Remler System makes these advantages available to everyone in the "29." It can be home built in an evening or completed and installed by any professional set-builder.

Parts can be and are chosen and specified solely on the basis of performance—parts, the use of which would raise the cost of a completely built factory-receiver to a prohibitive figure.

Savings effected from the shipment of parts in kit form, due to the elimination of double handling of many of them, to decreased bulk and weight and consequent smaller charges, and savings effected through delegation to the purchaser of the easy tasks of assembly and the installation of a minimum of wiring are passed on to the consumer in the form of prices very much below those which would have to be charged for a commercially-built product of inferior performance.

## The Remler '29' Circuit

The "29" is an 8-tube, shield-grid receiver, including a Selector-Amplifier Unit (No. 712) built, wired, and tested at the factory. Eight tubes line up this way: one stage of shield-grid radio frequency amplification functioning at the frequency of transmission, a regenerative first detector, an oscillator, 3 stages of shield-grid intermediate amplification functioning at a frequency of 115 kc., a second detector and a first audio stage.

## Shield Grid Tube Advantages

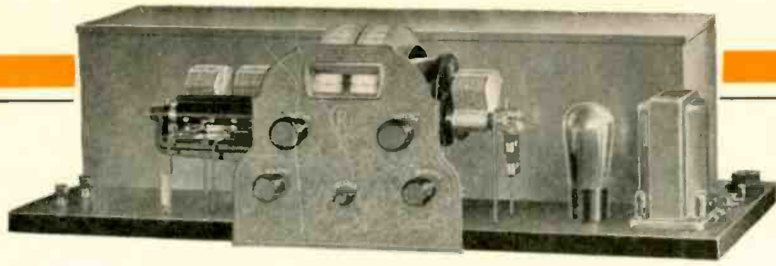
The latest tube development is the shield-grid tube. It is characterized by its inherent stability of operation and the large amplification per stage which it provides. Four of these tubes are employed in the Remler 29 and they are responsible for its smoothness of operation, its large amplification without sacrifice in quality and to a great extent for its remarkable selectivity. The use of the shield-grid tube is indicative of the forward policy followed of using equipment of special design whenever such equipment is found to provide superior results.

## Remler Power Amplifier

The Remler Power Amplifier is built for the CX 350 (UX 250) Power Tube. It makes use of two CX 381 (UX 281) Half-Wave Rectifier Tubes and of one CX 374 (UX 874) Voltage Regulator Tube and in addition to supplying filament current and plate voltages for the rectifier and power tubes will supply plate and grid bias voltages for the Remler 29 Receiver. The Remler No. 921 Second-Stage Audio Transformer, the Remler No. 923 Output Impedance-Compensating Transformer, the Remler No. 950 Power Transformer and Choke and the sockets for the various tubes are all assembled on a drilled and enamelled pressed steel base which is supplied with the No. 952 Power Amplifier Foundation Kit.

With the Foundation Kit are supplied sockets, center-tapped resistors, necessary bolts, screws, nuts, lugs, terminals and wire and a large, easily followed blueprint.

REMLER POWER AMPLIFIER



# NEW REMLER "29"

*Magnificent In Appearance—Unparalleled In Performance*

## Ready For Delivery Today—All Parts In Stock

Here is real 1929 radio for you. The finest receiver that money can buy. Latest Remler audio transformers give marvelous tone. New 115 K.C. screen grid amplifier unit, completely built up, wired and balanced in the factory. Metal base, drilled. Beautiful escutcheon plate. Only a few hours' time to build up. Undoubtedly the greatest value in radio. Price for all parts, as pictured above........ **$131.25**

(Usual discounts to dealers and set builders)

## Remler No. 950 Power Amplifier

The last word in amplification and tone quality, made possible by the combination of the new Remler audios and output transformer. Special terminal block provided for use of either magnetic or dynamic speaker. Uses 250 Power Tube, two 281 Rectifier tubes and glow tube. It is the only power amplifier system on the market which will operate the dynamic speaker as it should be operated. We guarantee deliveries on this item starting September first. Price for all parts........ **$116.50**

**Dealers:** We ship by mail, anywhere. When we tell you that deliveries are made immediately, we mean just what we say. These new Remler items will definitely be ready for you on September first, at the latest. Send the coupon now, with $50.00. We will ship your merchandise and you can pay the balance C.O.D.

## UNITED RADIO SUPPLIES CO.

1062A Howard Street — San Francisco, Cal.

*THIS COUPON SAVES TIME*

UNITED RADIO SUPPLIES CO.
1062A Howard St., San Francisco, Calif.

Per your ad in "RADIO" send me at once the following new REMLER items, for which remittance of $50.00 is enclosed, balance to be paid by me C.O.D.

........

........

........

Name........

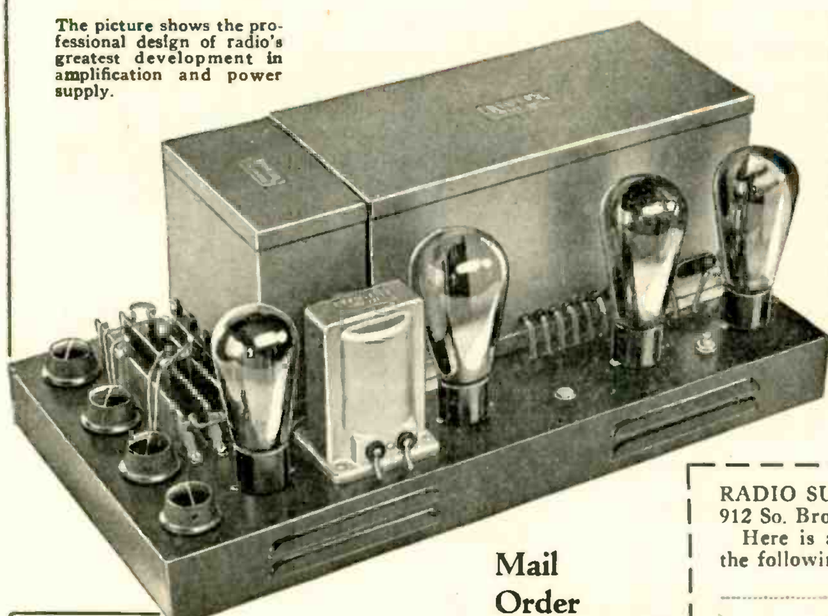
Street and No........

City and State........

# Remler No. 950 Power Amplifiers & "B" Supply

## Distributed In Southern California By Radio Supply Co.

The picture shows the professional design of radio's greatest development in amplification and power supply.



Radio Supply Company, the largest distributor of radio parts on the Pacific Coast, can make immediate delivery on the new REMLER "29" 115 K.C. shield grid receiver and on September first will make deliveries on the new Remler 950 Power Amplifier and B Supply. The new Remler 950 Power amplifier is a year ahead of the times. Because of special arrangement of parts the hum is eliminated. The tone quality is perfect. Very easy to assemble. Price for all parts........$116.50
New Remler "29" 115 K.C. receiver is a radical departure from the commonplace. The entire screen grid amplifier, r.f. and detector units are all in one large copper case—built complete at the factory, wired and balanced. A magnificent job. Price for all parts........$131.25

## Radio Supply Co.

912 So. Broadway, Los Angeles, Cal.

RADIO SUPPLY CO.,
912 So. Broadway, Los Angeles, Calif.

Here is a deposit of $50.00 (balance C.O.D.) for which send me the following Remler items *immediately*.

........

........

........

Name........

Street and No........

City and State........

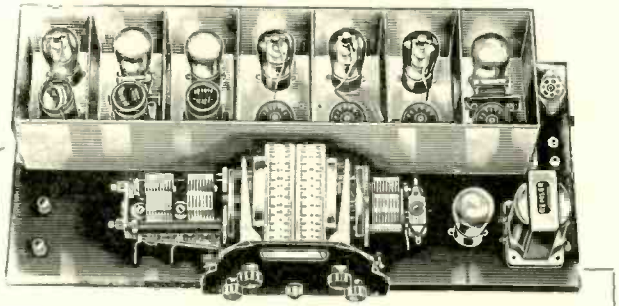
DEALERS—Let us show you what service means. Mail the coupon today. Regular dealer discounts allowed. C.O.D. orders accepted when $50.00 accompanies orders. You pay the balance when shipment reaches you.

**Mail Order Service To All Outside Dealers**

REMLER **NEWARK ELECTRIC CO.** FROST

# The Sensational Set of the Season

# New REMLER "29"



### LIST OF PARTS REQUIRED

| | | |
|---|---|---|
| 1 | Remler No. 712 Shield Grid Selector and Amplifier, including all wiring | $70.00 |
| 1 | Remler No. 752 Foundation Kit | 15.00 |
| 1 | Remler No. 920 First Stage Transformer | 12.00 |
| 2 | Remler No. 110 Universal Drum Dials | 9.00 |
| 1 | Remler No. 632 Two-in-line Condensers | 12.00 |
| 1 | Remler No. 638 Twin-Rotor Condensers | 5.00 |
| 1 | Frost No. 1895 500,000 Ohm Volume Control | 2.00 |
| 1 | Frost No. 1896 2,000 Ohm Sensitivity Control | 2.25 |
| 1 | Frost No. S1910 10 Ohm Gem Switch Rheostat | 1.00 |
| 1 | Frost No. 780 Cable Plug | 2.25 |
| 1 | Frost No: 782 Cable Plug Socket | .75 |

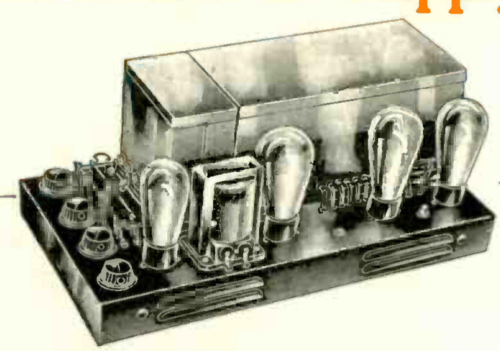
Complete Kit List Price ........ $131.25

## Complete Parts In Stock--Ready To Ship

AFTER you have read the amazing story of this newest and greatest receiver you will naturally want to build one for your own use. You can easily duplicate the remarkable selectivity, the ease of control, the extreme volume on distant stations and the wonderful tone quality of the original laboratory receiver. No other circuit with such wonderful performance has ever been offered to the public that could be built by the Listener in just a few hours' time. Simple two dial tuning control permits razor edge selectivity. Perfection of tone quality assured with the new Remler Audio Transformers. And just as this new circuit is the logical one for you to build, so also, is the Newark Electric Company the logical place for you to secure your parts. Complete stocks of all parts exactly as recommended—always in stock ready for immediate shipment. Dealers and Set Builders should write at once for schedule of discounts.

# REMLER No. 950 POWER AMPLIFIER and "B" Supply

TONE quality has already become the most important feature of radio receiver design. The new Remler power amplifier designed especially for use with the new Remler "29" receiver reproduces the full range of musical frequencies with a vividness and coloring which seems to bring the broadcasting artists into your own home. Many months of engineering research backed by the years of experience in specialized manufacture have brought the new Remler Audio Transformers to a degree of perfection which we feel will make them the first choice of those who truthfully appreciate perfection of tone. The new Amplifier is easily built by anyone in a few hours' time by following the simple blue prints furnished. Complete kits of parts always in stock ready for immediate shipment. Dealers and Set Builders should write immediately for discounts.



### LIST OF PARTS REQUIRED

| | | |
|---|---|---|
| 1 | Remler Transformer and Choke | $45.00 |
| 1 | Remler No. 952 Foundation Kit | 12.00 |
| 1 | Remler No. 921 Audio Transformer | 12.00 |
| 1 | Remler No. 923 Output Transformer | 20.00 |
| 1 | Frost No. 300 Resistance Kit | 9.00 |
| 3 | Frost No. 1405, 2 Mfd. Filter Condensers | 12.00 |
| 2 | No. 1104 Frost By-Pass Condensers | 2.50 |

Complete List Price ........ $116.50

**NEWARK ELECTRIC CO.**

*"Nothing but Radio"*

226 WEST MADISON STREET
CHICAGO, ILLINOIS

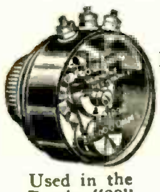
FROST FROST

FROST-RADIO FROST-RADIO

# FROST-RADIO

## SELECTED FOR THE NEW REMLER "29" SHIELDED GRID RECEIVER

### Frost-Radio Variable High Resistances No. 1895 and 1896



Used in the Remler "29"

The selection of these Frost units for the Remler "29" insures 100% stability of operation and perfect control of oscillation and volume. The resistance variation with Frost High Resistances is continuously variable, wonderfully smooth and absolutely accurate. Roller contact arm practically eliminates friction and wear of contact or resistance strip. 2,000 to 10,000 ohms, $2.25. 25,000 to 500,000 ohms, $2.00.

THE season's newest and most remarkable radio receiving set, the Remler "29" Shielded Grid Receiver, came to Frost for several of the most important parts used in its construction. Remler also utilizes Frost-Radio extensively in the famous No. 950 Power Amplifier, to which no introduction is necessary to readers of RADIO. In the Remler "29" the following parts are used:

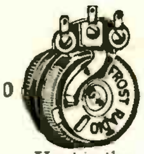
1 No. 1895 Frost 500,000-ohm Variable High Resistance
1 No.1896 Frost 2,000-ohm Variable High Resistance
1 No. 780 Frost Cable Plug
1 No.782 Frost Cable Plug Socket
1 No. S-1910 Frost 10-ohm Gem Rheostat, with switch

The Frost parts used in the No. 950 Remler Power Amplifier include the following:

1 No. 300 Frost Resistance Kit
3 No. 1405 Frost Filter Condensers
2 No. 1105 Frost By-Pass Condensers

Your dealer can supply you with any or all of these parts, as well as all of the new Frost-Radio parts recently placed at the disposal of set builders.

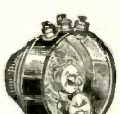
### Frost-Radio 10-ohm Gem Rheostat, with Switch, No. S-1910



Used in the Remler "29"

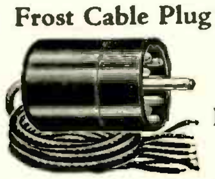
This is the famous Frost GOOD little rheostat with the addition of a DC switch rigidly mounted over the contact arm in an ingenious manner. Wiping contact, with positive off position. The Gem Rheostat was designed for continuous service of the hardest kind, and delivers it. Takes up very little space back of panel. Its frame is of metal, and resistance element is accurately wound on die cut flexible Bakelite strip. 3 to 30 ohms, $1.00. Without switch, 75c.

### Frost-Radio Gem Variable High Resistances

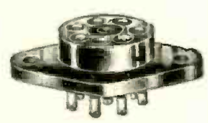


We put into these Gem Variable High Resistance Units all of the skill and care used in building our famous larger De-Luxe type. Instead of using a 2-inch Bakelite case, ¾ inches deep, as in the larger size, we make the Gem but 1⅝ inches in diameter, and ⅝ inches thick. Thus considerable space back of the panel is saved. A remarkable achievement in a compact, sturdy, exceptionally stable and long-wearing unit. 2,000 to 10,000 ohms, $2.50. 25,000 to 500,000 ohms, $2.25.

### Frost Cable Plug No. 780 and Socket No. 782



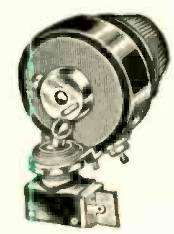
Used in the Remler "29"



Here is a cable plug that will stand the roughest possible treatment. Socket terminals are spun into moulded Bakelite, hence can never work loose no matter how much soldering is necessary. Plug and socket moulded from Bakelite, with color code moulded into material. Best quality cotton braid sheathed rubber covered wires are used in five-foot seven-wire cable.

No. 780 Cable Plug, complete with cable.................... $2.25
No. 782 Cable Plug Socket for Sub-Panel mounting, 75c

### Frost-Radio Variable Resistance With AC Snap Switch



A new item in the Frost line, and one that will appeal to every AC set builder. The 250-volt 3-amp. approved snap switch is rigidly mounted on case of High Resistance Unit and operates without lost motion, and with no added effort. Switch has widely spaced and thoroughly insulated soldering lugs, and is housed in metal case. 5,000 and 10,000 ohms, $3.00. 25,000 to 500,000 ohms, $2.75.

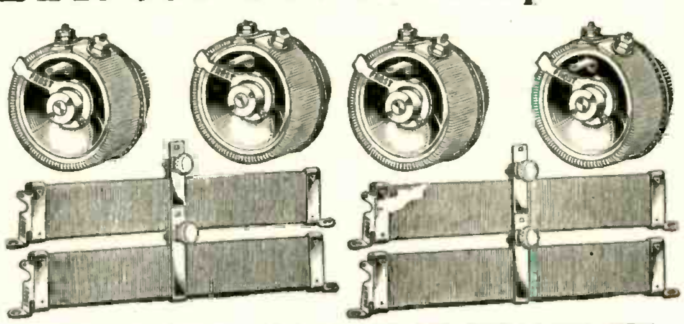
## And Also for the REMLER 950 Power Amplifier


### Frost-Radio Heavy Duty Filter Condensers

When we designed Frost-Radio Filter Condensers we set out to manufacture the finest condensers ever built—and we succeeded. We use only the very best grade linen paper and the finest foils available. Consequently, the voltage ratings we place on our condensers are conservative. Housed in gold-bronze lacquered metal cases in which the vacuum impregnated condenser is hermetically sealed. For those who want the best, there Is nothing finer. .5 to 2 mfds., $1.40 to $7.00.

### Frost-Radio By-Pass Condensers

These new Frost-Radio By-Pass Condensers have remarkable durability because of the high grade materials used in their construction. We use only the finest linen paper, and best grades of foils in building them, and we vacuum impregnate the entire condenser before it is hermetically sealed in its metal case. Conservative ratings. Capacities guaranteed accurate. .1 mfd. to 2 mfds. 80c to $2.00.



### FROST-RADIO UNIVERSAL RESISTANCE KIT

The Frost-Radio Universal Resistance Kit used in the Remler No. 950 Power Amplifier consists of three fixed resistors of 2,000 ohms each, wound on flexible Bakelite strips, four Frost-Radio 2,000 ohm potentiometers, and one 1,500 ohm fixed resistor. This kit supplies voltages of 0 to 30, 30 to 50, 50 to 70, 90 volts, 135 volts and 180 volts, the latter two voltages being variable between 90 volts and the full power of the amplifier, through the use of sliders on the fixed resistors. Complete, $9.00.

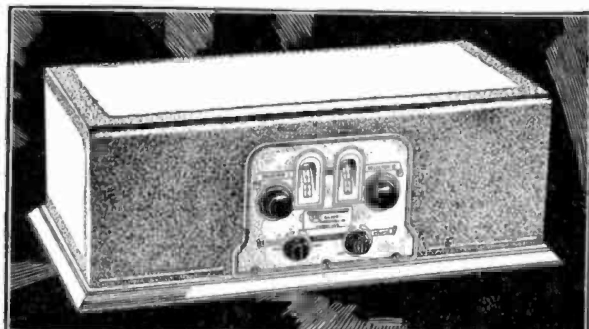
*Main Office and Factory* ELKHART, IND.

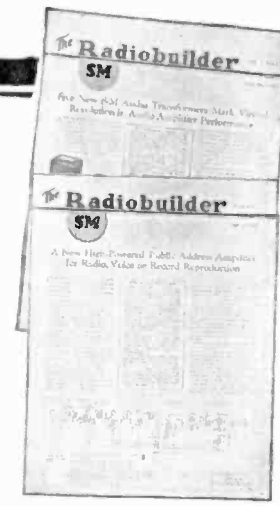
**HERBERT H. FROST, Inc.** San Francisco CHICAGO New York City

FROST-RADIO FROST-RADIO

SM

# FOREMOST *in* PERFORMANCE

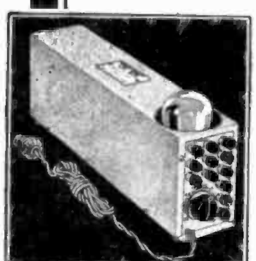


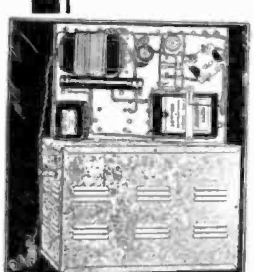



ON this page we present, in conjunction with one of our cooperating distributors, a summary of the most interesting information about kits and parts available to the setbuilder for the 1929 season under the most popular of all kit trade-marks.

Known always as a guarantee of reliability and sure results, the "S-M" mark carries this year an especial message of reduced cost, and of *exceptional eye-value*.

## Power Supplies and Power Amplifiers





FOREMOST among all power devices are the famous S-M Reservoir Power Units and Unipac Power Amplifiers. High undistorted output, and uniform reliable operation are insured by the S-M standards of design and workmanship. All of the models here mentioned use standard tubes (not included in the kit price) and are supplied either in kit form, at prices given, or completely wired at slightly higher prices. Complete information is given in the *big new* S-M catalog.

For sets requiring 180 volts B, type 670B Reservoir Power Unit ($40.50) will deliver up to 60 m.a. of current, with 22, 90, and 135 volts also available, besides 22-90 variable. The 670ABC ($43.00) is similar but supplies also 1½, 2¼ and 5 volt A.C. filament current. Type 675ABC ($54.00) gives 450 maximum voltage instead of 180, and has an adapter which allows a 210 or 250 type super-power tube to be used in the last stage of any receiver at all.

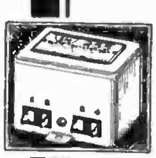
Type 676 ($49.00) is a Dynamic Speaker Amplifier; it amplifies output of any receiver through a 250 type tube, as well as supplying power to the speaker field. Adding an S-M 676 to any set having a dynamic speaker requiring 90 to 120 volts D.C. will improve marvelously both tone and volume.

S-M Unipac Power Amplifiers provide power amplification with super-power tubes (210 or 250 type), either single or in push-pull circuit, and all (except the 685) furnish B power also (45, 90, 135 volts) to the receiver. Where A.C. filament power is desired, an S-M 247 or 325 transformer is readily built into the amplifier. The 681-210 (push-pull, $87.00) is the most powerful single-stage amplifier made. The 681-250 at $81.50 uses only one power tube instead of two. Type 682-210 (2-stage push-pull, $102.00) uses a 226 tube in a stage preceding its push-pull super-power stage. Type 682-250 at $96.50 is similar, but with one super-power tube only in the last stage. Type 685 ($125.00) is the popular Public Address Unipac, using three stages for the amplification of microphone, radio, or record pick-ups to cover crowds up to 10,000 people. The 685 is the only such light-socket unit available, and presents a marvelous opportunity.

All S-M Unipacs give to the output not only tremendous volume *when wanted*, but at all times that fidelity in tone quality which is not to be had without super-power tubes. The new S-M catalog gives full information about power amplification, and is sent free on receipt of the coupon below.

*Are you receiving "The Radiobuilder" regularly? Published every month, this little magazine provides you with the earliest information on forthcoming S-M developments and with operating hints and kinks that will help you to get the most out of radio. To S-M Authorized Service Stations, "The Radiobuilder" is mailed each month, free of charge, together with all new Data Sheets and Service Bulletins as they come from press. To all others a nominal charge is made; see coupon.*

## Audio Transformers Radically New and Different



ALWAYS foremost in audio amplification, Silver-Marshall brought a surprise to the thousands who have regarded the older S-M audios as the summit of perfection, by introducing an entirely new principle in transformer manufacture—hailed at the 1928 R.M.A. Trade Show as the greatest advance in quality of reproduction brought forth in years.

These new S-M audios—the first transformers to give freedom from the hysteretic distortion found in all other types—are available in two sizes. The 225 first-stage and 226 second-stage ($9.00 each) show a curve absolutely without parallel. (See E, below). The 255 first-stage and 256 second-stage (smaller transformers at $6.00 each; see curve D) are still far in advance of any audios hitherto available at eight and ten dollars—such as seen at B, C, and D (actual curves of three well-known high-priced transformers).

Remember it—you can have this finer performance in every set you build!

Silver-Marshall, Inc.
852 W. Jackson Blvd., Chicago, U. S. A.

............Please send me, free of charge, the complete S-M Catalog.

For enclosed..............in stamps, send me the following:

....(50c) Next 12 issues of THE RADIOBUILDER
....($1.00) Next 25 issues of THE RADIOBUILDER

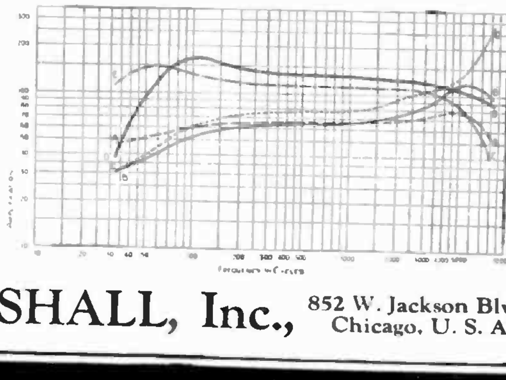
**S-M DATA SHEETS as follows, at 2c each:**

....No. 1. 670B, 670ABC Reservoir Power Units
....No. 2. 685 Public Address Unipac
....No. 3. 730, 731, 732 "Round-the-World" Short Wave Sets
....No. 4. 223, 225, 226, 255, 256, 251 Audio Transformers
....No. 5. 720 Screen Grid Six Receiver
....No. 6. 740 "Coast-to-Coast" Screen Grid Four
....No. 7. 675ABC Power Supply and 676 Dynamic Speaker Amplifier
....(50c) Sargent-Rayment Instruction Booklet

.......................................Name

.......................................Address

*If you don't wish to build, yet want your radio to be custom-made, with all the advantages that this implies, S-M will gladly refer your inquiry to an Authorized Silver-Marshall Service Station near you. If, on the other hand, you build sets professionally, and are interested in learning whether there are valuable Service Station franchises yet open in your territory, please write us.*

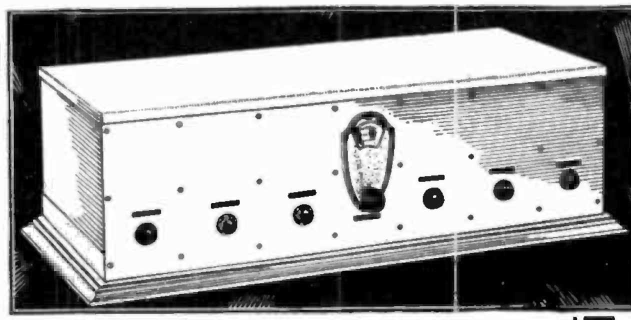


**SILVER-MARSHALL, Inc.,** 852 W. Jackson Blvd., Chicago, U. S. A.

SM

# SUREST SUCCESS *for the* SETBUILDER

IT is with unusual enthusiasm that *Wholesale Radio Service Co., Inc.*, presents such sure-fire winners as the new S-M kits. Setbuilders looking for superior performance will find in them opportunities unequalled.



A *Station Every 10 Kilocycles: The Sargent-Rayment Six*

### The 710 Sargent-Rayment Seven

A station tuned in for every ten kilocycles—a hundred stations heard in one summer evening, in the heart of Chicago interference—that is the performance record of the 710 Sargent-Rayment Seven—latest masterpiece of the inventors of the "Infradyne." The 710 is a precision laboratory instrument for the veteran fan. The thick aluminum shielding and chassis, finished in satin silver, give beauty of a strikingly appropriate type. Other features responsible for this unusual performance include five sharply tuned circuits in a four-stage screen grid r.f. amplifier, all tuned by a single illuminated drum, and provided with individual verniers. One knob controls volume from zero to maximum. There are no other controls. Each circuit is individually shielded, bypassed, and isolated from all others. New S-M transformers insure unbeatable tone quality. The set is a joy to build, so workmanlike is its design and layout.

The approved 710 Sargent-Rayment kit, manufactured exclusively by S-M, is priced at $120.00 with cabinet.

### The 720 Screen Grid Six

Here is a set which, in appearance alone, is worthy to stand with factory products selling at several times the price. But look further into the Screen Grid Six—examine the four tuned circuits—the new high-selectivity S-M 140 antenna coil—the rigid diecast gang condenser—the screen grid r.f. stages individually shielded in neat copper cans—and finally the marvelous new audio transformers, described on the opposite page. Then you will have some idea of the 720's overwhelming superiority in actual reception.

Try it. See these three screen-grid r.f. stages cut past a powerful local and reach out after a feeble signal a thousand miles away on the *next channel* (only 10 kilocycles difference!) and deliver it with loud speaker volume. And tone quality—well, it takes a vivid imagination indeed to get from the mere amplification curve on the preceding page, remarkable as it is, any idea of the glorious beauty which transformers like these impart to radio music.

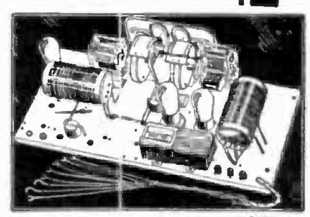
So—when we get hold of a set carrying the S-M guarantee, and are able to offer it at a list price of only $72.50 for the complete kit (the 700 cabinet is $9.25 extra)—or the entire set custom-built in this cabinet and tested in the S-M laboratories at $102.00—then we say it's a *bargain*. Order yours now!

### The 740 Coast-to-Coast Four

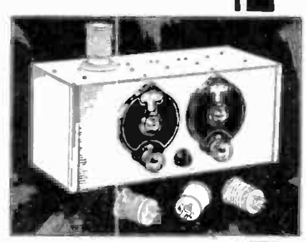
Offers the finest performance yet attained with this remarkable circuit. A screen grid r.f. amplifier stage, regenerative detector, far finer coils than ever before, the new Clough high-gain audio system, and an all-metal assembly make a receiver which cuts through local interference only 10 or 20 kc. away. Unequalled tone quality, and an appearance (in the cabinet) identical with the 720 Six,—yet the price is only $51.00 for the complete approved kit, with the 700 cabinet $9.25 extra. The 740 goes together easily and simply, and will out-demonstrate ready-made sets selling at twice its price.

### The 730 "Round-the-World"

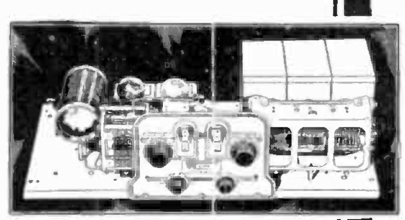
Have you had your taste of the "thrill band"—the short wave band from 17 to 200 meters? Down there you can hear European broadcasting stations; chain programs through heavy static; *television*—the low-wave band is its busy nursery. You can hear amateurs in almost every country, all in one evening—*if* you have this neat, trim, snappy little receiver—four-tube regenerative (non-radiating)—with one screen grid r.f. stage and two of the S-M high-gain audio stages. Four plug-in coils fit instantly into a 5-prong socket on top of the aluminum cabinet. The complete 730 kit, including cabinet, is $51.00; the 731 (same kit without the two audio stages, at $36.00) converts any set to short-wave reception. The 732 Essential Kit, at only $16.50, contains the condensers, coils, sockets and chokes.



*740 Coast-to-Coast Four: Best Money's Worth in the Fifty-Dollar Class*



*Five Continents in One Evening: 730 Short-Wave Set*



*720 Screen Grid Six: The Year's Biggest Value*

**Send for Our Free Dealer Catalog and Discounts!**

We are offering, this season as always, America's biggest radio values. Mail the coupon at the right—it will bring you our big new catalog—FREE. Maximum discounts to dealers. Immediate shipments from stock.

Wholesale Radio Service Co., Inc.,
6 Church Street, New York, N. Y.

Please send your new FREE catalog, listing S-M parts and kits as well as all standard brands of merchandise.

Name..............................

Address..............................

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WHOLESALE RADIO SERVICE CO., INC.

6 Church Street — New York. N. Y.

# 1929's Leading

# 10 KC!

## Selectivity

*Ready Aug. 30th*

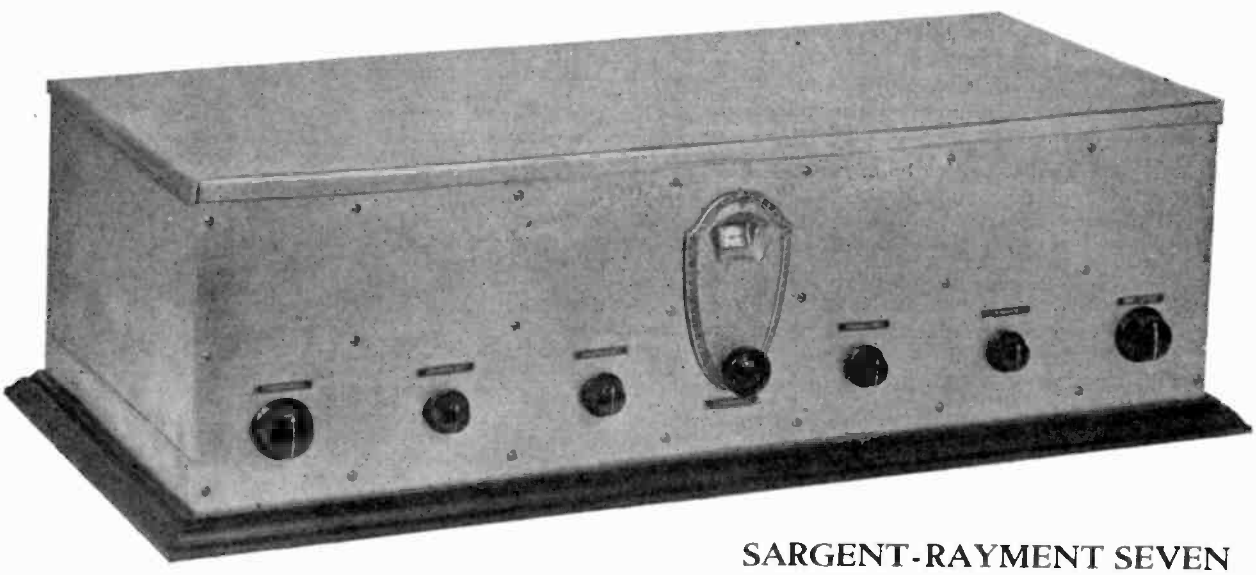
The Sargent-Rayment Seven will be ready for Aug. 30th delivery. Any of the jobbers listed on the opposite page should be able to supply either the built-up set or the kit.

"SELECTIVITY is today the most important requisite of a radio receiver. The present congestion of the ether and the clamor of many prospective broadcasters to get on the air make it imperative that a radio set receive one wave channel—and one only—at a time. This means ten kilocycle selectivity or less.

"In designing the Sargent-Rayment Seven, nothing has been spared to achieve the highest possible degree of selectivity. Not content with the final test in Chicago, the interference centre of the United States, the set was then transported to the West Coast where another complete test was run to make sure that the Sargent-Rayment Seven would operate under all conditions.

"In the Chicago test, West Coast stations were picked up, and in the West Coast test, Chicago stations were heard. This, being done in July, indicates that during the winter months and in a favorable location, reception of stations 2000 to 5000 miles away should be possible. It is reasonable to assume that present distance records will be smashed and some new ones set up before the season is over. The full power of four-screen grid tubes, plus the razor-edge selectivity of the Sargent-Rayment Seven, enable it to outdemonstrate any receiver made, regardless of number of tubes or type of circuit. Why cannot the others do the same thing? Because, the secrets of this circuit are in the design, and they are not being revealed."

(Signed) E. M. SARGENT.



SARGENT-RAYMENT SEVEN

Built by Silver-Marshall Inc.

## "CABINET"

The cabinet problem is completely solved in the Sargent-Rayment Seven. The kit, when assembled, forms its own cabinet. The entire outside is finished in grained aluminum, with name plate and panel indicators in black—a distinctive appearance and totally different from the usual run of radio receivers.

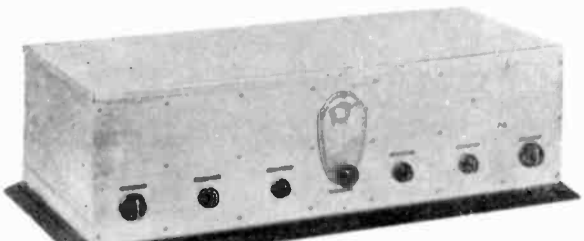
For the benefit of those who prefer a darker finish, Radio Constructors Corporation will supply either the kit or the built-up set in a crackle crystalline lacquered finish, the same dark surfacing generally used on metal cabinet radio receivers. An extra retail charge of $10.00 is made for this, and all orders involving it will be delayed in shipment three days to have the special finish put on.

Either the standard or the dark finished kits and sets may be bought through any of our jobbers.

**Write for Free Descriptive Booklet** The limited amount of space in this ad does not permit us to go into details about the new features of this circuit. We have therefore prepared a special 16 page descriptive booklet,—"RADIO PAR EXCELLENCE—1929"—which tells about the Sargent-Rayment Seven from start to finish. This booklet, written in plain, understandable language, explains the design of the receiver and shows conclusively just why we are able to make such wide claims for distance, selectivity and tone on the Sargent-Rayment Seven. We would appreciate the opportunity to mail you a copy. Just send in your name and address.

*$120.00 for the KIT complete with cabinet*

Sargent-Rayment Seven *NOW* Ready!



PRACTICALLY EVERY DEALER IN SOUTHERN CALIFORNIA BUYS FROM

# RADIO SUPPLY CO.

because we give *the* service!

The new Sargent-Rayment Seven, built by Silver-Marshall, is one of the outstanding receivers of the season. We carry this popular item, both in kit form and as a completely wired and tested receiver. The kit sells for $120.00, with aluminum cabinet. The completed set sells for $150.00, without accessories. Your orders receive immediate attention. Mail orders solicited from dealers anywhere. The great demand for this new item warrants your immediate order to avoid delay. We also carry all other radio kits in stock and the largest line of parts and accessories on the Coast. Usual dealer prices prevail.

# RADIO SUPPLY CO.

912 So. Broadway
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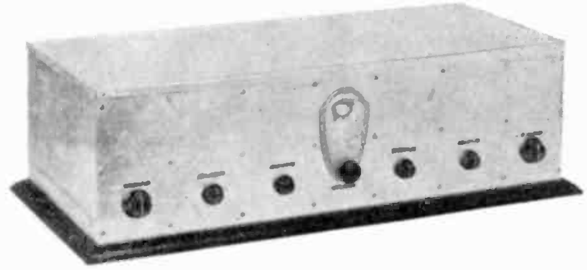


## The Season's Best Seller

**Because of its Spectacular Performance**

**Get Immediate Delivery from the Pacific Northwest's Jobber—**

WEDEL COMPANY

Prompt deliveries of the spectacular SARGENT-RAYMENT SEVEN can be made by us from stock. MAIL ORDER BUSINESS solicited. We serve the Pacific Northwest Territory more promptly and better than any other distributor. C.O.D. orders accepted when $40.00 accompanies order. Balance C.O.D.

The SARGENT-RAYMENT SEVEN kit, complete with beautiful sturdy aluminum cabinet, as illustrated above. All wiring instructions, wire, etc., go with the kit. Now ready for immediate delivery anywhere. 8 hour mail order service on this item.
Price, list................................................ **$120.00**

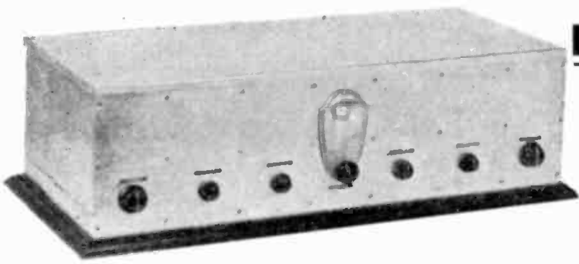
THE COMPLETELY WIRED SARGENT-RAYMENT SEVEN, ready to operate. Tested on the air, for selectivity, tone and distance. Guaranteed to perform to your entire satisfaction. A genuine laboratory custom built product, direct from the laboratories of the designer.
Price, without accessories................................ **$150.00**

**DEALERS:** WEDEL COMPANY solicits your business. Out of town orders shipped same day we receive them. Usual dealer discounts prevail. Tubes, speakers and standard accessories in stock.

## WEDEL COMPANY

*Radio and Electric Jobbers*

520 SECOND AVE. SEATTLE, WASH.



## Larger Sales than all other Kits combined!

# SARGENT-RAYMENT 7

# An Instant Success

July quota oversold—orders twice as heavy as anticipated—OFFENBACH has been selling a thousand dollars' worth of these kits a week. The phenomenal buying rush on this new receiver—before it was seen or heard by the dealer—assures its success as the biggest seller of the season. Deliveries now being made.

Offenbach specializes in dealer orders. Our dealer prices give you a fine margin of profit and our service is second to none. A large mail order department is at your service. Write for complete list of parts and accessories handled by us. We represent more than 125 national radio manufacturers as jobbers.

ORDER DIRECT FROM

*Radio Dealers Supply Service*

*Wholesale Division of*

**OFFENBACH ELECTRIC COMPANY**

*"The House of a Million Radio Parts"*

1452 Market Street San Francisco, California

DEALERS: Send the coupon now for your Sargent-Rayment-Seven kit, or completely wired receiver. Telegraph orders promptly filled. Mail order service to all parts of the world. All tubes and accessories can be purchased from us at regular dealer discounts.

RADIO DEALERS SUPPLY SERVICE
Wholesale Division of
OFFENBACH ELECTRIC COMPANY
1452 Market Street,
San Francisco, Calif.

Send me

V ..................SM-710 Sargent-Rayment Kit, unwired, List $120.00.

V ..................SM-710 Sargent-Rayment Set, completely wired, List $150.00.

for which I attach a deposit of $40.00, the balance to be paid for C.O.D. upon receipt of shipment.

Name..................................................

Street and Number..................................................

City.................................................. State..................

# RADIO

VOLUME X — SEPTEMBER, 1928 — No. 9


## Radiotorial Comment

SOME of the catch-penny radio stores are making abortive efforts to sell so-called radio vision receivers. These consist of a resistance-coupled amplifier and a neon lamp to be connected to the detector output of an ordinary radio, and a specially-perforated disk to be driven by a small motor. In the few localities where moving-picture transmitters are yet operated, such equipment may, or may not, dimly show a crude image, little larger than a postage stamp, depending upon the skill and luck of the operator.

This makes an interesting laboratory experiment for a class in high school physics. But as a source of amusement in the home it is a complete flop, unless the family find a joy in the exasperation of the would-be demonstrator. Stores which sell this kind of junk without warning the purchaser as to its limitations might well beware of the Better Business Bureau in their town.

These strictures do not apply to complete transmitting and receiving outfits which are sold for purely experimental purposes, and whose sellers do not attempt to obtain the buyer's money under false pretenses. Nor do they necessarily apply to outfits for receiving still pictures by radio, of which a number will be available before the end of this year. But a lot of energy will be radiated into space before we will see a satisfying radio movie transmitted from a station fifty miles away.

* * *

RADIO is the first of the modern inventions to keep the family at home. Most of the others take the family from the home. That is one reason why the home influence has waned. Radio's combination with the improved phonograph made the home still more attractive. Then came the home movies and soon there will be the home talking-movie, all combined in one instrument for home entertainment.

Arrangements are being perfected whereby photoplays and vaudeville acts may be heard as well as seen in the home. As much of this equipment has been developed from radio principles, its use has a peculiar fascination for the radio fan. In fact one of the best ways to anticipate the eventual radio movie is to become familiar with the methods of recording and reproducing sounds and scenes in the talking movies. Some space will be devoted to these developments in future issues of this magazine, as they are laying the foundation for future radio actualities.

* * *

RADIO experimenters who are using a photo-electric cell for the radio transmission of pictures or other purposes can gain a good idea of its action by thinking of it as a two-element vacuum tube, whose filament emission is caused by light instead of heat. This thought tells the entire story. The emitted electrons are attracted to a plate maintained at a positive potential by a *B* battery, thus causing the flow of a small electric current whose intensity varies with the intensity of the impinging light. This current is amplified with other vacuum tubes in the usual manner.

* * *

AMATEUR call letter prefixes throughout the United States and its possessions become the same as those of the broadcast stations after the first of October. "W" must precede the call letters of stations within the continental limits of the country and "K" of stations in Alaska and the insular possessions. Details regarding this as well as the tentative list of other international prefixes are published elsewhere in these columns.

* * *

WHAT is the "public convenience, interest and necessity" which is named as a prerequisite for the granting of a license to broadcast radio programs? What is the meaning of this shibboleth which is so generally and easily accepted as the basic principle in the law of radio, the principle which so successfully guided the early Radio Conferences in their deliberations?

The Radio Act of 1927 and the 1928 amendment thereto, in which this expression is frequently enunciated, do not define it. Nor is there any definition of it in many state statutes where it is often employed with reference to the regulation of public utilities. Apparently, like Topsy, it "just growed."

Actually it is an outgrowth of the "public be pleased" sentiment which replaced the old "public be damned" policy in business. Big business can no longer successfully ignore the effect of its private dealings on the public welfare. So that now the granting of a franchise for any business which serves the public is predicated upon the benefits to the community served rather than upon possible private profit to the individuals who seek the privilege.

Yet the idea is so relatively new that little provision has been made for its interpretation and enforcement. In radio, for instance, licenses were granted to practically all askers until the broadcast band became so crowded that they began to step on one another's toes. This resulted in poor service to the listeners and a halt was called on indiscriminate licensing. Service to the public became the criterion.

These are the rules of the game which must be interpreted and applied by the Radio Commission. It is up to the Commission to decide what is to the public convenience, interest and necessity.

The Commission, the broadcasters and the public are agreed that there are too many stations on the air. It is undoubtedly to everyone's convenience, interest and necessity that the number of stations be reduced. But it is indeed difficult to decide which stations should be the goats to be sacrificed.

Each station naturally objects to being selected as a goat. It brings great masses of documentary evidence to prove that it has committed no sin which justifies it being sacrificed. It secures thousands of letters and telegrams in praise of its service. Usually this praise is from a local community or from a special group, such as a religious sect or a political following. It ignores the fact that other local communities or special groups, whether a farm, labor or religious bloc, may consider the station neither convenient, interesting, nor necessary.

So the main point at issue, as developed in the many hearings that the Commission has held, seems to revolve about the question as to what constitutes the "public" whose convenience, interest and necessity is to be served. Is it the church people or the sport followers, the farmer or city dweller, the laborer or capitalist, or any other special group? Obviously it is no one of these several differentials. The public to be served is the integration of all of them, or at least of a large majority of them.

This broad and impartial analysis seems to be that followed by the Commission in making its decisions. While special groups may feel aggrieved, they should realize that inasmuch as there is not room for every special group, the smaller special groups must give way to the larger and to the general rather than to the particular interest. The majority should be served.

Nor need any worthwhile minority not be represented. Those stations which are catering to the tastes of the majority are willing to sell time to any minority interest that will put on a program of general interest. Thereby the minority has an opportunity to convert some of the majority to its way of thinking.

This discussion is necessarily abstract, as is any broad statement of general principles intended to apply to all cases. But it is fully in accord with the purpose of the radio law to prevent interference between stations and to recognize that the public interest must be paramount to private profit in broadcast service.

* * *

RADIO is a good and practical answer to the question of what should be done with the greater leisure which the American people have gained as a result of shorter working hours and labor-saving machinery. The lack of culture of which Europeans sometimes accuse us can and is being supplied by radio. And now that Tex Rickard has decided that broadcasting hurts boxing box-office receipts, the stations can find time to broadcast some more cultural form of program.

Radio has already advanced the standard of musical appreciation in America. It can perform the same service as regards art and literature. Many stations are beginning to find a greater public response to programs which combine instruction with entertainment.

* * *

ADVERTISING over the radio has killed the applause card. The listener doesn't give applause when he receives applesauce. Applause is de-cored applesauce anyway.

# Flying Radio

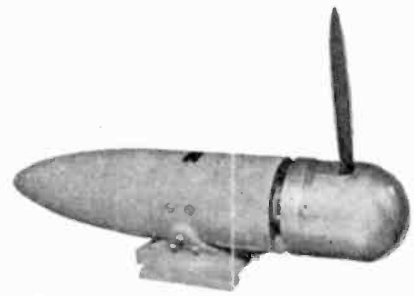
*By* George T. Conner

A question often asked and variously answered is, "Why do not more airplanes carry radio equipment?" Especially was this query manifest during that gloomy period when so many ocean flights were terminating disastrously, when so many venturesome aviators were disappearing without a word to indicate what fate had overtaken them in their daring attempts to prove the superiority of man over time and space. The general public is at a loss to understand why an agency which can so effectively summon aid to the storm-tossed ocean liner cannot with equal facility bring help to a disabled airship.

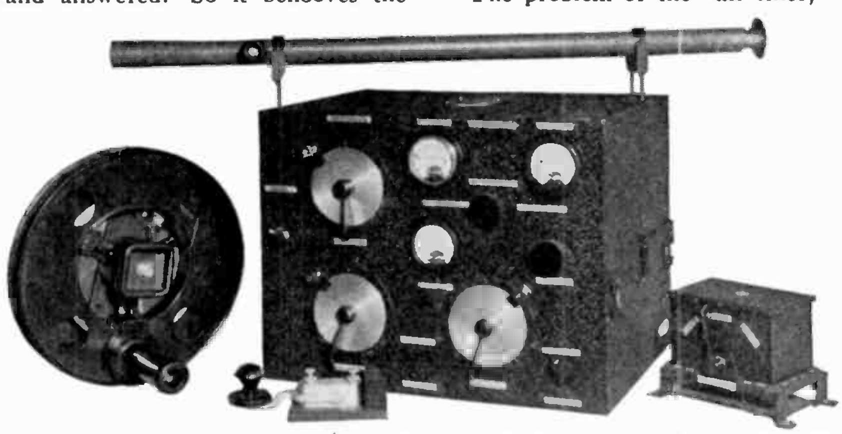
Why are aviators in general antagonistic toward having their planes equipped with radio? What can be done to reverse their attitude? The average aviator doesn't want radio. He has his hands full, without taking upon himself the additional burden of operating a "wireless station."

Although this condition applies more closely to the *solo* flyer, nevertheless on long trips, such as trans-oceanic hops, it is more than likely that two persons would have enough to do merely keeping the ship aloft and upon her course. In Ruth Elder's vivid account of her unsuccessful attempt to reach Paris in the "American Girl" it is made very clear that handling a plane is anything but child's play. When Captain Haldeman relinquished the controls to her occasionally she could dominate the speeding ship only by exerting every atom of strength and will power she possessed. Nor should we suppose the plane was any more docile when the captain was at the stick. What with manning the controls, keeping a constant watch over the indicators on the instrument board, having one eye on the thermometer, another on the lightning-riven clouds into which they were dashing headlong, feeling out the motor—coaxing it here, humoring it there—always striving with mind and muscle and instinct to avert swift disaster, there was little time left for any sort of sidestepping for either pilot or passenger—a case, we might say, where the passenger certainly earned her passage!

In the event of trouble every moment is precious. The ship must be watched as intently as a new-born babe getting off to a bad start, or an invalid slipping toward a bad end. The craft is a frail thing and small. Whatever steps become necessary for its preservation must be taken without delay, for there is small chance of a long respite after disability during which calls for help may be sent out and answered. So it behooves the pilot to concentrate strictly upon the business of flying, allowing his ears to become attuned to no other signals than the motor's drone and the roar of the wind down the sides of his ship.



*Wind-Driven Generator for Aircraft Transmitter*



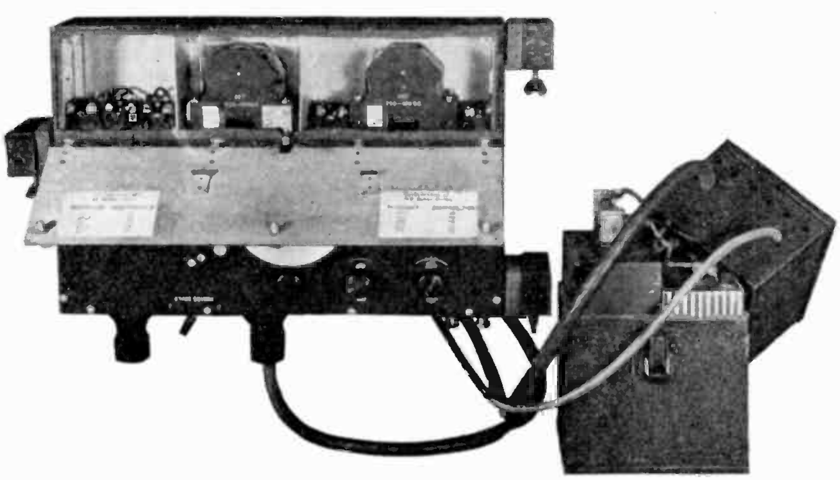
*R. C. A. 75-watt Aircraft Transmitter for 45 and 600 Meters. Also Antenna Reel, Key and Send-Receive Switch*

From the foregoing it may seem there is nothing to be gained by the lone flyer who would have his plane equipped with radio. Yet, everything depends on how much he demands in return from it. If he is willing to accept one-way signalling for his benefit, or a limited two-way communication, then radio most assuredly deserves a place in the cockpit or cabin.

The problem of the "air liner," with its comparatively spacious accomodations for an operator *as* an operator, sufficient lifting power so that the weight of radio equipment does not require a sacrifice at some other place, there is no excuse for not having an efficient installation on board. With the smaller planes, however, there is ground for an honorable excuse. Even so, it is deplorable that any ship, whether it carry one or a hundred persons, attempt a flight across trackless wastes of water without this ultra-modern means of contact with land. Is it really of necessity that they do so? Is it because of stubbornness or foolhardiness on the part of aviators? Isn't the reason to be found in the backwardness of radio, perhaps?—its failure to keep pace with the times?

If the *solo* flyer is to carry radio as a part of his equipment it must be well nigh automatic or he cannot use it. Is it possible, then, to build an automatic radio signalling device for the benefit of the "lone eagle"? If so, what should such a set be designed to accomplish? We do not want so much a means of the

(Continued on Page 44)



*R. C. A. 550-850 Meter Aircraft Radio Receiver*

# An Automatic Field Strength Recorder

*By* S. R. WINTERS

IS THERE a conflict between the reflected wave, traveling along the upper atmosphere, and the wave skirting the ground, producing well-defined maximum and minimum values of signal intensities with increasing distance? That is to inquire, are daylight radio signals heard with greater clarity at 800 miles than at 500 miles, due to interference between the wave reflected from the sky and the one hugging the earth?

This riddle in radio-wave propagation is the subject of a nation-wide study, enlisting the cooperative efforts of many eminent physicists, including Dr. L. W. Austin of the Bureau of Standards; Dr. Greenleaf W. Pickard of Newton Centre, Mass.; and Prof. C. W. Edwards, head of the department of physics of Duke University, Durham, N. C. The observing instruments will be trained on the long-wave stations of the R. C. of A., chiefly those located at Rocky Point, N. Y., and New Brunswick, N. J.

The results of these observations will be of world-wide significance, since the experiments are prompted by wave-propagation theories that are in disagreement between the different countries. For example, J. Hollingworth, a physicist of England, discovered that the strength of signals received at Aberdeen, Scotland, was three times as great as those intercepted at Manchester, England, although the latter city was several hundred miles nearer the transmitting station than Aberdeen. These daylight experiments, on a wavelength of 14,000 meters, afforded evidence of interference between reflected and ground waves, resulting in increased field strength with increasing distance.

"The measurements which have been made in Washington on the transatlantic stations of the R. C. of A. have not shown any definite periodic change of intensity with distance, at least in the daytime," reports Dr. Austin. These stations, operating on wavelengths between 11,500 and 16,100 meters, are situated at distances of 251 to 660 kilometers from Washington.

"At night," continues Dr. Austin, "there is plenty of evidence of interference between reflected and ground waves, as the signals from the stations at 435 and 660 kilometers have fallen with considerable regularity far below their day values during the summer, while those from the two stations at 281 kilometers have risen slightly at night, or remained fairly constant. The conditions of experiment are, of course, somewhat different from those in England, inasmuch as the signals are measured at one point and the transmitting stations at the various distances transmit on somewhat different wavelengths.

"Nevertheless, since these experiments, some of which have been continued over many years, indicate a regular falling off of intensity with the distance in the daytime, it would seem that they must be held to be in disagreement with the results of J. Hollingworth in England. Therefore, it would seem very desirable to carry out further measurements in other places, some of which might well be on signals over water as over land of different characteristics." These variations in signal strength at varying distances from the transmitting station practically nullify existing radio transmission formulas.

"Since the discovery of the great variability of the signal intensity at different times," points out Dr. Austin, "the general interest in transmission formulas has been much diminished, as it is evident that any formula laying claim to general accuracy would be so complicated that it could hardly be of practical value even if our knowledge of the subject were sufficient to derive it. The most that can be claimed for any formulas thus far suggested is a very rough approximation of the actual results averaged over very long periods. Thus far there has been no attempt to produce a formula applicable to the ultra short waves."

The apparatus employed at the Bureau of Standards for conducting the experiments pertaining to radio-wave phenomena is more intriguing, if not as significant, than the tests. The recorder is automatic, measuring the strength of both radio signals and static. E. B. Judson of the Laboratory for Special Radio Transmission Research, who designed the equipment, describes this unique radio receiving set that tunes itself as follows:

This recording system was designed for the purpose of obtaining some knowledge of the behavior of radio signals and atmospheric disturbances through diurnal periods. With this apparatus it is possible to obtain hourly observations of the field strength of several different stations and atmospheric disturbances throughout 24-hour periods.

The entire apparatus is controlled by a clock which at different five-minute periods during the hour actuates a series of relays, automatically turning on the receiving set and amplifiers and tuning to the desired stations.

The receiving set is the conventional three-circuit type, having a tuning range of from 60 kilocycles (5000 meters) to 12.0 kilocycles (25,000 meters). Two antennæ are used, one having an effective height of 16 meters for reception of trans-Atlantic stations and atmospheric disturbances, while the other has an effective height of 1.5 meters, and is used for nearby American stations. In order to insure a greater constancy of sensitivity, only audio-frequency amplification is used. This consists of two stages of transformer coupling, followed by four stages of resistance-capacity coupling. With this arrangement as long as all the filament currents remain constant and the plate voltages do not

(Continued on Page 50)

*Automatic Field Strength Recorder at the Bureau of Standards*

# Improvements in the All-Purpose Tube

*By* G. M. Best

DELVING into the history of radio usually makes dry reading, and the reader may find this compilation of historical data in the same category. However, useful information on vacuum tubes is always valuable as a handy reference, and in this particular case, we have found that little is known of the actual improvements which have been made in the mechanical and electrical characteristics of the well-known "A" tube.

In Fig. 1 are shown seven tubes which represent the development of the "A" tube, which, until the advent of a.c. sets, was the most popular tube in use. While some of the changes represent details in the base or glass bulb alone, the picture has been prepared with the idea of enabling anyone to identify any of the tubes he now has in use, particularly as to their approximate age.

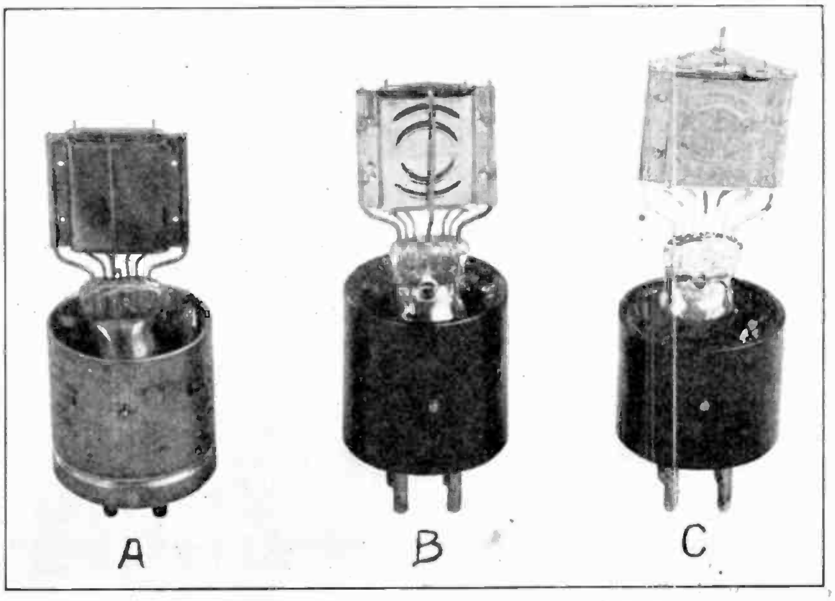



*Fig. 2. Changes in Structure of "A" Tube Elements*

When broadcasting first became popular, in 1921, the tube then in general use was the type '01, used for all purposes in the sets of that day, except that a special detector of the same mechanical design, with gas filled bulb, was used. The '01 required 1 ampere of filament current at 5 volts, and had about the same characteristics as regards impedance and power output as the present day '99 dry cell tube. If a set had seven or eight tubes, an enormous load was placed on the battery, and even a lowly two-tube set drew as much current as modern eight-tube outfits. The '01 is tube No. 1 in Fig. 1.

In the spring of 1922, this was superseded by the '01-A, tube No. 2 in the picture, having a ¼ ampere filament at 5 volts, a plate impedance of 10,000 ohms, and a mutual conductance of 800 micromhos at 90 volts plate and zero grid voltage. By cutting the filament consumption to one-fourth, a great incentive to multi-tube sets was created, and thereafter five- and six-tube tuned r.f. sets came into general use. The first "A" tube had a tipped bulb, and the interior of the glass was coated with a rainbow-colored deposit, created by the combination of gases within the tube and a compound of phosphorus and magnesium, during the process of manufacture. The base was the so-called "Navy" four-prong standard, of brass, with short prongs for contact with the socket springs.

In 1923, the tube was improved by the use of a tipless bulb, No. 3 in Fig. 1, thus minimizing the possibility of damage due to contact of the tip with other objects. The coating on the interior of the glass was silver in color, as in all present-day tubes, due to the use of magnesium without phosphorus in the "getter" or gas-absorbing material.

In the fall of 1924, electrical, as well as mechanical, improvements were made, and the tube No. 4 in the picture was the result. Besides constructing the base of bakelite instead of brass, the elements of the tube were made more rugged, and the grid and plate structures were moved closer together, and closer to the filament, thereby increasing the mutual conductance of the tube to 1000, and reducing the plate impedance to 8000-8500 ohms. This change, due to the increased mutual conductance, improved the performance of sets using the tube.

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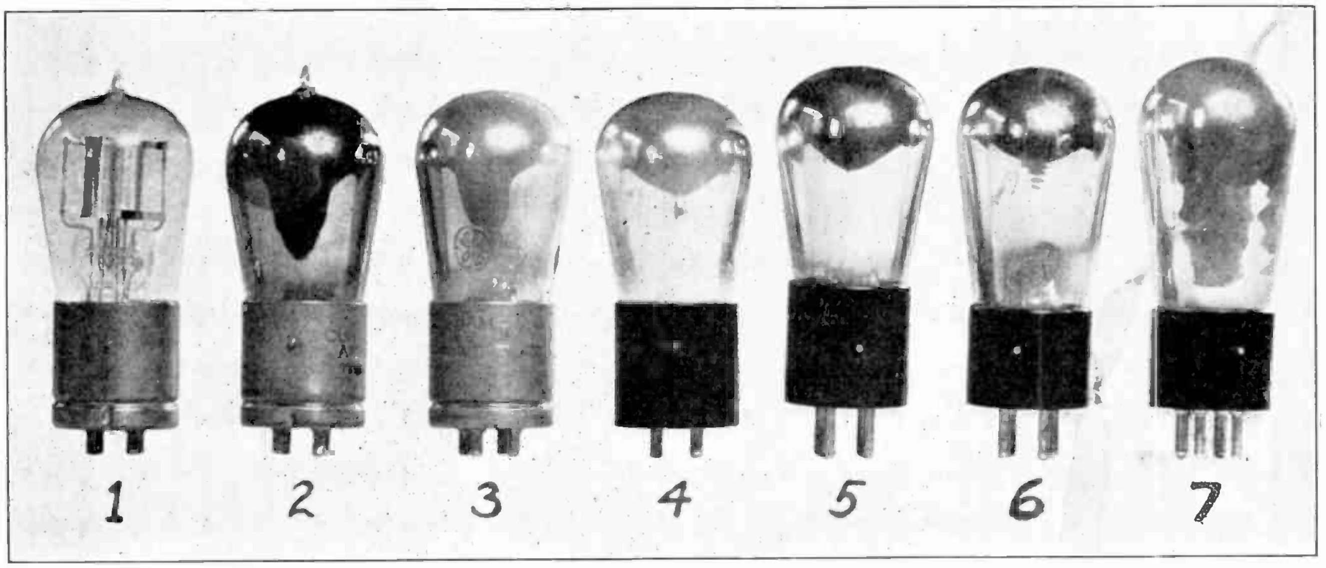



*Fig. 1. Progressive Development of the "A" Tube*

# The Plate Resistor Receiver

## Directions for Building a Seven-Tube A. C. Receiver of Unusual Excellence

*By* FRANCIS CHURCHILL

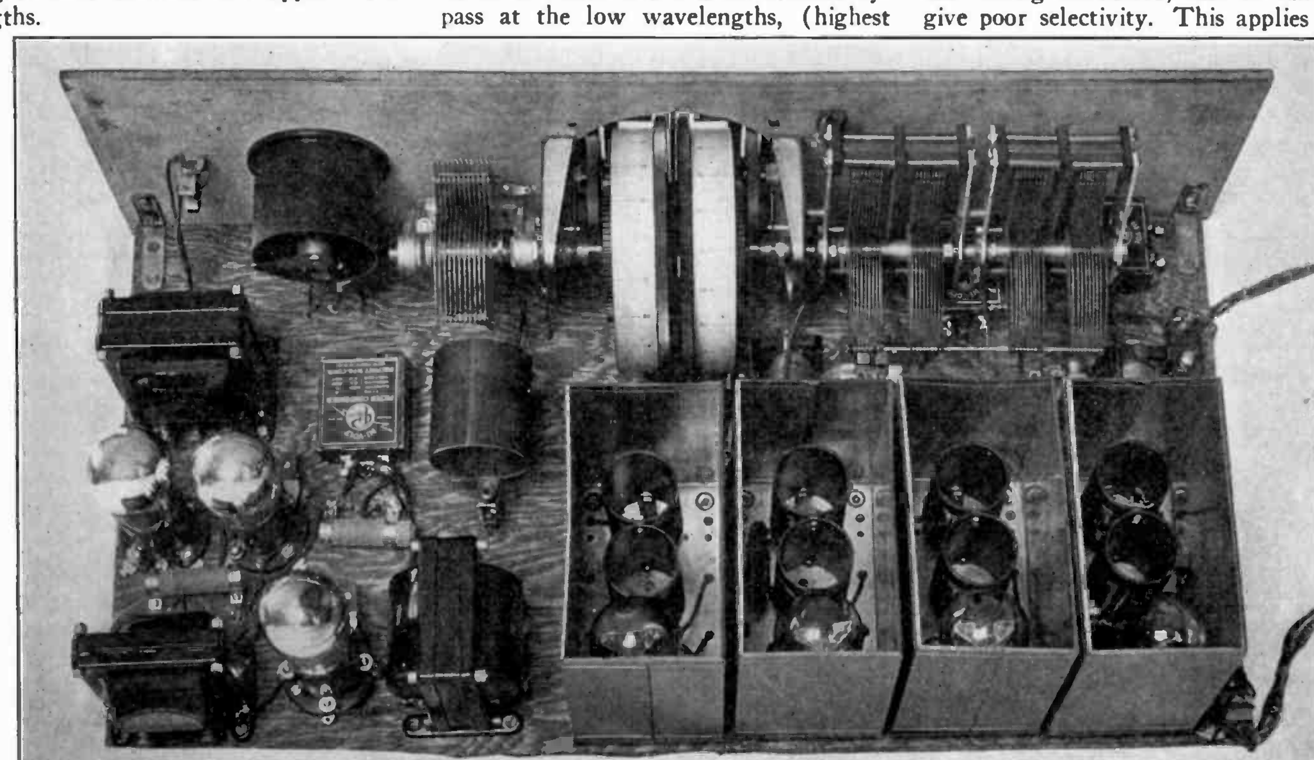
THIS receiver is described because of the rather interesting circuit arrangement of obtaining good sensitivity over the whole broadcast band of from 200 up to 550 meters. The special compensating feature was developed from another circuit, when it was thought possible to apply the idea to r.f. amplifiers. The principle upon which it works is the plate to ground capacitive reactance varying with frequency.

As a general rule, any receiver using one or more stages of radio-frequency amplification in straight transformer coupled circuits is unsatisfactory, because the amplification at the short wavelengths is greater in comparison with that at the upper end, due mostly to regeneration. Another disadvantage is that the selectivity varies greatly over the broadcast band, being very poor at the lower wavelengths. This selectivity of course varies with the volume control adjustment when the latter is ahead of the detector. This means that when the control is set for most local reception, the regenerative effect is not very noticeable and so the selectivity suffers since the resistances of the tuned circuits are greater. This is true because the high frequency resistance of practically all commercial coils or transformer secondaries is several times higher at the short wavelengths than it is at the upper wavelengths.

The circuit, shown in Fig. 1, is not offered as a cure-all for both of the defects of variable amplification and selectivity, but as a step towards bettering this condition. The amplification, with a good r.f. transformer, is nearly constant over the whole tuning range when ordinary d.c. or a.c. tubes are used. The selectivity seems to be more constant also for the reason given later in this discussion.

Referring to Fig. 1, the plate resistances, labeled *R*, are semi-variable from 0 to about 1,000 ohms. On one side of these resistances are the phase changing condensers, if such are necessary, and the r.f. transformer primaries. The phase controlling condensers *C* may not not be necessary with most r.f. transformers and may be replaced with .004 or .006 mfd. by-pass condensers. On the other side of the resistances *R* are the chokes for supply plate voltage, and the plates of the r.f. tubes. The r.f. chokes used have the effect of a small condenser over the broadcast band, the values varying from 4 to 5 micro-microfarads. This capacity is in parallel to the plate to filament capacity of the tube in each case, giving a value of 10 or 12 mmfd. This capacity has a reactance varying with frequency according to the formula $X = \frac{1}{2}\pi fC$, or inversely as the frequency. In other words it is a more efficient by-pass at the low wavelengths, (highest frequencies) than at the upper wavelengths of the broadcast band. The resistances *R* tend to isolate this capacitive reaction from the r.f. transformers, which means that the increased amplification at the lower wavelengths normally present is counteracted by this capacitive reactance. It is simply an electrical scheme to balance the amplification over the broadcast band and so removes the necessity for mechanical equalizers such as variable primary coupling.

It was mentioned previously that the selectivity seemed to be better also. This applies to the case of an amplifier wherein grid resistors are used to stop oscillation. The same reasoning for grid resistors, applies concerning gain characteristics except that the capacitance is between 40 and 100 mmfd. for the grid to filament capacity. This large a capacity, several times that of the plate circuit, tends to by-pass too much of the r.f. energy to filament, as it is of too low an impedance to allow high voltages to build up across the grid to filament. In receivers using grid "suppressors" or resistors, the resistance is generally less than 1000 ohms so as not to entirely isolate this large capacity from the capacity of the tuned circuit. This puts a very inefficient condenser with a differing phase angle across the tuning condenser, and so tends to give poor selectivity. This applies espe-



*Top View, showing Shielded R.F. Stages*

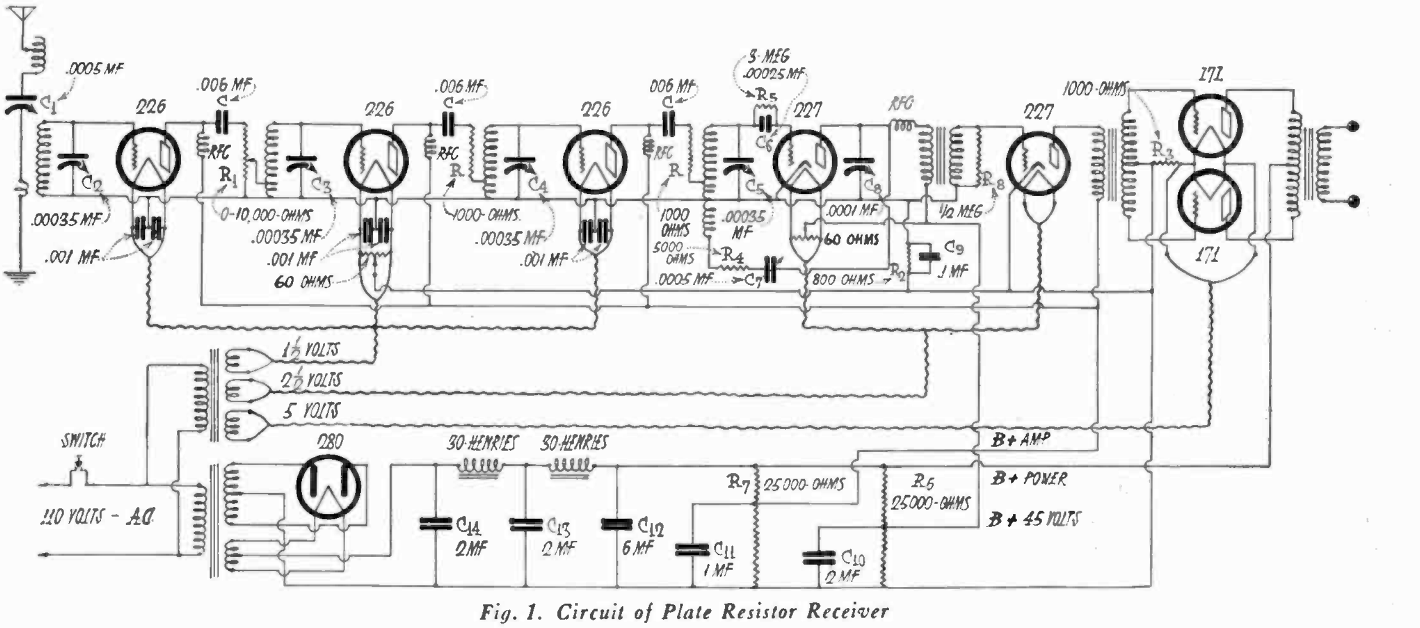



*Fig. 1. Circuit of Plate Resistor Receiver*

cially to the shorter wavelengths where the value of this poor condenser approaches that of the tuning condenser.

I imagine that there will be several "kick backs" about the above reasoning. Nevertheless it is a fact and the only reason the grid resistor type of r.f. amplifier gets by, is due to regeneration. Regeneration tends to sharpen the tuning; however, when the volume control of the receiver is cut 'way down, there is very little regeneration present. Most volume controls are either filament or plate current control types which reduce the amplification of the r.f. stages. This absence of regeneration makes it difficult to separate one local broadcast station from another, especially on the lower wavelengths.

By using the resistances in the plate circuit instead, the grid to filament capacities are simply in shunt to the tuning condensers and have about the same phase angle, so are purely additive, thereby providing better selectivity, whether there is regeneration present or not.

No special details of this receiver are given, with the exception of the experimental receiver shown in the photograph. Most set builders or experimenters will wish to use parts which they may have on hand. Probably any parts will work satisfactorily or an existing receiver may be modified to incorporate these resistances. For those who are interested in a few details of the experimental receiver shown, the following information will be in order.

The coils are of a double solenoid spaced winding type for use with .00035 mfd. tuning condensers. These coils may be made by winding 130 turns of No. 26 enameled wire on 1½ by 3 in. tubes with each turn spaced slightly. This makes 65 turns for each coil of the double solenoid and the windings should be in such a direction that the top turn of each forms a regular figure eight. The plate tap is taken from the 20th turn on one of the double coils. The detector coil has a tickler feedback coil which consists of 15 turns wound so as to make a continuous winding with the secondary. The first double solenoid has a two turn primary for antenna coupling. The antenna coil itself should have about 150 turns on a 2½ or 2¾ in. diameter for a small antenna. A larger antenna will require a smaller coil and so a tapped coil is a very convenient arrangement. Double solenoid coils were used because of the small external field. This is desirable when using small copper shielding cans such as those shown in the photograph. These cans measure about 3 x 6 x 5½ in. and have the tops and bottoms made to slip on in a manner similar to an ordinary tin-can cover.

The double drum dials are arranged to control the antenna series tuning condenser and the four-gang tuning condensers. The volume control $R_1$ consists of a 0-10,000 ohm taper-wound wire resistance. The audio amplifier is mounted on the same baseboard but at the opposite end from the detector tube. The audio amplifier consists of a very high quality transformer coupled single stage and push-pull stage. With the particular transformers shown, it was necessary to shunt the secondary of the first transformer with a ½ meg. leak in order to reduce the a.c. hum to an inappreciable amount. This leak does not reduce the signal strength practically any, but it does act as a termination for the transformer and so seems to reduce the "characteristic" a.c. hum when a.c. tubes are used.

The proper values of *C* bias are obtained by means of semi-variable resistors of the values shown. $R_2$ should be about 800 ohms for the number of tubes used in this receiver. Since the resistance $R_3$ is used to provide 40 volts or so bias on the grids of the two 171 power tubes in the push-pull stage, the *B* power supply unit should be capable of supplying about 40 milliamperes at 220 volts d.c. on the high voltage tap. The 45 and 135-volt taps can be taken off from a single shunt resistor or one from each two resistors; the advantage of using two resistors is that there is less tendency for audio feedback.

The *B* power pack and filament supply transformer should be mounted on

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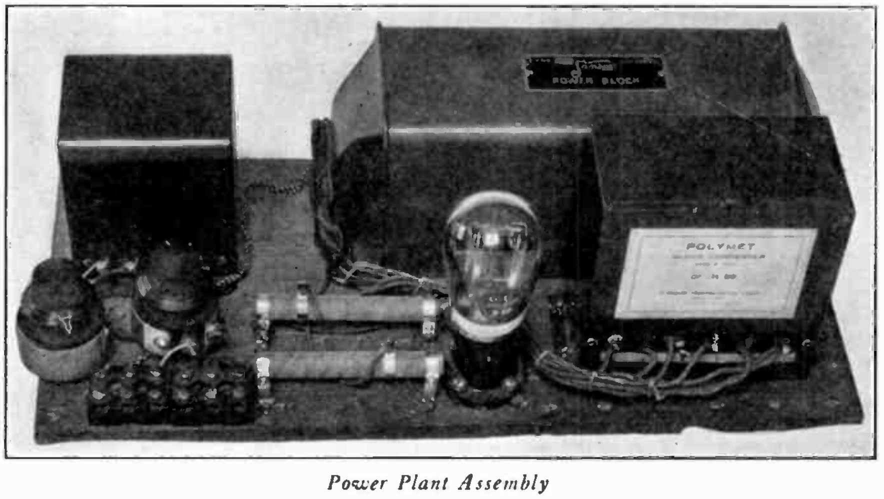

*Power Plant Assembly*

# Rebuilding An Electro-Dynamic Speaker

*By* Wm. Bostwick and T. McLean

Those who are experimentally inclined will be interested in a description of how an old Magnavox electro-dynamic horn speaker was converted into a cone type unit, thereby rejuvenating an otherwise obsolete unit, and permitting the enjoyment of the latest type of loudspeaker performance at small expense.

The old speaker was of the horn type, with a 6-volt d.c. field, and a moving coil attached to a diaphragm. As the field coil, with its associated shell and core is ideal in the construction of an electro-dynamic cone, this was removed from the old speaker, and the horn and diaphragm assembly discarded. In disassembling the speaker, the spring ring at the throat is removed by taking out the screws, so that the outer cover can be taken off. Next remove the aluminum diaphragm by taking out the circle of retaining screws about its edge, lifting the diaphragm very carefully, straight up. The moving coil will then be seen attached to the diaphragm by a small aluminum spider. Carefully cut the leads from the coil at about ¼ in. from the winding form and free the coil and form from the spider, retaining only the coil for future use. Remove any remaining hardware from the magnet assembly, until the flat top plate, in the center of which is the circular air gap, is exposed. This plate can easily be removed, and the core, around which the field coil is placed, is seen.

In the exact center of the end of this core drill and tap a hole ¼ in. deep, for a 6-32 machine screw, after which the metal plate can be replaced, and no further work will be required on the magnet or its housing. Clean out all metal chips around the air gap, as their presence would cause bad scratching of the coil itself, and impairment of the performance of the speaker.

The construction of the paper cone and its supporting medium is the most difficult part of the job, but should offer no particular trouble if instructions are carefully followed. Fig. 1 shows the completed cone assembly, and can be referred to during the process of manufacture if any points on its construction are not fully understood. A perfect sheet of high-grade drawing paper about a foot square will be required, and it should be laid out in accordance with the dimensions given in Fig. 2, using a compass and ruler to get the dimensions accurately recorded on the paper. Having cut out the cone, including the trimming of the ⅛-in. taps at the apex, the lap should be stuck to the opposite edge of the piece to form the cone, using Dupont's Household Cement for the job. Next place the cone with the base down on a flat surface and bend all the tabs at the apex into a position perpendicular to the cone base. This done, place the moving coil which was removed from the original speaker assembly on the cone so that the tabs are all inside, and so that the coil fits firmly against the shoulder formed by the cone. Cement the tabs against the inside of the coil form, first making sure the coil is true with reference to the cone. Use only enough cement to hold as the inside diameter of the coil form must not be decreased.

Next solder two No. 38 or 40 enamel copper wires to the two leads from the moving coil, and bring them out to the edge of the cone, cementing the wires and joints solidly to the cone at all points. At the edge of the cone connect a pair of heavier flexible wires, which may be run out long enough to reach the output transformer. The leather ring, which can be clearly seen in the pictures, is next fastened to the edge of the cone, completing the cone assembly proper. This ring should be of very thin calfskin, such as is used by pipe organ manufacturers, and the thinner the better, consistent with mechanical strength. It should be cut in three or four sections 3 in. wide, and cemented to the rim of the cone, allowing a ⅛-in. lap all the way around. Where the different sections of cut leather meet, use a plain butt joint, with no lap, if possible.

The paper washer for centering the cone is the last job on the cone, and may be made from the same material as the cone proper. This is cut exactly as

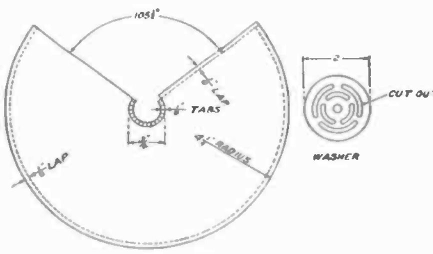


*Fig. 2. Layout of Cone and Centering Washer*

shown in Fig. 2, using a razor blade or manicure scissors. The washer is cemented solidly to the cone as shown in Fig. 3, taking care that it is parallel to the base of the cone. The exact position of this washer is taken care of by its size, so cut as shown, and place it as far towards the apex of the cone as it will go.

The mounting of the cone may be accomplished in a number of different ways, and in factory built jobs it is usu-

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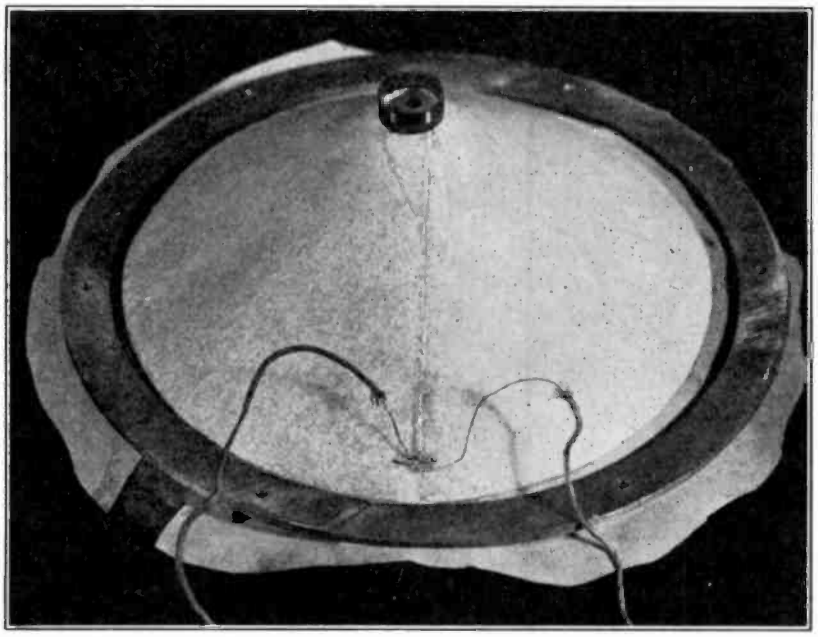


*Fig. 1. Cone Assembly, showing Moving Coil with Flexible Leads*

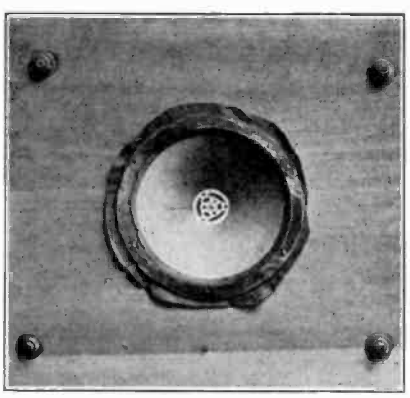


*Fig. 3. Cone in Place on Baffle Board*

# Radio Picture Transmission and Reception

## Photoelectric Equipment and Methods for Visual Communication

*By* JOHN P. ARNOLD, *Departmental Editor*

### PICTURE RECEIVING METHODS
#### II. Latent Images

IN THE first article of this series the common methods of visibly recording a picture transmitted by wire or radio were discussed. Here we consider some photographic methods by which a latent image of the original picture is first received. This involves the subsequent photographic processes of developing and printing before the picture can be seen. The limitations of this latter method have been discussed, especially the fact, as Dr. Ives has pointed out, that the receiving operator cannot, "by using his photographic knowledge and experience, choose the printing media and decide upon the conditions of exposure and development." Although it is possible, by voice communication, for the sending operator to instruct the receiving station in these matters, this not only involves a speech channel between the stations, but does not solve other difficulties that arise when it is not possible to watch the process of recording.

Despite these difficulties, there is no doubt that photographic recording produces pictures of superior quality. We will study two of these methods, one which makes use of a special form of galvanometer and the other a corona discharge acting on sensitive paper.

Berjonneau, Belin and Korn, among other investigators, have recognized the advantage of using some form of galvanometer to control the intensity of a beam of light. Thorne Baker, in the third chapter of his book, "Wireless Pictures and Television," describes the instruments most suitable for picture receiving systems. Among these the most notable are the string type, such as the Einthoven galvanometer, and the moving coil type, as represented by the oscillographs of Blondel and Duddell.

The "light-valve" is a form of galvanometer especially designed for picture receivers. Its operation is based on the familiar principle that a wire, carrying a current in a magnetic field, is displaced at right angles both to the direction of the field and the direction of the electric current. The instrument, shown in Fig. 1, was designed by E. C. Wente and is employed in the Bell system of picture communication. In the drawing, *R* is a flat ribbon carrying the picture signals. This ribbon is deflected to one side or the other of a small aperture in the pole piece of the magnet, *P*, through which passes a beam of light. The complete optical system is shown in Fig. 2.

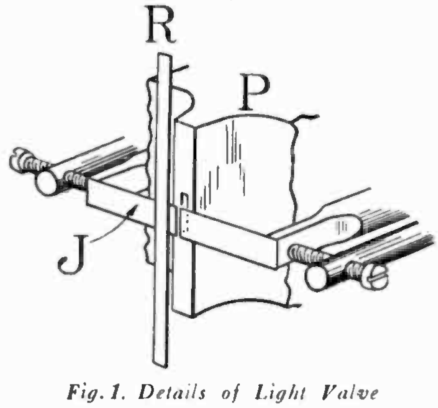



*Fig. 1. Details of Light Valve*

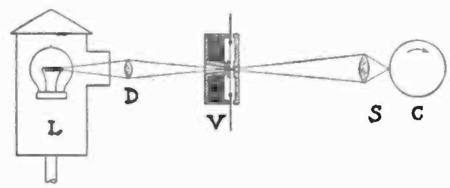



*Fig. 2. Optical System Used in Picture Recording*

If the field strength of the magnet is constant, the force acting upon the wire will be proportional to the picture signals which, in turn, represent a faithful electrical translation of the light and shade of the original picture. Therefore the movement of the ribbon past the aperture can be made to control the intensity of the light that falls upon a photographic film placed on the receiving cylinder. In the diagram, *V* is the light valve, *C* the receiving cylinder, *L* the light source and *D* and *S* the lens system.

Considering the movement of the ribbon in only one direction past the aperture (as would be the case where the picture signals are represented by varying direct current), it is possible, by changing their relative positions, to have a given signal either close or open the aperture. Thus a positive or negative of the original picture may be recorded on the photographic material. This adjustment also affords a means of controlling the "tone range" of the picture; that is, the ratio of the blackest portions of the picture to the lightest.

When such valves are used for receiving, two radically different types of picture structure may be obtained. These are known as (1) variable width and (2) variable density pictures.

1. This type of picture is obtained when a sharp image of the light valve aperture is formed on the sensitive surface of a photographic film placed on the receiving cylinder. The finished picture is then built up of lines of varying width, but of constant density. This structure, greatly enlarged, is shown in Fig. 3.

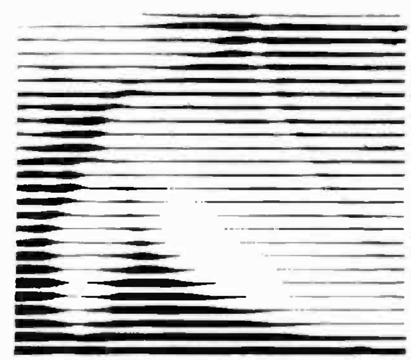


*Fig. 3. Structure of Picture Recorded by Variable Width Method*

2. Pictures of varying density, but of constant width, are produced when diffused light through an aperture of fixed length falls upon the photographic surface. If a structure of about 100 of these bands per linear inch is secured and the bands are exactly continguous, the completed picture resembles the ordinary photographic print, Fig. 4.

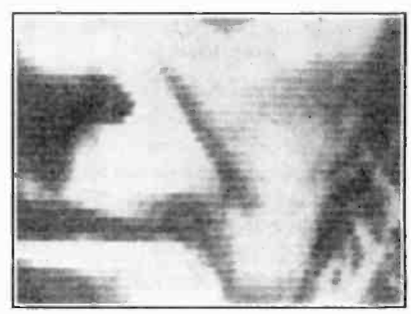
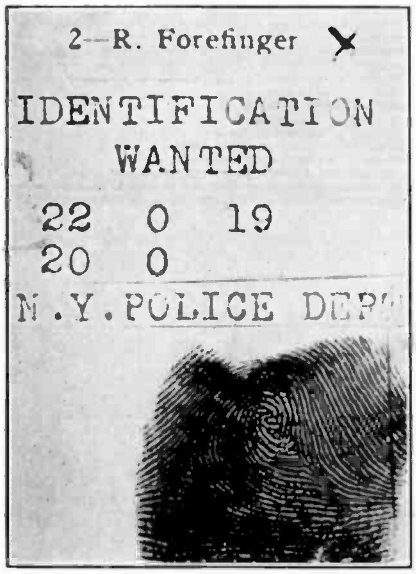


*Fig. 4. Example of Variable Density Recording*

Of the two methods, at least in the matter of the quality of the results, the variable density pictures are preferable. The variable width pictures are very similar to one type of photo-engraving (the "line cut") used in newspaper illustrations. It is also possible to record the picture with dots, instead of lines, by using a sectored disc between the light source and the photoelectric cell at the transmitter. This would be fairly easy to do in the case of direct current transmission, but is something else again where carrier currents are concerned. However, Dr. Ives, of the Bell Laboratories, recently described a method by which the picture is composed of rectangular dots of various sizes. This is a considerable improvement and much more pleasing to the eye than the variable width picture.

Whether a picture should be received

as a photographic negative or positive is a problem which cannot be discussed at length in this place. It is sufficient to state that, for variable density pictures, a positive transparency is placed on the transmitting cylinder and is received on a photographic negative. For variable width pictures, a positive is employed at the transmitting station and may be recorded as either a positive or negative. As a fact, there are eight possible combinations in sending and receiving pictures with the use of light valves and photographic materials, but the most satisfactory are the methods just described.




*Specimen of Commercial Telephotograph Transmission*

In the Cooley Rayfoto system, the latent image is recorded on slow photographic paper due to the corona discharge from a needle-point stylus riding over the surface of the paper. The direct action of the discharge eliminates the necessity for a complicated optical system or the use of light valves. Since it is possible to use rather insensitive photographic papers due, probably, to the actinic qualities of the spark (i. e., rich in ultra-violet rays), the recording can be carried on without resorting to dark room illumination. An oscillating circuit feeds into a Tesla coil and the high potentials produce the corona discharge at the point of the stylus, thus affecting the photographic paper. It is understood that the manufacturers of this apparatus also expect to take advantage of the visible printing methods described in the previous article. This will merely require the substitution of a paper which will be discolored by the corona discharge in accordance with the variation of the picture signals.

M. Belin reports that China has taken to picture transmission. It only remains for some demon historian to discover that the Chinese invented phototelegraphy and had progressed toward television about the time Marco Polo left the court of the Great Khan.

## STANDARDIZATION OF PICTURE TRANSMITTING EQUIPMENT

It would seem rather early, one might say to advocate the standardization of picture communication apparatus. The radio manufacturers, it may be argued, found little necessity for conforming to restrictive standards of design or construction until after the industry had been well established; moreover, in the case of "still" pictures, there is yet no intensive production at all. Such facts must be admitted, but considering the immediate future, they do not fit the case. Presently we shall see why.

The present status of the picture communication art must be understood to grasp the fact that the broadcasting of pictures will soon be an actuality. It is well known that the commercial service of transmitting facsimile messages, drawings, and photographs over telephone and telegraph lines, over submarine cables and by radio, has been established for some time. This is purely point-to-point communication for which the users may be paying $16 per lineal inch of picture. Decency suggests that the radio public do not make a party wire of these transmissions; for a lack of secrecy naturally hurts the companies engaged in this work.

Of greater interest to the radio listener is the fact that enterprising broadcasters are beginning to recognize the program value of pictures. Already several Eastern stations have established this as a part of their regular features and it is rumored that in all 150 stations have indicated their intention of installing picture transmitters. One manufacturer has just begun the production of reception apparatus and several other companies are known to be developing systems of their own.

With this indication that the broadcasting of pictures will soon become a fact, we are in a better position to understand the need for standardization. In comparing aural and visual communication, we must note a fundamental difference. In the design of a speech receiver we have little need for taking into account the type of transmitting apparatus or the method of transmission. In the reception of pictures, however, the design of the receiver is largely governed by the transmitting system, of which there are many. The various systems are so radically different that, if a number of them should be developed for radio broadcasting, the possessor of one type of receiver would be in somewhat of the same position as the man who has a radio set which will tune to only one station. Obviously this is not a very satisfactory state of affairs.

In pointing out the necessity for standardization, no attempt has been made to indicate how this may be accomplished; for that would require a thorough understanding of along just what lines the various manufacturers are working. It does seem, however, that some agreement could be reached in regard to synchronism, scanning, the mechanical details of printing apparatus, and the size and structure of the pictures, without stifling individuality in designing the apparatus.

Such concessions or self-imposed restrictions, which are necessary to insure uniformity, should not work any serious hardship upon the individual manufacturer; but, in any case, it can hardly be questioned that the matter of standardization must be considered at this time if the broadcasting of pictures is to become a popular form of entertainment.

## PICTURE TRANSMISSIONS

Below is given a list of broadcasting stations which are, or have been, transmitting pictures in one form or another. These transmissions are sporadic, especially in the case of television tests. As yet, nothing in this field is very definite.

*"Still" Picture Transmission*

WOR (422 m.)—Kearny, N. J.
WMCA (370 m.)—New York, N.Y.

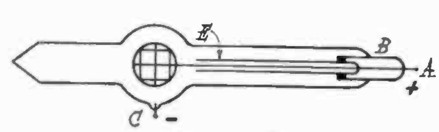
*Television Tests*

WGY (380 m.)—Schnectady, N. Y.
WRNY (370 m.)—New York, N.Y.
WLEX (40 m.)—Lexington, Mass.
WCFL (484. m.)—Chicago, Ill.

WGY television broadcasts are scheduled for 1:30 to 2:00 p. m. on Tuesday, Thursday and Friday and for 10:15 to 10:30 p. m. on Sunday, on 379.5 and 31.4 meters. The speed of the 24-line scanning disc is 20 revolutions per second.

## II. LIGHT SENSITIVE CELLS

Kunz (Phys. Rev. 7, p. 62, 1916; Astrophys. Jour., 45, p. 69, 1917) has designed a cell which is quite free from "dark currents." The central bulb, of glass or quartz, is 3.5 cm. in diameter,



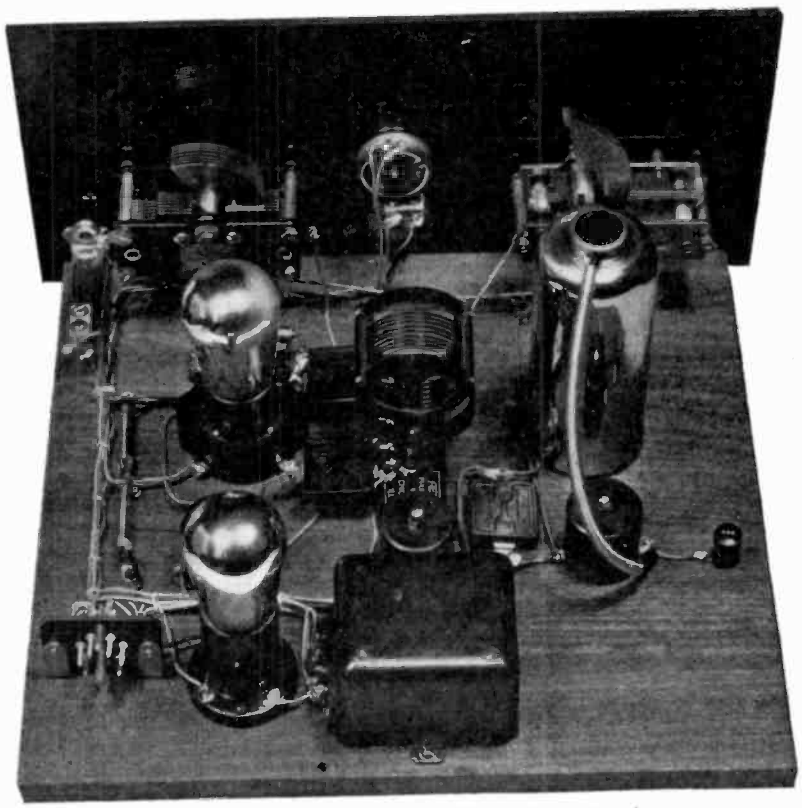

*Kunz Cell*

on the silvered inner walls of which is deposited an alkali metal making contact with the cathode terminal *C*. The anode is a platinum ring, 2 cm. in diameter, across which are stretched fine wires of platinum or silver. The long quartz sleeve *E* and the platinum "guard ring" *B*, (the latter being grounded) reduce leakage currents to a minimum. Such cells are adaptable for accurate measurements as well as for picture transmission and other general applications.

# Shield Grid Tube As Short Wave Amplifier

## Directions for Building An Efficient Non-Radiating Three-Tube Short Wave Receiver

*By* G. M. Best



*Arrangement of Apparatus in Three Tube Receiver*

To increase the range of short wave receivers is the earnest wish of all amateurs, as the use of the r.f. amplification ahead of the already perfected regenerative detector has not proved to be satisfactory with three element tubes, at frequencies higher than four or five million cycles. Short wave superheterodyne receivers have been very satisfactory in many instances, but are usually complex in construction and operation. Hence, the shield grid tube has afforded a happy solution to the problem, and it is coming rapidly into general use as an amplifier at the short waves.

Several excellent circuits using the shield grid tube as an r.f. amplifier have been developed during the past year, and recently several manufacturers have announced kits for building short wave receivers employing a single stage of shield grid r.f. amplification, with regenerative detector and the usual audio frequency amplifier equipment. But there are other reasons besides increasing the sensitivity of the receiver, for using the shield grid tube, the principal one being to insulate the regenerative detector circuit from the antenna system.

All regenerative short wave receivers radiate energy into the antenna system when the detector is oscillating, and hence will produce annoying squeals or whistles in neighboring short wave receivers. Up to the present time this has not proved objectionable due to the relatively few short wave sets in use, and these are scattered over a wide area. But as short wave reception becomes more popular, particularly with experimental television in view, single circuit regenerative receivers will become as unpopular as they were on the broadcast band three or four years ago. It is particularly important to prevent radiation from a short wave receiver due to the fact that such radiation is quite likely to travel phenomenal distances, as witnessed by the records made by Col. Foster at Carmel, Calif., with a single '99 tube.

Aside from prevention of radiation, and increase in sensitivity by the use of the shield grid amplifier, we also have the elimination of an annoying effect caused by the antenna on the operation of the regeneration control. When the receiver is tuned to a wavelength corresponding to the fundamental wavelength of the antenna system, or any of its harmonics, sufficient energy is drawn from the tuned circuit by the antenna system to stop the tube from oscillating, so that it is necessary to increase the capacity in the tickler condenser by a considerable amount at any of these points. This is particularly annoying when moving rapidly over a waveband while hunting for stations. By placing a radio frequency amplifier tube between the regenerative circuit and the antenna system, this effect is entirely eliminated.

Most of the shield grid short wave sets so far described in radio publications have used a completely shielded r.f. amplifier, with tuned input circuit as well as tuned plate, and thus requiring two completely shielded units. This also required two sets of plug-in coils for any given waveband, for one unit consisted of the antenna coil, with associated tuning condenser, and the shield grid tube, while the other unit consisted of the regenerative r.f. transformer, r.f. chokes, and the detector tube. If the r.f.

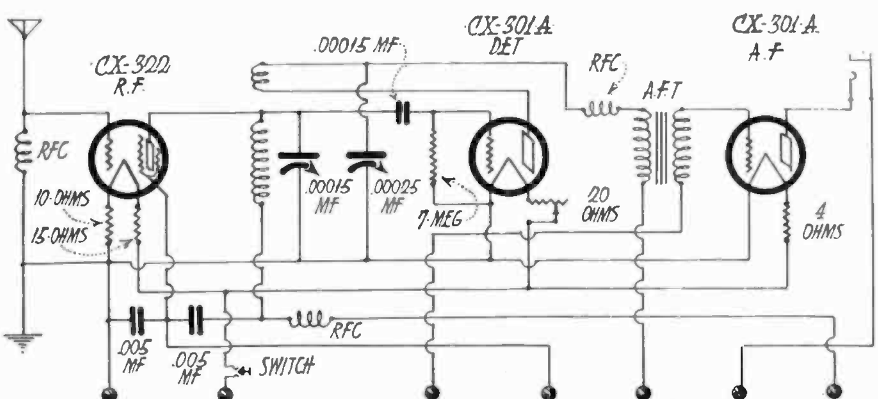



*Fig. 1. Three-Tube Short Wave Receiver for Shield Grid Tube*

stage is not well shielded, coupling between tuning units will occur, and the set will be unstable, as well as being a bad squealer, as the r.f. stage will surely radiate into the antenna system. Also, unless this shielding is good, the antenna effect noted above will still impair the operation of the feedback control.

Of course with a well shielded tuned r.f. amplifier like that of Don Wallace, which was described in detail in May 1928 RADIO, and with the antenna coupled to the input circuit of the shield grid tube through a small condenser, unusually good results with extreme distance reception are had. But it is not always practical to build a completely shielded set, and many do not like the extra control which is thereby introduced. In Mr. Wallace's receiver, the tuning of the antenna coil is sufficiently broad so that the dial can be set roughly for the waveband which is to be received, and left in that adjustment while the fine tuning is accomplished with the condenser shunted across the plate coil. For anyone who requires maximum selectivity and freedom from interference from nearby short wave transmitters, Mr. Wallace's arrangement is to be highly recommended.

For receiving short wave broadcast stations, television experiments, or transmission of radio pictures, the shield grid tube can still be used to advantage on the short waves without the use of elaborate shielding, by using the circuit shown in Fig. 1. Here the tuned input circuit to the r.f. tube is replaced by an r.f. choke so designed that it has the smallest possible amount of distributed capacity, and thereby makes an excellent aperiodic input circuit for the average outdoor antenna. This choke is used through all the short wavebands, and the only coils which have to be changed when switching bands are the tuned plate and tickler coils, which can be obtained as a plug-in unit ready made. A receiver using this circuit is shown in the picture, which indicates the arrangement of baseboard and panel apparatus.

The two tuning controls, detector filament rheostat, switch and the output jack are mounted on a 7 x 14 in. panel, with a baseboard about a foot square for the rest of the equipment. The plate tuning condenser in the r.f. amplifier circuit is at the right of the panel, looking at the picture, and in back of it is the shielded grid tube and input choke. The tube is enclosed in a copper shield, with special mounting for the socket, the leads being brought out through holes in the baseboard. While this tube shield is not strictly necessary, it keeps the shield grid tube isolated from the rest of the circuit, and prevents instability due to the close proximity of the tuned circuit to the elements of the tube.

The two inductance coils are mounted in a single unit, in the center of the baseboard, with detachable construction so that several coils may be used for different wavebands. The plate feedback condenser associated with the tickler coil is at the left-hand end of the panel. The detector tube is in back of the tickler condenser, with a cushioned socket to prevent trouble from microphonic tube noises.

As shown in the circuit, Fig. 1, there are two other r.f. chokes required, one in the *B* battery return lead to the plate of the r.f. amplifier tube, and one in the plate circuit of the detector. The former is mounted to the right of the coil mounting, and the latter to the left, in the picture of the set. A .005 or .006 mfd. bypass condenser is connected between the *B* battery end of the tuned plate coil and ground, and another condenser of the same size is used to keep the shield grid at ground potential, insofar as high frequencies are concerned.

**LIST OF PARTS FOR SHORT WAVE RECEIVER**

1 Panel 7x14x3/16 in.
1 Baseboard 12x12x3/4 in.
1 .00015-mfd. variable condenser
1 .00025-mfd. variable condenser
2 Tube sockets
1 Cushioned socket
1 Audio transformer
1 Set of plug-in coils, with mounting (see text)
2 R.F. chokes, 1½ m.h.
1 R.F. choke-special for antenna circuit
1 .00015-mfd. grid condenser
1 7-meg. grid leak with mtg.
2 .005-mfd. by-pass condensers
1 4-ohm fixed resistance
1 10-ohm fixed resistance
1 15-ohm fixed resistance
1 20-ohm rheostat with switch
1 Output jack
1 Cable plug with terminal
2 Vernier dials
1 Binding post for antenna
1 Copper tube shield, with flexible connector (shield optional).

A grid bias of 1½ volts negative, for the shielded grid tube, is obtained by means of the voltage drop across a 10 ohm fixed resistor placed in the negative filament lead to the tube, and an additional resistance of 15 ohms is placed in the positive filament lead to keep the total voltage across the tube filament at approximately 3.3, when a 6-volt battery is used.

The audio transformer shown in the picture was an old Western Electric coil made for the Signal Corps during the war, and now widely used by amateurs on account of its 9 to 1 turns ratio. It has been a favorite item in army surplus stock sales in recent years, and has no advantages over any other good high ratio audio transformer. If the receiver was to be used for music or speech only, it would be better to use two stages of audio with high quality transformers of lower ratio, but for telegraph purposes principally, for which this particular set was intended, a high ratio transformer with one stage of audio makes a satisfactory combination, and saves one tube.

In wiring the set, the leads were made as short as possible. The filament wires, *B* battery return leads, and everything except the grid and plate wires were cabled together, so as to reduce the potential between wires, at high frequencies, as much as possible by means of the capacity between them. As can be seen in the picture, the connections between the various bypass condensers, grid condenser and leak, and other important high frequency leads were made as short as possible, in some instances the apparatus itself becoming the connecting lead between two other pieces of equipment. Battery connections were brought to the set through a flexible cable and connector plug, but any arrangement suitable to individual needs may be used.

The ground connection can be made at the negative *A* battery, and the antenna is connected to the grid of the shield grid tube, at the point where the flexible grid connector joins the r.f. choke terminal. The control grid connection to the shield grid tube is made at the tip of the bulb, and the *G* terminal of the socket into which the tube is plugged is the shield grid, which is connected to the 45-volt *B* battery.

The tuning coils used in this set were all wound on 2 in. low loss forms, the coil for the 20-meter band having 3 turns of No. 18 enameled or silk covered wire for the tuned plate coil, and the same number of turns of No. 26 silk covered wire for the tickler coil. The tickler coil is placed inside the tuned plate coil, at one end, and is about 1¾ in. in diameter. For the 40-meter band, the tuned plate coil has 8 turns, while the tickler has 4 turns, and for the 80 meter band the tuned plate coil has 19 turns and the tickler 5 turns. By the use of a small diameter form, the field of the coil is limited to a short space, and reduces the interference due to direct induction from local stations.

A negative grid bias of 4½ volts is supplied to the audio amplifier tube, through one of the battery cable leads. This battery is not strictly necessary for code reception, but it permits greater undistorted output, and greatly prolongs the life of the tube, since the plate current is cut in half. A 4-ohm fixed resistance keeps the filament voltage at 5 volts or less, and this tube as well as the shield grid tube have not other filament adjustments, the rheostat controlling only the detector filament.

In tuning this set, the same procedure is followed as that for a receiver having

(Continued on Page 59)

# A High Range Vacuum Tube Voltmeter

## Constructional Details of a Novel Instrument Having a Range of 0-500 Volts

*By* HARRY B. LUBCKE

BY UTILIZING the properties of the vacuum tube to the fullest extent it is now possible to build a self-contained, single-tube, single-metered vacuum tube voltmeter with a useful overall range of 0-500 volts. As is the case with the ordinary vacuum tube voltmeter the instrument draws no current from the external circuit and operates equally well on d.c. or a.c. of any frequency.

With the instrument all ordinary laboratory measurements employing a vacuum tube voltmeter can be made and many others in addition because of its extended range. All radio receiver and socket-power voltages can be measured, including the high-plate voltages of the new 210 and 250 type power tubes. All receiver plate currents can also be measured by virtue of 0-1, 0-10, and 0-100 m.a. ranges provided for the indicating meter and brought out to terminals for external use.

A low range of approximately 0-10 volts uses the vacuum tube in the conventional voltmeter hookup, the voltage measured being impressed on the grid and the increase in plate current due to rectification read on the meter. For the intermediate and high ranges, of 0-100 and 0-500 volts, an inverted vacuum tube connection originated by Terman of Stanford University is used. Here the voltage measured is impressed on the plate, a positive potential is placed on the grid, and the change in grid current noted. The change in grid current is a decrease, due to the fact that a negative charge is given the plate from the measuring or external circuit.

The limit of input voltage with the conventional vacuum tube voltmeter is reached when the grid begins to swing positive, for precision work at least, since a current drain from the measuring source cannot be tolerated.

By inverting the vacuum tube, however, i. e., making the plate the control electrode instead of the grid, this limitation is removed. The grid is maintained at a positive potential by a suitable battery and the indicating meter inserted in this circuit. The plate is made negative by the impressed voltage, its potential affecting the grid current but to a much less extent than the grid voltage; by an amount approximately the reciprocal of the amplification factor of the tube.

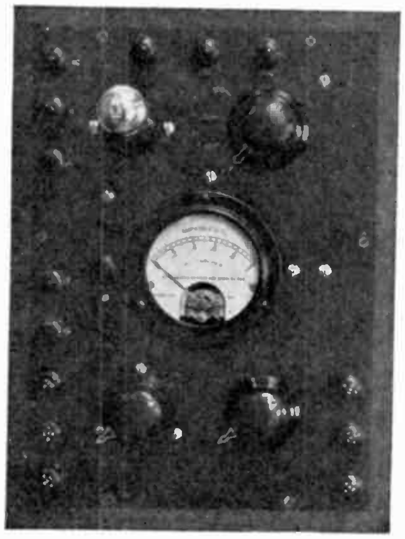


*Fig. 2. Panel View*

It was found that by varying the resistor in the grid circuit the input voltage range covered by a given tube and meter could be changed from some low value of perhaps 0-50 volts for no grid resistance to practically an infinite value for a very high resistance.

Since the negative charge on the plate tends to decrease the grid current, the IR drop in the grid circuit series resistor is a maximum for zero input, the meter reading some arbitrary maximum value. Increasing the value of input potential decreases this current, consequently decreases the IR drop and increases the absolute grid potential, all of which tends to keep the grid current constant. It is evident that a large value of series resistance makes this variation in grid potential great, nullifying the effect of the plate in a large measure, and thus making the input voltage range corresponding to a given meter scale-length great.

With the 199 type tube used and the 0-1 m.a. meter a 2000-ohm grid series resistance gave a 0-100-volt range, and a 50-000-ohm resistor a 0-500-volt range. By using values of one or two megohms it will be seen that ranges up to several thousand volts are easily obtainable, the limit being the flashover voltage of the

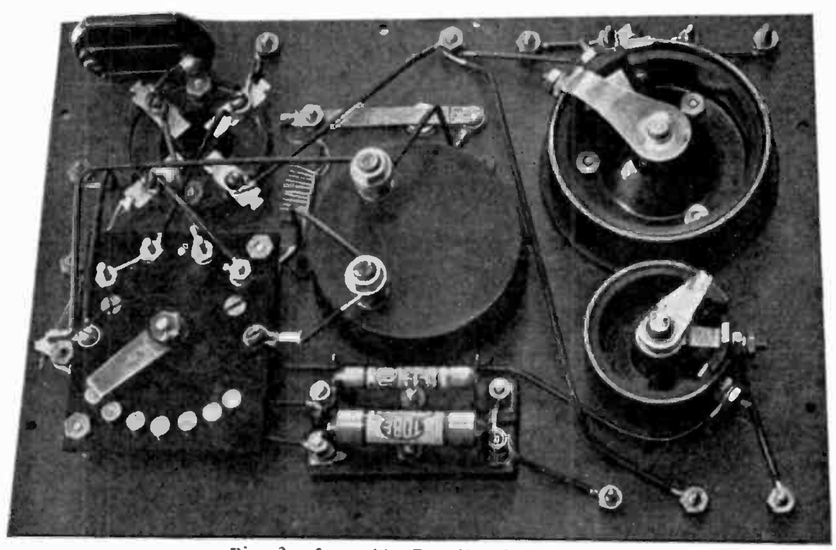


*Fig. 3. Assembly Details of Voltmeter*

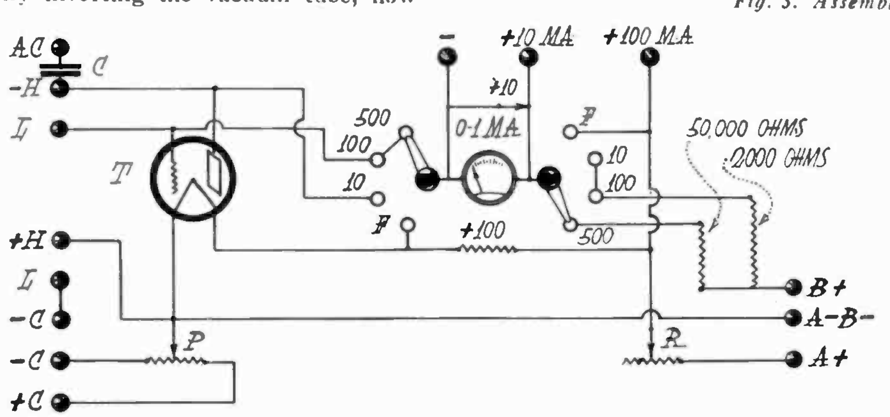



*Fig. 1. Circuit Diagram of Vacuum Tube Voltmeter*

tube, a factor susceptible to increase through the use of a larger tube.

The diagram of connections of the instrument is shown in Fig. 1. The two switches flanking the milliammeter represent the single range-change switch shown on the panel in the upper right-hand corner of Fig. 2 and in the lower left-hand corner of Fig. 3. The upper position of this switch, "500," connects the 50,000-ohm resistor and meter in series with the grid for the 0-500-volt inverted vacuum tube range; the next

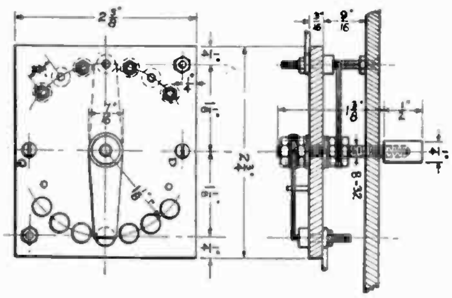


*Fig. 4. Construction of Tapped Switch*

position, "100," the 2000-ohm resistor for the 0-100-volt range; the third position, "10," the 2000-ohm resistor and meter in series with the *plate* for the normal vacuum tube 0-10-volt range; and the bottom position "F," a 100 m.a. shunt in the filament circuit across the meter for indicating the filament current of the tube.

The switch proper is of double arm rotary construction as shown in the detailed drawing, Fig. 4. Each arm passes over a set of 7 contacts located on the subpanel around which the switch is built, and consists of two spring bronze blades, both bearing on the contacts to give a constant resistance assembly. The lower arm is insulated from the shaft by bakelite or fibre washers and connection made to it by soldering on a flexible "litz" pigtail. Connection is similarly made to the upper arm by soldering to the shaft at its lower extremity, both pigtails being soldered to the external circuit wires and held under 6-32 screws marked *D* and *Q* in Fig. 4. Connections are made to alternate switch-points among the group of seven, giving the four positions required while the intervening ones serve as dead points to prevent short circuits. The subpanel is held to the main panel by two 1 in. 6-32 screws.

The panel drilling details are given in Fig. 5; the placing of the apparatus being evident from the pictures. The socket is mounted beneath the panel, only the top extending above, for sake of neatness. The wiring was done with celatsite insulated bus rather than stranded wire to secure permanence of calibration.

The 0-100 m.a. shunt is soldered between the "+100" external binding post of the meter and the + filament terminal of the socket. Two No. 30 B & S Advance resistance wires in parallel have the proper resistance for the make of meter used. The 10 m.a. shunt is soldered between the spring leaf of its push-button switch shown at the side of the meter, and one terminal wire of the meter. This shunt is permanently across the meter save when the push-button is pressed for taking readings and is a vital protection aid. Approximately 12 in. of the No. 30 wire is required, which is wound on a piece of 1/16 x 3/8 x 1 in. fiber non-inductively; that is, the wire is bent in the middle and wound on double.

The shunts are adjusted to their proper resistance by scraping and changing the length of wire for the 100 and 10 m.a. sizes, respectively. A calibration circuit consisting of a storage *A* battery, a variable resistance of the clarostat variety, an accurate 0-100 m.a. milliammeter as standard, and the instrument meter with shunt, are all connected in series and the shunts adjusted until both meters read the same.

With the ordinary vacuum tube voltmeter connection several calibration curves are possible of attainment by imposing widely different values of *A, B* and *C* batteries. However, an optimum calibration range exists for any given tube and meter which utilizes the scale of the meter to the maximum, the tube to cut-off, and maintains the grid always negative. This range has been determined for this instrument and is secured with 60 m.a. filament current, 90-volt *B* battery, and 13½-volt maximum *C* battery.

For this calibration a source of a.c. potential of variable, known magnitude is connected to the "low" input terminals marked L—L, on the instrument and in Fig. 1. This can best be a small step-down transformer with secondary shunted by a potentiometer, and a 0-10-volt a.c. voltmeter connected between one end and the slider, which terminals are also attached to L—L.

Before the power is turned on the filament current is set to 60 m.a., using the instrument meter by turning the switch to "F" and adjusting with the rheostat "R." The 90-volt *B* battery is connected, the range switch placed on "10," and the *C* battery voltage adjusted with the potentiometer "P" until a small current is flowing, say .05 m.a., the first meter division, which value is always taken as the zero reading. Then the power is turned on and the input voltage varied in approximately ½-volt steps, the input voltage and corresponding meter reading being noted and recorded.

The 0-100 and 0-500-volt ranges are calibrated with a variable source of d.c. voltage and suitable high range voltmeter. A block of used *B* batteries or a *B* socket-power device is suitable. The voltmeter need be accurate, but not necessarily of the high resistance type. The + side of the source is connected to the "+H" binding post, the negative to the "—H."

The filament being set at 60 m.a. and the input shorted, the *B* battery voltage is adjusted to give a full scale reading of 1 m.a., which takes about 9 volts for the 0-100-volt range and 50 volts for the

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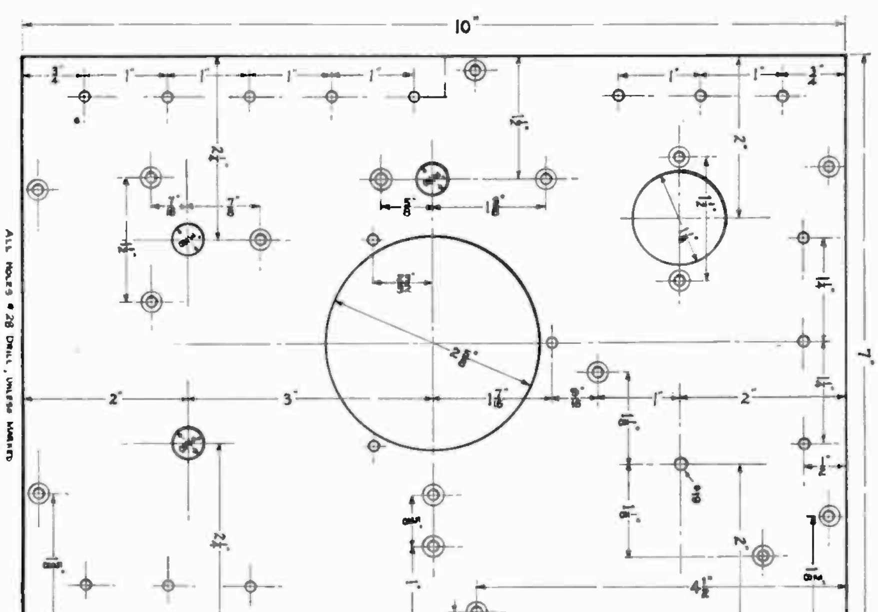


*Fig. 5. Panel Drilling Details*

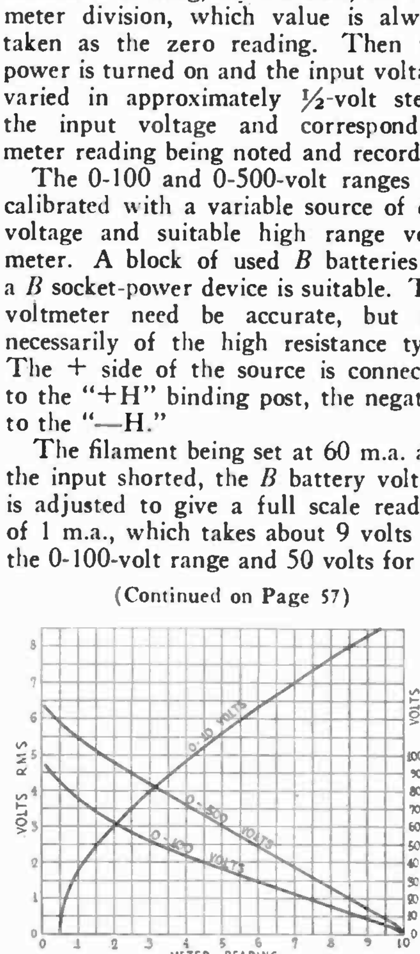


*Fig. 6. Calibration Curve of Voltmeter*

# R. F. Chokes and Methods of Testing

*By* G. F. LAMPKIN

A COMMON use for radio-frequency chokes is in transmitting sets, where they are used to feed operating voltages to the plate, or grid, of the tube oscillator. In such a case the d.c. battery, generator, or rectifier-filter, is usually in parallel with all or part of the r.f. circuit, and to prevent shorting the radio currents a choke in the d.c. branch is necessary. There are particular advantages that are gained by using the shunt method of feeding voltages to the tube. The r.f. and d.c. circuits are thereby made independent; the tuning condenser and inductance are not hot with dangerously high-plate voltage; the d.c. supply may be picked up from any convenient point, such as biasing resistor, voltage divider, etc., independently of the r.f. return path.

This latter point is of particular interest in r.f. amplifiers. Just as in audio amplification speaker filters are used to separate a.c. and d.c. components, so in radio amplification filters may be used and advantages of the same sort realized. The r.f. plate currents from two or more amplifiers find a common path in the plate supply unit, and if this common path has appreciable impedance, undesirable couplings that may give rise to instability are had. The r.f. chokes can be used to return each r.f. current directly to its respective filament, and the d.c. alone will flow through the common impedance. With the shield-grid amplifier more or less juggling has to be done to keep the direct and alternating currents in their proper places.

The three principal functions of r.f. chokes might be stated in a negative way: For an oscillator, connecting the choke across the r.f. circuit must not decrease the strength of oscillations; in the r.f. amplifier, connecting the choke for shunt feed must not cause a loss in output voltage; and in filtering, the choke must let little or no r.f. current flow through it. The first two statements are more or less equivalent—the one case is for a self-excited, and the other for a separately excited oscillator. All three statements give the requirements of a choke in terms of effect, rather than cause. As the optimum choke is best determined by experiment, the basis of choke comparison should be in terms of effect rather than in terms of cause—causes such as impedance value, positive or negative reactance, r.f. resistance, natural period, and so on. Obviously desirable qualities for a choke, also, are that it be physically compact, and that it be effective over a wide wave range.

A choke might be measured for r.f. leakage by a circuit such as that in Fig.

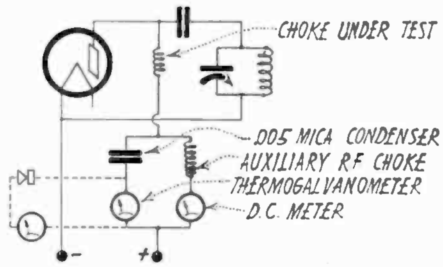


*Fig. 1. Circuit for Testing R. F. Chokes*

1. The choke is connected in its normal position in an oscillator, and the d.c. and r.f. components through it are separated by another choke and a condenser. A .005-mfd. or larger mica condenser prevents d.c. from flowing in the a.c. branch and registering on the thermogalvanometer. The condenser reactance is around 32 ohms at 1,000 KC., so that the auxiliary choke need be only of indifferent construction to shunt the greatest portion of the r.f. into the condenser and thermogalvanometer. The d.c. meter, if desired, measures the d.c. through the circuit. The thing that must be watched is that the capacity and inductance of the filter elements are not such as to resonate at or near the working wave. If so, a circulating current would be built up around them and the reading of the thermogalvanometer would be no measure of the r.f. leakage through the choke under test. As a rule the leakage will be too small to read accurately on the ordinary 100-milliampere thermogalvanometer, except in the case of the relatively high-power transmitters. It is possible to get relative readings at small powers, however, by using a fixed crystal detector and low-range milliammeter in the dotted circuit of the diagram for indicating the leakage current.

The statement that a choke should not decrease the strength of oscillations, nor cause a loss in output voltage, gives a clue to a very good method of testing r.f. chokes. The various chokes which it is desired to test may be put in an oscillating circuit, and the resulting strengths of output for each determined. This method was followed when it was desired to find a more compact choke than a single layer of No. 32 enamelled wire wound on a 1x5 in. cardboard tube, which had been in use in the units of a crystal-controlled transmitter. The transmitter was capable of operation anywhere from 50 to 100 meters, and it used the second harmonic of the crystal, so that the total wave range over which a choke was desired to operate was 50 to 200 meters.

That versatile instrument, a grid-meter driver, was at hand, made up in

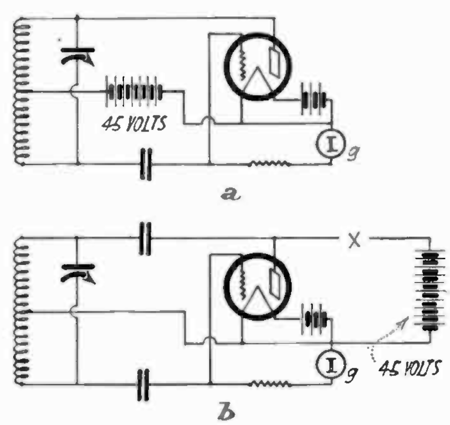


*Fig. 2 (a). Series Feed Hartley for Comparison Test*
*(b). Shunt Feed Hartley for R. F. Choke Test*

the Hartley circuit of Fig. 2a. A General Radio 1000-mmf. variable condenser, a plug-in coil of ten turns of No. 14 DCC 3-in. in diameter, a CX-

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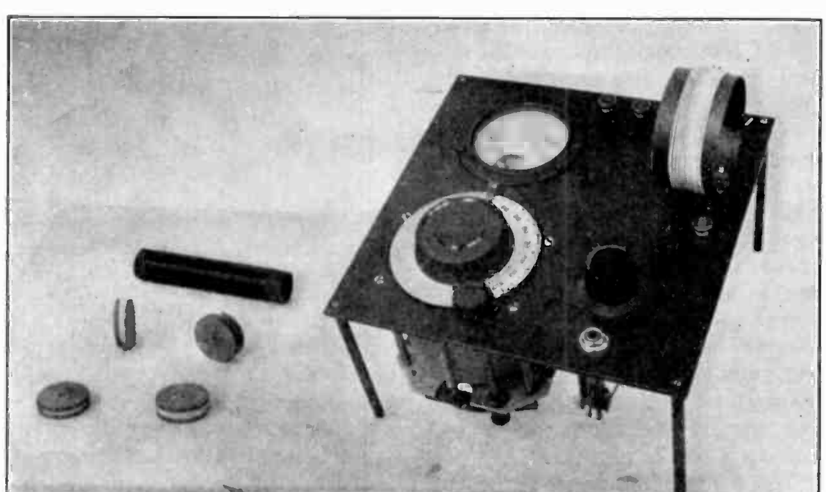

*Circuit Driver with Test Chokes*

# TECHNICAL BRIEFS

This department replaces the former Queries and Replies page, and in addition to containing answers to questions of general interest, a considerable amount of technical and semi-technical information will be included each month. New radio developments, useful data on radio theory and practice, and on subjects allied to radio will appear in each issue. Where personal answer to questions is required, a fee of 25 cents per question or diagram should be sent. Special diagrams, requiring an unusual amount of time to prepare will carry an extra charge, and the correspondents will be notified of the amount of this charge before answer is made.

SEVERAL queries have been received in regard to the circuits or nature of the amplifying equipment and loudspeakers used in Movietone and Vitaphone talking movie installations. While detailed information on these systems is not yet available, a brief description of the equipment used is herewith published for those who are interested, and undoubtedly these data will be of interest to experimenters, especially those working with power amplifiers.

The Vitaphone and Movietone systems differ principally in the manner of making a permanent record of the sounds associated with the episodes which are to be filmed. The Vitaphone places these sounds on a phonograph record disc almost identical in character with those sold for general use, except that their diameter is often larger, due to longer periods of continuous recording, frequently exceeding ten minutes time. The Movietone photographs the sounds on a small strip of the film used for taking the pictures, so that the picture appears on the screen as a square rather than a rectangle, due to the voice strip taking up a small amount of the available space ordinarily occupied by the picture. The audio frequency amplifiers, at the projection end, in the theatres are the same for either type of installation, except in the manner of converting the sound into electrical impulses. The relative space occupied by the picture and sound record is clearly seen in Fig. 1.

In the Vitaphone an electro-magnetic reproducer converts the mechanical vibrations of the phonograph needle into electrical impulses, the same as in the Electrola or the Panatrope, and a five-stage audio frequency amplifier magnifies these impulses to an amount sufficient to operate from four to six loud speakers, which are placed on the stage in back of or to one side of the screen. The amplifier consists of three stages of resistance coupling, in one unit, with a non-microphonic type of tube, followed by a push-pull fourth stage using transformer coupling, and a push-pull fifth stage power amplifier. The fourth stage uses tubes of the Western Electric 205-D type, having a power output of approximately 1½ watts per tube, and the fifth stage uses Western Electric 211-D tubes, commonly known as the 50-watt size,

*Fig. 1. Section of Movietone Film*

but actually delivering about 7 watts of undistorted power at audio frequencies per tube. To supply power to the last two stages individual rectifier systems are employed. The push-pull fourth stage is supplied by a full wave rectifier using two of the same type tubes as are used in the associated amplifier, and the fifth stage is also supplied by a full wave rectifier using two 50-watt tubes, with the grids and plate connected in parallel. Neither of these rectifiers are used to supply any of the other stages, the first three resistance coupled tubes receiving their plate supply from dry cell batteries.

The filaments of the tubes in the last two stages are operated from raw a.c. through a step-down transformer, while those of the preliminary stages are connected in series and operated from a storage battery. The input equipment of the Vitaphone consists of a phonograph turntable and synchronizing equipment for starting the record at the same instant that the beginning of the motion picture film is projected on the screen, together with the electro-magnetic pickup. The spiral groove on the record starts at the center of the disc and works out to the edge, the opposite from the system used for standard disc records for public use. This is supposed to produce less wear on the groove, and to prevent jumping of the needle. The record travels at half the speed of ordinary disc records. The output of the electric pickup is connected to the five-stage amplifier, and the amplified output supplies the horns back of the screen.

In the Movietone system the sound waves are photographed in the form of parallel black lines on the film, and to reproduce these lines the film is passed in front of a narrow aperture in the form of a slit in a metal plate, a powerful, concentrated filament mazda lamp providing the illumination at the aperture. The optical system is shown in Fig. 2. The variation in the intensity of the light caused by the passage of the photographed record of the sound on the film across the aperture, causes a variation in the intensity of the beam of light which is projected on a photoelectric cell. These light variations in turn produce fluctuating currents in the output of the photoelectric cell, and are magnified by the five-stage amplifier so as to operate the loud speakers. Due to the fact that the motion picture film, while being projected on the screen, is pulled across the picture aperture intermittently at the rate of 16 times a second, the sound waves are recorded slightly out of step with the corresponding pictures, so that at the instant the picture is being pro-

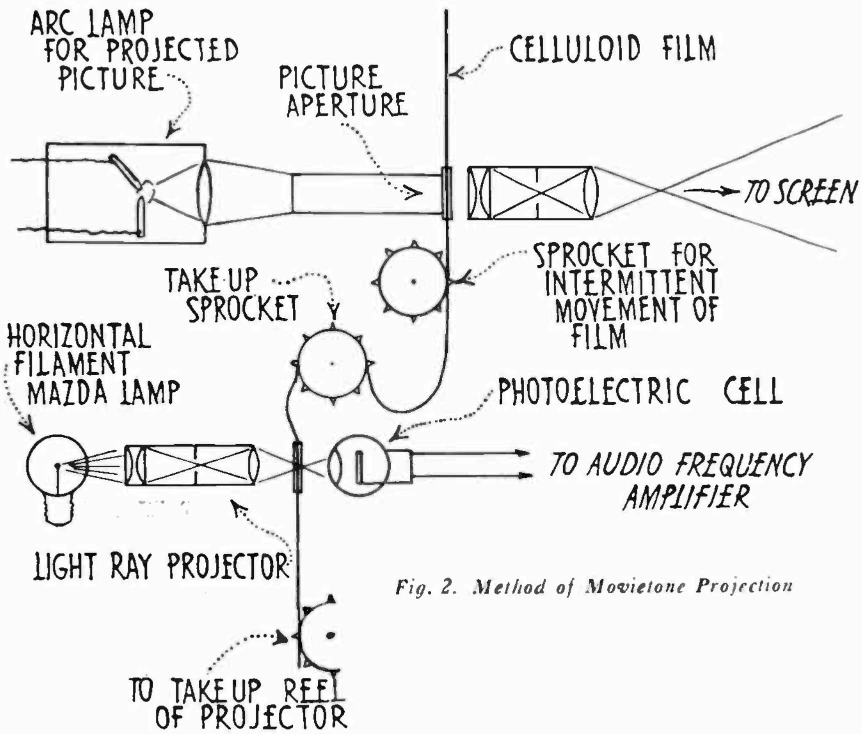


*Fig. 2. Method of Movietone Projection*

jected on the screen the piece of film having the associated sound record is being pulled smoothly past the photoelectric cell aperture, about a foot below the picture aperture.

The loud speakers are controlled by individual rheostats, so that the volume of any individual units may be adjusted. The units are built on the electrodynamic principle, except that an exponential horn is used instead of the customary cone. According to published statements this unit has a conversion efficiency from electrical to sound energy varying between 10 and 50 per cent in the frequency range of 60 to 7500 cycles, with a 50 per cent efficiency through most of its range. The moving coil consists of a single layer of aluminum ribbon wound on edge, the turns being held together by insulating lacquer, the coil being fastened to a diaphragm made of a piece of aluminum alloy, two thousandths of an inch thick. The horns are equivalent in performance to a straight projector over ten feet long, but due to being designed on the reflex principle occupy a much smaller amount of space without losing their effectiveness.

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A SURPRISINGLY small amount of information is available about the properties and characteristics of the dry type filter condensers, such as is used in *A* battery eliminators. With capacity ratings which range from 1500 to 3000 mfds., it is a source of wonder to the uninformed as to how such a high capacity can be attained in so small a space, since most of them are no larger than an ordinary 1½-volt dry battery.

Most of these condensers consist of sheets of foil wound around a core of impregnated compound, which provides a considerable leakage path between the two plates, as much as several hundred milliamperes at the load voltage. In a recent bulletin issued by the Aerovox Company, some interesting data were given. It appears that the capacity varies with the voltage applied across the terminals. Whereas a condenser might measure 2000 mfds. at 6 volts, it would have about 1500 mfd. capacity at 12 volts, and only 100 mfd. at 90 volts. To determine the capacity of the condenser at any given working voltage, a.c. is applied to its terminals, but with an ammeter in series with the line and a voltmeter across it to measure the impressed voltage and current drawn by the condenser. The capacity of the condenser is then found from the formula

$$C = \frac{I \times 10^6}{2 \pi f E}$$

where $C$ is the capacity in mfds., $I$ the current in amperes, $E$ the impressed voltage, and $f$ the frequency of the alternating current source.

The dry *A* condenser is polarized, which means that it behaves normally if connected to the output of the rectifier with the proper polarity, but if reversed, the leakage current through the condenser will be so great that the condenser will soon heat up and become damaged. The condensers may be connected either way when first put in use, but once they are placed in the circuit under working conditions, they should not be reversed thereafter. Most of the condensers now on the market have a conservative capacity rating at a given voltage, and at the customary commercial frequency of 60 cycles.

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A READER asks why it is that a received signal which is too weak to operate a detector tube is able to operate a tube used as an r.f. amplifier. Also why antenna circuits of factory-built sets are as a rule untuned.

Van der Bijl found that the ordinary detector tube, for a readable signal, required a high frequency voltage of between .01 and .05 volt, so that when voltages below .01 are impressed on the grid, the detected signal would be inaudible. Hence, to obtain an audible signal, it is customary to place amplifiers ahead of the detector, to step up the voltage to that required for readable signals. Even though the signal was inaudible in the detector output, it might still be there in measurable quantities, and by placing audio frequency amplifiers after the detector tube, the signal could again be heard. However, this is not as practicable as amplifying the signal before it enters the detector circuit, since the amount of amplification obtainable from existing audio frequency apparatus is limited. Many of the signals received by the average broadcast receiver have effective voltages of only a few millionths, which, while sufficient in amplitude to operate a tube as a radio frequency amplifier, will not furnish the detector grid with sufficient voltage to have a readable signal at the output.

Practically all factory-built receivers use aperiodic antenna coupling, with an untuned coil of few turns, closely coupled to the first tuned circuit. Undoubtedly, better selectivity could be obtained by tuning the antenna circuit, but this would require a separate control, as the tuning curve of the antenna tuning condenser, and that of the condensers across the secondaries of the r.f. transformers, are entirely different in slope, so that a gang condenser could not be used. The usual antenna tuned circuit consists of a loading coil, variable condenser, and a coupling coil, all placed in series between the antenna and the ground. To tune the antenna system through the broadcast band, and yet use a gang condenser for all the tuned circuits including the antenna, a different type of tuning condenser would be required for each individual antenna system, and this would be commercially impractical. Thus the system of untuned antenna and three or more tuned circuits in the r.f. amplifier, used to obtain sufficient selectivity, is the almost unanimous choice of the radio manufacturers today.

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A correspondent asks what is meant by giving the 115-kilocycle superheterodyne the designation "115 K.C. Super." The average superheterodyne circuit or kit uses the frequency of the intermediate amplifier as the trade name or circuit designation, and since this time-honored practice originated with this magazine in 1924, when the 45-K.C. superheterodyne was first announced, the intermediate frequency designation has been used ever since.

# With the Amateur Operators

## DESIGN AND CONSTRUCTION OF 5 AND 10-METER RECEIVERS

*By* A. Binneweg, Jr.

With successful two-way communication already accomplished on 10 meters, experimenters are centering their attention on the 5-meter band. Receivers for these bands require considerable attention for effective operation. The circuit for 5-meter use is shown in Fig. 1.

The grid condenser and the grid-filament capacity are in series and the resultant capacity is in shunt with the tuning condenser, thus decreasing the allowable inductance or capacity in the tuning circuit. The series arrangement consisting of the grid condenser, the grid-plate capacity and throttle condenser is also in parallel with the tuning circuit and gives rise to somewhat the same result. To minimize these "loading" effects, the tube capacities should be as small as possible; the smaller they are, the less the detuning of the tuning circuit when the throttle condenser is operated. Since the throttle-control is in series with two fixed condensers, the detuning effect can be practically eliminated, even at 5 meters, by using tubes of small internal capacity, a fairly small grid condenser, and by using a comparatively large throttle-condenser, operated near a maximum setting. This applies, in a degree, to all short-wave receivers. The size of parts necessary will depend upon the frequencies used.

Experiments show that best all-around results are secured with small grid condensers in spite of a possible small decrease in grid voltage. Regeneration is easier, and some tube filaments, under amateur operating conditions, do not deactivate as quickly, probably due to the decrease in oscillating current passing through the filament. Capacities of 5 and 10 mmfd. have given good results, and these are readily constructed as small air condensers. Stiff leads are soldered at right angles to two small ½-in. diam. round plates and fitted into small binding posts, which securely hold them, when once adjusted.

The r.f. chokes should be arranged as shown in Fig. 1. The self-capacitance of a winding can be reduced by winding it in sections and separating them, since there is capacity between each and every turn in the winding. The final result is a series of parallel circuits having a high $L/C$ ratio and a minimum possible circulating-current loss. The arrangement acts as a series of wavetraps, in this case, and if the number of turns in each trap is chosen so that the frequency-characteristics "overlap," a high impedance is obtained over the entire tuning range. The chokes should be used at positions of low voltage wherever possible. A small 20-turn Lorenz winding in the filament lead helps out.

Since the two condensers are close together, the dials on the panel will interfere. One can either allow the dials to overlap, use a small knob on the throttle-control, or else set the shafts, and the two sections of panel, at a slight angle. A vernier dial is necessary as the set will be adjusted to tune over a fairly large frequency range. If properly adjusted, very little change in throttle-control capacity will be necessary, over the range used.

A conventional type of short-wave antenna will serve, but the coupling-coil should consist of 1 or 2 turns about 2 in. in diameter. A series condenser if used, should not be over 100 mmfd.; at 5 meters, 30 mmfd. max. is plenty. Due to high resistance, antenna "dead-spots" are often very broad and cause regeneration troubles; the antenna should be disconnected while adjustments are made, and coupling should be very loose when it is used.

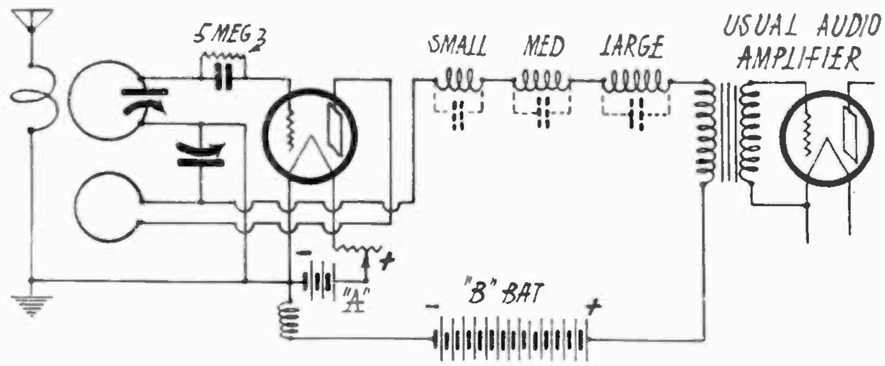



*Fig. 1. Circuit of 5-Meter Receiver*

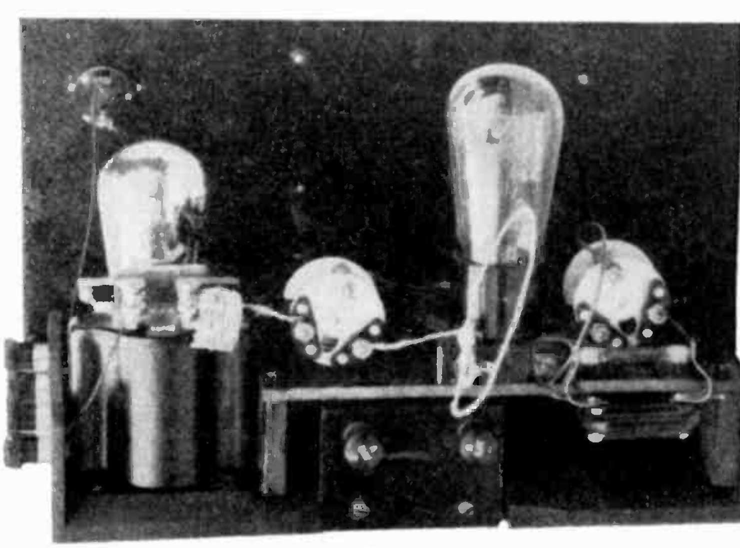
These receivers often require excessive "feed-back" for proper regeneration, showing that the losses in the tuned circuit are high, or that there is an r.f. leak somewhere; the choke may be poor or some metal part may be too close. With the proper choice of parts, and care in placing these, very good results will be obtained.

The ordinary, short-wave condenser is too large for 5- and 10-meter use, even though cut down. For short leads, compact arrangements, and all-around efficiency, midget condensers should be used. The inductances should be made small in diameter, should be mounted on the backs of the condensers and away from the front of the set. The most logical arrangement is to have the tube socket mounted between the two condensers so as to give the shortest possible leads. The tuning condenser should usually have a capacity of about 15 mmfd. and it is convenient for 5-meter work to have the throttle control about 45 mmfd. max.

Extension handles on the condensers are necessary; ¼ in. bakelite rods fitted into commercial attachments for this purpose serve very well. With some types of midgets, a short length of brass rod can be threaded to fit the shaft and the extension handle. If midgets are used, and the inductances are properly proportioned, a 6-in. extension handle will do. The receiver is already so small, that this increase in depth is not noticed. The panel is provided with the proper holes for the shafts and these are fitted with bushings.

At 5 meters high plate voltages are often necessary to secure proper regeneration. By careful adjustment, good results are secured with 45 volts on the detector; it is advisable to start with a 112 as detector and about 67½ volts on the plate; this tube oscillates easier than the 99, for instance, but requires less tuning inductance. One can make small frequency changes by withdrawing the tube-pins from the socket, moving the coils relative to each other, slightly bending them, or changing tubes. Different tubes regenerate over different ranges for given values, so that the receiver should be built around the particular type of tube used.

One should not overlook the reflector for reception. Very large increases in signal strength are possible with a properly designed system of wires arranged in the form of a parabolic cylinder. At 5 and 10 meters, these are of convenient size, and a simple system would consist of four wires, each one-half wave long, three of them being arranged vertically around a horizontal parabola and spaced one-half wave apart, with an antenna at the vertex and the actual receiving aerial at the focus. Means for tuning the wires, or else simply tune them to the middle of the band, could be provided as the tuning has been found not sharp. The same system could be used for transmitting. A reflector system would allow a minimum of power to be used, a less sensitive receiver, or both.



*A 5-Meter Receiver*

## AN 80-METER AMATEUR PHONE AND C. W. TRANSMITTER

*By* G. E. WEST, NU 7ZU

THE 80-meter phone and C. W. set described herewith is both simple and inexpensive. The average amateur can build and adjust it with ease. Many experimenters will find enough parts lying around the radio shack to build the whole set. Besides working well on 80 meters, the set will tune down to 40 or even 20 meters, and by merely inserting a key, it becomes an excellent C. W. code transmitter.

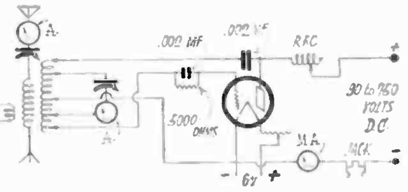


*Fig. 1. Circuit Diagram of 80-Meter Phone Transmitter*

The circuit diagram is shown in Fig. 1. The circuit used is the familiar, loose-coupled Hartley. The picture shows the complete set built up in the convenient "bread board" arrangement. The primary inductance consists of 7¾ turns of ¼ in. edgewise wound copper ribbon, 6 in. in diameter, spaced ¼ in. The secondary inductance consists of 5½ turns of similar ribbon, 4 in. in diameter. The primary is mounted on a hinge so that the coupling may be varied at will. The primary and secondary variable condensers are old Cardwell, 43-plate condensers with every other plate cut out. The alternate plates of the stator are sawed out by the use of a scroll saw. The rotor is disassembled and every other plate removed. In order to keep the spacing of plates equalized, each rotor plate removed is trimmed with a pair of tin snips, leaving only the lug through which the shaft passed. These lugs are used as spacers or washers when reassembling the rotor.

The fixed grid and plate condensers are .002 mfd. 3000-volt units, and are placed near the base of the tube so as to keep the leads short. The grid leak is a standard Radio Corp. 5000-ohm resistor. The radio frequency choke coil consists of 300 turns of No. 28 d.c.c. copper wire wound on a 1 in. cardboard tube. Taps are provided every 75 turns. The best number of turns to use should be determined by experiment, the number changing with the different wave lengths used. Three measuring instruments are provided. The aerial ammeter is an 0-1.5 thermocouple instrument. The tank circuit ammeter is an 0-10 thermocouple instrument, although an 0-5 scale would be more suitable. The plate circuit milliammeter has a scale reading from 0-200 mils. The telephone jack in the plate circuit is arranged so that a key may be inserted for C. W. signalling.

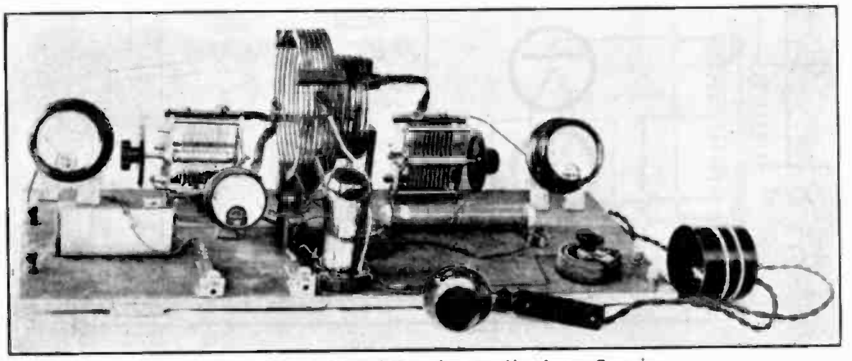
Absorption loop modulation is used because it is the simplest of all systems of modulation and at the same time gives excellent quality for low power sets. The absorption coil consists of two turns of No. 12 d.c.c. copper wire wound on a bakelite tube 3 in. in diameter. The ends of the coil are soldered directly on to the microphone leads. A 4-button Magnavox microphone is used in this set, although satisfactory results may be obtained with any good microphone.

The plate supply should be pure direct current. If rectified alternating current or motor generator supply must be used, then a good filter should be connected in, to smooth out the ripples. Best results will be had from a *B* battery supply. A well filtered motor generator supply is also satisfactory. Any voltage from 90 to 750 may be used, depending upon the type of tube available.

To tune up the set, place the plate clip at one end of the primary inductance and the grid clip near the other end. The filament clip should be between and somewhat nearer to the grid clip. Shunt the tank circuit condenser and ammeter across about six turns, three turns on either side of the filament clip. These settings are shown roughly in the wiring diagram. Light the filament, close the plate circuit and note the reading of the plate meter. With the aerial disconnected, vary the tank circuit condenser and move the clips slightly until the tank circuit ammeter shows the circuit to be oscillating. Continue these adjustments until maximum current is obtained on the desired wave length. The settings which give minimum plate current, consistent with reasonable radio frequency current in the tank circuit, will be best. Now connect in the aerial, adjust the coupling, and tune the aerial condenser until the maximum aerial current is obtained. A coupling of 2 in. or more is desirable, even though the aerial current may fall off somewhat. Slight readjustment of the primary circuit may be helpful.

Now insert the modulation loop and move it in and out until the modulation seems best. An actual test with another amateur fifty or more miles away is the only reliable way to make this adjustment. Mark the tube at the critical position so that it can be removed and replaced at will. Ordinarily the loop should be removed when using code.

The maximum power that can be successfully modulated by the loop absorption method is about 7½ watts, and hence nothing larger than a UX-210 tube should be used. This set is designed for low power and will give excellent results if it is constructed with reasonable care and operated within the limits of its capacity.



*Transmitter at nu 7ZU, for Radiophone Service*

## A 20-METER AMATEUR PHONE

*By* R. WILLIAM TANNER

IN BUILDING a radiophone transmitter to operate on 20 meters, it is necessary to keep in mind that the modulated r.f. output into the antenna circuit must be extremely steady, so that a conventional oscillator circuit such as has been customary at higher wavelengths is not advisable. It has been found preferable to use a low-power battery supplied oscillator, which can be kept constant in frequency, feeding an amplifier of higher power. The modulation system should preferably be the added voltage method, it being the easiest to adjust.

The added voltage system is merely a speech amplifier followed by a power amplifier which feeds the modulated current into a step-up transformer, the secondary of which is in series with the plate supply of the tube or tubes to be modulated. This adds an a.c. voltage (at the frequency of the speech) to the d.c. This system was invented by Heising, but is not to be confused with the constant current method.

The circuit for a constant frequency amateur phone transmitter is shown in Fig. 1. It will be seen that there are five tubes, namely, 201A oscillator, 171 intermediate power amplifier, 210 power amplifier, 201A speech amplifier and a 171 modulator (this is, in reality, an audio power amplifier, but will be termed a modulator to distinguish between it and the S. A.). A 201A battery operated oscillator was desired, but as the output was not high enough to furnish sufficient excitation to the grid of the 210, a 171 stage was placed between the oscillator and the power amplifier.

Small r.f. chokes are connected in the filament leads of the P. A., I. P. A. and oscillator tubes. Each choke consists of two separate layers of No. 18 d.c.c. wire. The bottom layer has 21 turns and the top 20. The winding form is 1 in. in diameter and about 2½ in. long. One layer is connected in each side of the filament supply close to the socket. There are six other chokes of different construction, three in the plate supply to the r.f. tubes and three in the grid leak circuits. These consist of 100 turns of No. 34 s.c.c. wire on a ¼ in. wooden dowel, which has been previously "boiled" in paraffine to exclude all moisture.

This may seem like an unnecessary number of chokes, but it must be remembered that at such a high frequency the r.f. currents like to go anywhere but the right place; therefore, we must post our little guards to keep the unruly r.f. currents in their proper paths.

The oscillator is of the shunt feed Hartley type. This was chosen for no special reason other than the ease of obtaining oscillations. The inductance $L_1$ is 4 turns of No. 14 enamel wire, 2½ in. in diameter tapped in the center for connection to the filament. The tuning condenser has a maximum capacity of .0003 mfd. A blocking condenser of .0025 mfd. is connected between the plate and one end of the inductance. The grid bias is obtained through an r.f. choke and 10,000 ohm resistance. Both plate and filament are supplied from *B* batteries. An 0 to 6v. voltmeter is across the filament close to the socket so that it is possible to keep the voltage constant. The grid condenser has a capacity of .0005 mfd. The plate voltage may be between 90 and 135.

The grid excitation for the first or intermediate power amplifier is obtained by taking the voltage drop across the plate half of the oscillator inductance $L_1$. The plate uses the shunt feed arrangement. A condenser of .0025 mfd. ($C_6$) prevents the short circuiting of the plate supply. The inductance $L_2$ consists of 3 turns of No. 14 enamel wire 2½ in. in diameter, and is tuned by a .00025 mfd. condenser. $R_1$ is a 200-ohm potentiometer, and is used in place of a center tap on the filament transformer. Two condensers of .01 mfd. may be connected from the center of the potentiometer to each side of the filament if desired. Two small *B* batteries, each of 22.5 volts, provides the grid bias, and $C_8$ is a grid blocking condenser of .0005 mfd. This amplifier is neutralized by the Rice method, $C_7$, and the grid half of $L_3$ being the neutralizing circuit.

The main power amplifier differs from the intermediate in that it is series fed and a grid leak of 10,000 ohms provides the grid bias instead of a *C* battery. Inductance $L_1$ is wound with 6 turns of No. 14 enamel, a tap being taken off at the center; the diameter is the same as the other coils. Part of this coil is used in conjunction with $C_3$ for the purpose of neutralizing the plate-grid capacity of the 210 tube, and the other half is used as the plate coil, tuned by a condenser similar to the one in the intermediate amplifier. The r.f. is bypassed across the plate supply by means of a .0025 mfd. condenser. *R* is a 200-ohm potentiometer, the reason for using potentiometers instead of a center tap on the filament winding being to provide a shorter path for the r.f. currents. Sometimes the filament transformer is placed a few feet from the tubes, which might be o.k. for the higher waves, but "not so good" on 20 meters. A milliammeter with a range of 0 to 100 m.a. is used in the plate supply as a help in tuning. Grid excitation is obtained by taking the voltage drop across the intermediate plate coil.

The number of turns in the antenna coil will depend on the size of the antenna and counterpoise, two or three usually being sufficient. The coupling may be fixed at about 1 in. Condenser *C* has a capacity of .0001 mfd., and an 0 to 1 amp. hot wire ammeter is connected in the counterpoise lead; as the antenna current was never over .3 amps, probably an 0 to .5A meter would be more suitable. This meter is not necessary as the plate milliammeter will indicate resonance perfectly. The antenna used with the writers' set was a single wire 18 ft. long, and the counterpoise was also a single wire, but only 14 ft. long. This is not the most efficient type of aerial system, but it worked fairly well.

The modulator and speech amplifier is merely a good audio amplifier. Transformer *T* is of a special construction and is made as follows: the cross section of the core is 1 in. by 1 in. The primary consists of 2000 turns of No. 34 enamel wire, and the secondary has 4500 turns of No. 28 enamel, which gives a turns ratio of 2¼ to 1. If the builder has plenty of time and ambition, he may wind the coils in layers, but the writer didn't have much ambition, as both primary and

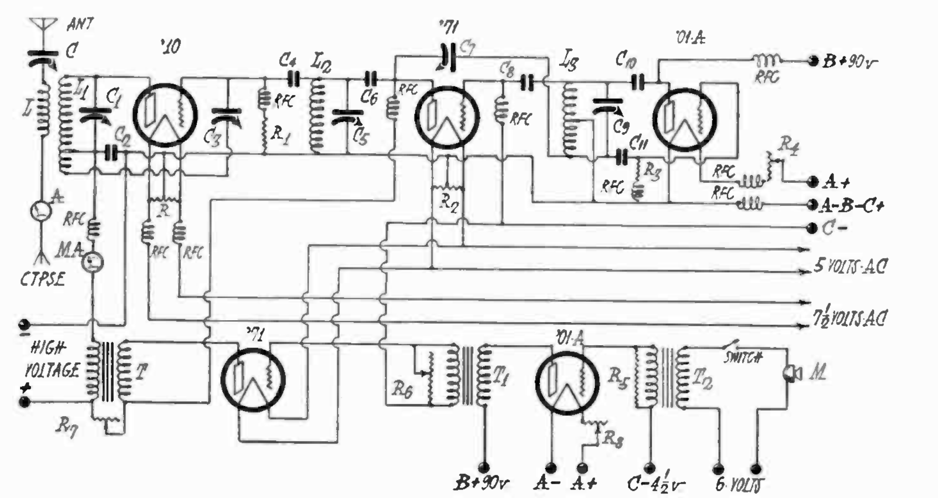


*Fig. 1. Circuit of 20-Meter Radiophone Transmitter*

### LIST OF PARTS

C—.0001 mfd. variable condenser.
L, $L_1$, $L_2$, $L_3$—See text.
$C_1$, $C_5$—.00025 mfd. variable condenser.
$C_2$, $C_6$, $C_{10}$—.0025 mfd. fixed condensers.
$C_3$, $C_7$—.00005 mfd. neutralizing condensers.
R, $R_2$—200 ohm potentiometers.
$R_1$, $R_3$—10,000 ohm grid leaks.
RFC—See text.
$C_4$, $C_8$, $C_{11}$—.0005 mfd. fixed condensers.
$C_9$—.0003 mfd. variable condenser.
$R_4$, $R_8$—20 ohm rheostats.
$R_5$—250,000 ohms.
$R_6$—Volume control 500,000 ohms.
$R_7$—Power Clarostat.
T—See text.
$T_1$—2 to 1 ratio audio transformer.
$T_2$—Modulation transformer.
5 UX sockets.
1 210 tube.
2 201A tube.
2 171 tube.
0 to .5 hot wire ammeter.
0 to 100 MA milliammeter.
0 to 6V d.c. voltmeter.
Core and wire for transformer T.
Western Electric 284W microphone.
Microphone switch.
Baseboard for transmitter.
Transformer, 2 7.5V windings, 1 1100V winding tapped in center.
5 volt filament transformer.
Double choke, 30 henries 120 m.a. each.
3 800-volt 2 mfd. filter condensers.
2 UX sockets.
2 UX 281 rectifier tubes.

secondary were scramble wound, which seemed to work very well. The core should be provided with an air gap to prevent saturation, as both coils carry fairly heavy d.c. currents, between 1/16 in. and 1/8 in. is about right.

$T_1$ is an audio transformer with a 2 to 1 ratio, which gave a very good quality of speech. $T_2$ is a modulation transformer, and a 250,000 ohm resistance $R_5$, of the grid leak type, is connected across the secondary of this transformer. The volume control $R_6$ is a 500,000 ohm variable resistance, and $R_7$ is a power Clarostat to lower the high voltage to about 180 for the plates of the modulator and intermediate amplifier. A W. E. single-button microphone is connected in series with the primary of the modulation transformer, together with a 6-volt battery and switch. The *C* bias voltages are 4.5 and 40.5 for the 201A and 171 respectively, and the same *C* battery is used for the I. P. A. and modulator. It is well to place an 0 to 25 milliammeter next to the plate of the modulator, as this makes it easy to get the correct voltage on the plate. The 171 tube draws 20 mills at 180 volts. This meter has another use, for while speaking into the microphone the reading should not change; if it does, distortion is present and the resistance of the volume control should be lowered until the meter is steady.

The parts for the modulator and speech amplifier should be mounted separate from the transmitter so that the movement of the operator, while varying the resistances, will not change the emitted frequency. Capacity effects at 20 meters are very great, and a good plan is to place the transmitter close to where the antenna and counterpoise enters the house. The audio unit may then be placed on the table next to the receiver at least 4 or 5 ft. from the r.f. units.

When designing the transmitter a small compact power supply was desired as space was at a premium, so the circuit shown in Fig. 2 was used. Two transformers are needed, one with a secondary of 5 volts to light the filaments of the two 171 tubes, and the other with three secondaries to supply the filaments of the 210 and rectifier tubes, and for the high voltage. The latter is wound in two equal sections of 550 volts each. After rectification by means of a pair of '81's, the output voltage is 470 at 100 mills; when drawing only 90 mills the voltage is 485. Two 30-henry chokes are shown, being a double choke of 30 henries each. The filter condensers are of 2 mfd. each and should be able to stand at least 800 volts. The last condenser may well be increased to 4 or 6 mfd. The parts are mounted on a baseboard 10 by 16 by 1 in. thick, which makes a compact and neat appearing power supply.

It is preferable to mount the transmitter in the breadboard fashion until the operator

(Continued on Page 40)

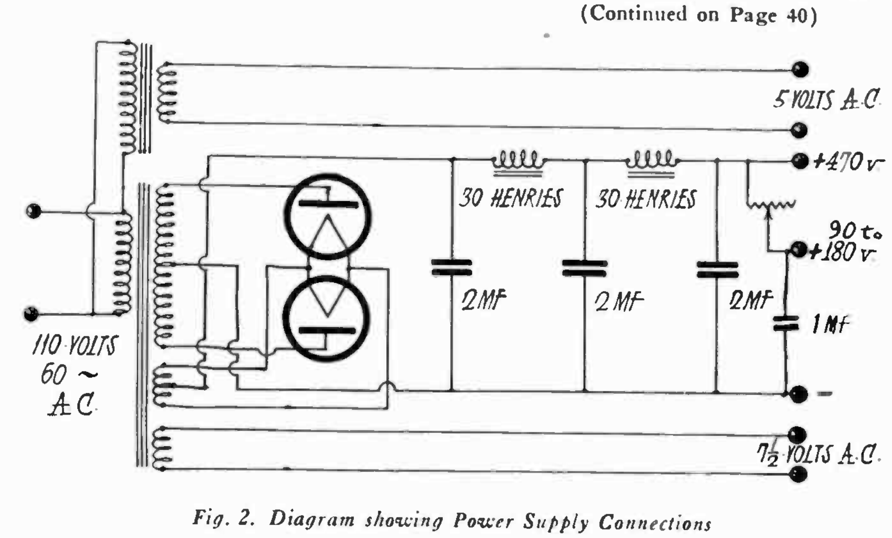
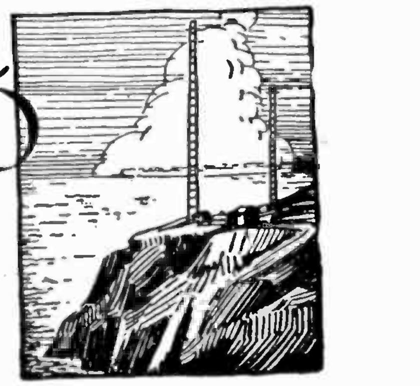


*Fig. 2. Diagram showing Power Supply Connections*

# The COMMERCIAL BRASSPOUNDER

## A Department for the Operator at Sea and Ashore



*Edited by* P. S. LUCAS
R. O. KOCH, *Assistant*

For four months we have been running this department without a single constructional article. Does this mean that none of the gang is doping out any new ideas along this line, or merely that those who are experimenting with improved receivers and transmitter appliances are indisposed to write them up for us? We have half a hunch that the trouble lies in the experimenter's modesty; that you fellows who do use your think-tanks (discriminating expression) become so familiar with the results of your work that you believe it "old stuff" and not worth writing. Well, if it is, we'll not be able to use it, of course, but we have found that in the majority of cases, what is old to 10 per cent of the gang is entirely new to the rest. And certainly that 10 per cent is willing to spare a little space for the benefit of those who can make good use of an idea which is new to them.

New radio frequency circuits, loading systems, coil mountings, short wave rigs, wave meters, are always in order. Mechanical ideas such as relays, switching arrangements, antenna stays, etc., often find a home in some other operator's brain. And you can bet every word will be appreciated by somebody, for this is one sure way of keeping the game alive.

### AWW

No, there is no exclamation mark after that heading. AWW is a call—and a snappy, swinging one at that.

We were attending to some business in Wilmington the other day, and as usual, had set aside an hour or two to cast our eyes over the ships lying there. Passing up the usual coastwise steamers and looking longingly at a couple of old square-riggers and a schooner, we finally decided to argue our way aboard a semi-loaded freighter displaying a Norwegian flag from her poop. She was the M/S *Skramstad*, out of Oslo, Norway, and bound for Yokohama and Kobe, and she signed, as we soon discovered, the radio call "AWW."

Luck was with us on two points. The customs officers had gone to lunch and the op was in the shack. T. W. Christensen was the latter's name; holder of a Norwegian first-class radio operator's license as well as a first officer's ticket; operator and third mate of the M/S *Skramstad*.

We have mentioned in other articles that the Scandinavian countries have been doubling up on these two jobs. It seems that there are no longer any shipping companies that employ an operator for full time services as such, except for the passenger ships, of course, but demand third mates who can handle the radio equipment. This means that men who want third mates' berths must obtain a radio operator's license, stand a watch on the bridge, take care of the radio apparatus and handle what message traffic, weather, time and press the captain desires. A regular watch in the radio shack is out of the question.

Such is the case on the *Skramstad;* and here we find a third mate, who, although it is impossible to spend much time in the shack, is very much interested in his work as a radio operator. That point was evident as soon as we stepped into the room; evident from the shining brasswork and the meticulously clean batteries. Mr. Christensen might well be proud of the condition in which he has kept his radio apparatus.

The transmitting equipment is a 1 kw. Telefunken spark, which, in its unusualness, is interesting to talk about. It was apparently built for compactness, although in this case it covers quite a lot of territory. The quenched gap stands about 6 in. high and measures 3 in. in diameter. It consists of three cylindrical units very similar to the Simpson. The secondary condenser consists of three Leyden jars 3 in. in diameter, mounted upon the bulkhead just above the gap. The O. T. coils are of the pancake type, covering the range from 300 to 800 meters. During the 300 meter days, however, the fundamental of the antenna had to be lowered by the use of a series condenser. This unit is still on the bulkhead, and should be kept there as a curiosity. It consists of two banks of four small Leyden jars, each measuring 1 in. in diameter and 1 ft. in length. The banks are connected in series parallel. An auxiliary transmitter is also carried in accordance with the Norwegian law. This outfit is merely a husky spark coil, operated by a set of Exides, with an auxiliary key. The same oscillatory circuit is used.

The original crystal receiver, which requires as much space as the transmitter, is no longer used. It is a massive thing, as all the old ones were, and differs from the American-made receivers in that instead of being housed in a cabinet it is built on a framework of ½ in. bakelite and mounted like a modern transmitter. Crystal holder, variable condenser, and coils are removable.

Contrasting with this impressive piece of architecture is the diminutive one-tube receiver now in use. This is a Telefunken type E 266 and measures almost 4½ in. square. The Telefunken tube is smaller than a UV 199, and as may well be imagined, is allowed no extra space. As far as results go, the receiver holds its own with the average aboard the American freighters. It is very sensitive, but with a single dial and a coupling arrangement it couldn't very well be expected to be too selective. The most interesting feature of the receiver is the plug-in coil arrangement, which beats everything we have ever yet seen. Each of two coils is enclosed in a small, flat mahogany case and made fast to a pivoting arrangement at the bottom. Four plugs on the base fit into their respective jacks, and the coupling of the two coils is varied by sliding one forward in the style used by the old spider-web arrangements. Coils varying the range of the receiver from 200 to 25,000 meters are available; and if they work as efficiently as they look they are some workers.

Well, the dinner bell finally broke up a pleasant conversation, so we took leave of Opr. Christensen and started for home. Probably in a couple of months the crew of the *Skramstad* will be reading press from 2UO, for Mr. Christensen is very much interested in short waves.

### MEXICAN WEATHER

*By* J. P. DUNHAM, UIZ
(*Fr. S. S. Argyll*)

So many ship operators are at a loss for weather forecasts between San Diego and Balboa, that I am submitting for approval the following:

Mexico City XDA, sends at 10:53 a. m., PST., cq, CZA qsd until 10:55 a. m., PST., and then proceeds with the time tick in the same fashion used in the United States.

With a lapse of about two or three seconds after the time tick, is sent, qst y CZA, followed by the word "Meteorológico" (Meteorological) following with names of districts and the ordinary number code for winds, etc.

Immediately after this, the weather is sent in Spanish, something as follows:

| | |
|---|---|
| PREVISION | |
| GOLFO DE MEXICO | |
| REGION OCCIDENTAL | Vientos moderados sureste |
| REGION SUR | Moderados noroeste |
| COSTA DE YUCATAN | Moderados este |
| PACIFICO | |
| COSTA OCCIDENTAL DE BAJA CALIFORNIA | Moderados del oeste |
| GOLFO DE CALIFORNIA REGION NORTE | Moderados del oeste |
| REGION SUR HASTA EL CABO CORRIENTES | Moderados del suroeste probable turbonada |
| COSTA SUR DEL PACIFICO | Algo Fuertes norte rolando al sur |
| GOLFO DE TEHUANTEPEC | Moderados este mal tiempo |

Translated, this would read:

| | |
|---|---|
| FORECAST | |
| GULF OF MEXICO | |
| REGION WEST | Moderate southeast winds |
| REGION SOUTH | Moderate northwest |
| COAST OF YUCATAN | Moderate east |
| PACIFIC | |
| WEST COAST OF LOWER CALIFORNIA | Moderate west |
| GULF OF CALIFORNIA REGION NORTH | Moderate west |
| REGION SOUTH TO CAPE CORRIENTES | Moderate southwest probably squall |
| SOUTH COAST OF THE PACIFIC | Somewhat strong north changing to the south |
| GULF OF TEHUANTEPEC | Moderate east bad weather |

Of course, the weather specifications are changed, but will give an idea as to the system used. You will note that the word "Vientos" does not appear in all the forecasts, sometimes it is omitted altogether and again it appears in each one. The word "Occidental" is occasionally abbreviated as "Occ."

Below, is the translation of the words most used in the forecast:

| | |
|---|---|
| AL | To the |
| ALGO | Somewhat |
| BAJA | Lower |
| CABO | Cape |
| COSTA | Coast |
| DE | Of |
| DEBILES | Weak |
| DEL | To the (of the) |
| ESTE | East |
| FUERTES | Strong |
| GOLFO | Gulf |
| HASTA | Until (to) |
| LLUVIAS | Rain |
| MODERADOS | Moderate |
| MEJORANDO | Better (ing) |
| NORTE | North |
| NORDESTE | Northeast |
| NOROESTE | Northwest |
| OBSCURO (or Nublado) | Cloudy |
| OCCIDENTAL | Occidental (or west) |
| OESTE | West |
| PREVISION | Forecast |
| PROBABLE | Probably |
| REGION | Region (portion) |
| ROLANDO | Changing |
| SUR | South |
| SURESTE | Southeast |
| SUROESTE | Southwest |
| TIEMPO | Weather |
| TURBONADA | Squall |

Following wx from XDA, the coast stations in Mexico, beginning with XAG, XAF, thence down the coast to Salina Cruz, all repeat the weather in Spanish with the exception of XAN, Salina Cruz, who is good enough to give it in English, repeating each word twice during the summer months.

However, if any of the fellows should not be able to get any of these stations, I will be very glad, while in Mexican waters, to have them call me—UIZ—and will repeat in English or Spanish.

A few more words about getting qso with the Mexican stations.

I have just been told by the operator at Santa Rosalia, XAG, that they, XAG, are now working on 2100 meters, spark, and that XAF, La Paz, is working in 1100 meters cw. and is practically receiving all morning from other Mexican stations on either that wave or short wave up to the time of broadcasting the weather, which is done, the last time I heard, on 600 meters spark.

All of the Mexican stations, after broadcasting the weather, cq for traffic and listen on 600 meters. However, let me warn those with messages for these stations, be sure and get qso immediately after they cq. If they don't, they might just as well file it until the next day when they cq again. I can appreciate that from experience! ! !

I wonder how many of the operators, traveling the Pacific Coast, have now noticed the lack of qrm from the said Mexican stations? Things are certainly peaceful along the Wabash.

## LETTERS TO THE EDITOR

Sir: Here is a whole-hearted outburst of appreciation of RADIO and its Brasspounder section—there is nothing like it for the seagoing operator.

As a suggestion, I believe quite a number of the gang would like a description of station 2UO. What a relief it is to copy his press after struggling with alleged "news" spewed forth by some of the dot factories.

Your declaration of war against LV QRM'ers is something needed for a long time. The more embarrassment you can cause those birds the better. Hope to have my call on the roll if caught jamming, and will certainly write up any QRM'ers I hear from now on.

June 19, 1928.

73s,
QT KDML

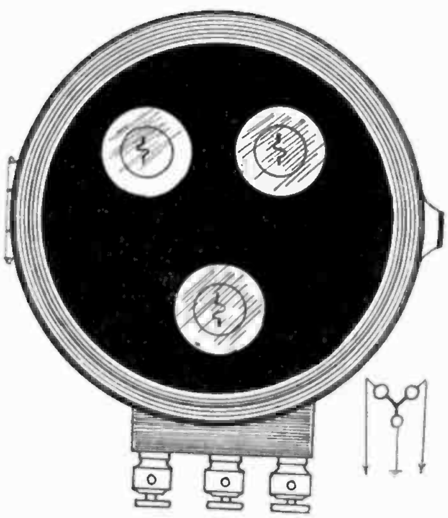
Thanx, OM. Now, how about somebody writing up 2UO. It's a long way from California, you know. Don't let Bill do it; do it yourself.

—Dep't. Ed.

## GROUND INDICATOR

*By* JACK BRONT

Especially on the older ships, swinging grounds are a source of so much trouble that they are generally referred to in terms not used in the most polite society. These grounds have the diabolical ability to immediately disappear once a determined search is instigated to locate and destroy them, but bob up again at the most critical moments. The mere mention of a "swinger" is enough



*Ground Indicator*

to throw the old-time telephone or telegraph testman into a mild epileptic fit.

After relentlessly pursuing swingers for weeks at a time and discovering their complete disappearance once the hunt was initiated, the writer requisitioned a discarded brass clock case and, using bulbs originally intended for the gyro compass, built the instrument shown in the illustration. The unit is very compact on account of the small size of the bulbs used—these not being much larger than auto headlight globes.

In star connection they were placed on a bakelite panel within the brass case, the glass front of which was obscured with jet black enamel except for circular spaces immediately before the individual bulbs. Of course the hinged cover of the case may be opened for inspection of the interior.

This mechanical Sherlock may be connected to any 110-volt line and the swinger or any steady ground located by elimination. It may be constructed in half an hour and sometimes saves hours and days of search. Left attached to any suspected line, the current consumption is small. Mounted on the bulkhead it is out of the way, but always ready for use.

## AN EVENTFUL VOYAGE OF THE TRAWLER "OCEAN"

*By* G. W. TRUDEAU, Ex-S/T "OCEAN"

Two p. m. Thursday, November 13, and the air is rent by a deafening whistle just outside the office of the Bay State Fishing Co. at their dock at East Boston, Mass. Recognizing it as the signal informing any of the crew of the fishing trawler *Ocean* who are ashore, that she is ready to sail, I reluctantly arose from the comfortable chair where I had been parked for the last hour meditating upon such unpleasant things as ships that sail thirty-six hours after arriving, and a sea-going op's life in general, and gathering up my books, papers, etc., for reading and study during the coming trip to the fishing grounds, I went aboard. Soon the *Ocean* was steaming down Boston Harbor, beginning what proved to be the most interesting trip of the eight months I had been sailing on her.

To give a general idea of what kind of vessels these fishing trawlers are: The *Ocean* has a 22½-foot beam, is 137 feet long, and her net tonnage is 91 tons. She has a low house running over the after three-fourths of the deck, atop of the forward end of which is the miniature pilot house overlooking the expanse of deck where the fish are dropped from the net, there to be cleaned and packed in ice below. The galley, which is also the mess room, is located aft down within the hull; over it runs the after part of the house, consisting of the engineer's quarters and the radio shack and operator's quarters combined. Altogether she hasn't a prepossessing appearance inside or out, and is far from the expectations of the new operator just out of school.

However, to go on with my story: Passing to the westward of the regular fishing grounds, Georges Banks, where the trawlers usually go, we began fishing Friday forenoon off Nantucket Lightship, where fish had been reported, and the following two days were uneventful.

The fishing was fair, each haul of the huge net showing about a ton of haddock, which is the principal kind caught, and small quantities of other kinds. The writer kept fairly busy despite the popular supposition that radio ops never work, for there is really more traffic handled on these trawlers than on most freighters, due to the fact that each boat must keep in touch with the other twelve radio-equipped boats of this company, copying, and reporting to the captain all messages that each boat sends or receives. So with keeping track of myself, and ten or twelve others eight hours per day, the time was not slow in passing.

However, Sunday night things began to move more rapidly. In fact everything that was not tied down moved more or less, mostly more, for a nor'wester set in, and while there undoubtedly have been worse storms, this one was no mere squall by any means. The advantage of my rather small quarters now became apparent; it was possible to grasp something solid on all sides, and therefore save myself from being thrown around very much. About midnight it became too rough for further fishing, and we began to jog, as heading into the wind with just enough speed to maintain headway is termed, and continued jogging throughout the night, and the next day.

During this period it was a case of sit tight and hold on, as the trawlers become rather lively in a storm and the deck is no place for anyone desirous of staying dry. Ye op was so inclined, but Monday morning had to go out atop the house to fasten a loosened guy wire in order to get off the

(Continued on Page 42)

# Inside Stories of Factory Built Receivers

## I. The Gilfillan Neutrodyne

The design and construction of the Gilfillan a.c. Neutrodyne are based upon a thorough laboratory study of the frequency characteristics of the several component parts and of the final assembly. Thus it is possible to produce a receiver which gives uniform amplification of all tones between 50 and 5000 cycles. A brief description of the methods employed by W. W. Lindsay, Jr., chief engineer Gilfillan Bros., Inc., appears at the end of this story.

As a result of these tests, the new Gilfillan line comprises two models of chassis, each of which is housed in various types of cabinets. The chassis for Model 33 is shown in Fig. 1 and its circuit diagram in Fig. 2. It employs three stages of r.f. amplification, detector and two stages of audio. It uses '26 type of a.c. tubes in all stages except the detector, which is a '27 heater, and the second audio, which is push-pull with two '12A tubes. The power plant with its '80 rectifier tube is an integral part of the chassis. The circuit diagram shows the provision that has been made for exciting a dynamic speaker field and for a phonograph pick-up input jack.

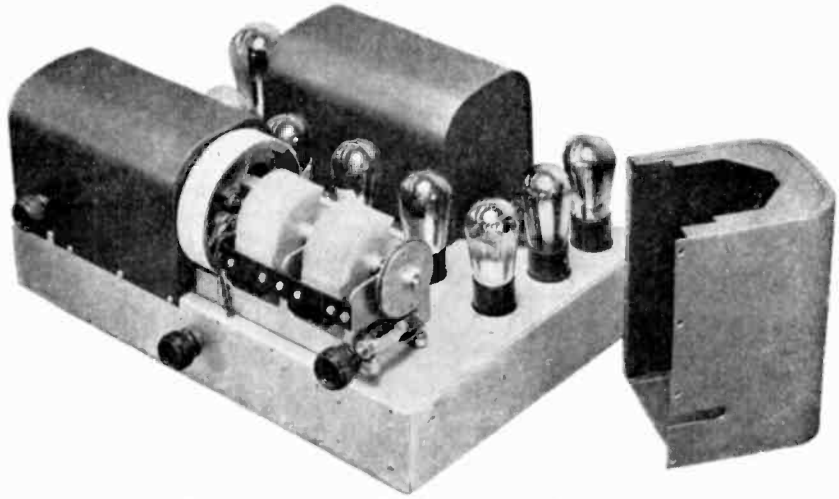


*Fig. 3. Chassis of Model 66 Gilfillan Neutrodyne*

It will be noted that the antenna input circuit employs a volume control and an input coil designed to give a rising voltage to the grid of the first r.f. tube with decrease in tuning frequency. This tends to compensate for the droop at the lower frequencies in the following stages and results in uniform sensitivity throughout the broadcast band.

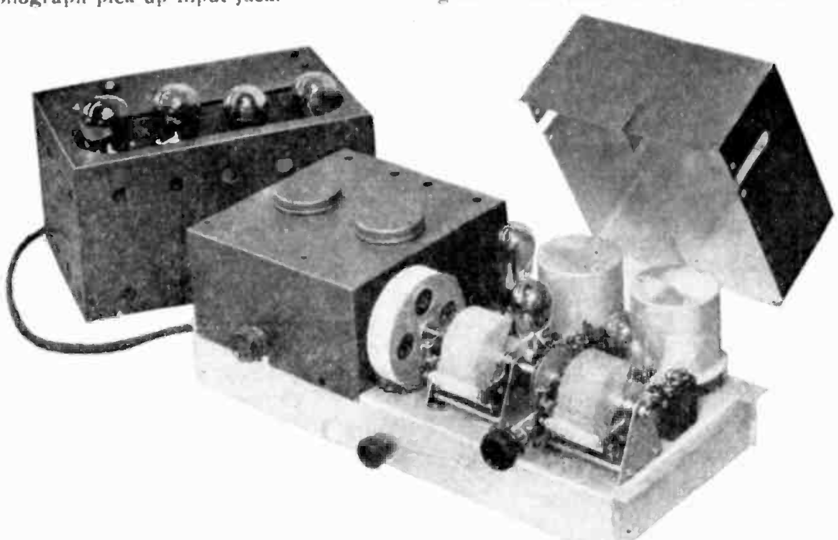


*Fig. 1. Chassis for Model 33 Gilfillan Neutrodyne*

Fig. 3 shows the chassis for the Model 66 and Fig. 4 is its circuit diagram. This has four stages of tuned r.f. and uses '10 power tubes in the last push-pull audio stage. This allows greater selectivity and sensitivity as well as greater volume, the distortionless output being five times greater than that of the Model 33, which is 700 milli-watts. The power plant and audio amplifier is contained in a separate unit. Otherwise the two models have the same features of worm-drive tuning, antenna compensation, and high and low a.c. line voltage control.

Fig. 5 shows the schematic arrangement of master-oscillator power-amplifier type of transmitter used in testing the receiver. This transmitter is modulated at various pure audio frequencies between 30 and 6000 cycles and a portion of the resulting modulated carrier is fed into an attenuation network and phantom antenna and thence to the receiver under test. Another portion of this carrier is fed into a percentage modulation meter

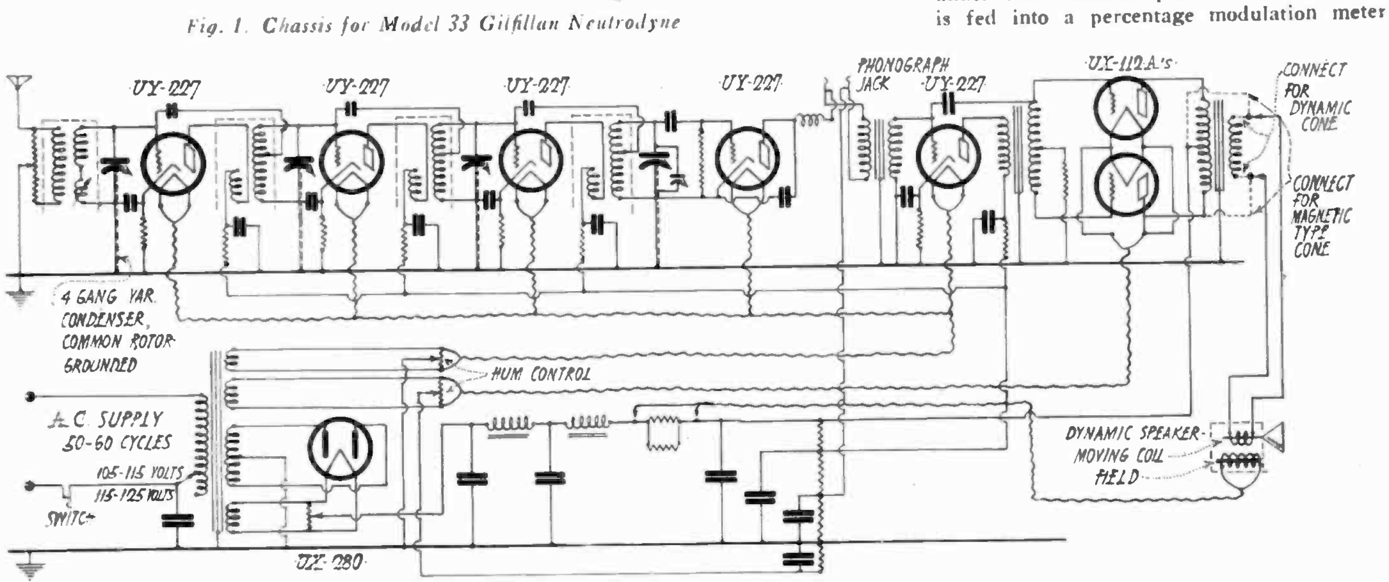



*Fig. 2. Circuit Diagram of Model 33 Gilfillan Neutrodyne*

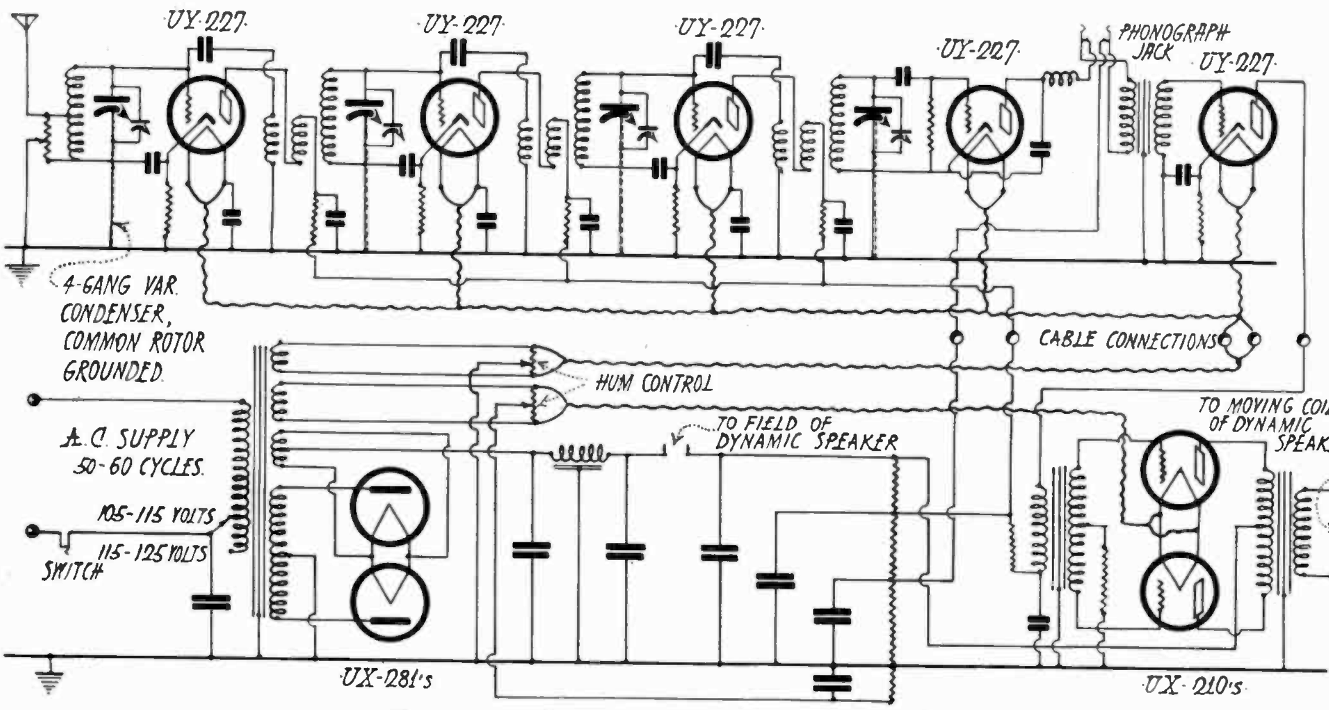



*Fig. 4. Circuit Diagram of Model 66 Gilfillan Neutrodyne*

calibrated over the range of audio frequencies to be used.

At the output terminals of the receiver an equivalent loud-speaker load and measuring meter is used. By noting the deflections corresponding to various tone frequencies applied to the transmitter with constant percentage modulation it is possible to determine the variation in fidelity of the entire receiver. This, of course, includes the suppression of the higher audio frequencies caused by the sharpness of the tuned radio frequency circuits as well as the discrimination against these higher frequencies by the detector grid leak-condenser combination.

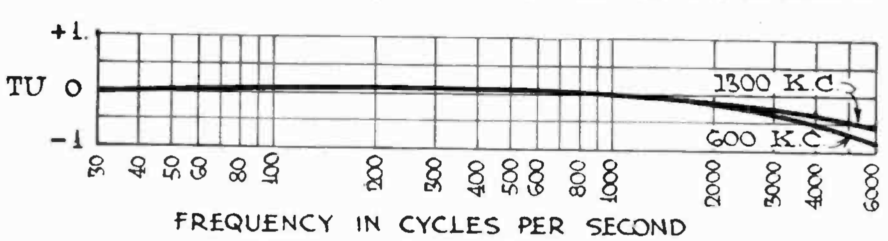



*Fig. 6. Over-all Audio Characteristics*

Measurements are, of course, made at various radio frequencies to determine any variation in quality at the extremes of the tuning range of the receiver. Other measurements include the sound pressure output of the loud speaker in its cabinet as well as the percentage of harmonics present.

The over-all audio characteristic of such a transmitter and associated input equipment is shown in Fig. 6. The reduction of the higher audio frequencies is apparent and allowance is, of course, made for this fact.

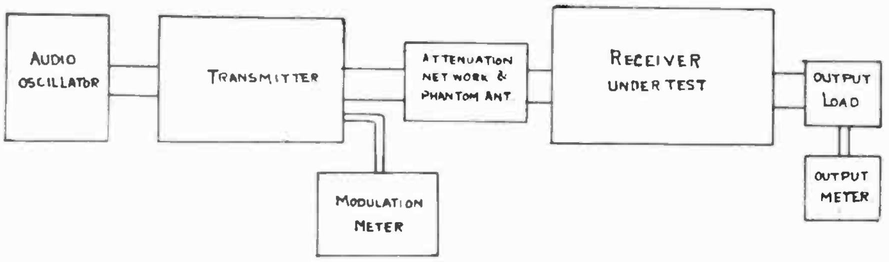



*Fig. 5. Schematic Arrangement of Testing Equipment*

## A 20-METER AMATEUR PHONE

(Continued from Page 36)

is familiar with the function of each part, after which it can be mounted in a better manner. The power supply and modulator-speech amplifier may be made permanent in the beginning as there are no critical adjustments here. In wiring the audio unit keep the transformers well spaced and shorten the grid and plate leads from the sockets to the transformers as much as possible, for unless this is done howling may result. The resistance $R_5$ helps greatly in preventing this and may be reduced to 100,000 ohms if the howling persists. It may also be necessary to connect a 1 mfd. condenser from the *B* positive terminal of transformer *T* to the center of $R_2$. When the *C* batteries get old the internal resistances increase sometimes, causing a howl, so that 1 mfd. condenser across these batteries will eliminate the trouble. Mount the oscillator and r.f. amplifiers on a 24 by 10 in. baseboard ¾ in. thick, and keep the different units well spaced to prevent feedback. No details will be given for the layout of these parts as some amateurs prefer certain makes of condensers, meters, sockets, etc., while others prefer other makes. Amateurs are notorious for not building according to the "blueprints," so it is sufficient to say to keep all inductances at right angles and well separated. Do likewise with the r.f. chokes.

When all of the parts are mounted and wired, procure four rubber bath sponges and glue one to each corner of the baseboard, and make all connections with flexible wire. Vibration of a 20-meter transmitter has a tendency to sound like an unfiltered plate supply, and the rubber sponges and flexible connections will eliminate the difficulty.

In making the initial adjustments the audio unit may be left out of circuit entirely. Connect all leads except the positive of the high voltage going to the power amplifiers, and place the hot wire ammeter in series with the tuning condenser $C_5$. Set the oscillator by means of a wavemeter or calibrated receiver, somewhere between 20.68 and 21.4 meters, as this is the band where phone is allowed. Now vary $C_5$ until a reading shows on the meter. If meter remains at zero it is possible that $C_7$ is set correctly, but if a reading is obtained vary $C_7$ until it remains at zero at any setting of $C_5$, which proves that the grid-plate capacity of the tube is neutralized. Now place the meter in series with $C_1$ and go through the same procedure. For this operation the 180 volts must be connected to the plate of the I. P. A. tube and $L_2$, $C_5$ tuned to the same wave as the oscillator. After this is done replace meter in the antenna circuit and connect *B* positive to the P. A. Tune $C$, $C_1$ and $C_5$ for highest antenna current. Now connect in the modulator and speech amplifier. When speaking into the microphone both the plate current on the 210 tube and the antenna current should increase slightly.

Modulation by added voltage and constant current was tried at first on the 171 I. P. A. but did not work well, sometimes making the oscillator unstable, due, perhaps, to the tube not being completely neutralized. The writer hopes to soon hear a large number of amateur phones on 20 meters. It is surely great sport to be able to talk across the continent in the daytime on low power.

# Radio Kit Reviews

## THE REMLER 29

THE Remler 29 is a 115 kilocycle superheterodyne using eight tubes. Four of these, those in the one radio frequency stage and three intermediate frequency stages, are of the shield grid type. Four of them, those in the oscillator, first and second detector, and first audio stage, are of the '01A type. It is ultra-sensitive, has 10 kilocycle selectivity, and fine tone quality. It has two tuning controls, a volume control and a control for sensitiveness and selectivity. It uses an aerial. A separate kit provides a second stage of audio and a power amplifier and plate current supply if needed.

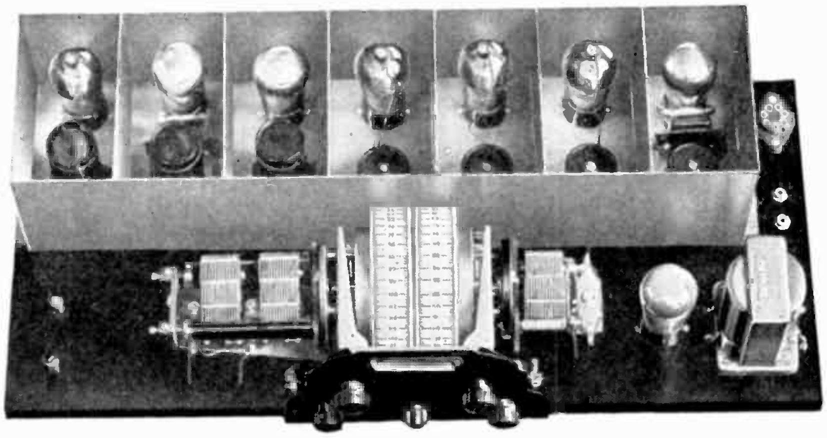
The kit is designed for easy assembly from several units. These consist of the No. 752 foundation kit, the No. 712 shield-grid selector and amplifier unit, drum dials and tuning condensers, variable resistors, first stage audio transformer, and battery cable and connections.

The foundation kit includes a pressed steel base and panel which are drilled and a bronze control panel. All necessary small parts, such as fixed and compensating condensers, jacks, binding posts, knobs, washers, bolts, nuts and screws, as well as a full-size blue print, are furnished in this kit.

The selector and amplifier kit is a single copper case completely wired at the factory with the r.f. and i.f. transformers and tube sockets, the oscillator circuit, and the two detectors. Each individual circuit, in turn, is fully shielded. The necessary coded wire for sub-base connections is included with this kit.

A shield-grid tube is used in the first r.f. stage because it gives a stability to the circuit which no regenerative tube would give. It is used solely to add selectivity, as ample gain is secured in the three i.f. stages. Regeneration is introduced into the first detector circuit by inductively coupling the tube's plate and grid circuits by means of a third winding in the r.f. transformer, which is shunted by a 2000-ohm variable resistor so as to control the amount of regeneration. Maximum regeneration is used only for reception of distant stations.

Further selectivity is secured in the three i.f. stages by keeping the gain per stage relatively low, though it is far greater than could be obtained from an amplifier using '01A tubes instead of the '22 tubes here employed. This amplifier is operated well below the point of oscillation so as not to cut the side bands.



*New Remler "29" 115 K.C. Super*

Both detectors are of the grid-leak, grid-condenser type with '01A tubes. This type of tube may also be used in the first audio stage, although a '12A tube gives a somewhat better relation between the impedances of the tube plate and the primary of the second audio transformer. The first audio is either a Remler 900 or 920 transformer, depending upon the power amplifier.

**PARTS REQUIRED FOR THE REMLER 29 SHIELD-GRID SUPERHETERODYNE**

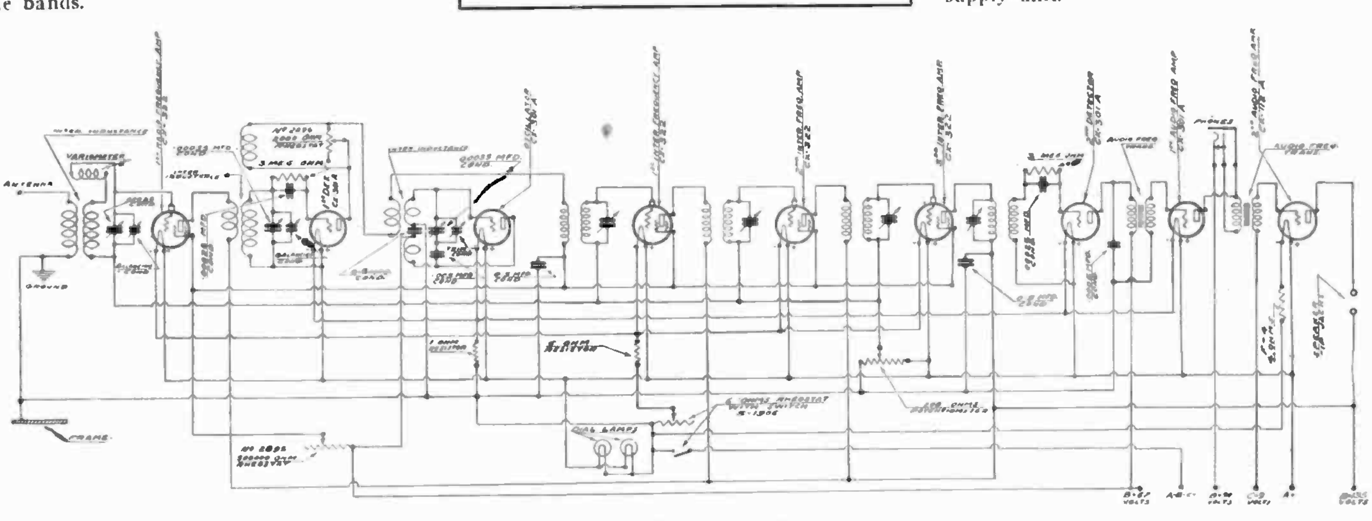
- 1 REMLER No. 712 Shield-Grid Selector and Amplifier. (All wire necessary for the complete receiver is included with this unit.)
- 1 REMLER No. 752 Foundation Kit Incorporating:
  - 1 Pressed Steel Base
  - 1 Pressed Steel Instrument Panel
  - 1 Bronze Escutcheon Plate
  - All necessary fixed and compensating condensers, cord-tip jacks, binding posts, bakelite knobs, insulating washers, bolts, nuts and screws.
- 2 REMLER No. 110 Universal Drum Dials
- 1 REMLER Type 632 Two-in-Line Condenser
- 1 REMLER Type 638 Twin-Rotor Condenser
- 1 FROST No. 1895 500,000-ohm Variable Resistor (Volume Control)
- 1 FROST No. 1896 2000-ohm Variable Resistor (Sensitivity Control)
- 1 FROST No. S-1910 10-ohm Rheostat and Switch
- 1 FROST No. 782 Battery Cable Plug Socket
- 1 FROST No. 780 Battery Cable and Connector
- 1 REMLER No. 900 or 920 First-Stage Audio Transformer

A panel rheostat with a limiting resistance in series controls the filament current to the shield-grid tubes. Filament control of the other tubes is automatic. The total filament drain is 1.6 amps. at 6 volts, from either a storage battery or *A* eliminator.

The r.f. and first detector circuits are tuned with a Remler 632 two-in-line condenser provided with adjustable balancing condensers to compensate for circuit capacity differences. The oscillator circuit is tuned by a Remler 638 twin-rotor condenser. Both condensers are controlled by illuminated drum dials and cover the broadcast band from 200 to 550 meters.

The antenna compensator is a small variometer whose rotor is mounted inside the secondary form of the antenna coupler. It is connected in series with the antenna coupler secondary and is included in the tuned circuit controlled by the first section of the two-in-line condenser. It allows equalization of the inductances of the two tuned circuits and is adjusted once and for all when the receiver is installed.

The plate voltages required are 67½, 90 and 135, the maximum plate current drain being 24 m.a., including one stage of audio with '12A tube. This can be secured either from dry batteries or from an a.c. power supply unit.



*Circuit Diagram of Remler "29" 115 K.C. Super*

This latest development of the superheterodyne circuit is exceedingly simple to operate and surprisingly low in cost. It gives clean-cut separation of stations in adjacent channels and has but one oscillator dial setting for each station, due to the 115 kilocycle intermediate frequency. With the recommended power amplifier for the second stage it gives the utmost fidelity of sound reproduction at great volume. The entire receiver can easily be assembled and wired in a few hours and can be housed in any cabinet designed for a 7 by 25-inch panel and 11 by 25-inch base.

## AN EVENTFUL VOYAGE OF THE TRAWLER "OCEAN"

(Continued from Page 38)

daily message to Boston, accomplishing it without getting very wet, despite the fifty-mile gale and downfall of sleet. Other trawler operators also had their individual mishaps, for I remember overhearing one chap remark that his tuner had come loose during the night, and that he tried to sleep and hold it in place at the same time. Another op told of finding the amplifier box on the floor upon arising. Fortunately, commercial apparatus is built to withstand such hard knocks as those.

The first incident of the trip occurred Sunday afternoon while we were still jogging. A heavy sea struck our rudder, and turning it quickly, also violently spun the wheel in the pilothouse. The helmsman, caught off his guard, was thrown over the wheel, and bruised so badly that he was forced to stay in his bunk the remainder of the voyage.

The sea and wind had both abated considerably by daylight, Tuesday, and we resumed fishing at that time. At 8:30 a. m. a motorboat was sighted, drifting with something flying from her short mast.

Completing the tow upon which we were engaged, the net was hauled aboard, and we steamed toward the motorboat. As we came alongside two badly frightened fishermen indicated that they wished to be taken off, whereupon our captain asked if they also wished us to endeavor to save their boat, and the reply was: "To Hell with the boat, save us!" And they fairly tumbled on board the *Ocean* in their eagerness to reach safety.

So completely unnerved were they by their recent experience that it was some time before we could obtain the details of their perilous trip, but finally, after being warmed and fed, they talked. They told of how the motor had been disabled by salt water getting into and short circuiting the ignition system late Sunday afternoon as they were trying to reach shelter from the storm; then of tossing wildly, a plaything of the wind and waves, for thirty-six hours; of drifting helplessly a distance of over eighty miles, seeing the shore lights pass, one after another, expecting any moment that their forty-foot vessel would be swamped or driven onto the rocks; and finally, of passing Nantucket Lightship during the night, and knowing that from then on the wind would carry them directly out to sea. Truly an unenviable experience.

A few hours after picking up the two men we received orders to proceed to Boston with our catch for Thursday's market, and shortly afterward I heard a broadcast from another ship which gave the position of an abandoned two-masted schooner, the *Rebecca D. Whilldin*, with a cargo of lumber. Realizing, from the position given, that she was near the course we would travel on the way to Boston, I gave the information to the captain, who was quite interested, and requested me to watch for further reports. I kept pretty close to the set for the rest of the day, but heard nothing more of the schooner until early evening, when a broadcast from the steamship *Beacon Oil* told of passing her, and gave her position at the time.

A little more excitement was furnished shortly after midnight when the steamship *West Inskip* was reported in distress, but after sitting up until 3 a. m. Wednesday, and nothing having developed, I turned in for a couple of hours sleep.

The wind had decreased steadily during the previous day, and Wednesday dawned bright and clear; one of those days after a storm that more than compensate us for the past discomfort. Starting early for home we took a course that would bring us near to where the schooner was last reported. By this time everyone aboard was cognizant of the schooner's plight, and the magic word of the sea, salvage, was heard frequently. Nothing occurred all morning, which seemed slow in passing, but at noon, the mate, who was on watch, reported a two-masted vessel just discernible ahead. This caused a rush to the deck, followed by an anxious hour until we were close enough to perceive that it was in fact the *Rebecca D.*

She lay, deserted and rather forlorn looking, with bow low in the water, one sail half lowered and flapping in the gentle breeze as she slowly rolled with the motion of the sea. Her deck load of lumber, gleaming dully in the sun, was piled high above her rail, overtopping our own rail by several feet.

Soon we were alongside and then followed a scene which might have been drawn from a novel of freebooters in the days of the Spanish Main; some twenty-odd men in all varieties and manner of dress scrambled over the rail and onto the deck of the *Rebecca*, recalling for a fleeting instant vivid word pictures read in pirate tales when a boy.

After thoroughly inspecting the vessel from stem to stern, finding a foot of water in her cabin, where chaos reigned, furniture, clothing, food, and what not being strewn around due to the heavy buffeting she had received, the sail was lowered and our crew fell to work making ready and fastening the towing lines. Both anchors had been dropped, evidently in an attempt to hold the vessel during the storm, but had failed and were now hanging loose, the depth of water being too great for them to touch bottom. The donkey engine for raising them was out of commission, making it necessary to cut the chains, but at last, about 2 p. m., the lines made fast and all in readiness, we began the thirty-hour tow into Boston.

Fortunately the wind continued moderate, and we accomplished the remainder of the trip without incident, arriving at our starting point in East Boston at 6 p. m., Thursday; having failed to make the market for that day because of our salvaging activities, but with everyone happy in the knowledge of an extra night at home.

The following spring, in March, a check was received for my share of the salvage money. A perfectly good check 'twas, too, but the amount it was drawn for read "Seven dollars and sixty-nine cents." Hi!

*Remler Power Amplifier and B Supply for 350 Tubes and Dynamic Speaker*

The Remler power amplifier is built for a '50 tube and uses two '81 half-wave rectifiers and one '74 voltage regulator. It will supply filament current and plate voltages for the rectifier and power tubes as well as plate and grid bias voltages for the Remler 29 receiver. It includes a Remler No. 921 second stage audio transformer, No. 923 output impedance-compensating transformer, and No. 950 power transformer and choke.

**PARTS REQUIRED FOR THE REMLER POWER AMPLIFIER**

- 1 REMLER No. 952 Power Amplifier Foundation Kit, incorporating:
  - 1 Pressed Steel Base
  - 4 REMLER No. 50 Sockets
  - 2 Frost No. FT 64 20-ohm Center-Tapped Resistors
  - 1 Set of Blueprints and Instructions. Necessary bolts, nuts, screws, lugs, terminals, and wire.
  - 1 No. 1832 Frost Potentiometer 200-ohm
- 1 REMLER No. 950 Power Transformer and Choke
- 1 REMLER No. 921 Second-Stage Audio Transformer
- 1 REMLER No. 923 Output Impedance-Compensating Transformer
- 1 FROST No. 300 Universal Resistance Kit
- 3 FROST No. 1405 2 mfd. Heavy Duty Filter Condensers
- 2 FROST No. 1104 1 mfd. By-Pass Condensers

These with the necessary sockets may be assembled on a No. 952 foundation kit to give a compact unit which can be mounted in a console cabinet with the receiver or encased in a No. 954 cover. This outfit is intended for use with a dynamic cone speaker and calls for a Remler 920 transformer in the first stage. If a smaller power tube is to be used without a power amplifier a first stage No. 900 and second stage No. 901 with a No. 922 output transformer can be built as an integral part of the complete receiver.

## FLYING RADIO

(Continued from Page 19)

land communicating with the ship, as we want an arrangement whereby the ship can communicate with land stations. In other words, it would be of little advantage to call the pilot of an airplane, except upon rare occasions; on the other hand, there would be a decided advantage in having an airplane send out its "call letters" at regular intervals, as these could be picked up by land stations and would indicate unmistakably that the ship was still on the wing.

It is possible to build a small, simple, self-acting transmitter deriving its power from a wind-driven dynamo, having for a part of its mechanism a rotating metal disc, also geared to the windwheel, upon the edge of which are contact pieces corresponding to the ship's call letters. While the plane is in motion this arrangement will send out its call in the wireless code with every revolution of the disc. In the event the signals stopped it would be taken for granted the flyer was down. His position could then be estimated from the length of time he had been out, the speed of his ship and the direction in which he was known to have been flying. Land stations could communicate either directly or by relaying with ships in the vicinity of the airplane in the hope of effecting a rescue.

Such a set would in no way interfere with the pilot, the weight would be almost nothing and the space it occupied would be negligible. If the construction were sturdy and the instrument rigidly attached to the plane in such a manner as to avoid straining and twisting, the set should require no attention whatever and should prove absolutely reliable. What the transmitter lacked in power would be compensated for by the use of sensitive receiving apparatus at the land station where a few tubes and batteries more or less would not bring about the problem encountered in the flying ship.

This arrangement practically amounts to a reversal of the idea involved in the radio beacon. For here the pilot, instead of listening to the beacon signals and trying to keep his ship riding down the crest of the "beam," so to say, sends out his own signals, automatically of course, and the stations on land do the listening, following his progress through the sky. Neither system, however, need interfere with the use of the other, should an aviator desire to take advantage of both simultaneously.

For the plane carrying more than one person the above arrangement should be modified somewhat. Imagine a set wherein the same coils, condensers, tubes and batteries (or wind dynamo) are used for both transmitting and receiving. Here would be two-way communition at a minimum of expense, space, weight and apparatus. By re-arranging

(Continued on Page 48)

**SEE IT AT THE SAN FRANCISCO AND LOS ANGELES RADIO SHOWS**

*New Model*

JENSEN DYNAMIC SPEAKERS

| | | |
|---|---|---|
| D-4 | Jensen Dynamic Speaker Unit for 6 volt Operation | $40.00 |
| D-5 | Jensen Dynamic Speaker Unit for 90 to 180 D. C. volt Operation | 43.00 |
| D-4AC | Jensen Dynamic Speaker Unit for 110 volt A. C. Operation | 55.00 |
| D-64 | Jensen Model 6 Cabinet with D-4 Dynamic Speaker Unit | 55.00 |
| D-65 | Jensen Model 6 Cabinet with D-5 Dynamic Speaker Unit | 58.00 |
| D-64AC | Jensen Model 6 Cabinet with D-4AC Dynamic Speaker Unit | 70.00 |
| D-74 | Jensen Model 7 Console with D-4 Dynamic Speaker Unit | 75.00 |
| D-75 | Jensen Model 7 Console with D-5 Dynamic Speaker Unit | 78.00 |
| D-74AC | Jensen Model 7 Console with D-4AC Dynamic Speaker Unit | 90.00 |

# New Cabinets of Extraordinary Beauty

A YEAR ago the Jensen Dynamic Speaker inaugurated a new era of radio reproduction. Today the market is flooded with quickly designed and hastily assembled dynamic speakers, but Jensen holds undisputed leadership. No single event in the radio industry holds such significance as Peter L. Jensen's development of the dynamic speaker and we predict that no other manufacturer will be able to duplicate such established supremacy without years of research and manufacturing experience in the dynamic speaker field.

The new Jensen models recently announced introduce an entirely new vogue of cabinet design. A new perfection of beauty has been attained surpassing all previous standards of radio furniture design. These new models are equipped with a small toggle switch instead of a clumsy feed-through switch, and the cords are silk covered to match the cabinet finish. These and all the other distinctive Jensen qualities and exclusive features are possible because Jensen Dynamic Speakers are built to a quality standard with price a secondary consideration. Volume production and manufacturing experience account for their moderate cost.

When you visit the Jensen Exhibits at the leading Radio Shows, you will appreciate the extra value—at no extra cost—which is inbuilt in every cabinet. We believe you will agree to our claim, "The Jensen Dynamic Speaker, the Finest in Radio."

## Jensen Radio Mfg. Co.

212 Ninth Street
OAKLAND

338 North Kedzie Avenue
CHICAGO

Jensen Dynamic Speakers are made in types to operate with 110 volt A.C. house current, 6 volt storage battery, "A" eliminator or trickle charger, 110 volt D.C. house current and 90 to 180 volt D.C. current as provided by many of the late model radio sets. The sensitivity of the instruments is the same in any case.

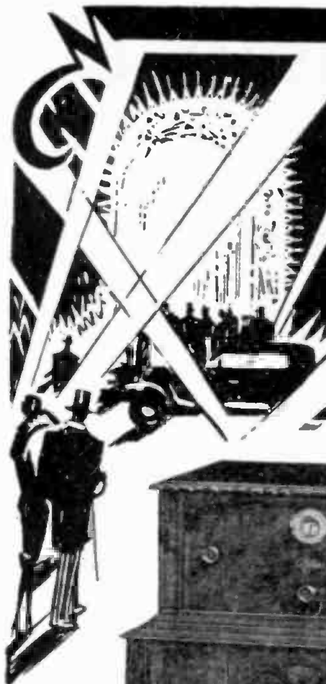
# JENSEN

## DYNAMIC•SPEAKER

*"The Finest in Radio"*

*A special two-color folder describes the complete line of Jensen Dynamic Speakers. Write for a copy.*

Licensed under Magnavox Patents



# Gilfillan

## New Radio Principles

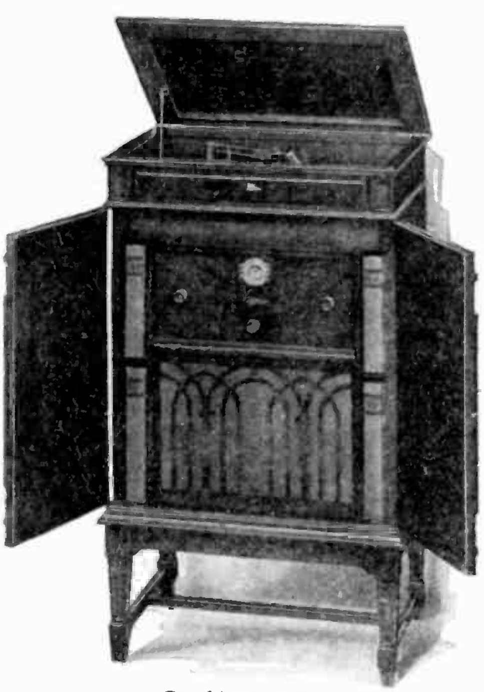
VERY decided improvements and new features have been designed and built into these new models. They of course, are A C operated but with the "hum" eliminated by a two "hum" controls. They have maximum selectivity—all oscillation being prevented by our neutrodyne feature. They are highly sensitive to weak distant stations. Our electric wave filter prevents severe interference. Extra safety factors and a 2-way switch are provided to prevent overloading and to compensate for variations in line voltage. Single tuning dial, volume control and Antenna Compensator Control are shown on the panels. Push-pull amplification with power supply of our own design and manufacture. All models are furnished with pick-up jacks for playing phonograph records. Jensen Dynamic speakers are used and every set is bench-made, thoroughly inspected and tested by expert engineers.

New Model 33 and Table

## See These New Models!

They lead the field for radio and mechanical designing and excellence of workmanship which is the assurance of their leadership in performance.

*See these New Models at the San Francisco and Los Angeles Radio Shows.*



Combination 77

GILFILLAN BROS., INC.

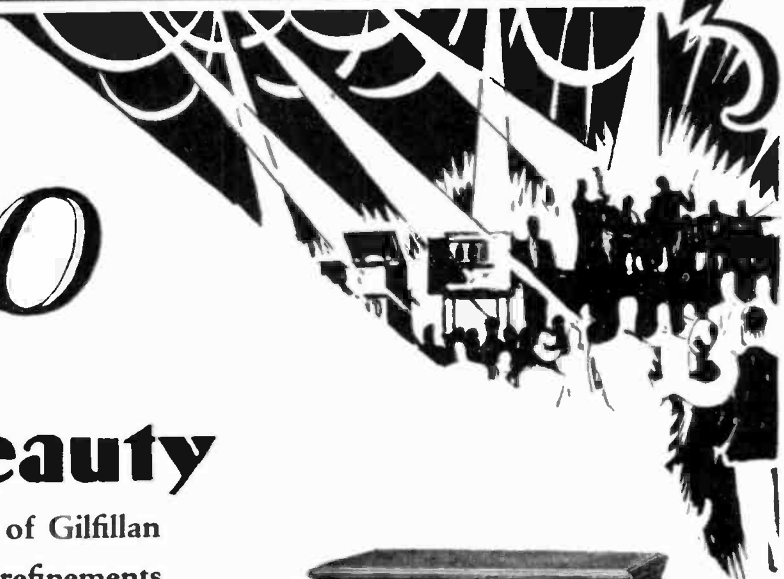
1815 Venice Boulevard, Los Angeles

536 Mission Street
SAN FRANCISCO

Republican and Terry Streets
SEATTLE

## THE RICHEST TONE IN RADIO

# Radio



## New Tone Beauty

TONE has always been the basis of Gilfillan reputation. But this year, new refinements and features have been made to improve and widen the range of Gilfillan tone quality. The widest range of tone reproduction has been accomplished. A uniformly amplified audio range of 50 to 5,000 cycles reproduces with utmost fidelity all the over-tones and tone shadings of voices or instruments making the most realistic and natural radio reproduction. The entire tone range of a full symphony orchestra is reproduced as brilliantly and distinctly as though the orchestra were in the same room. Even the playing of individual instruments can be recognized. Its realism is astounding—no other radio tone equals it's richness and clear enunciation.

New Model 66

New Model 44

## Hear This New Tone!

*Some very good Dealer's franchises open—Write us at once.*

It is the Tone Triumph of the year. Write us and let us give you the name of the Gilfillan dealer nearest you, where you can hear this richest radio tone.

GILFILLAN BROS., INC.

1815 Venice Boulevard, Los Angeles

536 Mission Street
SAN FRANCISCO

Republican and Terry Streets
SEATTLE

**BUILT FOR WESTERN RECEPTION**

## FLYING RADIO

(Continued from Page 44)

the circuits somewhat, by accepting a compromise between perfect transmission and perfect reception in order to gain compactness and simplicity, a practical working machine may be created which will put short wave signals through the air for a distance of many miles. The set—in fact, any set—should be placed far back from the motors of the ship in order to avoid interference from the ignition system. It should be completely shielded. Through a metal conduit, grounded to the frame of the plane, wires could be run to the headphones and transmitting key at the operator's seat. Also, there should be a lever located beside him for operating the throw-over switch, the switch itself being located within the metal shielding box. This lever should have three positions, the first cutting in the automatic signalling device, the second cutting in the transmitting key when the operator desired to send a message, the third position allowing the operator to listen in during two-way communication with shore stations or, perhaps, ships below him. No doubt a fixed-tune arrangement would be the best—would at least simplify any attempt at two-way communication from the viewpoint of the operator aboard the plane—all transmitting and receiving at both ends of the "line" being carried on over the same wavelength, thus eliminating the necessity for tuning. If the ship were making regular trips over long distances, all batteries should be replaced entirely after each flight, if batteries were used. A long single wire lowered from a reel and held taut by a weight constitutes the aerial, and this would be coupled to the grid side of the tube, or to the plate side, by means of the throw-over switch, according as the operator were receiving or sending.

This is a worthwhile field for experimentation. Whosoever perfects a reliable and *acceptable* means of linking the airplane with the earth by means of radio not only covers himself with glory, but bestows a blessing upon all of those who fly and those who anxiously wait below.

## TUBE IMPROVEMENTS

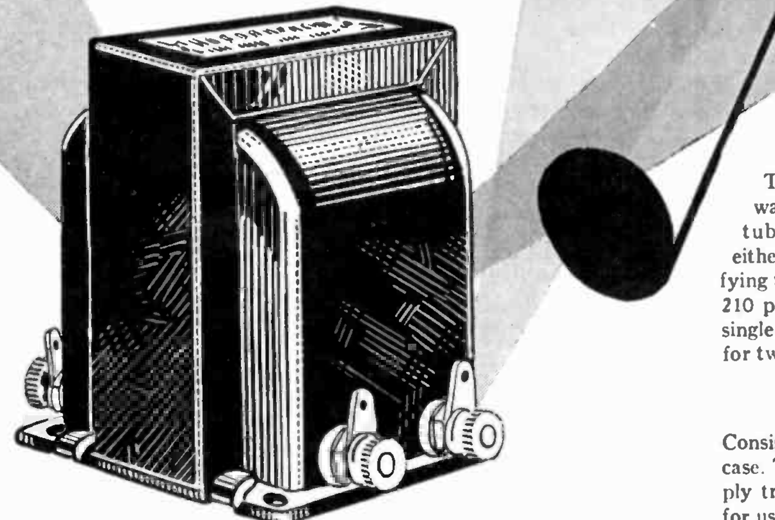
(Continued from Page 21)

Only a very slight increase in grid-plate capacity resulted from the change.

The next change came in 1925, when the X type base was announced, this tube being shown as No. 5 in the picture. No change was made in the construction of the tube, and its characteristics were the same as its predecessor. In 1927, however, the length of the bakelite base was shortened, and the bulb made longer, to improve the appearance of the product.

This tube, No. 6 in Fig. 1, continued

(Continued on Page 50)

# THORDARSON R-300 AUDIO TRANSFORMER

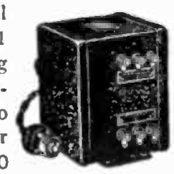
SUPREME in musical performance, the new Thordarson R-300 Audio Transformer brings a greater realism to radio reproduction. Introducing a new core material, "DX-Metal" (a product of the Thordarson Laboratory), the amplification range has been extended still further into the lower register, so that even the deepest tones now may be reproduced with amazing fidelity.

The amplification curve of this transformer is practically a straight line from 30 cycles to 8,000 cycles. A high frequency cut-off is provided at 8,000 cycles to confine the amplification to useful frequencies only, and to eliminate undesirable scratch that may reach the audio transformer.

When you hear the R-300 you will appreciate the popularity of Thordarson transformers among the leading receiving set manufacturers. The R-300 retails for $8.00.

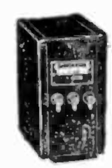
**THORDARSON ELECTRIC MANUFACTURING CO.**
*Transformer Specialists Since 1895*
**WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS**
*Huron and Kingsbury Streets — Chicago, Ill. U.S.A.*

### Power Supply Transformers



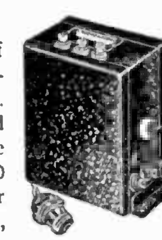
These transformers supply full wave rectifiers using two UX-281 tubes, for power amplifiers using either 210 or 250 types power amplifying tubes as follows: T-2098 for two 210 power tubes, $20.00; T-2900 for single 250 power tube, $20.00; T-2950 for two 250 tubes, $29.50.

### Double Choke Units



Consist of two 30 henry chokes in one case. T-2099 for use with power supply transformer T-2098, $14; T-3099 for use with transformer T-2900, $16; T-3100 for use with transformer T-2950, $18.

### Power Compacts

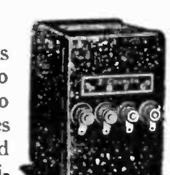


A very efficient and compact form of power supply unit. Power transformer and filter chokes all in one case. Type R-171 for Raytheon rectifier and 171 type power tube, $15.00; Type R-210 for UX-281 rectifier and 210 power tube, $20.00; Type R-280 for UX-280 rectifier and 171 power tube, $17.00.

### Speaker Coupling Transformers

A complete line of transformers to couple either single or push-pull 171, 210 or 250 power tubes into either high impedance or dynamic speakers. Prices from $6.00 to $12.00.

### Screen Grid Audio Coupler



The Thordarson Z-Coupler T-2909 is a special impedance unit designed to couple a screen grid tube in the audio amplifier into a power tube. Produces excellent base note reproduction and amplification vastly in excess of ordinary systems. Price, $12.00.

THORDARSON ELECTRIC MFG. CO.
500 W. Huron St., Chicago, Ill. 3583-G

Gentlemen: Please send me your constructional booklets on your power amplifiers. I am especially interested in amplifiers using........................tubes.

*Name*..............................

*Street and No.*..............................

*Town*.......................... *State*..........................

## TUBE IMPROVEMENTS

(Continued from Page 48)

in use until the spring of 1928, when another, and to date the last, improvement in the tube was made. This tube, No. 7 in the picture, employed a new construction, known as the "mica disc" principle of filament suspension. This change can be seen more clearly in Fig. 2. Tube *A* is the original "A" tube, as of 1922, with the bulb removed so as to show the structure of the elements. Tube *B* is the improved tube, with closer spaced elements and more rugged construction, and Tube *C* is the new mica disc type. By changing to the new method of filament suspension, and arrangement of the grid and plate structure, the tube is practically free from liability to damage during shipment, and the microphonic noises have been greatly reduced. The contact pins were nickel plated, insuring better contact with the socket springs.

The improvements in construction of the tube have been accompanied by greatly improved production methods, enabling savings to be made which have been rapidly passed on to the user. For this reason the improved rugged tube available today costs only a little more than one-eighth as much as the first "A" tubes, which sold at $9.00 for a short time after their introduction.

## FIELD STRENGTH RECORDER

(Continued from Page 20)

change the system retains its calibration with sufficient accuracy (within 10 per cent) over periods of several months.

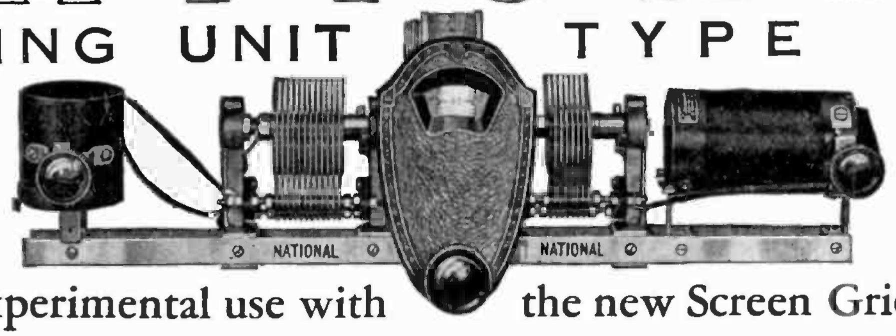
The last audio-frequency amplifier is coupled to a rectifier circuit, containing the recording galvanometer, through an air-core audio-frequency transformer. A three-electrode tube having the plate and grid connected is used for rectification. Generally, tubes used in this manner give a slight galvanometer deflection, when no signal is present, due to the initial velocity of the electrons. This current, however, can be balanced out by a reversed electromotive force across the galvanometer if it is comparable to the current received from signals. Records of variations of signals and atmospherics are made with a Cambridge-Paul Thread Recorder.

This instrument is essentially a sensitive recording galvanometer having a moving coil arranged to give a series of instantaneous records of the deflections of the galvanometer pointer. The moving coil of the galvanometer is suspended between the poles of a magnet and has attached to it a pointer which overhangs the drum. Between the pointer and the drum an inked thread is stretched parallel to the axis of the drum, at a short distance above its surface. A presser bar is situated above the galvanometer pointer. This bar is normally held free

(Continued on Page 52)

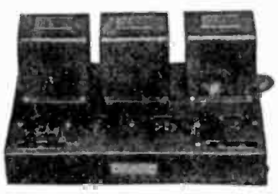
# NATIONAL

## TUNING UNIT TYPE 222




## For Experimental use with the new Screen Grid Tube

A NEW NATIONAL Browning-Drake Transformer, together with a new and beautiful Velvet Vernier Drum dial, Type F, brings out the good qualities of this highly efficient tube in a manner that is both pleasing and inspiring to the experimenter. Perfectly stable operation is obtained without the use of cumbersome shields or other energy-absorbing devices. The rigid workmanlike construction of this unit makes its installation simple and permanent. No cutting of sub-panel is required. Everything goes into place with a minimum of fitting and wiring. You will be agreeably surprised at the efficient results derived with this tuning-unit when used with the UX 222 tubes. *List Price type 222* **$25.00.** Two other types also available.

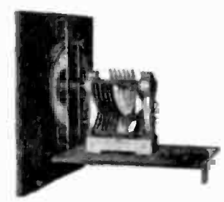


**NATIONAL PUSH-PULL AMPLIFIER-for 210 or 250 tubes.**

For the fidelity and volume of distortionless audio reproduction now required by modern radio standards and now made possible by recent speaker developments. The curve is "flat" over practically all audio-frequencies, the power output sufficient for the largest hall. The design is compact—the quality is NATIONAL.

**NATIONAL SHORT-WAVE EQUIPMENT for use with 222 tube**

This NATIONAL Velvet Vernier Dial Type E and special Equicycle Short-Wave Condenser are now offered by NATIONAL CO. INC., for experimental work in short-wave reception of broadcast, code and television signals. Also offered are newly designed short-wave R. F. Transformers in a set of 4, covering the bands from 15 to 115 meters, R. F. Choke, H. F. Impedance, special Panel and sub-Panel with all sockets and mounting clips.



***Send for new Bulletin 130-P***

**We shall be at the Pacific Radio Show, San Francisco, Don Wallace in Charge. Booth No. 123. Look us up.**

NATIONAL CO · INC · W · A · READY · PRES · MALDEN · MASS ·

# Two radio magazines for the price of

# ONE!

Hundreds and hundreds of readers of "RADIO" have availed themselves of our special money saving offer whereby you subscribe to two radio magazines for the price of one. "CITIZENS' RADIO CALL BOOK" and "RADIO" —both magazines sent to your address for a full year for the price of a one year subscription to "RADIO"—$2.50. The next issue of the "CALL BOOK" will be out on September first. Better subscribe now to avoid missing it. "RADIO" will be sent to you for 12 months, starting with our September issue, out on August 25th. Save $2.50 by subscribing today.

***MAIL COUPON NOW!***

——————— COUPON ———————

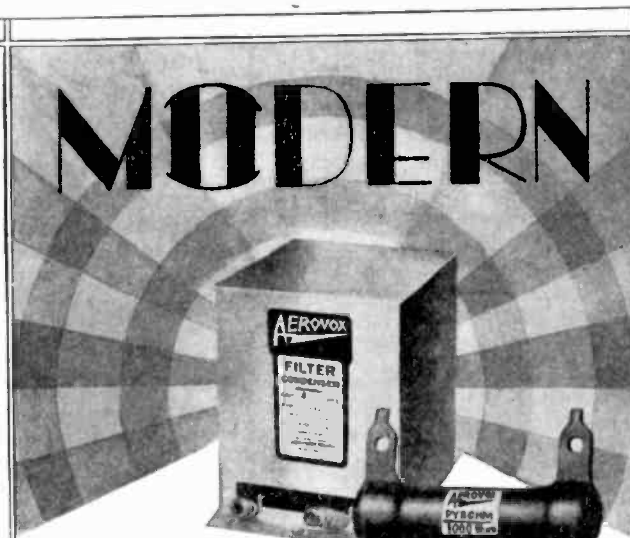
"RADIO,"
433 Pacific Building,
San Francisco, Calif.

Here is $2.50. Send me "RADIO" and "CITIZENS' RADIO CALL BOOK" for one full year starting with the SEPTEMBER issue of both magazines.

Name............................................................

Street and No...............................................

City and State...............................................




THE tremendous increase in popularity of powerful amplifiers and power units has brought with it an insistent demand for modern condensers and resistors, built to rigid standards and according to all improved methods.

Aerovox condensers and resistors are meeting the most rigorous tests imposed by modern power equipment. They are built to stand up under the severest service conditions.

Write for "The Research Worker" a free monthly publication that will keep you abreast of the latest developments in radio.

**AEROVOX**

**68-A WASHINGTON ST., BROOKLYN, N. Y.**

## FIELD STRENGTH RECORDER

(Continued from Page 50)

of the pointer by a cam and its follower. At regular intervals the cam makes a half revolution, first allowing the presser bar to fall upon the pointer and immediately raising it to its normal position. As the presser bar falls it depresses the pointer on the drum, dipping the inked thread between the pointer and the paper, producing a dot on the paper making a visible record of the deflection of the galvanometer at the moment. The drum of the recorder is arranged for two speeds, one giving a complete revolution in 24 hours and one giving a revolution every two hours for short time records. For the present purpose the 24-hour revolution is used.

The clock controlling the entire system has its face plate equipped with twelve brass segments arranged in a circle, each segment representing five minutes. A spring on the end of the minute-hand makes an electrical connection with each segment as it passes over. The cam allows the presser bar to depress once every 30 seconds, making ten dots on the paper for one five-minute segment.

For the present purpose, the first five-minute segment in the hour is connected so that when the minute-hand contact passes over it, a relay closes, turning on the receiving set, tuned to the station having the highest frequency of those to be measured. The amplifiers, the rectifier tube and the presser bar control are switched on simultaneously by means of other relays.

The following segments operate the same relays as the first, but are arranged to close other relays which connect parallel variable capacities across the primary and secondary tuning capacities of the receiving set. This allows the receiver to be tuned to other frequencies effective only for a certain clock segment.

The entire system is slightly sensitive to change of pitch of a signal. The pitch of signals being recorded is, therefore, set to 1000 cycles by means of an electrically-driven 1000-cycle tuning fork. A 30-ohm damping resistance across the galvanometer coil slows its period so that it is little affected by change of speed in transmission. Absolute calibration of the system is obtained from a radio-frequency oscillator feeding into the antenna circuit; while the amplifiers and rectifier may be checked at any time by connecting them to the output of the telephone comparator. The deflection-current curve of the galvanometer is nearly straight over the usual range of observations. As a protection against heavy atmospherics the deflection is limited just below full scale by limiting the output of the last amplifier tube.

Continuous records of several stations and atmospheric disturbances have been made at this laboratory since 1926.

# Replace your old radio!

## *Seven and a half million sets now obsolete*

### 1928 Features

Few radios AT ANY PRICE combine ALL of these features which are essential to today's new radio reception.

The Crosley Radio Corporation

NEUTRODYNE

AMPLIFICATION

Neutrodyne 10×10×10=1,000

Other systems 5×5×5=125

***Crosley Radios tune efficiently***

Crosley Neutrodyne circuit is sharp, sensitive and selective. Distant stations are easily found. Local stations tune without squealing.

***Crosley Radios are shielded***

Each element shielded from each other provides maximum selectivity and *is featured* in the most expensively made sets.

***Crosley Radios are selective***

In crowded districts where many local stations fill the air you find in Crosley radio a means of listening to ONE at a time.

***Crosley Radios have volume***

Volume may be increased to tremendous proportions without distortion. This provides plenty of volume for power speakers.

***Crosley Radios can be softened to a whisper***

A positive volume control enables operator to cut any program down to faint and scarcely audible reception.

***Crosley Radios fit any kind of furniture***

Outside cases are easily removable and chassis are quickly fitted into any type of shape console cabinet.

***Crosley Radios have illuminated dials***

The modern way enables you to see clearly in the dusk or in shadowy corners.

Your set has served you well *but* you will *not be satisfied* with *its strained stringy tones when* you hear a *new full toned power speaker* Crosley set

$25 New Dynamic DYNACONE *Amazing Speaker*

6 tube GEMBOX AC ELECTRIC $65

### FIVE DAYS FREE TRIAL IN YOUR OWN HOME

Crosley originated the idea of a national policy of home demonstration. Home is the place to buy a radio set. Compare a Crosley radio set with any other that you are contemplating buying and you will choose the Crosley. If you have electric current in your home, your set should be a modern, AC electric receiver. A converted battery set is out of date. If you pay more than $65.00 for a radio set, it should have two 171 output tubes, push-pull instead of one, eight tubes instead of seven. To be up-to-date, your new radio set should be designed to take and supply the current for a power or dynamic type of speaker. Crosley sets are so designed. Other sets designed for power speaker use are much more costly. You should demand the tone quality and the performance resulting from high power output coupled with dynamic speaker. Your set should be completely shielded and incorporate the highly sensitive, genuine, neutrodyne circuit. It should have a modern illuminated dial. An examination of Crosley radio sets will show you many other modern exclusive features.

**$25.00 NEW DYNAMIC DYNACONE AMAZING SPEAKER!**

The Dynacone is a new revolutionary speaker at a price less than many good magnetic speakers. The first minute you hear this new reproducer, it will thrill you to a new conception of what radio broadcast reception should be. Crosley manufacturing speed and straight line methods permit the extremely low price.

**WHY PAY MORE THAN CROSLEY PRICES?**

We urge you to listen to a Crosley radio set, try it, put it to any test you can think of. No sets that approximate Crosley prices can compare in performance. Why pay a high price for a set that can compare favorably with Crosley–

**SIX TUBE GEMBOX AC ELECTRIC, $65.00**

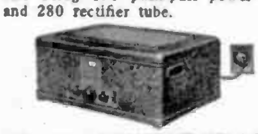
Self-Contained AC electric receiver. It utilizes two radio, detector, two audio and a rectifier tube—171 power output tube. Designed for use with the new Crosley Dynamic power speaker. Operates from 110 volts 60 cycle AC house lighting current.

Crosley prices do not include tubes.

### 1928's greatest radio

**8 tube SHOWBOX $80**

Genuine Neutrodyne, 3-stages radio amplification, detector, 3 stages audio (last two being 171 push-pull power tubes) and 280 rectifier tube.

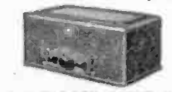


**8 tube JEWELBOX $95**

Genuine Neutrodyne, 3 stages radio amplification—227 detector tube, 3 stages audio frequency, and 280 rectifier. Shielded coils, modern illuminated dial, highly selective and powerful.

**6 tube BANDBOX $55**

An improved model of the 1927 receiver that led the world to better radio. Genuine Neutrodyne—every modern fitting and refinement including illuminated dial. The set you can safely buy where AC current is not available—selective, sensitive.



**5 tube BANDBOX Jr. $35**

Operates entirely from dry cells and is especially designed where no electric current is available either for AC radio or recharging storage batteries.

**Improved MUSICONE $15**

The outstanding Magnetic type speaker available, still maintaining its leadership, today, as from its inception in 1925. Improved, it is without question the greatest speaker value you can find.

# CROSLEY


The Crosley Radio Corporation

Powel Crosley, Jr., Pres.

Cincinnati, Ohio

*Montana, Wyoming, Colorado, New Mexico and West, prices slightly higher.*

**5 DAY FREE TRIAL COUPON**

*Your name*..........................................

*Address*..........................................

Mail this coupon to the factory. Nearest dealer will bring you receiver checked.

Please let me try receiver and proper speaker, I have checked, in my own home without obligation for 5 days.

JEWELBOX ☐ SHOWBOX ☐

GEMBOX ☐ BANDBOX ☐ BANDBOX JR. ☐

## SEVEN-TUBE A.C. RECEIVER

(Continued from Page 23)

a separate baseboard several feet from the receiver to eliminate a.c. induction and two cables should be run to the receiver. One cable supplies 5 volts, 2½ volts and 1½ volts a.c. for the filaments, and the other cable furnishes the *B* power. In wiring the receiver the filament leads should be twisted and bunched together towards the rear edge of the baseboard. This latter arrangement keeps the a.c. leads away from exposed grid leads. The use of variable center-tapped filament resistances is another important item in constructing an a.c. tube receiver. The use of a heater-type tube in the first audio stage and push-pull amplification in the second stage of audio, helps to keep a.c. hum down to a minimum. The problem of a.c. hum is important when an audio amplifier is used which amplifies frequences down as low as 60 cycles nearly as well as at 1000 cycles. That factor and the use of a good dynamic type of loudspeaker, which will actually reproduce the real low tones, may be sources of grief to a constructor unless some of the suggestions mentioned are followed. Nevertheless, the use of an excellent audio amplifier and dynamic loudspeaker

### LIST OF PARTS

C—.006 mfd. fixed condensers.
$C_1$—.0005 mfd. variable condenser.
$C_2$, $C_3$, $C_4$, $C_5$—.00035 mfd. variable 4-gang condenser.
$C_6$—.00025 grid condenser.
$C_7$—.0005 mfd. max. variodenser.
$C_8$—.0001 mfd. max. variodenser.
$C_9$—.1 mfd. by-pass condenser.
$C_{10}$—2 mfd.
$C_{11}$—1 mfd.
$C_{12}$—6 mfd.
$C_{13}$—2 mfd.
$C_{14}$—2 mfd.
R—1000-ohm semi-variable resistances.
$R_1$—0-10,000-ohm volume control.
$R_2$—800-ohm resistor.
$R_3$—1000-ohm resistor.
$R_4$—5000-ohm semi-variable resistor.
$R_5$—3-megohm grid leak.
$R_6$, $R_7$—25,000-ohm voltage divider resistors.
$R_8$—½-megohms leak.
4—R.F. transformers (see text).
1—Antenna coil.
1—Double drum dial.
1—7 x 24 in. walnut veneer panel.
1—12 x 24 in. baseboard.
1—Audio transformer.
1—Input push-pull transformer.
1—Output push-pull transformer.
6—UX tube sockets.
2—UY tube sockets.
3—UV 226 tubes.
2—UY 227 tubes.
2—UV 171 tubes.
1—UV 280 tubes.
1—Power pack (power transformer and two 30-henry chokes).
1—Filament transformer.
4—80-millihenry radio-frequency chokes.
6—.001 filament r. f. by-pass condensers.
2—Variable center tap filament resistors.
1—Fixed center tap filament resistors.

is to be greatly recommended in order to fully enjoy good musical programs.

The adjustments of the receiver are simple. $C_7$ should be adjusted by means of a wooden screw driver until very little detector regeneration is present; that is, at minimum capacity. The trimmer condensers of $C_2$, $C_3$, $C_4$ and $C_5$ should be adjusted until the set is most selective on some local station. The resistors $R$ should be about 1000 ohms or somewhat less. The variable center-tap filament resistors should be adjusted until the a.c. hum disappears or is a minimum. The 45 and 135-volt taps should be adjusted, with the tubes operating, until the correct values are obtained as measured with a voltmeter. The variodensers $C_7$ and $C_8$ and the resistance $R_4$ should be adjusted after the other adjustments have been completed. These three adjustments should be made so that the detector will spill into oscillation over entire broadcast band when $C_7$ is turned up a little too far. This automatic detector regeneration scheme is a circuit which was recently developed by Mr. Clement.

Since the antenna circuit is tuned, and three tuned r.f. stages with a regenerative detector are incorporated into the receiver, the selectivity and sensitivity are very excellent. It is possible to receive distant stations through local ones with very good quality. The quality on local stations is excellent.

## QUESTIONS AND ANSWERS

**What changes will I have to make in my 45 kilocycle superheterodyne, so as to use the type A tubes throughout?—L. J., Brantford, N. D.**

Diagrams showing how to make this change have appeared in these columns several times during the past three years. Where the transformers peak at 45 kilocycles with type 99 tubes, the frequency is lowered to 40 kilocycles with type *A* tubes. If the i.f. transformers peak at 52 k.c. with the 99 tubes, then they will peak at about 45 k.c. with the type *A* tubes. If the transformers are two or three years old, they are probably 45 k.c. with 99 tubes, and when the *A* tubes are installed the size of the filter condenser should be increased from .00025 mfd. to .0003 mfd. If they are the 52 k.c. type, then the condenser should be .00025 mfd. instead of .0002 mfd., the latter tuning the filter to 52 k.c. The 25-ohm volume control rheostat controlling the filaments of the first two i.f. tubes should be omitted, and the filaments of all eight tubes controlled from a single 1-ohm rheostat. Volume should be controlled by shunting a 0-50,000-ohm variable resistance across the primary of the second i.f. transformer. If trouble from oscillation is experienced, it may be necessary to shunt the primary of the third i.f. transformer with a 12,000-ohm fixed resistance, as the amplification per stage with the type *A* tubes will be considerably greater than is possible with the 99 tubes, and this increased overall gain may cause the amplifier to oscillate badly when the volume control rheostat is set near maximum.

## R. F. CHOKES

(Continued from Page 31)

301A tube, a 0.05-megohm grid leak, and a 1:5-milliampere d.c. grid meter, were parts of the layout. It was proposed to run the driver first as a series-feed oscillator, Fig. 2a, and take the readings of grid current at each dial setting as a measure of the strength of oscillations. This was perfectly permissible, for, with other factors constant, the flow of grid current is directly dependent on the r.f. voltage across the oscillating circuit. These data, using series feed, were taken as the standard of comparison to see how much introduction of the choke in shunt feed lowered the strength of oscillations.

The new chokes for test were jumble-wound on small wooden spools in a variety of winding dimensions, numbers of turns, and so on, data on which are given in Fig. 3. Each choke in turn was connected in at X in the shunt-feed circuit 2b, and was submitted to the oscillation strength test; the resulting readings appear in graphical form in Fig. 3. As may be seen, the best choke of the lot was No. 3; No. 6 choke gave exactly the same curve—it was really two of the No. 3 chokes on one form. The other chokes were worse in varying degrees. No. 1 choke, which had a narrow, deep winding, was worse at the lower waves; No. 5 choke, also with a narrow, deep winding, but plain enamelled wire, was bad at the higher waves, though only slightly more so than No. 4, with a wide shallow winding. It is pointless to try to assign reasons for the various performances of the chokes—perhaps the particular way in which the turns jumbled had as much as anything to do with the results.

The No. 3 wooden-spool choke was not as good as the single-layer-solenoid choke over most of the band, as the tests showed. However, it did not at any point show a series-resonance dip such as the single-layer speciman did at 62 meters. The oscillation strength with either choke was not as high as with series feed. The average difference between the wooden-spool and the single-layer choke was about the same as the difference between the single-layer choke and series feed.

The picture shows the Hartley grid-meter driver and some of the chokes that were tested. The operating range of a choke can be extended by winding two or more different-dimensioned sections in series, each section to be particularly effective over one portion of the wave range. The forms for the chokes can be made from sections of spools, with end flanges of cardboard of thin formica. Thus chokes can be developed to order in a short time if only a grid-meter driver is at hand.

### Television Picture Frequencies

THERE seems to be some confusion as to the number of images which must be transmitted per second to eliminate the "flicker" in television. Some investigators recommend the transmission of ten to twenty images per second, depending upon the efficiency or the inherent limitations of their systems. The conventional picture frequency is usually stated to be 16 images per second, which is substantially correct, although Dr. Ives, of the Bell Laboratories, points out that the actual image repetition necessary to extinguish flicker is proportional to the logarithm of the field brightness. It is hardly possible that objects scanned at intervals greater than 1/16 second would give results comparable with the modern moving picture.

### Know Your Metals

SELENIUM, of course, is a metal," reports *Television*, our British contemporary. "Selenium is undoubtedly non-metallic," avers Smith's "General Chemistry." All right-thinking gentlemen will prefer the latter statement. At the time of its discovery, selenium was thought to be a metal; but, then, selenium was discovered in 1817. Chemists now group the element with sulphur and tellurium although in some of its physical properties it does resemble the metals.

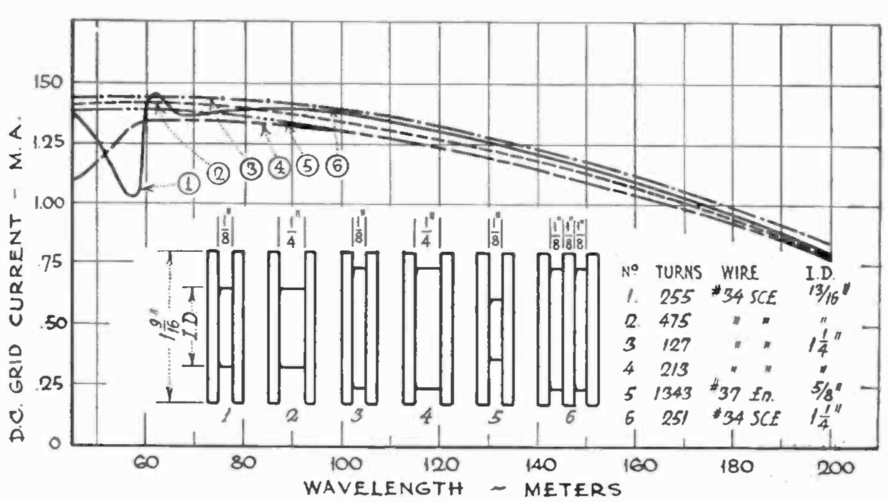



*Fig. 3. R.F. Choke Test Data*

## VACUUM TUBE VOLTMETER

(Continued from Page 30)

0-500-volt range. The $C$ battery is not used in these ranges and can be used alone and in conjunction with one 45-volt block to give these voltages. As before, the input voltage is varied in convenient steps and the meter readings noted for the 0-100-volt range and again for the 0-500-volt range.

These data are then plotted, securing curves as shown in Fig. 6. For quick reference, and especially for service use, the calibration chart shown in Fig. 7 is useful. It is made through the use of the calibration curves; the even voltage values, say every ½ volt with the 0-10-volt scale, being picked off on the curve and projected down the "meter reading"

**PARTS USED**

- 1 '99 type vacuum tube.
- 1 0-1 m.a. milliammeter.
- 1 25-ohm rheostat.
- 1 400-ohm potentiometer.
- 1 UX socket.
- 14 lettered binding posts: +A, —A, +B, +C, 2 —C, 3 +, 3 —, 2 plain.
- 1 2000-ohm resistor.
- 1 50,000-ohm resistor.
- 2 Resistor mountings.
- 1 .001 molded mica condenser.
- 1 set switch parts; 14 sw. points, 2 laminated switch arms, 1 knob, 1 pc. 2 3/8 x 2 3/4 in. panel, 6-32 bolts.
- 3 lengths insulated bus wire, assorted colors.
- 1 7 x 10 x 3/16 in. panel, black.
- 1 7 x 10 x 2 in. (inside) walnut case.

scale. This gives two scales, that of the meter and the corresponding value of voltage, on opposite sides of a line making reading easy and rapid. The 0-100 and 0-500-volt curves can be treated similarly and their scale placed above the other as has been done in Fig. 5.

It will be noted that the scales are legible and open at the lower end instead of folded as is usually the case. This fortunate characteristic makes possible accurate readings at low inputs and does much to preserve the continuity of the 0-500-volt overall range.

The a.c. high range scale employing the series condenser wherein the input is connected between the "+H" and "AC" binding posts theoretically measures the peak value of the a.c. wave. Actually, however, it measures some value less than this due to the fact that available condensers are not ideal and pass some leakage current. Since the root-mean-square value is the value meant when an a.c. voltage is mentioned, it is best that these ranges be calibrated to read r.m.s. values.

In operation, the filament current is always set to 60 m.a. and the $C$ or $B$ voltages adjusted to give the correct zero reading. In the case of the 0-10-volt range where the $C$ battery potentiometer is used to set zero, variation of $B$ voltage as great as 20% has no effect on the calibration, making the use of two 45-volt blocks satisfactory almost regardless of their condition; while for the high ranges, a $C$ battery is not used and the zero setting maintained with the $B$ battery. Provision is thus made for all the operating adjustments within the instrument; making the use of external ammeters, voltmeters, or other instruments unnecessary.

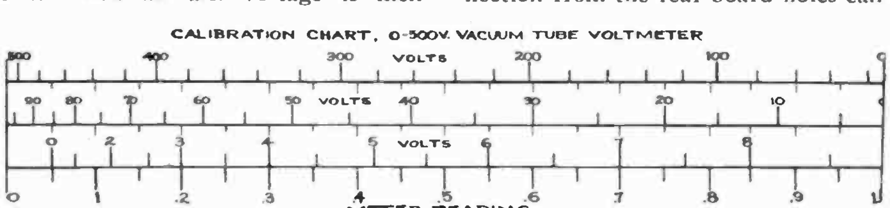


*Fig. 7. Chart for Quick Reading of Calibration*

## ELECTRO-DYNAMIC SPEAKER

(Continued from Page 24)

ally held in place by a metal framework and ring which is a part of the metal housing of the field coil. But for the experimenter a combination such as is shown in Fig. 4 will be easily built without having to work up a sheet metal assembly, and only requires two boards about 2 ft. square, of 1-in. non-warping

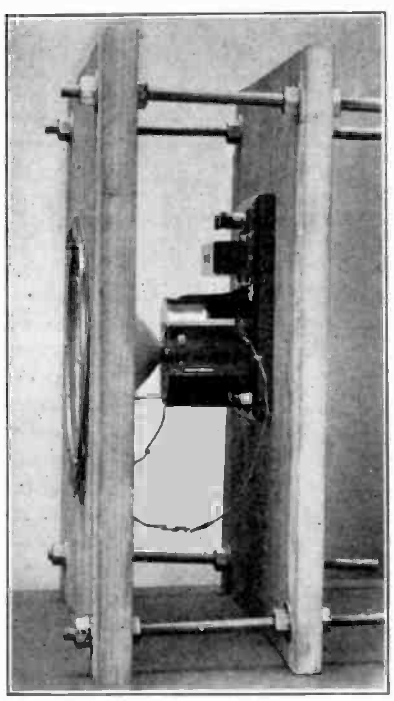


*Fig. 4. Completed Speaker in Wooden Frame*

stock. One board acts as the baffle, and has a 7-in. hole cut in the exact center, while the other board is used to mount the field coil. If there is noticeable reflection from the rear board holes can be drilled in it around the coil mechanism until this reflection becomes negligible. A metal ring is required to hold the cone to the baffle board, and this may be made of strip brass, with an outside diameter of 8¾ in. and an inside diameter of 7 in., using stock about ⅛-in. thick. Holes are drilled in the ring to accommodate seven or eight wood screws, and are shown in the diagram of the cone details.

The instrument is now ready for assembly, and four holes of a size large enough to pass a ½-in. bolt are drilled at the four corners of the two boards, and the boards are then fastened together as shown in Fig. 4., each thickness of board being bounded on each side by a washer and nut. Bolts 10 in. long and ½ in. full thread are required. Adjust the nuts until the boards are exactly parallel, and 7 in. apart. Now place the structure so that the board with the 7-in. hole is parallel with the table, and on top, and place the cone through this hole, centering it and attaching it to the board by means of the metal ring placed over the leather edging of the cone. Do not stretch the leather tightly, as the cone should be free to move at least ¼ in. back and forth when in operation. The two input leads can be fastened to a terminal block on the back of the front board, with sufficient slack to allow free movement of the cone.

Now place the field assembly on the bottom board and adjust its position until the moving coil fits exactly over the air gap around the core, and so that it would not touch the inner or outer edges of the gap at any point, if the boards were to be moved closer together. Now fasten the base of the field coil firmly to the back board, and pile ⅝ in. of brass or copper washers on top of the core of the magnet, arranging them so that all their holes lie in line with the drilled and tapped hole in the center post. Now screw the two boards toward each other by loosening the nuts on the under side of the baffle, and guide the moving coil into the air gap. Bring the two boards closer together until the paper centering washer comes in contact with the pile of washers on the center post. Now place a 6-32 machine screw having a brass washer under the head, through the hole in the paper washer, and into the tapped hole in the core of the magnet. Then note the position of the coil with respect to the air gap, which should be so that you can just see the top turn of its winding flush with the top plate of the magnet structure. If this turn cannot be seen, the coil is too deep, and another spacing washer or two are required between the paper centering washer and the pole piece. If two or more turns are seen, brass washers should be removed from the pole piece until the right adjustment is obtained.

The adjustment of the moving coil as to exact center is next made, loosening the 6-32 screw, but not removing it. Place the speaker in a vertical position, and with one hand in front and one behind, move the coil around in its gap until you think you have it centered. Then, holding it there, get someone to tighten the screw, and then move the cone in and out, listening for any scraping sounds. If none are heard the coil is clear of both edges of the gap and is in its correct adjustment.

The moving coil must be connected to an output transformer having a turns ratio of at least 25 to 1, as the impedance of this coil is only a few ohms, whereas that of the power tube is several thousand. An output transformer of that type accompanies the old horn type speaker, but if the frequency characteristic of this transformer does not suit the user there are several of correct size which are now obtainable in the open market.

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## SHORT WAVE RECEIVER

(Continued from Page 28)

no r.f. tube, the wavelength control being the plate tuned circuit of the r.f. amplifier, and the regeneration or oscillation control being the detector plate condenser. The detector filament should be operated at a voltage such that smooth regeneration and spill-over into oscillation takes place, without clicks or howls. If a loud squeal occurs when the set is turned on, the tickler condenser is probably advanced too far, and the capacity should be reduced. If trouble is had with the r.f. amplifier tube oscillating, which may be indicated by numerous loud heterodyne whistles with the antenna disconnected, it can sometimes be eliminated by slightly reducing the plate voltage to the shield grid tube. A change in shield grid voltage will also affect the tube's oscillation point, but as no trouble of any sort was had with the experimental set shown in the picture, it is anticipated that no difficulty of this sort will be experienced by those who build it.

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An "electric set," according to the R. M. A. standard nomenclature, is a radio receiver operating from the electric light line, without using batteries. If it employs tubes which obtain filament or heater current from an a.c. line without the use of rectifying devices, but with built-in tube rectifier for plate and grid voltages, it is an "a.c. tube electric set." If it uses current supplied by a d.c. line it is a "d.c. tube electric set." If it is designed to be operated from batteries it is a "battery-operated set." If the latter is connected from a power unit operating from the electric light line and supplying filament and plate potentials to the tubes, it is a "socket-powered set."

## Amateur and Special (Experimental and Technical Training School) Station Calls To Be Changed

Under section 2, paragraph d, of article 14 of the International Radiotelegraph Convention, Washington, 1927, call signals of private experimental stations (which under article 1 are "(1) a private station intended for experiments with a view to the development of radio technique or art; (2) stations used by an 'amateur'—that is to say, a duly authorized person who is interested in the radio technique solely with a personal object and without pecuniary interest) shall consist of the letter or letters indicating the nationality and a single figure followed by a group of not more than three letters."

While the requirements of the convention are not actually effective until January 1, 1929, it has been deemed advisable to change the call signals effective October 1, next, as the division desires to show the new signals in the annual list of Amateur Radio Stations of the United States, edition June 30, 1928, rather than to change the calls effective January 1, 1929, and publish the new calls in the June 30, 1929, edition.

Therefore, beginning that date, all stations in the classes above named within the continental limits of the United States are hereby ordered to add to their call signals the letter "W," and those in Alaska, Hawaii, Porto Rico, and the Virgin Islands, should add the letter "K." These letters should precede the call signal; for example, station 4ABC, if within the continental limits of this country, becomes W4ABC and, if in Porto Rico, becomes K4ABC.

## International Prefixes for Call Signals Of Amateur Stations Tentatively Assigned

CI. Chile.
CF. Canada.
CL. Cuba.
CN. Morocco.
CP. Bolivia.
CR. Portuguese colonies.
CS. Portugal.
CV. Rumania.
CW. Uruguay.
CZ. Monaco.
D. Germany.
EA. Spain.
EI. Ireland.
EL. Liberia, E.
ES. Estonia.
ET. Ethiopia.
F. France and colonies.
G. England.
HA. Hungary.
HB. Switzerland.
HC. Equador.
HH. Haiti.
HI. Dominican Republic.
HJ. Colombia.
HP. Honduras.
HS. Siam.
I. Italy.
J. Japan.
K. United States.
LA. Norway.
LO. Argentina.
LZ. Bulgaria.
M. England.
N. United States.
OA. Peru.
OH. Finland.
OK. Czechoslovakia.
ON. Belgium and colonies.
OU. Denmark.
PA. Holland.
PJ. Curacao.
PK. Dutch East Indies.
PP. Brazil.
PZ. Surinam.
RA. Russia.
RV. Persia.
RX. Panama.
RY. Lithuania.
SM. Sweden.
SP. Poland.
SU. Egypt.
SV. Greece.
TA. Turkey.
TF. Iceland.
TG. Guatemala.
TI. Costa Rica.
TS. Sarre.
UH. Hedjaz.
UI. Dutch East Indies.
UL. Luxemburg.
UN. Yugoslavia.
UO. Austria.
VE. Canada.
VH. Australia.
VO. Newfoundland.
VP. English colonies.
VT. India.
W. United States.
XA. Mexico.
XG. China.
YA. Afghanistan.
YH. New Hebrides.
YI. Iraq.
YL. Lettonia.
YM. Danzig.
YN. Nicaragua.
YS. San Salvador.
YV. Venezuela.
ZA. Albania.
ZK. New Zealand.
ZP. Paraguay.
ZS. South Africa.

## CALLS HEARD

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oa-2ap, oa-2bb, oa-2dy, oa-2fx, oa-2jy, oa-2lm, oa-2rf, oa-2rx, oa-2sa, oa-2ss, oa-2tm, oa-2yi, oa-3ca, oa-3cp, oa-3ew, oa-3hl, oa-3jc, oa-3jk, oa-3jo, oa-3kr, oa-3lp, oa-3ls, oa-3nt, oa-4ab, oa-4at, oa-4bb, oa-4bd, oa-4fw, oa-4go, oa-4lj, oa-4mn, oa-4pn, oa-4rb, oa-4rg, oa-4wa, oa-4ws, oa-5bg, oa-5hg, oa-5rj, oa-5mb, oa-5wh, oa-5wp, oa-5wp, oa-5bw, oa-5dx, oa-6sa, oa-6mu, oa-6dh, oa-7ch, oa-7bq, oa-7lj, oa-7rl, oz-1ap, oz-1ar, oz-1at, oz-1fe, oz-1fj, oz-2ae, oz-2ai, oz-2am, oz-2aq, oz-2be, oz-2bg, oz-3ar, oz-3au, oz-3aw, oz-4ae, oz-4am, eg-5by, eg-6qb, ef-8fc, ef-8fd, ef-8fk, er-5aa, ei-1cr, sa-bx2, sa-dq4, sa-fa6, sb-1aw, sb-1ak, sc-2ab, sc-2as, sc-3ak, sc-cnag, se-2ah, sh-bzl, sv-1xc, su-1bu, fm-tun2, fl-1ab, fo-a3v, fo-a4e, fo-a6r, ac-1ax, ac-1cl, ac-2ff, ac-2ck, ac-8ag, ac-8zw, ac-gdvb, ac-gmov, ai-2kt, aj-2by, aj-4bk, aj-4zz, aj-8sn, aj-jxax, aj-jxcx, aj-jxix, aj-7cb, am-1ab, am-3ab, nj-2pa, nq-5fl, ns-1fmh, ny-1aa.

Amateurs can add to the reputation of their stations and become better known if they put up their call letters on a board fastened to the aerial pole. A piece of half-inch board, one by two feet, painted black and with the call letters in white, would attract many visitors and brother amateurs to the stations. Ordinary house paint can be used for the letters and background. The white letters should be put on first; then the black background painted around them.


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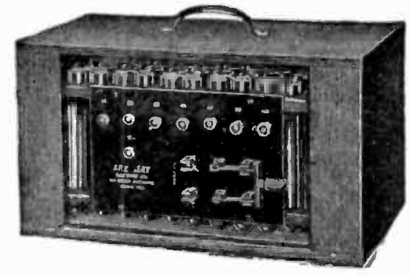

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| G. E. Kenotron Rectifying Tubes (type T.B.1) | " 1.25 ea. |
| Eby A.C. Adapter Harness with Volume Control. For 6 tube Sets, list $10.00 | " 5.00 ea. |
| Gould Kathanode Unipower, Automatic Radio "A" Power (6 volt), list $39.50 | " 13.75 ea. |

AMERICAN SALES CO., 19-21 WARREN ST., NEW YORK CITY

## Photoelectric Cells — Glow Lamps and Television Disks

*Write for Bulletin E-3*
PHOTION INSTRUMENT CORP.
574 Southern Blvd., New York City

## *Read* what BIG money these fellows have made in the RADIO BUSINESS

**$375 One Month Spare Time**

"Recently I made $375 in one month in my spare time installing, servicing, selling Radio sets. And, not so long ago, I earned enough in one week to pay for my course."
EARLE CUMMINGS,
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**$1597 In Five Months**

"The N. R. I. is the best Radio school in the U. S. A. I have made $1597 in five months. I shall always tell my friends that I owe my success to you."
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302 Safford Ave.,
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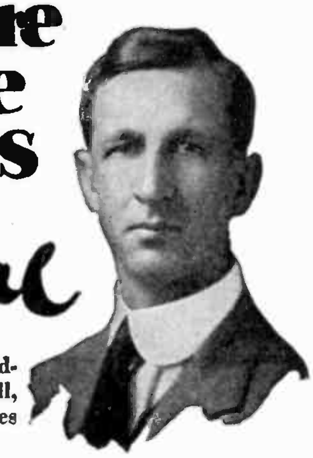
**$1164 Spare Time Profits**

"Look at what I have made since I enrolled, $1,164—money I would not have had otherwise. I am certainly glad I took up Radio with N. R. I. I am more than satisfied."
HENRY R. HEIKKINEN,
123 W. Erie St., Chicago, Ill.

**Over $1000 In Four Months**

"My opinion of the N. R. I. course is that it is the best to be had at any price. When I enrolled I didn't know a condenser from a transformer, but from December to April I made well over $1000 and I only worked in the mornings."
AL. JOHNSON,
1409 Shelby St., Sandusky, Ohio.

# *I will show you too* how to start a spare time or full time Radio Business of Your Own *without capital*



**Radio's amazing growth is making many big jobs. The world-wide use of receiving sets and the lack of trained men to sell, install and service them has opened many splendid chances for spare time and full time businesses.**

Ever so often a new business is started in this country. We have seen how the growth of the automobile industry, electricity and others made men rich. Now Radio is doing the same thing. Its growth has already made many men rich and will make more wealthy in the future. Surely you are not going to pass up this wonderful chance for success.

**More Trained Radio Men Needed**

A famous Radio expert says there are four good jobs for every man trained to hold them. Radio has grown so fast that it simply has not got the number of trained men it needs. Every year there are hundreds of fine jobs among its many branches such as broadcasting stations, Radio factories, jobbers, dealers, on board ship, commercial land stations, and many others. Many of the six to ten million receiving sets now in use are only 25% to 40% efficient. This has made your big chance for a spare time or full time business of your own selling, installing, repairing sets.

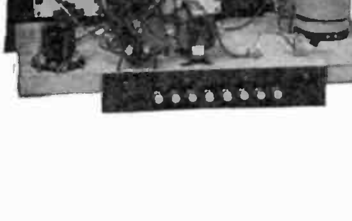
**So Many Opportunities You Can Make Extra Money While Learning**

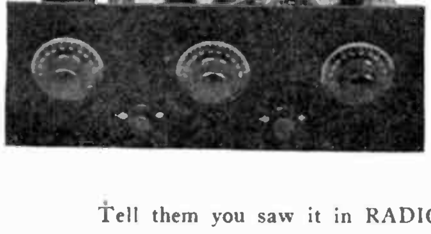
Many of our students make $10, $20, $30 a week extra while learning. I'll show you the plans and ideas that have proved successful for them—show you how to begin making extra money shortly after you enroll. G. W. Page, 1807-21st Ave., S., Nashville, Tenn., made $935 in his spare time while taking my course.

**I Give You Practical Radio Experience With My Course**

My course is not just theory. My method gives you practical Radio experience—you learn the "how" and "why" of practically every type of Radio set made. This gives you confidence to tackle any Radio problems and shows up in your pay envelope too.

**You can build 100 circuits with the Six Big Outfits of Radio parts I give you. The pictures here show only three of them. My book explains my method of giving practical training at home. Get your copy !**





**I Will Train You At Home In Your Spare Time**

I bring my training to you. Hold your job. Give me only part of your spare time. You don't have to be a college or high school graduate. Many of my graduates now making big money in Radio didn't even finish the grades. Boys 14, 15 years old and men up to 60 have finished my course successfully.

**You Must Be Satisfied**

I will give you a written agreement the day you enroll to refund your money if you are not satisfied with the lessons and instruction service when you complete the course. You are the only judge. The resources of the N. R. I. Pioneer and Largest Home-Study Radio school in the world stand back of this agreement.

**Get My Book**

Find out what Radio offers you. My 64-page book, "Rich Rewards in Radio" points out the money making opportunities the growth of Radio has made for you. Clip the coupon. Send it to me. You won't be obligated in the least.

*This Book points out what Radio offers You Get a copy!*


**Address**

**J. E. Smith, Pres.**
**Dept. 9 R**
**National Radio Institute**
**Washington, D. C.**

**This coupon is good for a FREE copy of my *Valuable Book* Mail it NOW!**

J. E. Smith,
President,
Dept., 9R
National Radio Institute, Washington, D. C.

Dear Mr. Smith: Send me your book. I want to know more about the opportunities in Radio and your practical method of teaching at home in spare time. This request does not obligate me to enroll and I understand no agent will call on me.

Name........................ Age........
Address...................................
City........................ State......

# *A* FAMOUS LINE

Speakers Licensed under Airchrome Patent June, 1928, believed to be the most important speaker patent outstanding

Bookcase Model

Price $35.00

Lacquer Finish with beautiful high-lighted effect

THE addition of a line of speakers under the recent Whitmore Airchrome patent marks another important step in Browning-Drake progress. The well known kit has been famous for years. The factory-built receivers are giving exceptional service in thousands of homes and soon Browning-Drake speakers will win equal renown.

Remarkable tone quality, always associated with Browning-Drake receivers, is further ensured by a reproducer which carries notes in the bass almost a full octave lower than may otherwise be obtained.

Speakers are now available from $25.00 to $75.00 in five different models, each one built to the highest standards. Factory-built receivers range in price from $95.00 to $295.00, including electric and battery operated models. The wonderful 1929 type A.C. Shield Grid Kit lists at $26.00. Write for full information on this complete line of quality apparatus.

*We have some territory open for both exclusive distributors and authorized dealers. Write for our proposition on this line which brings both profit and prestige.*

BROWNING-DRAKE CORPORATION
CAMBRIDGE , , , MASS.

# BROWNING-DRAKE

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*Press of*
THE JAMES H. BARRY COMPANY
SAN FRANCISCO, U. S. A.

JULY, 1928

25 CENTS

# RADIO



IN THIS ISSUE

## FIRST SHOWING OF NEXT SEASON'S RADIO MODELS

# MAGNAVOX DYNAMIC

## POWER SPEAKERS

### FOR EVERY SET

AC AC

Seventeen years ago the first radio loud speaker was created. It was a Magnavox. It was a dynamic. Today the Magnavox Dynamic is in 400,000 homes, in the sets of America's fine radio manufacturers, in the stores of the country's best dealers.

Magnavox Dynamic "translates" the audio delivery of the power tube into a faithful reproduction over the full range of frequencies. It gives ample volume with studio realism.

*Write your name on margin of page below for speaker bulletins giving full information.*

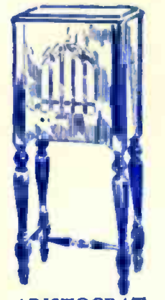
THE MAGNAVOX COMPANY

Oakland, California

*Eastern Sales:* 1315 So. Michigan Avenue, Chicago

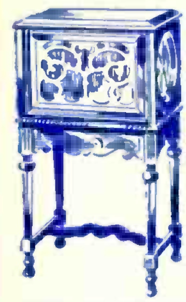
Magnavox Dynamic Speakers are protected by 13 U. S. and foreign patents. Infringements will be prosecuted.

DC DC



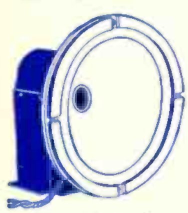
**ARISTOCRAT MODEL**
Beautiful butt burl walnut cabinet finished in two tones. It houses Dynamic 6, 7 or 80 unit. List prices:
*With—*
*Dynamic 6, DC. $70*
*Dynamic 7, DC. $75*
*Dynamic 80, AC. $85*

**BEVERLY MODEL**
Gracefully proportioned cabinet finished in light mahogany.
*For AC Operation, $70*
*A-Battery Operation $55*



**CORDOVA MODEL**
With dynamic 700 unit. 110 volt, 60 cycle AC. Combining rectifier and power amplifier. Takes place of last audio stage in set. Handsome walnut cabinet.
*List $175. Unit $125*

**DYNAMIC 80**
110 volts AC. Has power transformer and dry rectifier. The most popular unit of the new line. Designed to operate with AC. sets.
*Unit, list $50.*



**DYNAMIC 6**
6 volts DC. Field current consumption, .65 amperes. Operates from A battery.
*Unit List Price, $35*

**DYNAMIC 7**
110 to 220 volts DC. Field current consumption, 45 to 90 milliamperes.
*Unit, list $40*

# FADA Radio

# Excels in the Radio Essentials

Tone Quality ✓ Distance ✓ Selectivity ✓ Reliability

# FADA-10

(Illustrated)

THIS new Fada set, pictured below, ready to operate as illustrated from house current lines, in a two-tone ornamental metal cabinet, is a real winner—make no mistake about that.

An A. C. Fada—Single Dial—Illuminated Station Finder, showing wave lengths—Volume control—from full on, smoothly down to a whisper — Vernier for Super-fine operation — Single casing encompasses entire mechanism— Completely shielded—Improved circuit that minimizes A. C. hum—Exceptional long life, five A. C. tubes—Seven tubes total—Adapted for either short or long antenna—180 Volts on power tube—Operates efficiently on any rated 90 to 130 Volt A. C. line—Available in 25 or 60 cycle models—Unusually attractive cabinet.

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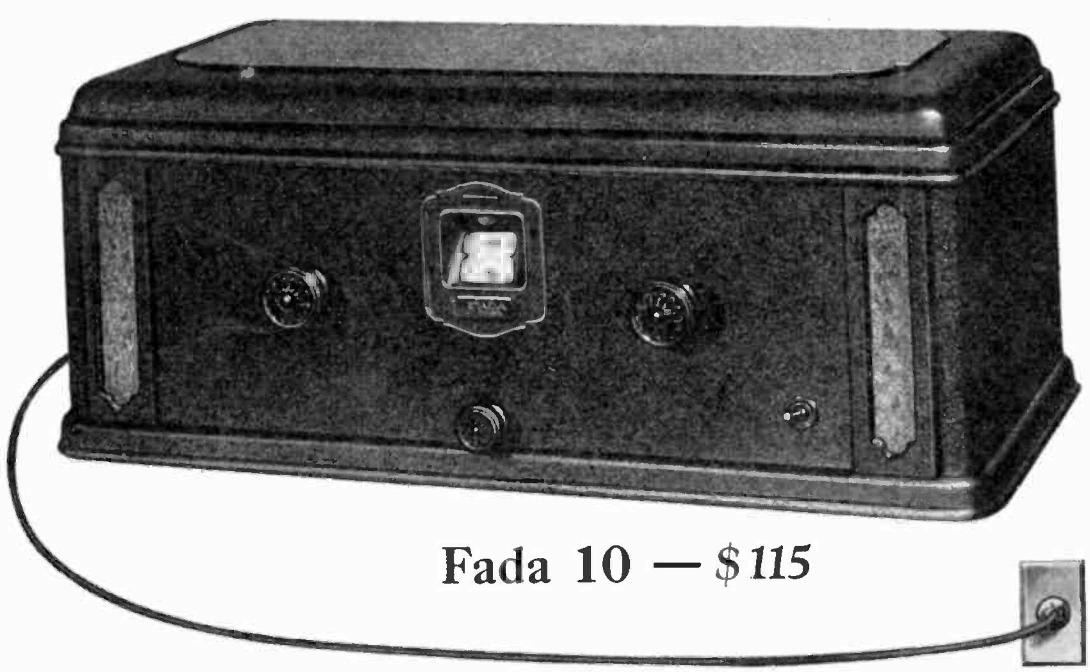
Jackson Avenue, Orchard and Queens Streets

LONG ISLAND CITY, N. Y.

CHICAGO KANSAS CITY SAN FRANCISCO



Fada 10 — $115

$110 East of the Rockies

RADIO

Established 1917

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FORECAST FOR AUGUST ISSUE

Features of the August issue include an account of some new aids for aerial navigation by S. R. Winters (which was crowded out of the July issue by Jack Kaufman's story), a straight-from-the-shoulder article on radio grounds by Heckert Parker, and "A Selective Screen-Grid Receiver" by Francis Churchill. G. M. Best tells how to make a short-wave adapter for any a.c. receiver. L. T. Carlson describes the construction of a power phone transmitter. James Montagnes illustrates radio control of forest fires in Canada. Maynard J. Columbe gives simple directions for adapting the 115-k.c. superheterodyne to short waves. In addition to the usual departments it is hoped to start a new department on radio pictures, edited by John P. Arnold.

METALLIZED

# *Durham*

## *Resistors for Every Power Purpose!*

NOW, after three years of experiment and research, International Resistance Co. offers a complete line of resistances for all types of receivers, power amplifiers and accessory radio devices at new low costs which represent important savings.

Durham Resistors are supplied in ranges from 500 Ohms to 10 Megohms, while Durham Powerohms range from 1 to 50 Watts and are supplied with every practical type of tip as illustrated. All are constructed upon the well-known Durham Metallized principle which has been approved in every type of service by the most important set and amplifier manufacturers in the country.

As for years past with Durham Resistors, these modern Powerohms are guaranteed for accuracy and absolute dependability.

Samples and full data with accurate operating curves together with prices, supplied upon request.

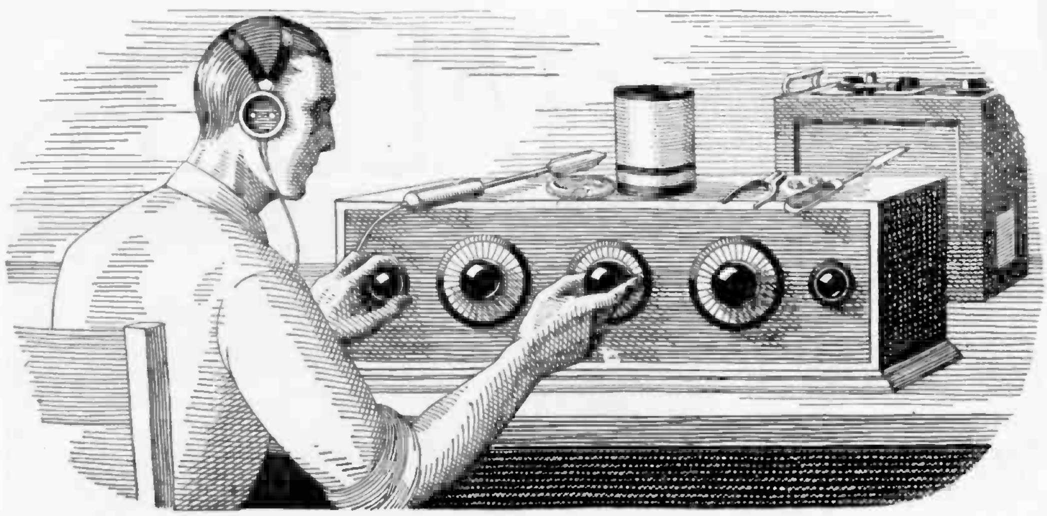
1 *Durham Resistors—500 Ohms to 10 Megohms; standard brass end tip, mould or pigtail type.*
2 *Durham Grid Suppressors—250 Ohms to 3000 Ohms in steps of 100; standard brass end tip.*
3 *Durham Powerohm—1 Watt; 250 to 1,000,000 Ohms; standard brass end tip or pigtail type.*
4 *Durham Powerohm—2½ Watts; 500 to 250,000 Ohms; standard brass end tip type.*
5 *Durham Powerohm—2½ Watts; 500 to 250,000 Ohms; knife-end type.*
6 *Durham Powerohm—2½ Watts; 500 to 250,000 Ohms; soldered end tapped type.*
7 *Durham Powerohm—2½ Watts; 500 to 250,000 Ohms; screw-end type.*
8 *Durham Powerohm—5 Watts; 250 to 250,000 Ohms; soldered end tapped or screw-end type.*
9 *Durham Powerohm—10 Watts; 250 to 250,000 Ohms; soldered end tapped and screw-end type.*
10 *Durham Powerohm—25 Watts; 250 to 250,000 Ohms; soldered and tapped.*
11 *Durham Powerohm—50 Watts; 250 to 250,000 Ohms; soldered and tapped.*
12 *Durham Mounting supplied in various lengths to carry any required number of Powerohms where quick change of resistance is necessary.*

INTERNATIONAL RESISTANCE COMPANY
2½ South 20th Street, Philadelphia, Pa.


**DURHAM METALLIZED**

**RESISTORS & POWEROHMS**

METALLIZED



*If all the Radio Sets I've "fooled" with in my time were piled on top of each other, they'd reach about halfway to Mars. The trouble with me was that I thought I knew so much about Radio that I really didn't know the first thing. I thought Radio was a plaything—that was all I could see in it for me.*

# I Thought Radio Was a Plaything

## *But Now My Eyes Are Opened, And I'm Making Over $100 a Week!*

$50 a week! Man alive, just one year ago a salary that big would have been the height of my ambition.

Twelve months ago I was scrimping along on starvation wages, just barely making both ends meet. It was the same old story—a little job, a salary just as small as the job while I myself had been dragging along in the rut so long I couldn't see over the sides.

If you'd told me a year ago that in twelve months' time I would be making $100 and more every week in the Radio business—whew! I know I'd have thought you were crazy. But that's the sort of money I'm pulling down right now—and in the future I expect even more. Why only today—

But I'm getting ahead of my story. I was hard up a year ago because I was kidding myself, that's all—not because I had to be. I could have been holding then the same sort of job I'm holding now, if I'd only been wise to myself. If you've fooled around with Radio, but never thought of it as a serious business, maybe you're in just the same boat I was. If so, you'll want to read how my eyes were opened for me.

---

When broadcasting first became the rage, several years ago, I first began my dabbling with the new art of Radio. I was "nuts" about the subject, like many thousands of other fellows all over the country. And no wonder! There's a fascination—something that grabs hold of a fellow—about twirling a little knob and suddenly listening to a voice speaking a thousand miles away. Twirling it a little more and listening to the mysterious dots and dashes of steamers far at sea. Even today I get a thrill from this strange force. In those days, many times I stayed up almost the whole night trying for DX. Many times I missed supper because I couldn't be dragged away from the latest circuit I was trying out.

I never seemed to get very far with it, though. I used to read the Radio magazines and occasionally a Radio book, but I never understood the subject very clearly, and lots of things I didn't see through at all.

So, up to a year ago, I was just a dabbler—I thought Radio was a plaything. I never realized what an enormous, fast growing industry Radio had come to be—employing thousands and thousands of trained men. I usually stayed home in the evenings after work, because I didn't make enough money to go out very much. And generally during the evening I'd tinker a little with Radio—a set of my own or some friend's. I even made a little spare change this way, which helped a lot, but I didn't know enough to go very far with such work.

And as for the idea that a splendid Radio job might be mine, if I made a little effort to prepare for it—such an idea never entered my mind. When a friend suggested it to me one year ago, I laughed at him.

"You're kidding me," I said.

"I'm not," he replied. "Take a look at this ad."

He pointed to a page ad in a magazine, an advertisement I'd seen many times but just passed up without thinking, never dreaming it applied to me. This time I read the ad carefully. It told of many big opportunities for trained men to succeed in the great new Radio field. With the advertisement was a coupon offering a big free book full of information. I sent the coupon in, and in a few days received a handsome 64-page book, printed in two colors, telling all about the opportunities in the Radio field and how a man can prepare quickly and easily at home to take advantage of these opportunities. Well, it was a revelation to me. I read the book carefully, and when I finished it I made my decision.

What's happened in the twelve months since that day, as I've already told you, seems almost like a dream to me now. For ten of those twelve months, I've had a Radio business of my own. At first, of course, I started it as a little proposition on the side, under the guidance of the National Radio Institute, the outfit that gave me my Radio training. It wasn't long before I was getting so much to do in the Radio line that I quit my measly little clerical job, and devoted my full time to my Radio business.

Since that time I've gone right on up, always under the watchful guidance of my friends at the National Radio Institute. They would have given me just as much help, too, if I had wanted to follow some other line of Radio besides building my own retail business—such as broadcasting, manufacturing, experimenting, sea operating, or any one of the score of lines they prepare you for. And to think that until that day I sent for their eye-opening book, I'd been wailing "I never had a chance!"

Now I'm making, as I told you before, over $100 a week. And I know the future holds even more, for Radio is one of the most progressive, fastest-growing businesses in the world today. And it's work that I like—work a man can get interested in.

Here's a real tip. You may not be as bad off as I was. But think it over—are you satisfied? Are you making enough money, at work that you like? Would you sign a contract to stay where you are now for the next ten years—making the same money? If not, you'd better be doing something about it instead of drifting.

This new Radio game is a live-wire field of golden rewards. The work, in any of the 20 different lines of Radio, is fascinating, absorbing, well paid. The National Radio Institute—oldest and largest Radio home-study school in the world—will train you inexpensively in your own home to know Radio from A to Z and to increase your earnings in the Radio field.

Take another tip—no matter what your plans are, no matter how much or how little you know about Radio—clip the coupon below and look their free book over. It is filled with interesting facts, figures, and photos, and the information it will give you is worth a few minutes of anybody's time. You will place yourself under no obligation—the book is free, and is gladly sent to any one who wants to know about Radio. Just address J. E. Smith, President, National Radio Institute, Dept. 7-R, Washington, D. C.

J. E. SMITH, President,
National Radio Institute,
Dept. 7R, Washington, D. C.

Dear Mr. Smith:

Please send me your 64-page free book, printed in two colors, giving all information about the opportunities in Radio and how I can learn quickly and easily at home to take advantage of them. I understand this request places me under no obligation, and that no salesman will call on me.

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Address........................................

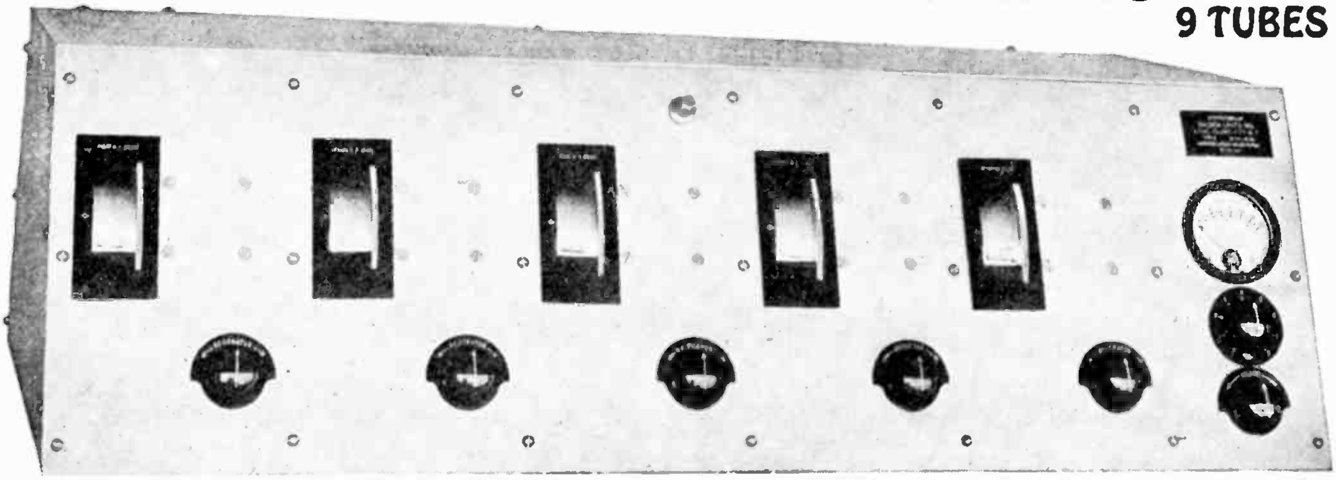
Town........................................ State....................

Occupation........................................

LEUTZ

# UNIVERSAL TRANSOCEANIC

9 TUBES



# TRUE SELECTIVE POWERFUL

## NEW IMPROVEMENTS

THE UNIVERSAL TRANSOCEANIC has now been completely redesigned to use the new 222 Screened Grid Tubes in the four stages of radio frequency amplification. The total radio frequency amplification is now approximately 810,000 compared with only 10,000 obtained with the 201A tubes. This allows increased receiving range, greater volume on distant signals and without any loss in selectivity. The detector circuit has been altered to use the new 200 type detector.

The audio amplifier has been further improved, a total of four stages being employed, two of these stages in a push-pull system. The push-pull power amplifier will take either two 210 or two 250 power tubes, the most powerful audio amplifier one could desire. The undistorted output available for the loud speaker is approximately five times greater than a receiver using only one 210 or 250 power tube.

The 400/500 Volt DC Current Supply has been changed to the full wave type using two 281 rectifier tubes for increased output. Provision has been made to use a Dynamic speaker if desired. The addition of the Leutz "A" Current Supply having a capacity of 3 amperes at 6 volts makes it available for all electric operation.

*Present owners of Transoceanics can have the above improvements added to their receivers at a nominal cost, sending the receiver to our factory.*

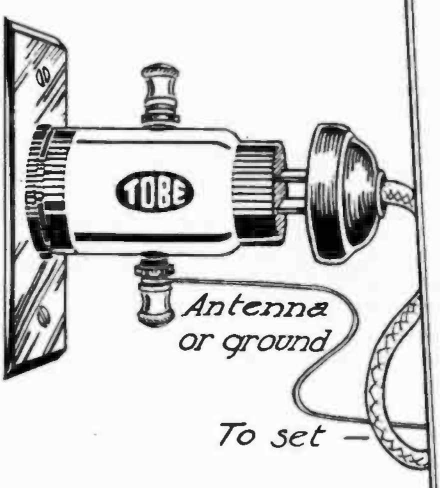
WRITE FOR LATEST LITERATURE TODAY

C. R. LEUTZ, Inc., 195 Park Avenue, Astoria, New York

# QUALITY AT LOW COST

# 4 PURPOSE LIGHT-SOCKET AERIAL and POWER OUTLET

TOBE




## COMBINES
### 4 RADIO CONVENIENCES
**in one small unit at a negligible cost**

1. A perfect indoor antenna, eliminating static pick-up and giving clear, pure tone reception, or—

2. A convenient and efficient ground without troublesome water pipe connections or long wires, and—

3. A power socket outlet which may be used for operating set, B eliminator, power pack, charger or any electrical apparatus, and

4. Takes the place of a lightning arrester, protecting the set from all high potential atmospheric discharges.

**The most convenient of all recent radio developments. With it your set is as self-contained and as easy to operate as a reading lamp.**

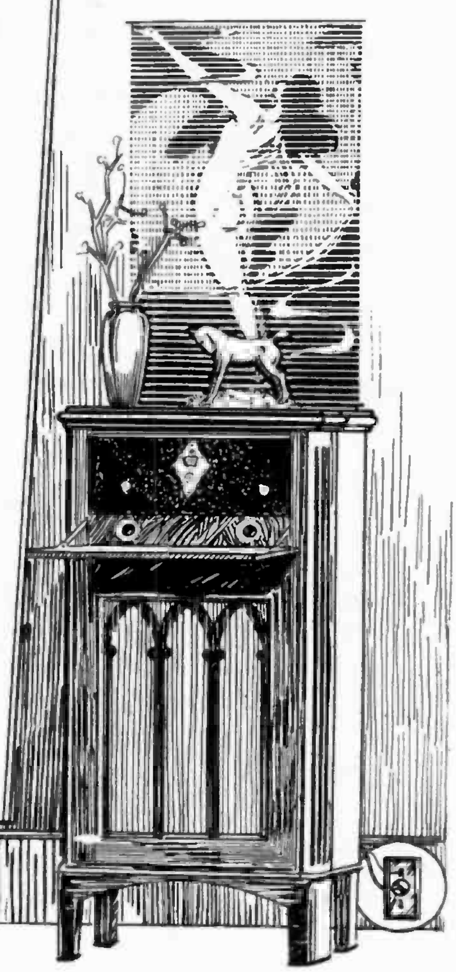
### TWO-YEAR GUARANTEE

**Each "4 Purpose Aerial" is sold with a TOBE iron-clad two year replacement guarantee.**

### TEN-DAY FREE TRIAL

**Special arrangements with your dealer enable you to test the "4 Purpose Aerial" in your home for ten days free trial. If you are not absolutely satisfied after using with your own set and under your own receiving conditions, your money will be returned to you without question.**

***Secure your "4 Purpose Aerial" now!***



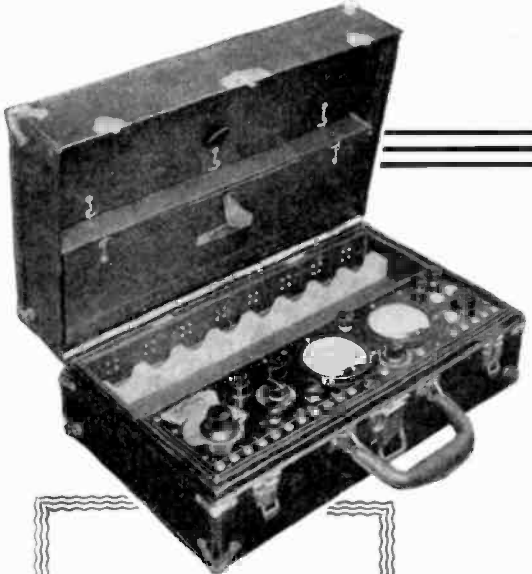
$2.00

10 DAYS FREE TRIAL

*2 year replacement guarantee*

# TOBE DEUTSCHMANN CO.

CAMBRIDGE, MASS.



# A.C. SUPREME SERVICE INSTRUMENTS D.C.

Trade Mark Reg. U. S. Pat. Off.

## FOR DEALERS, SERVICE MEN AND PROFESSIONAL SET BUILDERS

**"Supreme" Model 100A**

**Radio Service Instrument and Travelling Case**

Instrument lifts out of case. Fully equipped with instrument, all tools, and supplies necessary for a service man to step out on a job. This case contains compartments for everything and has a tube shelf designed for instant accessibility but absolute protection to tubes. Under this swinging shelf are felt-lined compartments for small tubes, oscillator coils, etc. Has lock and key. Strong leatherette covered case, size 10½x18x7 inches. Price complete, $98.50 net. Equipped with large A.C. meter O-3, O-18, O-150 volt triple scale with leads, in leather case. $11.00 extra.

Installment plan. $28.50 cash and 8 monthly payments of $10.00 each.

HERE ARE A FEW REASONS WHY THEY ARE TELEGRAPHING ORDERS FOR SUPREMES

1. The tube broadcaster sends out a modulated wave to test radios at any time, any place.
2. It is the only oscillator with which you can synchronize condensers in single dial control radios with both meter reading and audible sound.
3. It tells the oscillation quality of all tubes and whether they are normal, abnormal or subnormal.
4. It rejuvenates up to twelve tubes at one time in a scientific manner. In or out of the radio.
5. It locates open transformers from the socket and has a feature that it will play the radio with bad transformers for estimating, to locate further trouble.
6. It will demonstrate condenser and choke coil outputs on radios not wired for that purpose and also inductive output.
7. It will test fixed condensers and has a calibrated .0005 variable condenser.
8. It has contained various fixed condensers up to 2. mfd, a 500,000 ohm variable resistance and a 30 ohm variable resistance for your use at any time and for quick demonstration purposes.
9. And it will make every milliammeter and voltmeter test imaginable.
10. It is equipped with a high resistance double scale precision voltmeter, O-10, O-250 volt for all eliminator and other readings requiring a meter using only .001 ampere at full scale. The millimeter is O-100 and both meters are large 3¾" diameter with jeweled D'Arsonval movement, fully guaranteed. The A.C. Meter has three scales, O-3, O-18, O-150, which is portable and has leads to plug into the Supreme pin jacks.
11. The book which goes with the Supreme is entitled "How to Service Radios and Money-Making in Radio Service," and is some book.
12. All adapters, double plug cords, test cords, etc., for A.C. and D.C. work are standard equipment.

Our Engineering Department is at the service of Supreme owners at all times to help them in their service work and is worth the price of the instrument. However, in the Supreme you get an assembly that you could not duplicate yourself at the price and you get three years development. Send for one today, and watch your service business take a decided boost.

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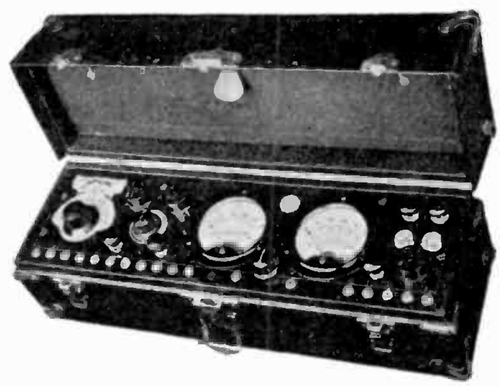

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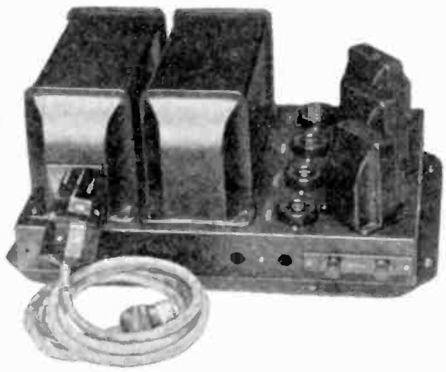

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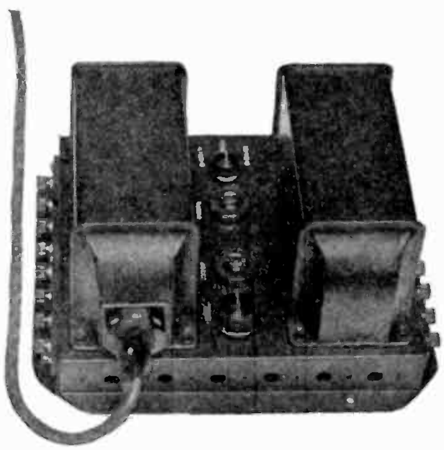

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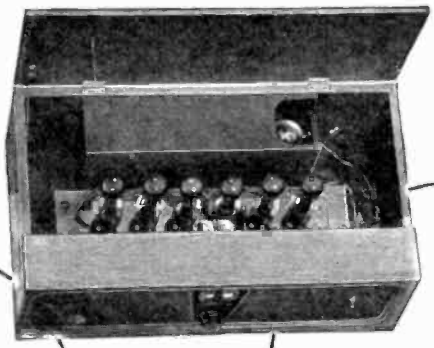

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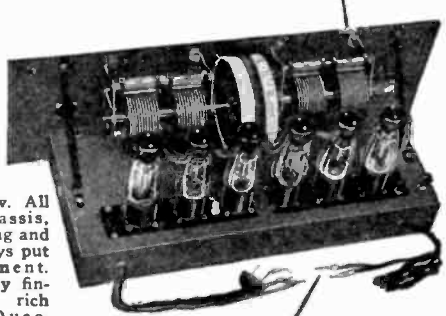
Console Model. A beautiful solid walnut cabinet finely finished. Equipped with "Peerless" Speaker. Size 26"x40"x 16" deep.



Rear View. All metal chassis, very strong and rigid, stays put in shipment. Beautifully finished in rich brown Duco. Panel sizes—7"x18", or 7"x21".

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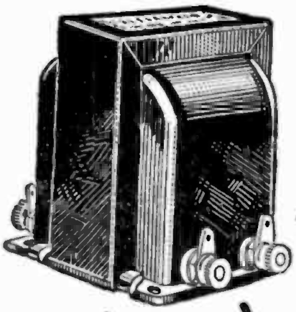

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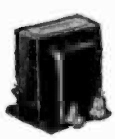

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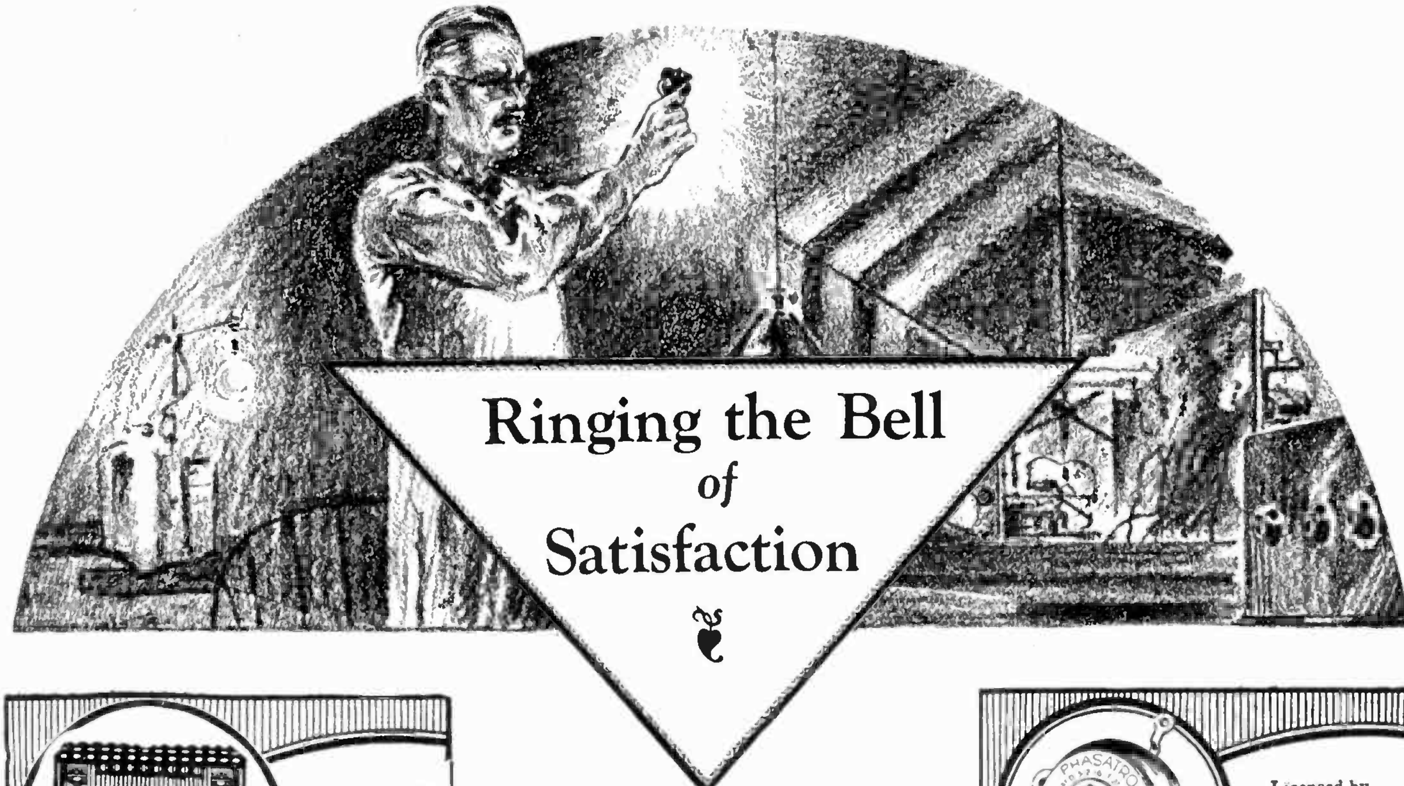

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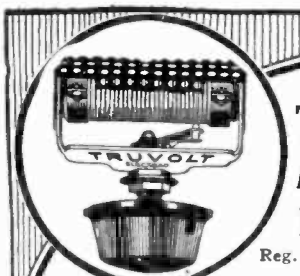



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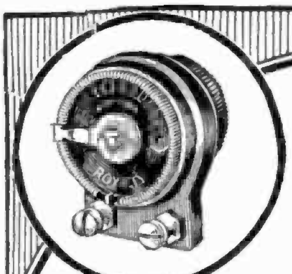

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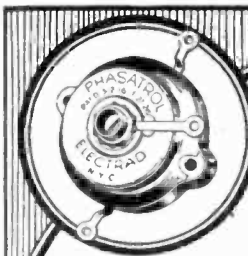



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# RADIO

VOLUME X | JULY, 1928 | No. 7

## Radiotorial Comment

### *The Scramble for Short Waves*

The past few months have witnessed a wild scramble for the privilege of using the short waves between 5 and 200 meters, which were once considered worthless. They were given as a plaything to the amateurs when these enterprising young men were crowded out of the 200 to 550 band of wavelengths by the broadcasters. With characteristic ingenuity and energy the amateurs soon astounded the world with remarkable records of long-distance transmission even when using very little power. Their erstwhile toy suddenly became valuable and once again the amateurs are faced with attempts to wrest from them that which they have developed.

In the band of wavelengths between 5 and 200 meters, or more technically, between 60,000 and 1500 kilocycles, there are 5,850 channels each 10 kilocycles in width, as compared to the 96 channels now available for broadcast telephony.

At the International Radiotelegraph Convention in November certain of these frequencies were allotted for amateur use, some of them being exclusive and some to be shared with other services. The exclusive allocations include the 300 kilocycles or thirty 10 k.c. channels between 41 and 42.8 meters, and the 400 kilocycles or forty 10 k.c. channels between 20.8 and 21.4 meters. There are also 2000 kilocycles between 10 and 10.7 meters and 4000 kilocycles between 5 and 5.35 meters which are reserved for amateur and experimental use, but which yet have many difficulties in practical use. The amateurs also share with various fixed and mobile services the 285 kilocycles between 150 and 175 meters and the 500 kilocycles between 75 and 85 meters.

This means that about one-eighth of the frequencies in this band is now open to amateur transmission, of which 700 kilocycles of usable frequencies are exclusive, 785 kilocycles are shared, and 6000 kilocycles are yet to be applied to practical use. All the other frequencies, including 850 kilocycles for broadcasting, are reserved for various governmental and commercial services.

While the amateurs are not entirely satisfied with these limitations, they are working contentedly and with little or no interference to other services. But in the absence of specific permission to use the short waves, certain commercial interests, especially a number of newspapers, have acquired amateur licenses and are transacting commercial traffic thereunder. This is contrary to the law which provides that an amateur shall have no pecuniary interest in his work and which specifically prohibits him from broadcasting news, this being classified as a limited commercial service.

Not only are these stations violating the law which governs amateur transmission privileges, but they also have had the temerity to complain of amateur interference with their news broadcasts and to request that amateurs refrain from using the amateur channels upon which these broadcasts are made under the disguise of amateur call letters. Naturally the amateurs resent and have protested against this invasion of their privileges.

A happy solution to this difficulty has been effected by the Federal Radio Commission in the granting of twenty short-wave channels to the American Publishers Committee, by whom the various newspapers will be given allocations. Thus the newspapers are given what they now need and the amateurs may continue to use their present channels without commercial interference therein.

But this episode is but a mere incident in the battle that is being waged by conflicting interests who desire to secure short-wave channels. Although all frequencies between 1500 and 28,000 kilocycles were reserved by the International Radiotelegraph Convention, relatively few definite assignments have yet been granted by the Federal Radio Commission. The Radio Corporation of America and the Mackey Company have each been granted fifteen channels, the American Telephone and Telegraph Company nine, the Robert Dollar Company eight, and the Tropical Radio Telegraph Company seven. A large number have also been reserved for Army and Navy use as well as for airplane communication.

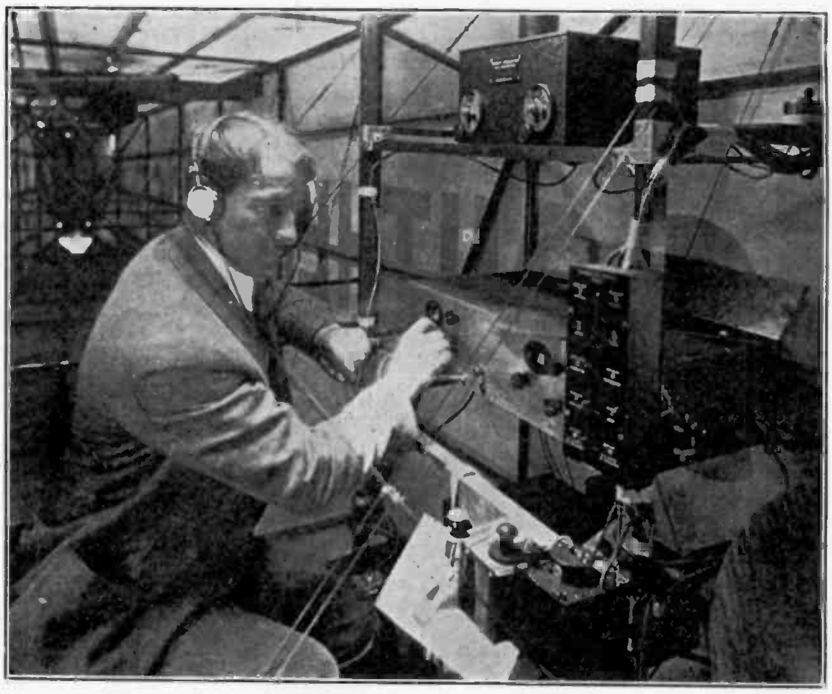
So far as is now known no specific allocations have been made for the radio transmission of pictures, the regular broadcast and commercial channels sufficing for the little that is now being done. This new art, especially the transmission of moving pictures by radio, may eventually require more space than will be available unless the Commission is most sparing in its allocations to other services. A 100-kilocycle band is necessary as a single channel for the eventual transmission of a moving picture having the fineness or definition in a small image no better than that given by a newspaper half-tone. Even a small picture having ninety-six lines to the inch requires an 80-kilocycle band for its transmission. In view of these facts the Commission would seem to be justified in granting permission to use a number of wide channels especially for experiments in picture transmission.

If further evidence were needed as to the value of this short-wave prize, for which there are so many claimants, ample proof is provided by the remarkable radio communication maintained by the "Southern Cross" during its flight toward Australia. Never was it out of radio touch with the world while crossing the vast expanse of the Pacific. With but 50 watts power on 33 meters its signals were always picked up by ship or shore stations so that anxious waiters were constantly informed as to its conditions and its progress. This would have been an impossible feat on long waves. The prize is valuable, may its allocation be equitable!

# Radio's Part in the "Southern Cross" Flight

*By* JACK KAUFMAN

ONCE again short wave radio history has been written in a flight across the Pacific Ocean, and the value of short wave radio transmission to long distance aviation conclusively proven. The flight of the *Southern Cross*, from San Francisco Bay, California, to Brisbane, Australia, via Honolulu and the Fiji Islands, during which complete reports by short wave radio telegraphy were sent and received continuously, was of tremendous interest to the entire aviation industry, as well as to the public generally. The newspapers gave unusual publicity to the feat, stressing the value of the short wave transmission from the plane, which kept the listeners on shore and at sea in constant touch with the plane's progress, so that there was no doubt as to the condition of the fliers at any time during their three periods of flight.



*Interior View of "Southern Cross," Showing Radio Installation*

Those who were fortunate enough to be listening to the transmission from KHAB, the *Southern Cross*, were able to follow its course from hour to hour with scarcely a break, and the public, through the published newspaper radio log, was equally well informed. But there has been little accurate information as to what comprised the radio equipment, so that a description should prove of interest not only to every radio amateur, but also to those concerned with aviation or other commercial applications of short wave transmission.

The radio equipment was designed by Ralph Heintz, of the firm of Heintz & Kaufman, Inc., San Francisco, who have been active in the field of short wave transmission and reception for a number of years, and was built and installed by that company. Following the successful demonstration of the capabilities of the short wave transmitter used on the ill-fated *Dallas Spirit*, a description of which appeared in October, 1927, RADIO, Captain Kingsford-Smith of the *Southern Cross* had a duplicate outfit installed in his plane, late in the fall of 1927. Two endurance flights made during the winter, in an attempt to establish a new endurance record, gave ample opportunity to test the transmitter. As described in detail by J. G. Eisenberg in May, 1928, RADIO, a detailed log covering some ninety-seven hours of flight was kept, proving that the transmission from the plane, on a wave length of 33.4 meters, was relatively free from skip distance and fading effects, and would be thoroughly reliable for a trans-Pacific flight.

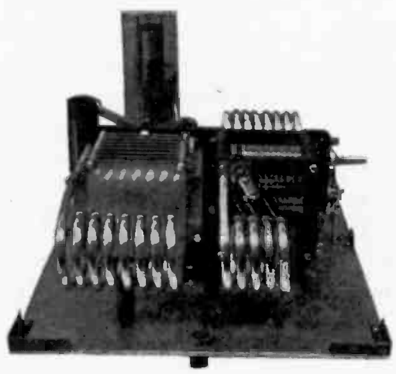


*Fig. 2. Constructional Details of Short Wave Transmitter*

With perfect confidence, therefore, in the reliability of the radio equipment, the *Southern Cross* left Oakland on May 31, reaching Honolulu on June 1, and after a rest of thirty-six hours, covered the 3138 miles from Honolulu to Suva, in the Fiji Islands, without mishap. During this time, totalling exactly sixty-two hours, the radio transmitters worked continuously, for when not sending a message, the key was left closed so that the carrier wave could be heard by those on shore, as an indication that the plane was continuing on its course safely, except when working on 600 meters, when the short wave set was cut out altogether. At no time was the plane out of hearing of a shore station, and while its signals were not heard consistently on the Pacific Coast during the last six hours of its second hop from Hawaii to Fiji, they were heard by any number of stations at Hawaii, Samoa, Fanning Island,

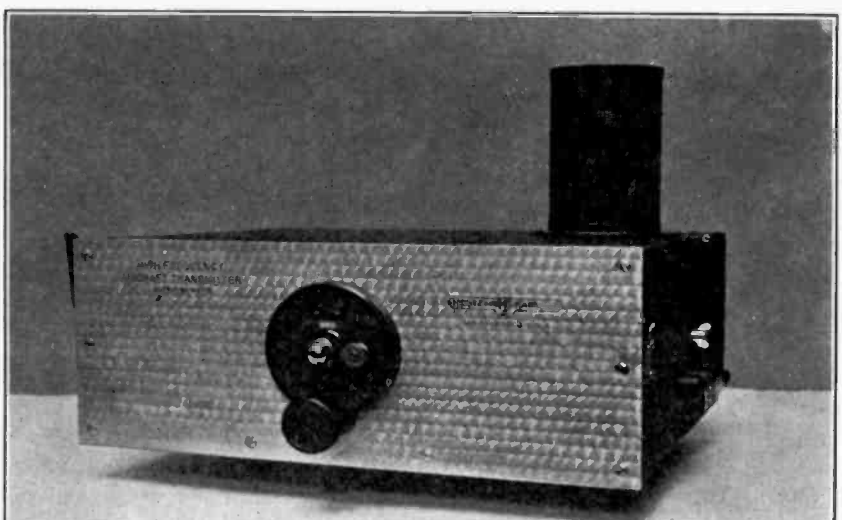


*Fig. 1. Short Wave Transmitter on "Southern Cross"*

and various other points where short wave receivers were installed.

The radio equipment consisted of three transmitters and three receivers; a short wave transmitter operating on 33.4 meters, a commercial wave transmitter adjusted to 600 meters, and an emergency spark transmitter for use in case the plane was forced down. The receiving set consisted of a two stage audio frequency amplifier and three receiving units, all mounted in one aluminum case, so that any of the three receivers could be used by throwing a switch, with the headphones plugged in the output of the audio amplifier common to all three receivers. A short wave receiver covering all the amateur bands, an intermediate wave receiver for 600-meter ship or shore work, and a radio beam receiver for receiving U. S. Army radio beacons operating on 1034 meters, comprised the three receiving units. The total weight of this receiving outfit, together with the three transmitters, was exactly 100 pounds, a surprisingly small weight considering the amount of apparatus represented.

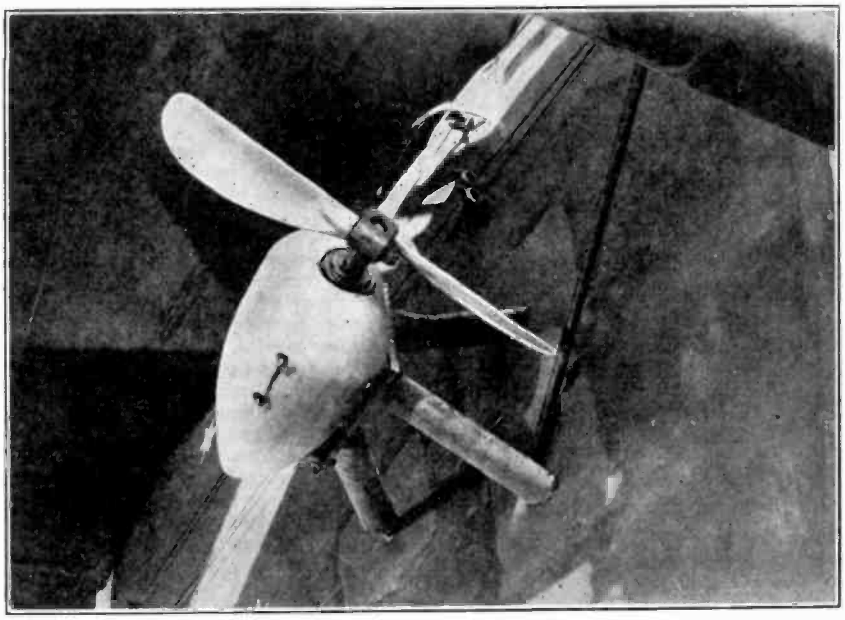


*Fig. 5. Wind-driven Generator in Housing, on Fuselage of "Southern Cross"*

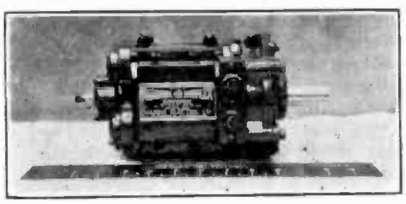


*Fig. 4. Generator Assembly, Showing Relative Size*

The main transmitter was the 33.4-meter set, a picture of which is shown in Fig. 1, while the actual construction is shown in Fig. 2. The transmitter is of the tuned-grid tuned-plate type, the circuit of which is given in Fig. 3, and employs one 50-watt type UV-211 tube, with plate and filament supply from a two-unit wind driven generator. This generator is shown disassembled in Fig. 4, and is also shown in place on the side of the plane in Fig. 5.

The generator is a special Aladdin-Duplex built by the Harris Electric Co. of San Francisco, and provides two a.c. voltages, both 240 cycles, one of 10 volts for the filament and the other 65 volts for the plate transformer, which in turn steps up the voltage to 900 before being applied to the plate of the tube. Duplicate generators were mounted on each side of the fuselage, on the under part of the wing, and were automatically connected or disconnected in case one of them failed during transmission. The generators, driven by 18-in. impellers, were so designed that no matter what the speed of the impeller, the generator voltages would always remain constant. No small part of the credit for the successful transmission from the plane is due to these generators, as the use of generators having poor voltage regulation would have resulted in a wobbly signal which might have been impossible to follow. The antenna consisted of a wire approximately 26 feet long, weighted at the free end, and suspended from a take-up reel on which was mounted the radiation ammeter. This reel is shown in Fig. 6. When operating on 600 meters, wire from another reel is run out until resonance at 600 meters is obtained.

The 600-meter transmitter was identical in general construction with the 33-meter outfit, and was used during the flights for communication with ships, and such shore stations as had no short wave receivers. The range of this transmitter was much less than that of the short wave outfit, and served more as an auxiliary to the latter. Both transmitters were contained in aluminum cases, mounted one above the other on the side of the navigator's chamber, projecting only about 8 in. from the wall.

The emergency transmitter was designed for use in case the plane was forced to light in the water, and hence was made completely waterproof. It consists of a 1-in. spark coil transmitter, very broadly tuned to 600 meters, and supplied with power from a 9-volt hot-shot dry cell battery. The entire transmitter was self-contained in a water-tight box, with the key underneath a rubber-covered hole in the box, so that to key the transmitter, the rubber was pressed, thereby operating the key underneath, but preventing water from entering the transmitter.

The antenna for the emergency transmitter consisted of a 200-ft. section of stranded wire, suspended in the air by a hydrogen-filled balloon, such as is used in the meteorological service. A deflated balloon fastened to a small tank of hydrogen under pressure was carried on the flight, so that it could instantly be filled by turning on a valve and releasing the balloon. Sufficient power could be obtained from the batteries to operate the set for eight hours, and tests made

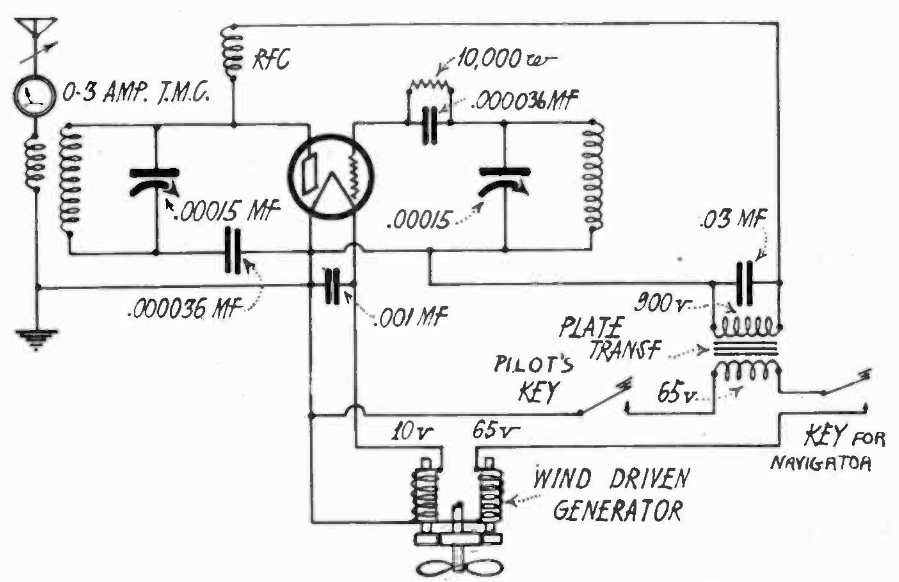



*Fig. 3. Circuit Diagram of "Southern Cross" Transmitter*

with it before the flight showed that it had a range of over 200 miles at night, thus enabling the fliers to broadcast their position to any ships in their vicinity.

Reports from various parts of the world have been pouring into San Francisco since the flight, telling of the reception of signals from the plane. Without taking into account the recording of extreme distance reception, the reliability of the short waves for aircraft transmission, giving continuous communication with shore stations during a flight of over 7000 miles, is a direct refutation of recent statements by several writers that the short waves are worthless for aircraft use. During the flight to Honolulu, a number of commercial messages were exchanged between the plane and a shore station in San Francisco, thus establishing the first commercial message service of its type. Signals from the plane were picked up in South Africa by FO-A3V, at Bloemfontein, indicating the remarkable range of the short wave transmitter.

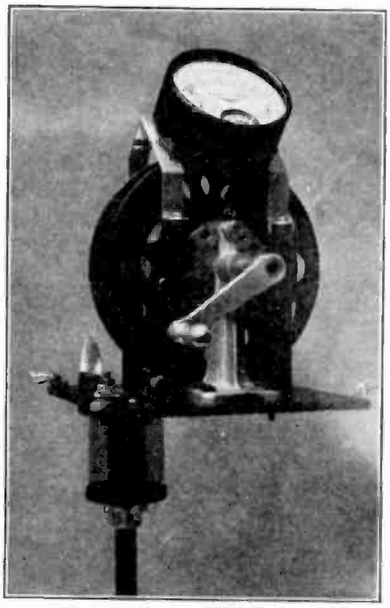


*Fig. 6. Antenna Reel, with Radiation Meter*

It may be of interest to know that Commander Richard Byrd has equipped his plane, the Floyd Bennett, with transmitting and receiving equipment similar to that used on the *Southern Cross*, and expects to use this equipment in maintaining contact with his base of supplies during the projected flights over the South Pole this year.

One of the most remarkable features of the flight was an incident which occurred when the plane was flown from the Victoria Park landing in the town of Suva, Fiji Islands, to Naselai Beach, about 20 miles from Suva, where the takeoff to Brisbane was made the day following. Two stations in San Francisco which had maintained constant watch on the plane's wave since leaving the United States were listening in on June 6th in the early evening, at the time the plane was scheduled to hop off for Australia, and picked up the carrier wave from the plane for a period of about 10 minutes, while the plane was making the short flight to the beach. No pre-arranged schedule had been contemplated, and the operator on the plane did not send any messages, but simply tied down his key for a few minutes, and signed off with his call letters just before the plane landed on the beach.

During the first few hours of the flight from San Francisco, and from the Barking Sands take-off at Hawaii, the U. S. Army radio beacon signals were heard, but they were lost thereafter, and not again picked up, indicating that to make this service reliable for long distance flights, either the power of the beacon transmitter must be increased, or it should be adapted to short wave transmission so as to increase the range. This beacon was described fully in the August, 1927, issue of RADIO, and was first used for the flight of Lieutenants Maitland and Hegenberger in the Army's Fokker plane, practically a duplicate of the *Southern Cross*.

## SOME SHORT WAVE PHONE STATIONS

| *Call Letters* | *Location* | *Wavelengths* |
|---|---|---|
| AGC | Nauen, Germany | 17.2, 26.0 39.8, 40.2 |
| AGJ | Nauen, Germany | 56.7 |
| ANE | Bandoeng, Java | 17.4 |
| ANH | Malabar, Java | 17.4, 27.0, 32.0 |
| A-2FC | Sydney, N.S.W., Australia | 32.0 |
| A-2ME | Sydney, N.S.W., Australia | 28.5 |
| A-3LO | Melbourne, Australia | 29.8, 32, 36 |
| F-8GC | Radio LL, Paris | 60. |
| G-2NM | G. Marcuse, Caterham, England | 32.5 |
| G-5SW | Chelmsford, England | 24. |
| I-1AX | Rome, via Savoia 80 | 45. |
| JB | Johannesburg, South Africa | 32. |
| KDKA | Westinghouse E. & M. Co., East Pittsburgh, Pa. | 39, 68. |
| PCJJ | Philips Lamp Works, Hilversum, Holland | 30.2 |
| U-2XAA | Houlton, Maine | 22.99 |
| U-2XAD | G. E. Co., Schenectady, N. Y. | 21.96 |
| U-2XAF | G. E. Co., Schenectady, N. Y. | 32.7 |
| U-2XBA | Newark, N. J. | 65.18 |
| U-2XE | A. H. Grebe, Richmond Hill, N. Y. | 58.5 |
| U-2XG | W. E. Co., Rocky Pt., N. J. | 16.02 |
| U-6XAI | Inglewood, Calif. | 66.04 |
| U-6XAR | San Francisco, California | 33.00 |
| U-9XU | Council Bluffs, Iowa | 61.06 |
| WGY | G. E. Co., Schenectady, N.Y. | 35. |
| WIZ | R. C. A.,, New Brunswick, N. J. | 43.35 |
| WLW | Crosley Radio Corporation, Cincinnati, Ohio | 52.02 |
| WOWO | Fort Wayne, Indiana | 22.8 |
| WRNY | Coteysville, N. J. | 30.91 |

## WIRELESS TELEGRAPHY IN THE 1927 MISSISSIPPI RIVER FLOOD

*By* Joe H. McKinney

Little did the Mississippi River Commission realize the important role wireless telegraphy would play in a future disaster when they approved the installation of wireless transmitting and receiving equipment aboard their survey boats and dredges at the Dredging Depot, Memphis, Tennessee, in 1923. For four years their small chain of stations carried on efficient communication between the field parties and the Memphis office, expediting the movement of floating equipment and writing new history in river navigation.

In April, 1927, the Commission left St. Louis, Missouri, for New Orleans, Louisiana, on their annual inspection trip. Their steamer, the *U. S. Inspector*, was equipped with a new vacuum tube transmitter, and was manned by one radio operator.

The river was rising fast, but there was little thought of an impending flood. The *Inspector* proceeded south until forced to tie to the bank behind a small island just above New Madrid, Missouri, because of high winds. These strong head winds lasted for several days, causing high waves to wash against the levees already weakened by the rising water. The Commission's only contact with the outside world was by radio. They ordered a constant watch to be kept at the land station in Memphis while the operator aboard the *Inspector* remained on duty an average of 18 hours a day. Relief crews were ordered to the weakening points along the levee in order to top the levees with sand bags. As the wind subsided the *Inspector* proceeded on to Memphis and hence to New Orleans, Louisiana, being at all times in constant touch with flood relief headquarters, having added an extra operator at Memphis in order that a continuous radio watch might be maintained.

As levee after levee gave way, flooding millions of acres and making thousands homeless, radio equipped boats were rushed to the stricken areas. These boats plied the Mississippi and her tributaries, picking up refugees and their effects, feeding them and landing them at the Red Cross Relief Camps in dry territory and along the levees. Where a town was completely isolated from the outside world insofar as communication was concerned, a wireless equipped boat would be rushed to the assistance of the relief workers and inhabitants.

Radio operators were hard to find. The few on duty remained at the key from sixteen to twenty hours a day. All requisitions for relief supplies, communications from flood sufferers to outside friends, Red Cross official business and, in fact, all touch with the outside world from some districts was maintained by radio. Static was exceptionally bad, making it necessary to establish radio relay stations every 150 miles or so from Memphis to Baton Rouge, Louisiana. Answering requests for operators, the Navy sent about thirty men, the Marine Corps twenty. These men had portable transmitters which they installed in towns impossible to reach by boat.

Had it not been for the communication system many more lives would have been lost, relief work handicapped and relatives of flood victims slow in obtaining information. Approval for dynamiting the levee below New Orleans was relayed by radio. In the opinion of the writer, the value of radio proved itself as never before in history except at the sinking of the *Titanic*.

During the peak of the flood, lasting approximately one month, more than four thousand radiograms averaging forty words each were handled by the Mississippi River Commission's radio net alone, employing only fifteen commercial operators.

# The A. C. 115 Kilocycle Superheterodyne

*By* G. M. Best

THE recent announcement of several types of shielded grid tubes for operation from a.c. current supply is of great interest to owners of shielded grid receivers, as it will enable the elimination of the storage battery supply required by previous models of the tube, and thus convert the receiver into full a.c. operation. After obtaining a supply of the new a.c. shielded grid tubes, a 115-k.c. superheterodyne was converted from d.c. to a.c. filament supply, and the results have been so satisfactory that the information is being passed on to those who have already built this set, or are contemplating its construction.

A revised circuit diagram, showing all the connections for a 9-tube receiver, is given in Fig. 1, from which it can be seen that the principal change is in the filament and *C* biasing circuits, there being no changes in the coils, condensers, or the high frequency connections.

The shielded grid tubes which were used were Arcturus, which have a 15 volt heater element and with the cathode connected to one side of the heater, thus requiring only a 4-prong tube socket. These tubes required a separate filament source from that used for lighting the filaments of the rest of the tubes in the set, as no transformer having a 15-volt secondary, as well as 2½ and 5 volts, was available. A G. E. 50-watt bell ringing transformer having secondary voltages of 8, 16 and 24 is adequate for the purpose, as the 16-volt winding is just right for four shielded grid tubes. A special 15-volt filament transformer can be obtained for the Arcturus tube, from most radio supply houses. The heater current of the shielded grid tube, at 15 volts, is .35 amperes, so that the four tubes draw about 1.4 amperes from the transformer.

As can be seen from the diagram, the heater element has one side grounded to the cathode, so that the negative *B* supply, through the *C* biasing resistors, is connected to the cathode side of the heater, which is also grounded. The mixer, oscillator, detector and first audio tubes are of the '27 type, with 2½-volt heater supply and the cathode brought out as a separate connection, so that five-prong tube sockets must be used for these four tubes. There is ample room for these sockets in the shield bases, so that the only constructional change is to remove the four-prong sockets, and substitute the new type. The power tube, which may be of the type '12-A or '71-A, has its filament lighted from a.c. by means of a 5-volt winding on the power transformer which supplies current for the type 227 tubes, and does not require a new socket.

All heater wiring should be run in twisted pairs, and kept away from grid or plate wires. It is preferable to run these wires along the back of the shield base, and terminate the three a.c. pairs at a separate cable terminal, or a group of terminals other than those used for the *B* voltage supply leads, as the use of the same cable for the a.c. as well as the *B* voltages would introduce bad a.c. hum which could not be eliminated.

A 45-volt positive bias is applied to the four '27 tubes, through a 60-ohm variable resistance, which can be obtained in the form of a small resistance strip which may be connected to the two heater terminals of one of the five-prong sockets. The slider is easily adjusted with a screw driver, and once it is set, it can be left permanently adjusted. The a.c. shielded grid tubes have the control grid terminal on the top of the bulb the same as for the d.c. models, and the shield grid is connected to the "G" terminal of the tube socket as is customary with this tube.

The volume control system is the same as for the d.c. model, with a 500,000-ohm variable resistor in the 45-volt *B* supply to the four shield grids, and the plate of the mixer tube. The oscillator tube has a 4½- volt *C* bias, and the four-shield grid tubes receive 1½ volts negative *C*, while the first and second audio tubes receive 4½ and 9 volts negative, respectively. This *C* bias is obtained by means of the voltage drop through a set of resistances placed between the negative *B* supply lead, and the common ground connection to the cathodes of all the a.c. tubes. The power tube has a separate *C* bias resistance, as a '71-A tube might be used in place of the '12-A tube shown in the diagram. The values of the resistances are given in the diagram, and while the plate current total for each individual set may be slightly more or less than that obtained with the experimental model, the resistance values will be near enough for all practical purposes. If the resistances and their associated 1 mfd. bypass condensers seem to be too great an expense, a 9-volt *C* battery, with taps at 1½ and 4½ volts can be used equally as well, and will last a year or more.

The apparatus which will no longer be needed, in converting a d.c. model to a.c., will be the rheostat-switch located in the center of the panel, the filament voltmeter, and the 200-ohm potentiometer. The latter may be used in place of the 60-ohm potentiometer recommended for the positive bias to the type '27 tubes, and in place of the rheostat-switch, a snap switch for turning on and off the 110-volt a.c. line may be installed. An a.c. voltmeter to indicate

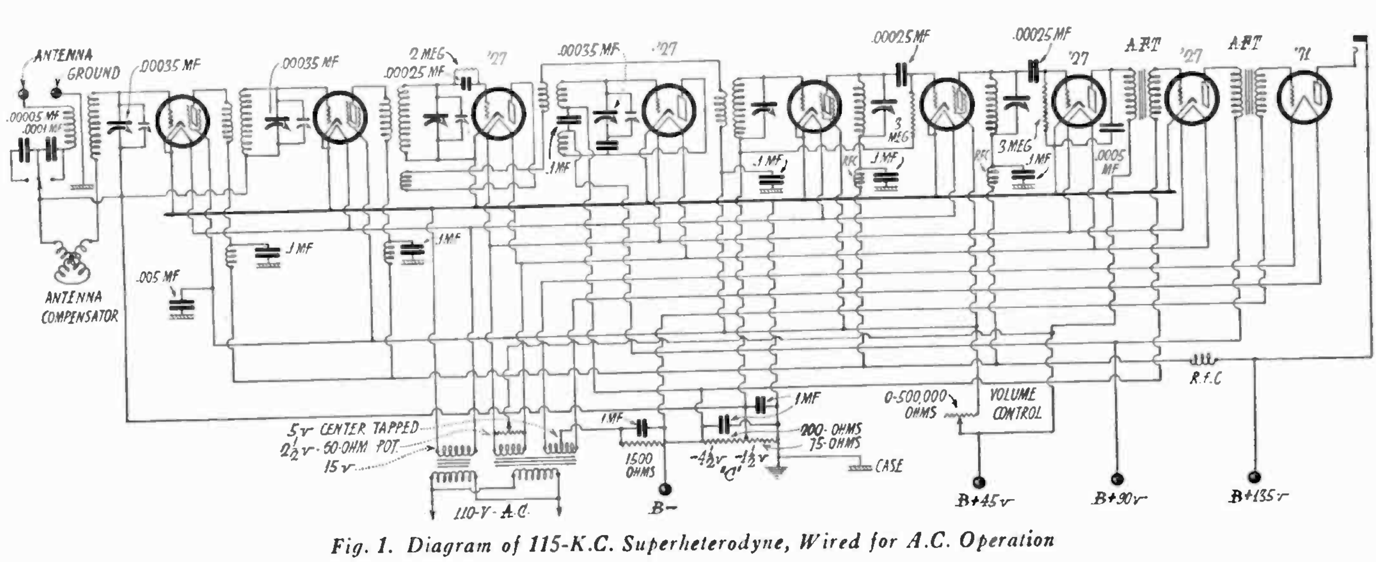



*Fig. 1. Diagram of 115-K.C. Superheterodyne, Wired for A.C. Operation*

the a.c. line voltage and enable the proper regulation of the voltage in case it varies considerably would be a handy adjunct, which could be installed in place of the d.c. voltmeter, but it is not necessary to the operation of the set.

In turning on the set, the shielded grid tube heaters will heat the cathodes of the tubes to full temperature in a few seconds, but the type '27 tubes will require nearly a minute before they will function, so that the set will remain dead during that time. If, after the set is in operation, there is an objectionable amount of a.c. hum, it may be due to several causes. Adjust the positive bias to the type '27 tubes, and make sure that the ground connection is in place. If the hum still persists, it may be due to oscillation of the r.f. amplifier because the volume control is advanced too far. At the extreme setting of the volume control, where the r.f. amplifier has a tendency to oscillate, a certain amount of a.c. hum will occur, and this is not of the deep, 60-cycle type, but rather is a nasal buzzing sound. This noise will not prove objectionable on stations at a reasonable distance from the set, so that for average reception, it will not be noticed.

The audio transformers used in the set are especially good at the very low audio frequencies, and hence they will pass any a.c. ripple which is present in the output of the detector or first audio tubes. By using a heater type tube in the first audio stage, this hum is cut to a minimum, and even when used with an electro-dynamic speaker mounted on a wall type baffle, the hum was not objectionable, although noticeable when no station was being received.

If a.c. shielded grid tubes other than the Arcturus are used, the cathode of each shielded grid tube will be a separate terminal, and five prong sockets will be required for all four-shielded grid tubes. The only change necessary in Fig. 1, in that event, would be to connect the cathodes in parallel with those of the type 227 tubes, and to provide a.c. voltage for the heaters of the shielded grid tubes from a separate filament winding, unless the voltage required happened to be the same as for the 227 tubes, in which case the heaters could be placed in parallel with the 227 tube heaters, and operated from 2½-volt a.c. supply.

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Motor-boating can ordinarily be stopped by connecting a 2 mfd. condenser across the $-B$ and $+$ detector $B$ terminals of both the plate supply unit and the receiver and by inserting a 50,000-ohm resistance between the two terminals.

# The Spider's Web

*By* A. E. KENNELLY

*(As Told to C. William Rados)*

THE general aspects of radio are of tremendous importance to the world today," said Prof. Kennelly as we sat in his book-lined office recently. A. E. Kennelly was formerly president of the Institute of Radio Engineers and also president of the American Institute of Electrical Engineers.

"Due to radio, *genus homo* has become a creature somewhat similar to the spider. His tentacles extend over an area. The spider's web extends his influence over an area far greater than the spider alone can attend to. When anything disturbs the tranquillity of his web, the spider can exert his influence over that object. The radio operator who sits at the base of an antenna weaves a web out over water and air. Wherever the radio influence is felt, there the operator has extended his cûlture, ideas and civilization.

"Think of the value of mass broadcasting in keeping the language the same over large areas. As the listener sits there he is only a part of a group of thousands and possibly hundreds of thousands. Those listeners are isolated only physically. They receive the same ideas and language through the air.

"A disaster comparable to a war, would be the drifting apart of the two great branches of the English-speaking race in language. There is a drift towards separation of the spoken language from the written that is noticed here and in Great Britain. Unfortunately, while the printed language remains the same on both sides of the Atlantic, there has been a gradual trend towards two different spoken branches.

"When the New York-London telephone first opened, the operators had some difficulty in understanding each other. Although they used technical terms which differed on the two shores, they had to ask, 'Are you speaking English?' The drift had already gone so far as to include different technical terms for the same object or action. As broadcasting and other uses of radio, both code and voice, help unify a country's language, so will radio assist in keeping the two branches of the spoken English the same.

"Thirty years ago French was in a fair way to become the official international language. In fact, when I attended the last international radio conference at Washington the official language was French. The tendency today is toward one international radio language. Radio is hastening that. It takes radio about a fifteenth of a second to 'go' from New York to the antipodes, half the way around the world.

"In this one-fifteenth of a second world, radio is an influence tending toward the use of one international language. Around the Mediterranean Sea, French is the language used for official international purposes. On the Atlantic Ocean the international languages are French, English and Spanish. On the Pacific the language is English. Gradual filling of the air with radio tends to make for one world language. Other languages will doubtless survive, but radio is boundaryless, and one common trunk air language will be necessary for general understanding.

"The world is three-quarters water, one-quarter land. Whoever controls the waters and air of the globe by radio, ships, and planes, controls the world. Not in the 'Uber Alles' sense,' he hastened to explain. "I mean 'control' in the sense that civilization and ideas are spread."

"Civilized countries must control the waterways of the world. To mankind with a multitude of land problems the other three-quarters of the surface of the globe is sometimes forgotten. Yet at the Washington conference much time was spent on marine radio.

"Many Asiatics do not love us. To many of them the European is an ignorant man. With this understanding the future might see grave East-West problems. However, radio is a force for mutual understanding, for promoting international peace and amity.

"Last March I attended a meeting in New York held jointly with a meeting of British engineers at London. Three thousand miles across the sea, those men talked to us in New York. They spoke about their views on current problems. They told us how they felt about various matters. Radio will permit more joint meetings. It will help us understand each other.

"Before the telephone was invented, business men used much profane and strong language in their business talk. In the dealings of that period it was customary to swear great oaths and use strong language. The business man who refrained was not one of 'the boys.' Then these business men started using the telephone. Operators were instructed to cut off captains of industry as soon as they started using fiery language. The business men soon found themselves talking to silent machines. The final result was they developed methods of talking which carried on business conversations without the use of improper language."

# A Small Public Address System

## Directions for Assembling a Four Stage Audio Amplifier from Standard Parts

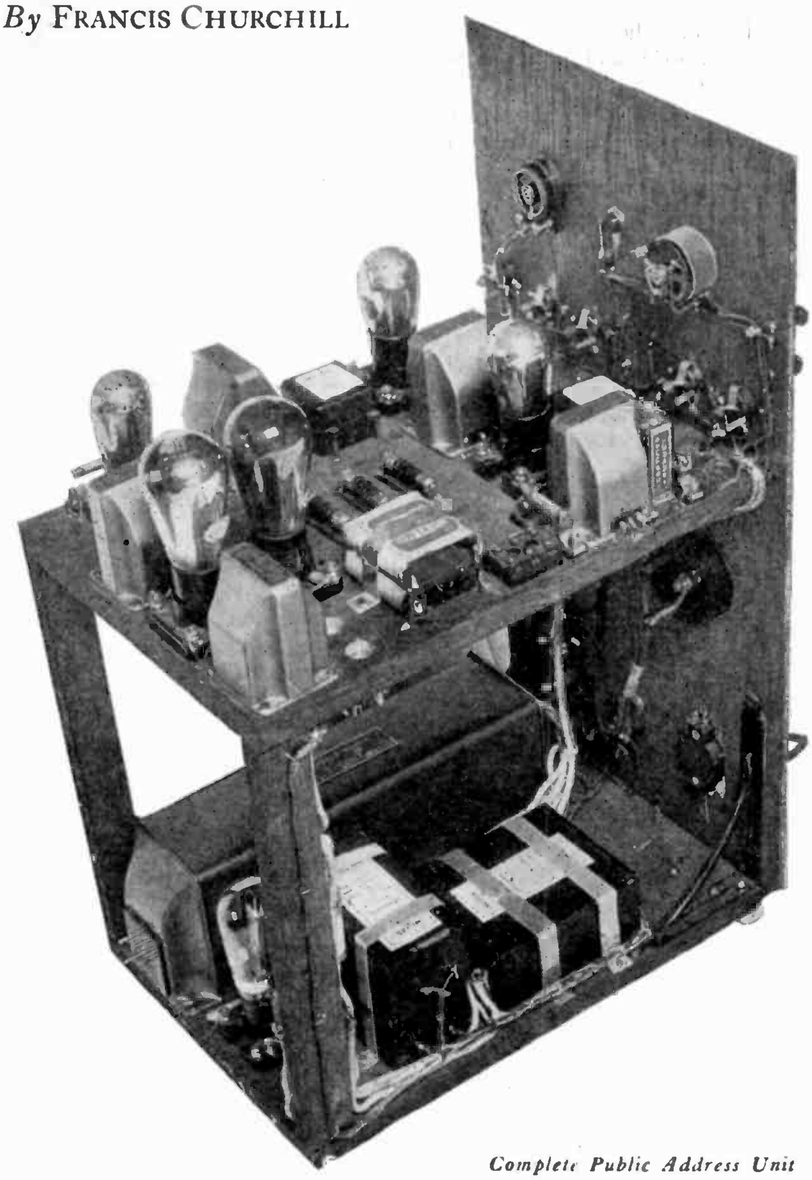
*By* FRANCIS CHURCHILL

THE need for a small public address amplifier to be used in an auditorium can be met at a reasonable cost by assembly from standard parts in accordance with the experimental model here described. It is designed for local pick-up with a microphone or phonograph or to amplify the output of a radio receiver. Exclusive of tubes, microphone and loud speaker, the cost is less than $200.

It employs four stages of amplification, consisting of three equalized transformer-coupled stages and a push-pull output stage for C X 310 or 350 power tubes. The first two stages use *A* tubes and the third stage a 112 tube. It will operate two electrodynamic speakers without overloading. An external 6-volt battery supplies filament current for the first three stages, all other current and voltage requirements being met by the power supply unit which is incorporated in the set.

In the accompanying picture of the complete unit the amplifier system appears on the upper shelf and the power supply unit on the lower shelf. But less a.c. hum would be introduced by assembling them as separate units and keeping them several feet apart.

On the lower portion of the panel are mounted the 110-volt a.c. terminal plate, a switch for turning the output on or off, and four output jacks for the loud speakers. On the center of the panel is a 0-50 milliammeter for measuring plate currents and a 0-15 a.c. voltmeter for measuring filament voltage to the push-pull stage. The milliammeter terminates in a phone plug which can be plugged into



*Complete Public Address Unit*

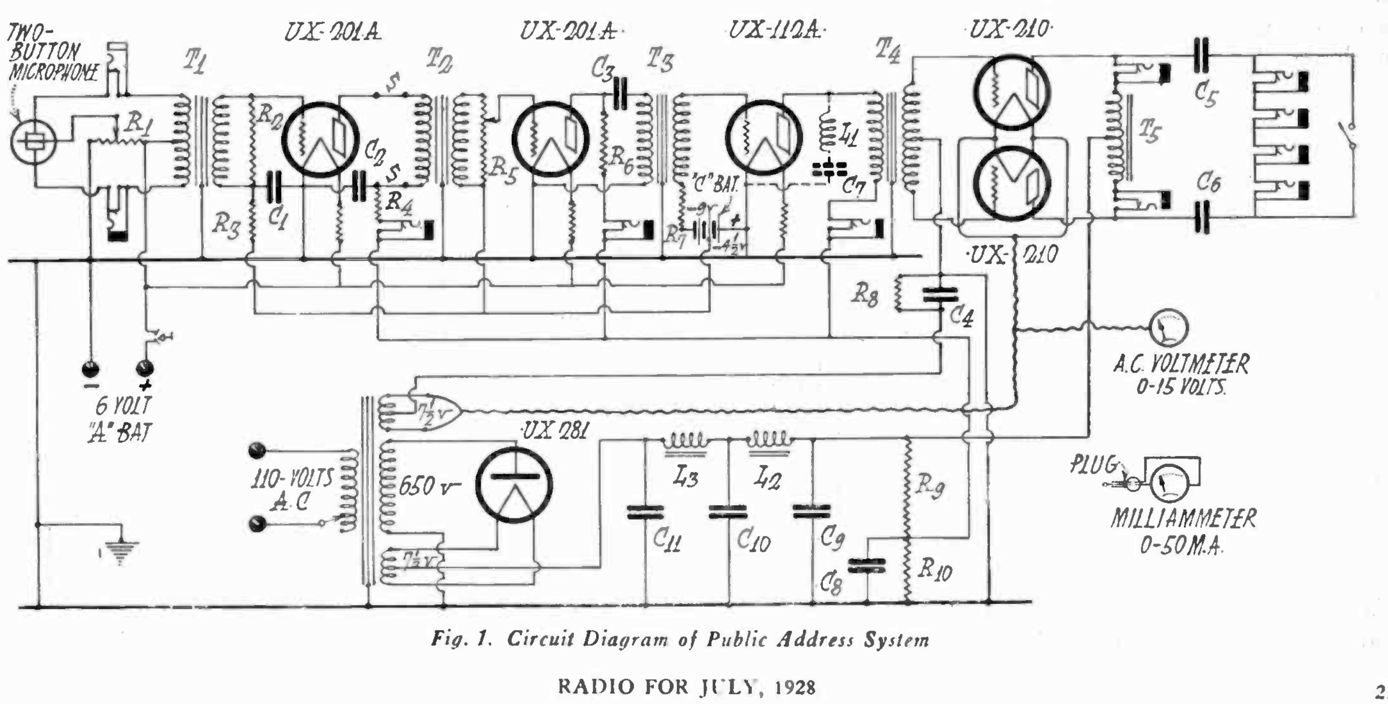
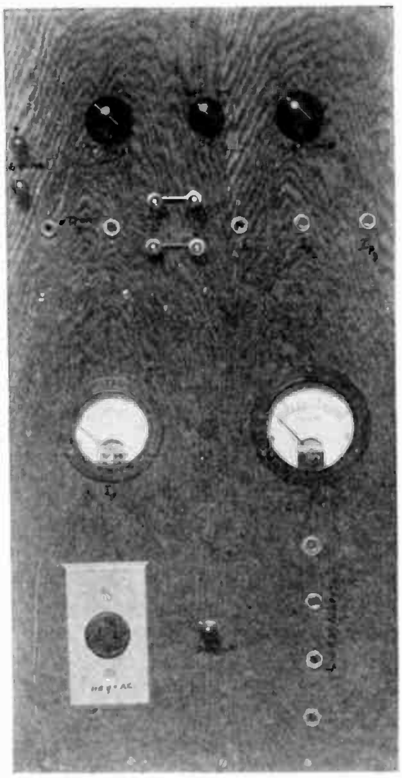



*Fig. 1. Circuit Diagram of Public Address System*

any one of the three jacks above the voltmeter for checking plate current, or it can be plugged into either side of the microphone. The panel also provides for control of microphone current and of volume.

The transformers should be widely separated and all grid and plate leads should be as short as possible. The layout shown in the picture of the amplifier unit is a good one to follow in order to

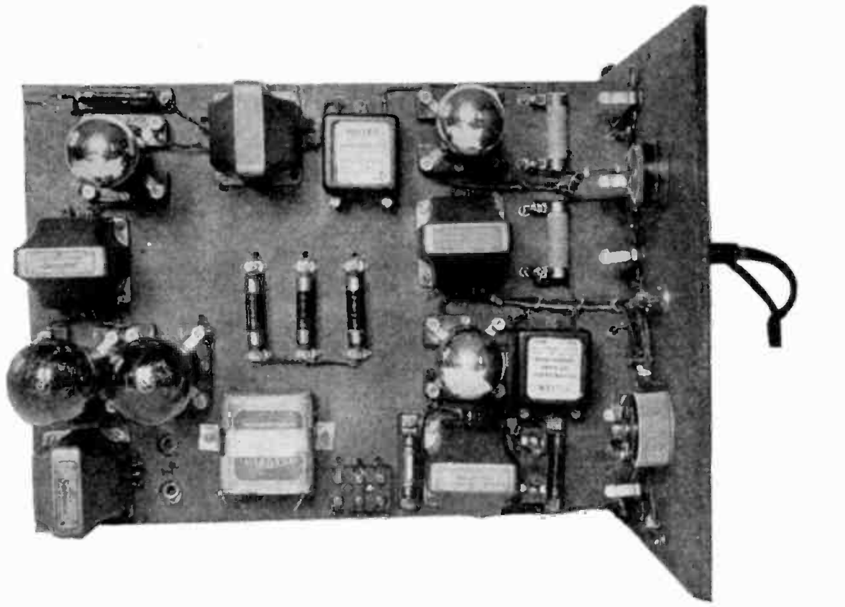


*Panel for Public Address System*

avoid the howling that sometimes results when such high amplification is employed in an audio amplifier.

This great amplification is necessary when using a standard two-button microphone, which has a low output level. Not more than 14 to 18 milliamperes should be used through each side or button, this being checked with the milliammeter by means of the two jacks shown on the panel and wired as shown in Fig. 1. The battery supply is obtained through a 200-ohm potentiometer $R_1$ shunted across the 6-volt storage battery.

Since the impedance of most two button microphones consists of a resistance of about 200 ohms, the microphone transformer for stepping this low impedance of 200 ohms up to some high value, 100,000 ohms, is necessary. It is possible to get a voltage gain of over 20 by means of a good transformer here. The one used was designed for a 200-ohm to 100,000-ohm impedance and when so terminated, has a very excellent frequency characteristic. The impedance of the grid to filament of the tube is very high, so a 100,000-ohm resistance $R_2$ in the form of a metallized leak is shunted across the secondary. The 4½-volt $C$



*Audio Amplifier Section of System*

battery is connected to this transformer through a special resistance filter in order to eliminate any tendency towards oscillation from the common $C$ battery. The audio frequency path is through the condenser $C_1$ to filament, while the 4½-volt negative lead is through the 250,000-ohm resistance $R_3$.

The output of the first tube goes through four binding posts on the front panel. This enables the operator to use the last three stages of amplification by connecting the right hand binding posts to a phonograph electrical pick-up unit, or to the output of the detector tube of a radio receiver. Thus the amplifier system can be used for several purposes.

The plate voltage for the first tube is fed through another resistance filter $C_2R_4$ consisting of a 2-mfd. condenser and a 25,000-ohm resistance. The audio path is through $C_2$ and the d.c. path through $R_4$. The resistance $R_4$ also reduces the voltage from 150 down to about 80 or 90 volts, which is correct for a 4½-volt $C$ bias.

The next transformer $T_2$ is a 1 to 3 ratio high quality transformer having the volume control $R_5$ shunted across the secondary. This volume control should be a 0-500,000-ohm potentiometer, preferably with a logarithmic variation of resistance. It should be tapering in

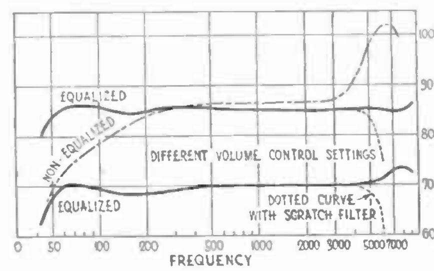



*Fig. 2. Frequency Characteristics of System*

value so that a small turn of the control knob at the high end will cause a large change of resistance and a small change at the lower end. The use of this method of volume control causes a slight change

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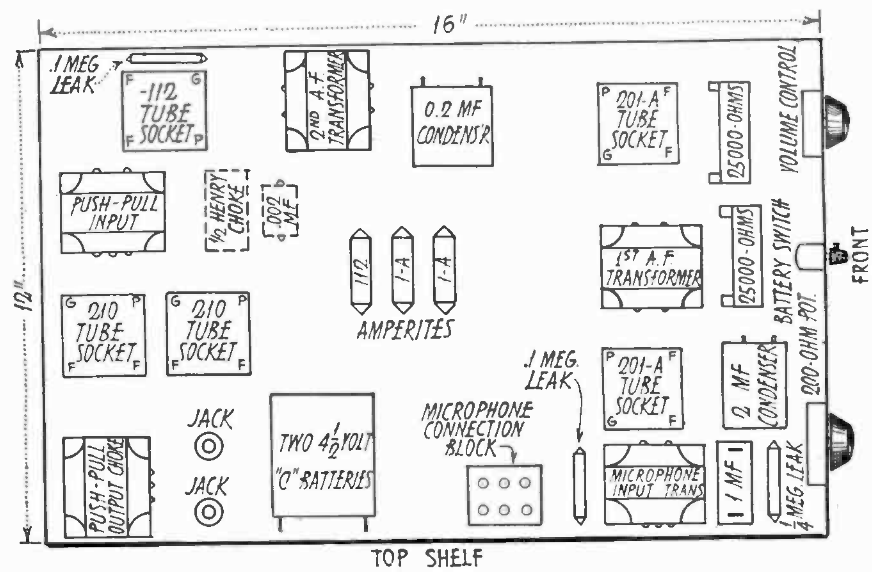



*Fig. 3. Suggested Layout for Audio Amplifier*

# Volume Control Methods

## A Discussion and Comparison of the Various Means Used to Control the Sound Volume from a Receiver

*By* NELSON P. CASE, E. E.

INASMUCH as the method of volume control often makes the difference between an excellent receiver and a mediocre one, it seems that this subject should receive more attention than it has in the past. This article will attempt to give an impartial analysis of all the commonly used methods, in an effort to determine the best method or methods for different types of sets. Obviously there are a number of places in the set where the volume can be controlled. We will take these up, more or less in order, starting with the loud speaker itself.

If the speaker is mounted in a cabinet with doors over the grill, the volume can be controlled to some extent by opening or shutting the doors. This is objectionable, as the presence of the doors in the path of the sound waves results in reflections, interference effects, etc., which alter the tone.

Another method is to shunt the loud speaker with a variable resistance, thus by-passing more or less of the current around the speaker. This would be satisfactory if it were not for the fact that there is every probability that one or more tubes in the set will be overloaded on strong local signals, which results in a badly distorted current being sent to the speaker. This distortion will be present in the output of the speaker, no matter how low the volume is turned. The conclusion is apparent that the loud speaker is not the proper place for a volume control.

Coming now to the audio-frequency amplifier, we find that only one method of controlling volume is available here. This consists of varying a high resistance shunt across a transformer winding, generally across the secondary of the first transformer. The advantages of this method are: smooth, noiseless control, no losses introduced into radio frequency circuits, and improvement in the tone where transformers of dubious characteristics are used.

The latter action is brought about in the following way: poor transformers have very pronounced resonant peaks, which are usually located somewhere between 800 and 2000 cycles. Where the loud speaker response is already very good, the action of the shunt resistance is to add to the damping, thus broadening the resonant peak and reducing its amplitude. See Fig. 1. The lower the shunt resistance, the greater is this effect; since the resistance will be lowest when receiving a local station, the action is to

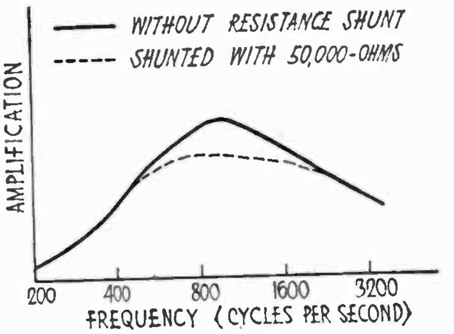



*Fig. 1. Effect of Shunt Resistance*

improve the tone on locals more than on distant stations; this is desirable because quality is not usually one of the prime features of distant programs, anyway, due to the presence of static and other noises which are unavoidably picked up with the signal. If the resistance is placed across the secondary of the first transformer, it will produce the maximum improvement in tone quality.

To see why this should be so, we must examine the conditions of the circuit a little more closely. The normal load on the transformers consists almost entirely of the plate impedance of the preceding tube, which is effectively shunted across the primary of the transformer. In general, the plate impedance of the detector tube is much higher than that of any succeeding tube, so the effective load on the first transformer is less than that on any of the others. Hence it is desirable to introduce our extra load on this transformer.

If the transformers are of the modern high quality type, the damping action is not necessary, and in this case the connections are often changed so that the high resistance is hooked up as a potentiometer or voltage divider. Even in this case, however, it is still desirable to place the volume control in the first stage, in order to prevent overload on the first audio amplifier tube. The only objection to this system of volume control is that it does not prevent the detector from becoming overloaded on strong local signals, if plenty of radio-frequency amplification is being used. Since most present-day receivers do employ a great deal of radio-frequency amplification, however, it seems that this objection is sufficiently strong to justify the statement that the volume control should come on the radio-frequency side of the detector, in order to avoid overload on any tube which handles audio-frequency currents.

The radio-frequency amplifier offers a number of possible positions for a volume control, since changes in tube conditions, such as grid, plate, and filament voltages, in the radio-frequency amplifier cannot produce distortion of the audio-frequency output. This statement is rather surprising at first sight, in view of the number of times the contrary has appeared in print, but a rather simple mathematical analysis will show that it is true. Hence we are free to choose our method of volume control on the basis of other factors, resting assured that whatever method we choose will give as good tone quality as any other method. (This assumes that the amplifier is sufficiently stable so that the volume control does not have to be turned away down to prevent oscillation; a condition which must be satisfied anyway, for the receiver to be satisfactory.)

The method which has been previously discussed in connection with the audio-frequency amplifier has occasionally been employed in the radio-frequency end, but the condition which is an advantage in the former case, viz., its effect in increasing the damping, is undesirable here, because it tends to make the set broad in tuning.

The same objection holds for that method whereby the grid returns of the radio frequency amplifier tubes are brought back to the slider of a potentiometer connected across the filaments. When the grid is made positive, the volume is reduced all right, but the input resistance of the tube drops to a relatively low value. This low input resistance affects the damping of the tuned circuit in just the same way that the external resistance previously mentioned does, producing broad tuning. This method has the further disadvantage of causing the tubes to draw excessive plate current when the grids are positive, resulting in shortened life for the *B* batteries, as well as for the tubes themselves.

If the receiver is of such a design that it cannot be made to oscillate, perhaps as satisfactory a method of volume control as any is that which makes use of a variable high resistance in the plate circuits of the radio frequency tubes, thus varying the plate voltage applied to the tubes. This resistance is ordinarily shunted by a fairly large condenser, the purpose of which is to by-pass the radio-frequency currents around the resistance, and it is the presence of this condenser which makes this method unsatisfactory for receivers that can be made to oscillate.

When a tube goes into oscillation, there is usually a sudden change in plate current; this surge makes the resistance-condenser circuit tend to charge and discharge at a rate determined by the time constant of the circuit. With the values of resistance and capacity generally used, this time constant is such that the system charges and discharges at an audible frequency, resulting in a terrific howl just as the set goes into oscillation. This explanation is not intended to be strictly accurate from a technical standpoint, but it is sufficiently so to give a general explanation of the phenomenon referred to.

It is the opinion of the writer that, for the ordinary types of receivers, the filament rheostat on the radio frequency tubes is about the best method for controlling the volume. If the set is properly designed for this method, no drawbacks accompany its use. The points of design which should be kept in mind are:

(1) the rheostat should be in series with a fixed resistance of such value that the tubes will burn at their rated voltage when the volume control rheostat is turned full on; this is to keep the user from inadvertently turning the filament voltage up to too high a value;

(2) the rheostat should be of such a resistance that the filament voltage will not be below 60 per cent of the rated voltage when the volume control is set at a minimum; at this value the emission has nearly ceased, hence there is no need of carrying the voltage lower; a higher resistance rheostat would only crowd all the control into a smaller portion of the arc through which the rheostat arm swings;

(3) the rheostat should be placed in the positive side of the filament, the grid being returned to the negative side through a *C* battery of appropriate value. This arrangement insures that the volume control will not change the grid potential; this point is of minor importance, as the only effect of a changed grid potential with this method is to make the control a little less smooth and even.

The filament rheostat method of control is not recommended for those receivers which use a.c. tubes, however, as these tubes have such heavy filaments that it takes quite an appreciable time to change their temperature after the filament voltage is changed. This causes an annoying delayed action on the volume control. The plate resistance method is good for these tubes, as a.c. sets should not be worked close to the oscillation point anyway, on account of the excessive hum which results from such operation.

Several single control receivers employ no tuned circuit in the input to the first tube, using instead a resistance or radio

(Continued on Page 76)

## FIGURING GREAT CIRCLE DISTANCES

*By* Arthur Hobart

The shortest distance between two points on the earth's surface is the great circle passing through them. This distance may be computed by means of a simple formula which can be used by anyone who is able to look up the sines and cosines of angles in a table of trigonometrical functions. These functions are found for three angles, one corresponding to the difference in longitude between the two points and the other two corresponding to the latitudes of the points.

The difference in longitude is found by subtracting the lesser from the greater longitude if both are east or both are west longitude, or by adding them if one is east and the other is west. If the latter sum is greater than 180 degrees it should be subtracted from 360 degrees to find the true difference in longitude $D$.

Depending upon whether $D$ is greater or less than 90 degrees and upon whether both the latitudes are either north or south or whether one is north and the other south, four cases are possible, each requiring a slightly different formula.

Let the latitude of the point nearest either pole be designated as angle $a$ and the latitude of the point nearest the equator be called $b$. Look up the sines and cosines of $a$, $b$, and $D$, multiplying and adding them according to the proper formula given herewith. The result is the cosine of the angle along the arc $c$ of the great circle between the two points. Since one minute of this arc $c$ equals one nautical mile or 1.15 statute miles, multiply the number of degrees in the arc by 60 and add the number of minutes to determine the number of nautical miles, and multiply this by 1.15 to get the number of statute miles.

The formula and the solution of a typical problem for each of the four possible cases follows:

Case (1)—when both latitudes are north or both are south and $D$ is less than 90 degrees.

$\cos c = \sin a \sin b + \cos a \cos b \cos D$.

Find the distance between a point 37° 48′ N, 122° 23′ W and a point 14° 2′ N, 171° 20′ W. Then $a=37° 48'$, $b=14° 2'$, and $D=48° 57'$.

sin 48° 57′=.75414. cos 48° 57′=.65672....($D$)
sin 37° 48′=.61291. cos 37° 48′=.79016....($a$)
sin 14° 2′=.24249. cos 14° 2′=.97015....($b$)
sin $a$ sin $b$=.61291×.24249.................=.14862
cos $a$ cos $b$ cos D=.79016×.97015
×.65672 .................................................=.50342

The angle whose cos is .65204 is 49° 18′. Then (49×60)+18=2958 nautical miles or 3406 statute miles.

Case (2)—when both latitudes are north or both are south and $D$ is more than 90 degrees.

$\cos c = \sin a \sin b - \cos a \cos b \sin D$.

(This differs from Case (1) in that sin $D$ is used instead of cos $D$ and that the second term is subtracted from instead of added to the first term.)

Find the distance between a point 52° 30′ N, 14° 50′ E and a point 18° 30′ N, 149° 20′ E. Here $a=52° 30'$, $b=18° 30'$, and $D=134° 30'$. As the sine or cosine of an angle which is greater than 90 degrees is same as the sine or cosine of the angle which is equal to that angle, minus 90 degrees, 134° 30′—90°=44° 30′ is used when consulting the tables in this and similar cases.

sin 44° 30′=.7009 cos 44° 30′=.7133........($D$)
sin 52° 30′=.7934 cos 52° 30′=.6088........($a$)
sin 18° 30′=.3173 cos 18° 30′=.9483........($b$)
sin $a$ sin $b$=.7934×.3173=......................25174
—cos $a$ cos $b$ sin $D$=.6088×.9483×
.7009= —.40463

The angle whose cos is —.15289 is 81° 12′ which must be subtracted from 180 degrees because of the minus sign, leaving 98° 48′. Then (98×60)+48=5928 nautical miles or 6826 statute miles.

Case (3)—when one latitude is north and the other south and $D$ is less than 90 degrees.

$\cos c = \cos a \cos b \cos D - \sin a \sin b$.

Find the distance between a point 37° 48′ N, 139° 43′ W and a point 14° 2′ S, 171° 20′ E. Here $a=37° 48'$, $b=14° 2'$ and D=360°—(139° 43′+171° 20′)=48° 57′. The angles and functions are the same as in Case (1) but because of the north and south latitudes the sines are subtracted from instead of being added to the cosines.

cos $a$ cos $b$ cos $D$= .50342
—sin $a$ sin $b$= —.14862

The angle whose cos is .35480 is 69° 13′. Then (69×60)+13=4153 nautical or 4782 statute miles.

If the product of the cosines is less than the product of the sines the resulting angle should be subtracted from 180 degrees to get the required distance. This occurs when angles $b$ and $D$ become large.

Case (4)—when one latitude is north and the other south and $D$ is more than 90 degrees.

$\cos c = -\sin a \sin b - \cos a \cos b \sin D$.

Find the distance between a point 52° 30′ N, 14° 50′ E and a point 18° 30′ S, 149° 20′ W. Here $a=52° 30'$, $b=18° 30'$ and $D=(14° 50' + 149° 20')-90°=74° 10'$.

sin 74° 10′=.9620. cos 74° 10′=.272 ......($D$)
sin 52° 30′=.7934. cos 52° 30′=.6088......($a$)
sin 18° 30′=.3173. cos 18° 30′=.9483......($b$)
—sin $a$ sin $b$= —.7934×.3173= —.25174
—cos $a$ cos $b$ sin $D$=
—.6088×.9483×.962= —.55540

The angle whose cos is —.80714 is —36° 11′, which must be subtracted from 180 degrees because of its minus sign, leaving 143° 49′. Then (143×60)+49=8629 nautical or 9936 statute miles.

The laborious multiplications in these operations can be avoided by adding logarithmic sines and cosines instead of multiplying the natural functions. This has been done by A. H. Babcock in March *QST* from whose article this one is adapted. But as many readers are not skilled in using logarithms, the long-hand method is used here. Approximate results can quickly be obtained with a slide rule.

# A Questionnaire for Radio Engineers

*By* G. M. Best

The asking of questions for brain exercise seems to be a popular pastime, judging from the current fiction magazines, and now we have the Radio Questionnaire, which appeared in a recent issue of the *Radio Manufacturers' Monthly,* in an article by W. W. Harper.

The article dealt with the qualifications which were most desired in engineering assistants, laboratorians, and others employed in the engineering departments of radio manufacturing plants. Included was a questionnaire which was suggested as a test to be used by a manufacturer in determining the capabilities of applicants for positions in the laboratory. The answers were not given in the article, so they are worked out here for the guidance of students, and to exercise the brains of those who already consider themselves competent radio technicians.

It was stated that a radio engineer must not only be well versed from a purely technical standpoint, but he must be able to apply his knowledge so that a good product can be made at a minimum cost. Hence he must be grounded in electrical engineering as well as have practical knowledge of radio and its problems. The man who has a preponderance of knowledge along practical radio lines and little of the theoretical side of electricity may be unsuited for laboratory work.

Most radio manufacturers prefer a man having an accurate understanding of Ohm's law and other fundamentals of electricity, so the questionnaire has been divided into two parts, the first part dealing mostly with Ohm's law and the elementary principles of electricity, while the second part is devoted to specialized radio problems. Something is wrong with a man's training if he can answer all or most of the second group and none of the first group. Those readers who find themselves in this category can take heed, and by studying the points on which they are somewhat hazy, they can thereby improve their general usefulness in handling radio problems.

At the risk of our reputation, we have prepared a set of answers to the questions in as brief a form as is possible. For a more detailed discussion of any of the questions in Group One, the reader is referred to any standard text on electricity and magnetism.

### Group One

**1. Express Ohm's law in three different ways.**

$E=IR$ $I=E/R$ $R=E/I$, where $E$ is the voltage, $I$ is the current in amperes, and $R$ is the resistance in ohms.

**2. Determine the values of $R$ and $R_1$ in the network shown in Fig. 1.**

The voltage drop across $R_1$ in series with the 3-volt lamp is 5 volts, and applying Ohm's law, the resistance of this lamp is 24 ohms; since $R_1$ has a 2-volt drop, the same formula gives a value of 16 ohms. The 5-volt lamp has a resistance of 20 ohms, and the combined resistance of $R_1$ in series with

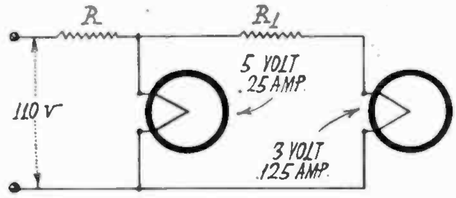



*Fig. 1*

the 3-volt lamp and the 20-ohm resistance of the 5-volt lamp is 13.3 ohms, since the resistance in multiple is equal to their product divided by their sum. Since the current drawn by the two lamps totals .375 amperes, the total resistance shunted across the 110-volt source is 293.3 ohms, and subtracting the value of 13.3 ohms leaves 280 ohms as the value of $R$.

**3. Give the equation for e in the network of Fig. 2, in which all the values indicated by capital letters are known.**

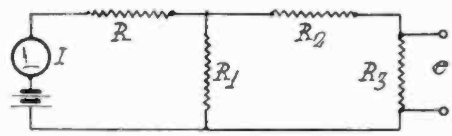



*Fig. 2*

$$e=\frac{I\ R_1\ R_3}{R_1+R_2+R_3}$$

The derivation of this formula involves an interpretation of Pollard's Theorem. This seems to be a "catch" question. Engineers who fail to solve it without consulting a reference should not be discouraged.

**4. Determine the required values of the resistors $R_1$, $R_2$ and $R_3$ in the network of Fig. 3 in order that the maximum current drain on the battery is limited to .01 amp., and with the other conditions as shown.**

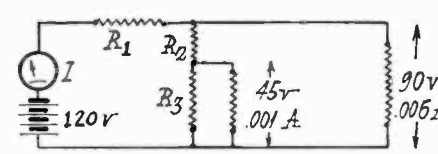



*Fig. 3*

Compute the total resistance across the 120-volt source, since the current flow, .01 amp., is known. Result, 12,000 ohms. From data given on the diagram, the voltage drop across $R_2$ in series with the combination of $R_3$ and the resistance in shunt with it, is 90 volts, leaving a balance of 30 volts drop across $R_1$. By Ohms law, $R_1$ equals 3000 ohms.

Since the total current consumed is .01 amps., and one of the 90-volt branches consumes .006 amps., the current flowing through the $R_2$, $R_3$ combination must be .004 amps. The resistance in shunt with $R_3$ consumes .001 amps., so that $R_3$ has .003 amps. flowing through it. The voltage drop across $R_3$ is given as 45 volts, so that $R_3$ is thus 15,000 ohms. Subtracting the drop across $R_3$ from the total drop across $R_2$ in series with $R_3$ and its associated resistance leaves a voltage drop of 45 volts, so that with .004 amp. flowing through it, $R_2$ is 11,250 ohms.

To check these figures, work out the value of the resistance in shunt with $R_3$, which is 45,000 ohms, and this combined with $R_3$ is 11,250 ohms. This resistance, in series with $R_2$, will be 22,500 ohms, and the remaining resistance in parallel with it is 15,000 ohms, since the voltage drop is 90, and the current .006 amps. The combination of these two resistances is 9000 ohms, which in series with $R_1$, which is 3000 ohms, makes a total of 12,000 ohms, the value required.

**5. Define the following terms and indicate their relation to other circuit values: (a) resistance, (b) conductance, (c) reactance, (d) impedance, (e) admittance, (f) susceptance, (g) reluctance, (h) permittivity.**

(a) Resistance is the ratio of the voltage across the circuit to the current flowing through it. Its unit is the ohm, which is defined as that resistance which will permit one ampere of current to flow, at a pressure of one volt.

(b) Conductance is the reciprocal of resistance, or the ratio of current to voltage. Resistance denotes how difficult it is to force a unit current through a given conductor, while conductance denotes how easy it is to produce the same current in the same conductor. Its unit is one mho.

(c) Reactance is the effect produced by an inductance or capacitance in a circuit, expressed in terms of frequency as well as the inductance and capacity values. To find the reactance of an inductance, multiply the inductance in henries by 6.28 times the frequency of the a.c. in cycles per second. To find the reactance of a condenser, multiply its capacity in mfds. by 6.28 times the freqency of the a.c. and divide 1,000,000 by the product. It is expressed in ohms, and an inductive reactance is positive, while a capacitive reactance is negative.

(d) The impedance of a circuit is the ratio of the a.c. voltage across it to the current flowing in the circuit. Its unit is the ohm. Impedance is a vector quantity, and is equal to the square root of the sum of the effective resistance squared and the reactance squared.

(e) The admittance of a circuit is the reciprocal of the impedance. Its unit is the mho, the same as for conductance.

(f) The susceptance of a circuit is the reciprocal of its reactance, with the unit expressed in mhos.

(g) Reluctance is obstruction to magnetic flow. In a simple magnetic circuit, it is the ratio of the magnetomotive force to the magnetic flux.

(h) Permittivity is the specific permittance of a substance, permittance being the power of storing or holding an electric charge. It is analogous to electric conductivity and magnetic permeability.

**6. Explain Kirchhoff's laws and how they differ from Ohm's law.**

Kirchhoff's laws are as follows: At any point in a circuit there is as much current flowing to the point as there is away from it. In any closed electric circuit the algebraic sum of the electromotive forces and potential drops is equal to zero. If there is no electromotive force in the circuit, the sum of the potential drops in one direction is equal to the sum of those in the opposite direction. Kirchhoff's laws apply to voltage, current or resistance conditions in a complex network, whereas Ohm's law applies to the relation between these quantities in a single simple circuit or its network equivalent.

**7. Explain the difference between peak, average and root-mean-square values of alternating currents.**

The peak value of a sine wave is the value reached at the maximum point attained during an alternation. If the maximum voltage is $E$, then the peak value is equal to $E \sin 2\pi ft$. where $f$ is the frequency in cycles per sec., and $t$ is the time in seconds. The average value is equal to the maximum value divided by $\pi/2$, or $.6366\ E$. The root-mean-square value, also called the mean effective value, is that continuous value which gives the same total current squared times resistance loss. It is equal to the square root of the mean square of the variable values. In simple terms, it is equal to the amplitude divided by $\sqrt{2}$, or $.7071\ E$.

**8. What do commercial measuring instruments indicate: peak, average, or R. M. S. values?**

Instruments of the hot-wire and electrodynamometer types indicate R. M. S. values.

**9. What does a direct current meter read on rectified alternating current: peak, average, or R. M. S. value?**

A d.c. meter reading unfiltered rectified a.c. would read the average value.

**10. What is meant by the form factor of an alternating current wave?**

The ratio between the effective and average values of a sine wave is called the form factor.

**11. What is the value of the form factor for a pure sine wave?**

For a pure sine wave, the form factor is 1.11.

**12. Correct the following sentence by striking out the undesired words: "Impedances must be added algebraically geometrically and not geometrically algebraically."**

Impedances must be added geometrically and not algebraically.

## Group Two

**1. The circuit of the General Radio Decade Bridge is shown in Fig. 4. Explain what other equipment you would need and how you would proceed to measure the inductance of a small air core coil of approximately 300 microhenries; to measure a paper condenser of unknown value; probably between .1 and 2 mfd.?**

A calibrated variable inductance is connected to the terminals marked *STD* and the unknown inductance is connected to the terminals marked *X*. Standard variable inductances are available in several sizes, and the one whose range will cover points considerably above and below 300 microhenries should be used. As the inductance to be measured probably has more effective resistance than the standard, which is usually very low resistance, the resistance $C$ is inserted in the same arm with the standard by throwing the switch to *1*.

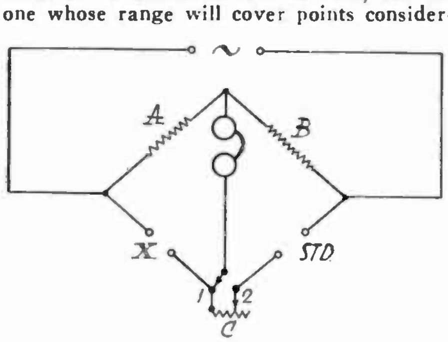


*Fig. 4*

The oscillator is turned on, and the standard inductance is varied until the tone of the oscillator is at a minimum. Then the resistance $C$ is varied until the tone can no longer be heard, or is very faint, after which a slight readjustment of the standard inductance is made in case the balance has been upset. The value indicated on the scale of the standard can then be obtained from the curve accompanying the standard, in case the ratio arms $A$ and $B$ are of equal resistance. If they are unequal, as would be the case if they were set at a ratio of 100 to 1000, then the unknown resistance is equal to $A$ times the inductance of the standard, divided by $B$. If it is impossible to obtain a null point with resistance $C$ in series with the standard, the switch is set to point *2*, and the resistance is thus placed in series with the unknown, which has less resistance than the standard.

For measuring a paper condenser of .1 to 2 mfd., it is necessary to have a group of standard condensers so that any capacity within a reasonable range can be obtained. The standard condenser group is connected to the terminals marked *STD*, and the adjustment of the bridge for the null point is made the same as for the inductance method. By the use of ratio arms of 100 and 1000 ohms, a proportion can be arranged so that a condenser of from .01 to .2 mfd. can be used as a standard for measuring capacities ten times greater. The capacity is equal to the resistance of arm $B$ times the capacity value of the standard, divided by the resistance of $A$. In measuring paper condensers, whose internal resistance is often high, the resistance $C$ will probably be needed to obtain anything like a null point, especially if the standard condensers are of highest grade mica dielectric.

**2. In what units do we measure (a) the intensity of a radio wave, (b) amplification, (c) attenuation?**

(a) In microvolts per meter. (b) In terms of voltage increase, or in transmission units. (c) Usually the transmission unit.

**3. What is meant by a transmission unit?**

The transmission unit is an electrical unit for measuring the efficiency of an electrical circuit. It is defined as ten times the common logarithm of the power ratio. $TU=10 \log (P_1/P_2)$, where $P_1/P_2$ is the power ratio.

**4. Name the element or elements of a radio broadcasting system, (transmitter and receiver) which affect the fidelity of reproduction or tone quality.**

In the transmitter, the microphone, speech amplifier, and the type of modulation employed. In the case of the latter, where the Heising system is used, the inductance of the plate choke common to the oscillator and modulator tubes has a marked effect on the low frequencies, if the inductance is not high enough.

In the receiver, the characteristic of the tuned circuits, with reference to their ability to pass a wide enough band of frequencies so as not to cut off some of the audio frequencies with which the r.f. carrier is modulated; the stability of the detector tube, and the characteristic of the audio frequency amplifier.

**5. Given a high impedance resonant circuit, how would you go about determining the peak voltage across either the coil or the condenser with a given induced voltage?**

If the circuit is of the parallel resonant type, the voltage across the coil or condenser is the same, but if it is of the series resonant type, the factor of internal resistance of the coil and condenser may slightly change the effective voltage across either coil or condenser. A vacuum tube voltmeter of the $C$ bias type is the most convenient voltage indicator to use. The voltmeter input is shunted across that part of the circuit whose voltage is to be measured, and the plate current noted in the customary manner. The voltmeter is then disconnected from the tuned circuit, and sufficient positive $C$ bias by means of dry cells is applied to the grid, so as to produce the same amount of plate current as was caused by the a.c. voltage. The d.c. voltage thus applied is the peak a.c. voltage.

**6. Which type of vacuum tube voltmeter draws the less current, the grid rectification or anode rectification type? Which has the lowest input impedance? Which would you use for voltage amplification measurements?**

The grid rectification type draws less current than the anode rectifier. The grid rectification method presents the lowest input impedance. Preferably the anode rectification type, which, for the sake of clearness, is defined as one which uses a three-element vacuum tube with negative $C$ bias on the grid.

**7. Discuss the various methods of measuring high frequency resistance.**

They are divided generally into four methods: substitution, calorimeter, resistance-variation, and reactance-variation. The substitution method consists in substituting a known resistance standard in place of the apparatus whose resistance is unknown, after a certain definite current indication is obtained. When a value of standard resistance is obtained which indicates the same current flow as that permitted by the unknown, the value of the standard is equal to the value of the unknown resistance. This method is not highly accurate, except for measuring small changes in the resistance of a circuit.

The calorimeter method consists in placing the apparatus whose resistance is desired in some form of calorimeter, which measures the rise in temperature of the apparatus. With the current flowing through the circuit measured by an accurate high-frequency meter, the unknown resistance is calculated from the observed current and the power consumed in raising the temperature in the calorimeter.

The resistance-variation method consists in setting up a simple circuit such as an inductance and capacity, with source of induced voltage, and an ammeter to read the h.f. current flowing in the circuit. The resistance is measured with the unknown apparatus in the circuit, and is then measured with a resistance standard in the circuit, so that the unknown resistance value can then be obtained by subtraction.

The reactance-variation system is also called the decrement method, and is analogous to the resistance-variation method, two observations being taken. In a simple resonant circuit, the current is measured at resonance, the reactance is then varied, and a new current reading taken. The total resistance of the circuit is then calculated from these two observations.

**8. What methods are available for determining the inductance of an iron core choke under certain definite operating conditions?**

It is assumed that "definite operating conditions" refers to the inductance of the choke while direct current is being passed through the windings. An inductance bridge such as is shown in Fig. 4 can be used, if the direct current through a suitable high resistance is impressed across the points of the bridge to which the headphones are connected, and the standard is a condenser group instead of a standard inductance. As most iron core chokes have a value of inductance much higher than is available in variable standards, the reactance balance method is preferable. A special bridge can also be set up, having ratio arms on opposite sides, as was described in RADIO in the September 1924 issue, the d.c. current supply and the a.f. source being in series.

**9. What factors control the output impedance of a three-element tube and how is the output impedance related to other factors involved in a radio frequency amplifier?**

The plate-filament spacing, and the plate area; the plate voltage used, as well as the grid voltage, and the grid mesh and di-

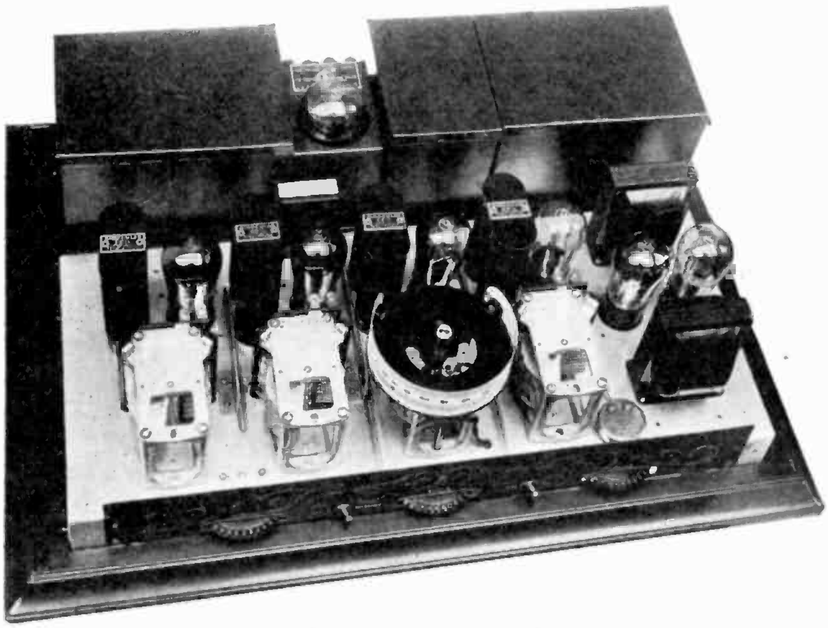
(Continued on Page 78)

# New Factory Built Receivers at R.M.A. Show

The Grebe A.C. Synchrophase Six has three stages of tuned r.f. with '26 tubes, binocular coils, straight line frequency condenser, and tube isolation circuit; a '27 tube detector, and two stages of audio with a '71A tube in the last stage. A complete *A B C* power plant with '80 rectifier tube is a part of the chassis.

One feature of this new set is a "local distance" switch which shunts a resistance across the primary of one of the r.f. transformers for controlling selectivity and sensitivity. Special precautions are taken to insure firm contact with the tube prongs in the sockets so as to avoid a.c. hum. There are two tuning controls and one volume control with horizontal tangent wheel verniers and a horizontal illuminated dial. A smooth, gradual control of volume is attained with a sharply-tapered variable resistance shunted across the primary of the r.f. input transformer.

The chassis is of heavy aluminum with four reinforcing ribs. A mahogany veneer cabinet with bronze control board fits over the mounting-frame which forms the base. It is available either as a cabinet or with table mounting.

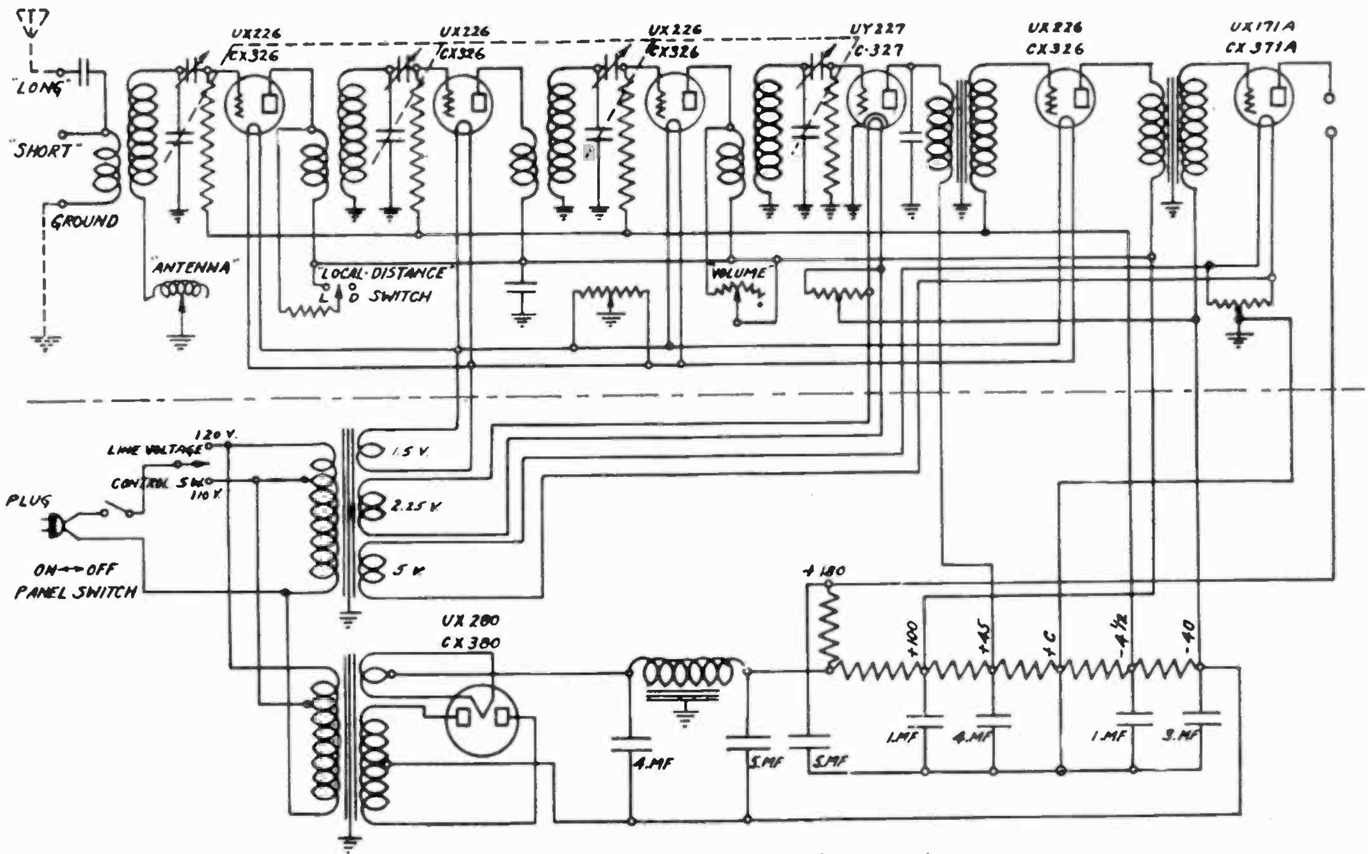


*Chassis of Grebe A.C. Synchrophase Six*

*The Fada 31*

New items in the Fada line include six a.c. receivers and two loudspeakers. Four of the receivers have the same type of six-tube chassis with rectifier, and use an outside antenna. Two of them have eight tubes and rectifier and use either a loop or antenna.

The six-tube chassis uses five '27 tubes, one '71 tube, and an '80 rectifier, giving three stages of r.f., detector, and two stages of audio. It has a single tuning control, with illuminated dial. Extra fine tuning may be done with a vernier control of the antenna




*Circuit Diagram of Grebe A.C. Synchrophase Six* condenser. Change in volume is accomplished by varying the equalizing r.f. stage. A small switch controls the 110-volt a.c. supply. The chassis frame is of heavy steel.

The "10" model with this chassis is in a two-tone metal cabinet, 21 x 9 x 12 in. The "11" is in a burl walnut cabinet 11½ x 25¾ x 13¼ in. The "30" model is a walnut console, also containing a Fada 4B cone speaker, and the "31" model is a high-boy console with space for a built-in speaker.

The eight-tube models have four r.f. stages and two '71 tubes in a push-pull last audio.

*The Fada 70*

A jack provides connection for a plug from any phonograph pick-up which thus utilizes the two stages of audio and the loudspeaker for record reproduction. The loop is automatically disconnected when folded within the cabinet, and the antenna is then automatically connected. They have the same controls as the six-tube models. The "50" model is housed in a walnut cabinet 11¾ x27 x 17 in. The "70" is a Sheraton console with a built-in dynamic speaker.

One of the new loudspeaker models, the Fada-4, is a 7 in. cone housed in a mantle-clock metal case 13½ x 11½ x 9½ in., the cone being driven by a rod from a balanced armature. The other, the Fada-14, is an electro-dynamic speaker in a cabinet which also houses the power supply.

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The R C A Radiola 18 combines in one cabinet a six-tube radio set using a.c. filament supply and a UX-280 rectifier with filter for plate voltages. It employs an improved form

*Radiola 18*

of r.f. amplifier tuning using three UX-226 tubes, a UY-227 detector, and a UX-226 and 171-A as audio amplifiers. The set is turned on or off by a single power switch. Tuning is accomplished with one knob which moves an illuminated indicator dial past a window in the panel. The intensity of volume is controlled by a switch at the left.

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The Majestic seven-A.C. receiver employs a standard chassis, which is available in four table and console models. It has a tuned antenna input to three stages of tuned r.f. (R.F.L. balanced circuit), detector, and two stages of audio with push-pull connection of two '71 tubes in the last stage. It

*Model 71 Majestic*

has single-dial control with secondary controls of selectivity and of volume.

Model 61 is in a walnut cabinet with a Majestic electric power unit. Model 62 consists of a one-piece cabinet and table. Model 71 is essentially the cabinet type mounted on a Majestic dynamic power speaker. In Model 72 the dynamic speaker is mounted over the receiver and both are concealed by doors of matched burl walnut.

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The new Kellogg line of a.c. receivers is housed in four models, one table cabinet and three consoles. They use tuned and balanced r.f. amplification and two stages of transformer coupled audio with a built-in output

*Model 516 Kellogg Receiver*

transformer. Kellogg a.c. tubes are employed together with a power unit especially designed for the set. Both radio and audio circuits are completely shielded. Of the three knobs on the illuminated control panel, one is a zone switch divided in kilocycles, one is a single station selector, and one a volume control by means of variation in *C* bias. The table model is encased in a brown metal cabinet and has two r.f. stages. The Model 516 console is 42½ in. high, 31 in. wide and 18¾ in. deep, has four 4 r.f. stages and built-in speaker. The 514 and 517 models are slightly larger and more elaborately finished but otherwise is similar to the 516.

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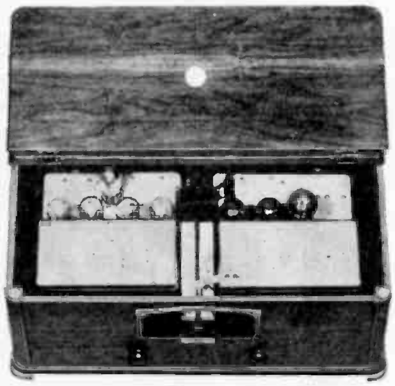
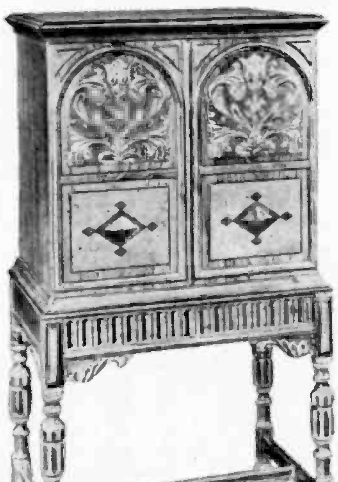
The Balkite a.c. receiver is a seven-tube neutrodyne using three stages of tuned r.f. a tuned detector and two stages of audio with two '12A tubes in the last stage. It is equipped with power plant supplying a.c. for filaments and d.c. for plate voltages. A jack is provided for phonograph connection. The single



*Balkite A-5*

tuning dial is of the large drum direct drive type. The two other controls are for volume and an off-and-on switch. The escutcheon is recessed for easy tuning. The chassis is completely enclosed by shielding so that the only exposed parts are the connections for aerial,



*Balkite A-7*

ground, and speaker, the tube sockets, and the drum dial. It is made in two Berkey & Gay furniture models, a table cabinet and a high boy with dynamic speaker and one model in a steel case.

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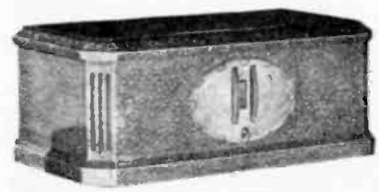
The Freed-Eisemann NR-80 is a seven-tube neutrodyne with integral tube rectifier



*Freed-Eisemann NR-80*

and filter for plate supply. It is made in two types, one for a.c. filament tubes and one for

(Continued on Page 50)

# Some of the New Loud Speakers

New items from the Magnavox Company consist of a number of cabinet model electro-dynamic speakers, and three speaker units without cabinets. The Dynamic-6 is an improved electro-dynamic cone unit, with magnetic field supplied by 6 volts d.c., at .65 ampere. It is furnished complete with output transformer and filter, and is ready to mount on a suitable baffle board. The Dynamic-7 is similar in appearance to the Type 6, but has a field requiring from 110 to 220 volts d.c., at from 45 to 90 milliamperes, so that it is suitable for use as the choke coil in a

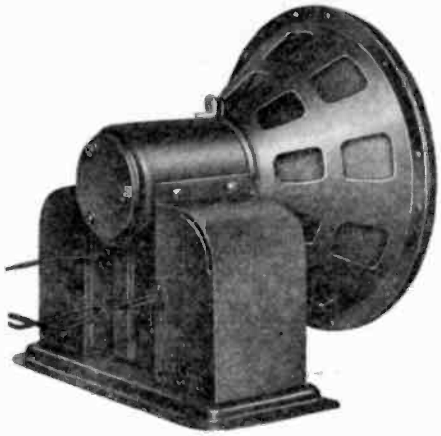

*Magnavox Dynamic 80 Speaker Unit.*

*B* power supply filter circuit. The Dynamic-80 consists of a speaker unit mounted on a metal baseplate, on which is also placed a step-down transformer and contact rectifier, so as to supply about 25 watts of rectified a.c. to the field of the speaker. This type of unit is most suitable for use with a.c. receivers, and requires no separate source of d.c.

*Improved Belvedere Model Magnavox Electro-Dynamic Speaker.*

Among the cabinet models are the Beverly, a table speaker of particularly fine appearance; the Belvedere, which is designed to be set on the floor alongside a console type receiver, and has an open back so as to avoid cabinet resonant effects; the Aristocrat, a console type cabinet speaker; and the Cordova, which contains a stage of power amplification using a type 210 tube. All the cabinet models except the Cordova come in three types, using either Type 6, 7 or 80 units.

News items from the Jensen Radio Mfg. Co., makers of the Jensen electro-dynamic loudspeaker, include a type D-44 cabinet speaker which operates directly from the electric light socket. The unit obtains its field excitation from rectified alternating current, supplied by a Westinghouse transformer and



*Unit for Jensen D-44 Cabinet Speaker*

Rectox contact rectifier, especially designed for Jensen use. The entire unit is mounted on a metal base, the rectifier equipment being completely enclosed. It is contained in a handsome cabinet for table mounting, or it may also be had in console form. The unit is furnished separately, for use in electric phonograph, or console type radio receivers.

Improved units, with cabinet types as well, include one for operation from 6 volts d.c., at .4 amperes, and another requiring 90 volts d.c., at 40 milliamperes. All models have a frequency range of from 20 to 5500 cycles, with uniform response throughout that frequency band.

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The RCA 105 loudspeaker is of the electro-dynamic type in a walnut floor model cabinet which contains a *B* and *C* eliminator with two UX-281 tubes which supplies voltage not only for a radio set, but also for a power amplifier with UX-250 power tube in

*RCA 105 Loudspeaker*

the cabinet. The entire equipment is operated from 110 volt a.c. The speaker unit uses a corrugated moisture-proof paper cone.

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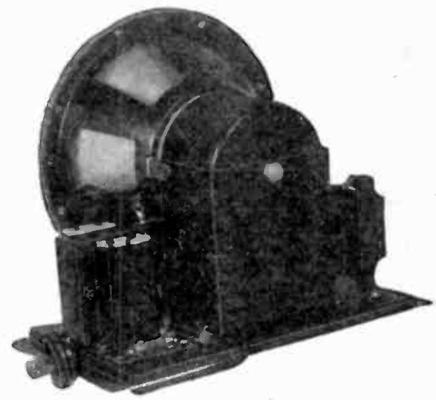
Newcomb-Hawley dynamic cone speakers, which are manufactured under license from the Magnavox Company, are available in two models of chassis, each of which are supplied either as a separate unit, or mounted in various styles of cabinets, tables, and consoles. The Model NH-6 has a field winding designed for operation from a 6-volt battery. Model NH-9 is equipped with rectifier and filter to supply the field winding



*Model NH-3 Dynamic Cone Chassis.*

with 90 volts d.c. from a 110-volt a.c. source. Both are equipped with input transformers.

No. 100 provides a unique mounting for a NH-9 chassis, as it also houses a motor-driven phonograph turntable and has space for any a.c. electric radio set. A selector

*Rear View of Newcomb-Hawley Table Model.*

switch provides connection for either radio or phonograph reproduction. No phonograph pick-up is included.

Model 80 is a new addition to their line of magnetic cone reproducers, the chassis being sold separately, as a cabinet or as a table.

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Martin-Copeland electro-dynamic speakers are made in three types, each of which is mounted in an artistic brown mahogany table cabinet. Type D-6 requires one-half ampere at 6 volts d.c. from a battery. Type D-90 requires 90 to 110 volts d.c. for its field, and Type D-110 is equipped with a rectifier and filter so that 110 volts a.c. may be used.

(Continued on Page 56)

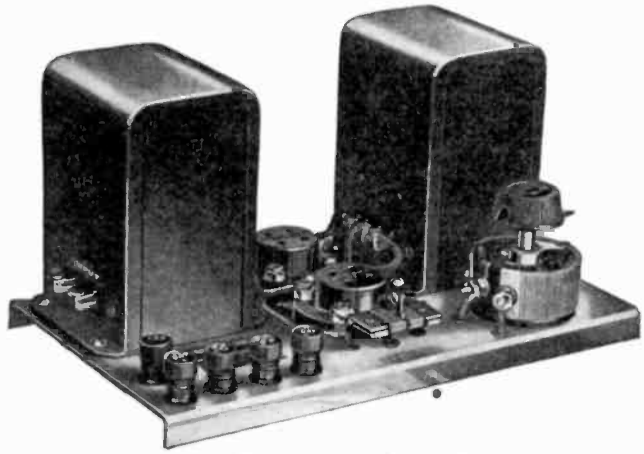
# D. C. and A. C. Power Units, Audio Amplifiers

The General Radio Type 445 plate supply and grid bias unit uses a UX-280 rectifier tube and provides any desired combination of voltages from 0 to 180 volts, by means of four adjustable wire-wound resistance units.

*General Radio Plate Supply Unit*

An adjustable grid bias voltage from 0 to 50 is also available. It is equipped with an automatic cut-out switch to break the 110-volt a.c. circuit when the cover is removed for adjusting voltages or connecting wires to binding posts. Its dimensions are 15 x 7 x 7 in. and its weight 16 lbs.

The General Radio Type 441 push-pull amplifier is a completely wired second stage of audio consisting of two high quality push-pull transformers with the necessary resistances and sockets mounted on a brass baseboard. It is intended for use with any type of power or semi-power tube. Where a first stage amplifier of 20 to 30 provides a signal input of 6 volts, two '26 tubes are recommended. When a signal voltage of 15 to 20 is available at the amplifier input, the '71 type of tube is recommended. This form of



*General Radio Push-Pull Amplifier*

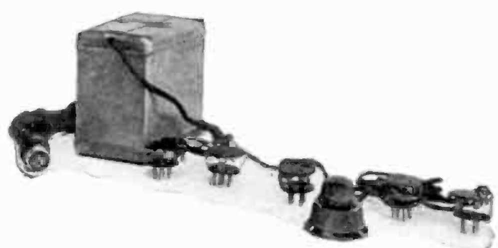
connection tends to cancel out distortion due to tube overloading and a.c. hum, giving a maximum undistorted power output.

The Powerizer is essentially a transformer for supplying alternating current of the proper voltage for the filaments and heaters of a.c. tubes. Thus the "A" model is designed to supply current to seven '26 tubes, two '27's and two '71 tubes. The "P 171" model supplies *B* and *C* voltages by means of an '81 rectifier tube, in addition to the *A* current. The "PXY-1" model not only supplies *A*, *B* and *C* current to the set, but also to a '10 tube in the device itself, making it a combined power plant and power amplifier. A special type of this model is made for use with the Radiola 25 or 28 sets. The "PD-5" is for

*"PXY-1" Model Powerizer*

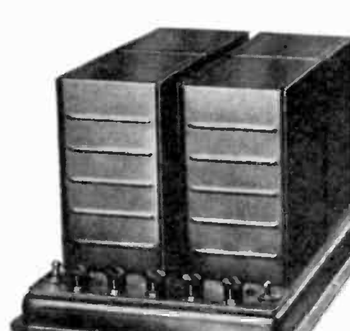
d.c. sets using '99 tubes. It supplies *B* voltage and 0.5 amperes *A* current at 3 volts.

In this line also are two power amplifiers without current supply for the set. The Powerizer "PX-2" is a two-stage unit with a '26 tube in the first stage and a '10 tube in



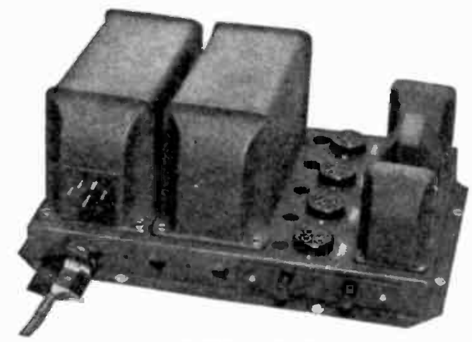
*"A" Model Powerizer*

the second, together with an '81 rectifier. The "PX-3" has three stages, using '27 tubes in the first and second and a '50 in the third stage. Both use special alloy core transformers.



*R. C. A. "B" Eliminator*

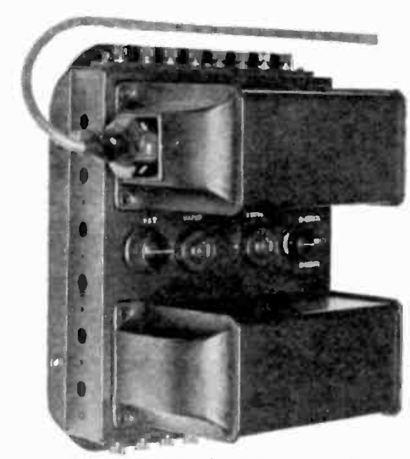
The Samson PAM 16-17 is a two-stage power amplifier operated from a 110, 115 or 120 volt a.c. source and having an undistorted power output of 7 watts. It uses a '27



*Samson PAM 16-17 Amplifier*

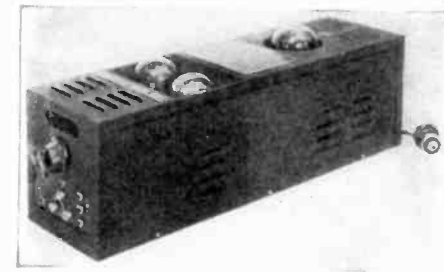
tube in the first stage, and two '10 tubes in the second push-pull stage, with a '81 tube as rectifier. It is intended to give great volume from a radio set or phonograph pick-up.

The Samson ABC-71 is a power unit designed to supply constant voltage to sets using a.c. tubes. The supply is adjustable for 110, 115 or 120 volt a.c. It uses a '80 tube as rec-



*Samson ABC-71 Power Unit*

tifier and '74 as voltage regulator, and through various binding-posts supplies 1½, 2½ and 5 volts a.c. for *A* current; 45 to 90



*"PX-2" Model Powerizer*

volts variable; 90, 135, and 180 volts *B*; and -4½, -9 and -43 volts *C*. It is built to meet the A. I. E. E. and National Board of Fire Underwriters' requirements.

A new RCA *B* eliminator, Model AP-1080, employs no tubes, liquids or mechanical parts to be replaced, the rectifier being of the contact type and enclosed and sealed in a

(Continued on Page 58)

# Summary of R. M. A. Show Exhibits

ABOX Co., Chicago, Ill., *A* power plants, for supplying *A* current from the lighting mains for d.c. sets, and a group of electrolytic condensers and filter equipment.

A-C DAYTON Co., Dayton, Ohio, four table model receivers, three with six a.c. tubes and one with six d.c. tubes; all using tuned r.f. circuit.

ACME ELECTRIC & MFG. Co., Cleveland, Ohio, complete line of *A*, *B* and *C* eliminators, in separate and combined units, using disc rectifier for *A* and '80 tube for *B C;* also tone filter, push-pull transformer for '50 tube, and "Flash" five-tube receiving set.

ACME WIRE Co., New Haven, Conn., an improved type of Parvolt paper condenser, in all sizes and voltages required. Also a new line of Celatsite wire for a.c. filament wiring, and a new 12 conductor cable for a.c. receivers.

AERO PRODUCTS Co., Chicago, Ill., complete kits of parts for short wave receivers and a new kit for building a short wave transmitter, for radiophone as well as telegraph service.

AEROVOX WIRELESS CORP., Brooklyn, N. Y., a group of non-inductive paper condensers in all capacity or voltage ratings, fixed mica condensers, filter condenser blocks, wire wound resistors, grid leaks, and a new large capacity *A* condenser for *A* eliminator service.

ALL-AMERICAN MOHAWK CORP., Chicago, twelve new models with '80 rectifier tube and a.c. tubes. These include two table cabinets with phonograph jack, one having six tubes and three r.f. stages and one being eight tubes for four r.f. and push-pull audio. These are also incorporated in various consoles with or without magnetic or dynamic speakers; also with phonographs.

ALLEN BRADLEY Co., Milwaukee, Wis., a complete line of fixed, variable and tapped resistance units, including the famous Bradleystat.

ALUMINUM Co. OF AMERICA, Philadelphia, Pa., a complete line of aluminum box shields, panels, and cabinets, cut to size for all popular kits and circuits.

AMERICAN MECHANICAL LABORATORIES, INC., Brooklyn, N. Y., makers of Clarostats. New items include a dual clarostat with screw-driver adjustment so as to save space, and a line of socket antenna plugs, voltage regulators for a.c. sets, and many types of power rheostats and variable resistors.

AMERICAN-BOSCH MAGNETO CORP., Springfield, Mass., eight-tube a.c. receivers in table cabinet or in console with cone speaker, and nine-tube console with dynamic speaker and push-pull audio. All use R. F. L. circuit.

AMRAD CORP., Medford, Hillside, Mass., four a.c. operated console models with seven tubes and '80 rectifier, three stages tuned r.f. and push-pull second audio using either '10 or '50 tubes; built-in dynamic speaker; one model includes phonograph.

AMSCO PRODUCTS Co., New York City, a group of fixed and variable resistors, for all types of radio service, especially in *B* power devices. A group of single and gang variable condensers, the gang condensers being guaranteed to within ½ of 1 per cent as to matching.

F. A. D. ANDREA, INC., New York City, six new a.c. models, four of which are six-tube receivers, and two are deluxe models with eight tubes. The six-tube consoles have built-in electro-magnetic cone speakers, and the eight-tube console has an electro-dynamic unit. A new type of circuit is used in these receivers, differing from all previous models. Two loud speakers, one of which is an electro-dynamic cone, with table cabinet mounting, are also announced.

APEX ELECTRIC MFG. Co., several table and console model a.c. receivers, using the neutrodyne circuit, also a model for d.c. operation.

ARCO ELECTRIC CORP., a group of *A* and *B* power units, including battery chargers, *A* power unit parts such as chokes, transformers and automatic control relays.

ARCTURUS RADIO Co., Newark, N. J., a new line of a.c. tubes, including a shielded grid tube, high mu, special detector and power amplifier, all of the four prong variety so as to be adaptable to sets already wired for d.c. service.

ARGUS RADIO Co., New York City, four six-tube a.c. sets using three stages of tuned r.f. with one shield grid tube; single dial control with selector switch and volume control, in table cabinet or one of three consoles with built-in dynamic speaker.

ATWATER KENT Co., Ardmore, Pa., a complete line of six and seven-tube a.c. receivers and a group of loud speakers. Model 40 is completely enclosed in a metal cabinet and employs improvements in circuit and apparatus which will be featured this season.

BALKITE (Fansteel Products, Inc.), North Chicago, Ill., a new line of table and console a.c. receivers with built-in power supply. Two table models and two hi-boy consoles.

BELDEN MFG. Co., Chicago, Ill., a new line of wire equipment for a.c. receivers, as well as flexible cords for loud speakers, extensions and battery wiring.

BENJAMIN ELECTRIC MFG. Co., Chicago, "red-top" sockets (4 and 5-prong), r.f. transformers, sub-panel brackets, battery switch.

BEST MFG. Co., Irvington, N. J., an improved loud speaker unit of the electro-magnetic type, known as the B. B. L. motor. It has a large armature and magnet, so as to handle the high power required by present day speakers.

BIRNBACH RADIO Co., New York City, a line of radio parts and accessories, including r.f. transformers of the regenerative type, extension cords, and battery cable connectors.

L. S. BRACH MFG. CORP., Newark, N. J., *A B C* eliminators, as well as separate power plants for *A* or *B* service. Their line of lightning arresters, automatic filament control resistors, and other radio accessories has also been enlarged.

BREMER-TULLY MFG. Co., Chicago, six a.c. Counterphase receivers and two speakers, a magnetic and a dynamic. There are two six-tube, two seven-tube, and two 8-tube models, table cabinet or console with speaker.

BROOKLYN METAL STAMPING CORP., Brooklyn, N. Y., a new device for connection to a radio receiver, by which the voice can be reproduced by the loud speaker by talking into a microphone.

BUCKINGHAM RADIO CORP., Chicago, Ill., a group of five six-tube tuned r.f. sets for either a.c. or d.c. operation, in table and console models.

D. K. BULLENS MFG. Co. Pottstown, Pa., three grades of permanent magnets for loud speaker manufacturers, including chromium, tungsten and cobalt alloys.

BURGESS BATTERY Co., Madison, Wis., the new Super *B* battery, which has unusually long life, an addition to their full line of *A* and *B* batteries of the dry cell type.

BUSH & LANE PIANO Co., Holland, Mich., seven a.c. seven-tube receivers and two speakers, magnetic cone and dynamic. Four of the receivers have a tuned r.f. circuit, one in a table cabinet, two in consoles with cone speaker, and one in a console with dynamic speaker. Three have a neutrodyne circuit in console with cone or dynamic speaker.

CARTER RADIO Co., Chicago, Ill., a complete line of radio parts and accessories, including all types of rheostats and potentiometers, fixed resistors, condensers, and a variety of outlet plates for radio wiring of homes and buildings.

CASE RADIO CORP., Marion, Ind., seven a.c. receivers and one d.c. model, in table and console models, some with air column loud speakers, and several with built-in electro-dynamic units. The most expensive model has a phonograph attachment, and uses a loop antenna.

CELERON Co., Bridgeport, Pa., complete line of celeron panels, tubing, rods

# Summary of R. M. A. Show Exhibits

and sheets, especially for manufacturers and jobbers.

C-E MFG. CO., Providence, R. I. several new a.c. tubes, including a shielded grid a.c. tube having a low voltage filament, and designed to fit in a five-prong socket.

CENTRAL RADIO LABORATORIES, Milwaukee, Wis., new types of power rheostats for both light and very heavy duty, wire wound resistors of all sizes, and a complete line of potentiometers and variable resistances for volume control service.

CHICAGO-JEFFERSON FUSE & ELECTRIC CO., Chicago, Ill., a new line of power transformers for filament lighting service in a.c. sets, also of Concertone audio transformers.

CHILLICOTHE FURNITURE CO., Chillicothe, Mo., radio cabinets and radio furniture of all types, for standard makes of receivers, as well as practically all radio kits now on the market.

CONTINENTAL FIBRE CO., Newark, Del., a line of extra thin wall Bakelite-Dilecto tubing for r.f. coils, panels, tube sockets and fittings for all radio parts.

COLUMBIA PHONOGRAPH CO., New York City, a new line of combination radio receivers and electric phonographs. The radio receiver is the Kolster, and is available in two console models, with built-in loud speaker.

CORNISH WIRE CO., New York City, radio wire products, as well as adapter harness equipment for converting d.c. receivers to a.c. operation.

CROSLEY RADIO CORPORATION, Cinnati, Ohio, new Jewelbox, Showbox and Gembox models for a.c. operation; also a new Dynacone dynamic speaker, an improved Bandbox and Bandbox, Jr. for battery-operation. The a.c. Gembox has two stages of radio frequency amplification and a non-radiating regenerative circuit. Illuminated single dial control. Housed in metal container with gold highlights. The coils are shielded. A combination neutrodyne and non-radiating regenerative circuit is claimed to be the equivalent of an additional stage of radio frequency amplification. The Dynacone speaker is built on the electro dydynamic principle; frequency range from 50 to 7000 cycles; the Dynacone is made in two types one for sets having no output transformer and one for sets with an output transformer. The showbox and jewelbox receivers have push-pull audio amplification and are equipped with power units capable of delivering sufficient current to energize the field of the Dynacone speaker. Two Crosley Musicone cone speakers are also available. These speakers are of the magnetic type.

CROWE NAMEPLATE & MFG. CO., Chicago, panel metal escutcheons, nameplates, dials and scales.

E. T. CUNNINGHAM, INC., New York City, a complete line of nearly 40 types of radio tubes, for d.c. and a.c. service.

DAY-FAN ELECTRIC CO., Dayton, O., an eight-tube a.c. receiver with tuned r.f. circuit in either table cabinet or console with speaker, and an eight-tube similiar model for battery operation.

DEJUR PRODUCTS CO., New York City, a line of radio parts, including vitreous enameled resistors, variable condensers, r.f. transformers, sockets and rheostats. An a.c. voltage regulator is another new item and is equipped with an a.c. voltmeter to insure accurate adjustment.

DIAMOND ELECTRIC SPECIALTIES CORP., Newark, N. J., dry batteries and radio tubes.

DONGAN ELECTRIC MFG. CO., Detroit, Mich., new audio transformers, including power push-pull input and output, and a power transformer for filament lighting of a.c. tubes; power transformers for all services; filter chokes for *A* and *B* eliminators; and by-pass condensers.

DUBILIER CONDENSER CORP., New York City, special filter devices for attachment to all types of electric power equipment which causes radio interference. In addition, an enlarged list of fixed paper and mica condensers as well as metallized grid leaks, and improved light socket antenna plugs.

H. H. EBY MFG. CO., Philadelphia, Pa., vacuum tube sockets for all types of a.c. and d.c. tubes, complete group of binding posts for all purposes.

ELECTRAD, INC., New York City, Tonatrol units, Truvolt resistance units of all types and sizes, fixed mica condensers, by-pass and filter condensers, grid leaks, rheostats, potentiometers, and other radio accessories.

ELECTRICAL RESEARCH LABS., Chicago, Ill., makers of Erla products, a voltage regulator for a.c. sets, designed to be connected between the power line and the input to the receiver. Three new models of a.c. receivers, in console cabinets, with built-in dynamic cone speakers. The dynamic units will also be available as separate items. A phonograph pickup is another new item.

ELKON WORKS, INC., Weehawken, N. J., a new dry element *B* eliminator, dry *A* eliminators, a dynamic loud speaker, and a tapering battery charger, which has an automatic adjustment of charging rate to suit the condition of the battery.

FANSTEEL PRODUCTS CO., North Chicago, Ill., a new line of radio receivers, and a complete line of *A* and *B* power units. (See Balkite).

FARRAND MFG. CO., Long Island City, N. Y., five electro-magnetic cone speakers in various table styles, and three electro-dynamic models, including a console model of unusually handsome appearance. The electro-dynamic units are available separately, for a.c. or d.c. operation.

FEDERAL RADIO CORPORATION., Buffalo, N. Y., six types of a.c. receivers, of six and seven tubes, with four of the models also available for d.c. operation. All sets are single control with illuminated scale, and have push-pull amplification in the power stage. The console cabinets are available in carved walnut or mahogany, and are equipped with built-in-air column speakers, or can be had with electro-dynamic cone units.

FERRANTI, INC., New York City, audio transformers, including new types of push-pull input and output transformers, the latter being designed both for high impedance speakers, and those of the electro-dynamic type which have low input impedance.

FORMICA INSULATION CO., Cincinnati, O., a complete line of Bakelite products, including drilled and engraved panels for all popular kits and circuits.

FREED-EISMANN RADIO CORP., Long Island City, N. Y., a new line of a.c. receivers employing the tuned r.f. circuit, in handsome wood and metal cabinets both in table and console styles, also loud speakers of electro-magnetic and electro-dynamic types.

FRESHMAN CO., INC., New York City, eight models of seven-tube a.c. receivers, using the Equaphase circuit, in table and desk consoles. One model includes an electric phonograph attachment.

FRENCH BATTERY CO., dry *A*, *B* and *C* batteries for every service, including new heavy duty batteries for *B* service.

FROST, HERBERT H. INC., Chicago and Elkhart, a complete line of new parts include new heavy duty filter condensers, *B* blocks, new moulded mica condensers, by-pass condensers, fixed wire resistances, variable resistances, air-cooled rheostats, a.c. snap switches, cable plugs and a complete power amplifier universal resistance kit. The kit consists of three fixed resistors of 2000 ohms each of the new Frost "A" series, wound on flexible Bakelite strips and four 2000 ohm heavy duty wire wound potentiometers as well as one 1500 ohm series "A" fixed resistor. These fixed resistors are equipped with sliding contacts to give variable 135 to 180-volt taps. The resistor for the *C* bias will

# Summary of R. M. A. Show Exhibits

give proper bias for the type and number of tubes used. Convenient wall outlets, hook-up wire, medium duty filters, panel brackets, center tapped resistances, Gem Hum Balancers and UX base sockets for subpanel mounting are included in the Frost line for the new season.

GENERAL INSTRUMENT Co., New York City, a complete line of radio parts, including improved models of variable condensers.

GENERAL RADIO Co., Cambridge, Mass., audio frequency oscillators of the beat frequency type, as well as the conventional types, impedance bridges, artificial lines and networks for telephone line measurements, input and output transformers for the 350 power tube, and power transformers of all types are but a few of the many new items introduced this season.

GENERAL TRANSFORMER CORP., Chicago, Ill., a complete line of power packs for manufacturers, including separate items of transformers, chokes and tuned audio transformers.

GREENE-BROWN MFG. Co., Chicago, Ill., *A* and *B* eliminator units, the *A* unit employing a dry plate rectifier, with 2½ amp, output, and the *B* unit supplying 85 milliamperes at 180 volts, using a gas-filled rectifier tube.

GRIGSBY-GRUNOW Co., Chicago, Ill., Majestic seven-tube a.c. receivers with R. F. L. circuit in table, spinet, console and hi-boy models.

HAMMARLUND MFG. Co., New York City, plug-in coils for a short wave receiver, covering the 20, 40 and 80 meter bands; space wound on a celluloid form, with a variable primary coil. Kits of parts for building tuned r.f. sets employing Hammarlund circuits, and a complete line of variable condensers, r.f. chokes, r.f. transformers and other parts for the professional set builder and the experimenter.

HIGH FREQUENCY LABORATORIES, Chicago, Ill., a new line of custom-built sets, including superheterodynes, using shielded grid tubes, and complete *ABC* socket power devices, as well as tuned r.f. and audio transformer equipment for the set builder.

HOYT ELECTRICAL INST. Co., electrical meters for all purposes, especially test sets for the a.c. tubes and sets.

HOWARD RADIO Co., Chicago, Ill., seven models of receivers using six, seven, or eight a.c. tubes and employing a tuned r.f. circuit; with or without loud speakers. The eight-tube models have push-pull audios with '71 tubes in last audio stage.

HYATT ELECTRIC CORP., portable radio receivers, as well as a group of accessories for all types of sets.

INTERNATIONAL RESISTANCE Co., Durham, Ind., grid leaks from 250 ohms to 20 megohms; power ohms from ⅛ to 50 watts, 1000 to 50,000 ohms; made with variety of lugs and terminals for every manufacturing need.

JENSEN RADIO MFG. Co., Oakland, Calif., four cabinet type electro-dynamic speakers, and three units for separate installation. The cabinet styles are both table and console, finished in walnut. The units are furnished either for a.c. or d.c. operation.

JEWELL ELECTRIC INST. Co., Chicago, Ill., a.c. and d.c. set tester, new types of a.c. meters, both portable and for panel mounting.

HOWARD B. JONES, INC., Chicago, Ill., three multi-plugs for connecting radio receivers with associated batteries or rectifier equipment.

KARAS ELECTRIC Co., Chicago, Ill., radio parts and accessories, the latest item being a set of a.c. transformers for filament lighting service. Included in the list of new parts are subpanel brackets, condenser control systems, and the new type 28 audio frequency transformer.

KELLOGG SWITCHBOARD & SUPPLY Co., Chicago, Ill., four new receivers, all a.c. operated, one being a table model and the rest consoles. Tuned r.f. amplification, using Kellogg a.c. tubes and with two stages of transformer coupled audio with output transformer, used in all four models. The sets are completely shielded, and have illuminated control panels.

KENRAD CORPORATION, Owensboro, Ky., a line of 16 radio tubes, known as Archatrons.

KING MFG. Co., Buffalo, N. Y., four receivers, two of 5 and 6-tubes for d.c. operation, using the neutrodyne circuit, and 6 and 7-tube a.c. models, one with push-pull amplification in the power stage.

KINGSTON PRODUCTS CORP., Kokomo, Ind., a complete line of *B* eliminators using Raytheon *B H* rectifiers and designed specially for use with 25, 30, 40 or 60-cycle supply; furnished 125 m.a. at 120 volts for '71 tube; also an Elkon *A* unit supplying 2½ amp. at six volts.

KODEL RADIO CORP., Cincinnati, O., a.c. power plants for operation of d.c. receivers from a.c. power lines, as well as trickle chargers, and high rate battery chargers, all using the Kuprox dry element charging unit.

KOLSTER RADIO CORP., Newark, N. J., seven types of a.c. receivers, of six and seven tubes, the console models having built-in electro-dynamic speakers. Besides two table models, there are two loud speakers, one a table type cone, and the other an electro-dynamic model in a console cabinet.

MAGNAVOX Co., Oakland, Calif., electro-dynamic loud speakers, in table, console and unit form, including a.c. units for operation from the electric light socket. The units are also available for d.c. sets, and all cabinet and console models can be had equipped with the d.c. units.

MARTI ELECTRIC RADIO Co., INC., three models of a.c. receivers, including a table model. Sets are eight tubes, with three stages of tuned r.f., detector and three stages of resistance coupled audio, with 210 power tube.

MCMILLAN RADIO CORPORATION, Chicago, Ill., four eight-tube a.c. receivers with four stages of shielded radio frequency, detector and three stages of audio frequency, (push-pull); built on steel framework; full wave rectification system. The Winchester is a table model 10x25x16, single dial control. The New York Combination is a table cabinet with mounting table, housing cone speaker, 39x27x16. The Westminster is a high boy console in American walnut, housing same receiver as the Westchester. The Warwick is a console model in combination walnut and satinwood.

MICARTA FABRICATORS Co., Pittsburg, Pa., a line of panels and other products for the professional set builder, as well as the radio factories.

MINERVA RADIO CORP., Chicago, Ill., seven types of seven-tube tuned r.f. receivers, all for a.c. operation, with one table model. The console models have built-in loud speakers, three of which are of the electro-dynamic type.

MOLDED WOOD PRODUCTS, INC., Chicago, Ill., two loud speakers with exponential horn, and a cone assembly for separate installation in console cabinets.

LESLIE F. MUTER Co., Chicago, Ill., a.c. power units, by-pass and filter condensers of all sizes and a variety of radio parts such as rheostats, switches, grid leaks, and new types of audio frequency transformers, including double impedance units.

NATIONAL CARBON Co., radio receivers, including a special d.c. model using high-mu tubes so as to economize on *B* battery power, and a.c. models of both table and console types. A new cone type loud speaker is also announced, as well as a complete line of *A*. *B* and *C* batteries.

NATIONAL Co., INC., Malden, Mass., tuning units for regenerative tuned r.f. sets, a new drum dial of the vernier type, in addition to short wave condensers and coils, push-pull amplifier equipment, and *B* power units.

NEWCOMBE-HAWLEY, INC., St. Charles, Ill., electro-dynamic speakers, as well as improved air column reproducers and magnetic-cone reproducers.

(Continued on Page 64)

# New Instruments for Radio Measurements

The Weston Model 537 A.C.-D.C. radio set tester is provided with an a.c. voltmeter, a d.c. volt-milliammeter, and an ingenious system of switches and binding posts for automatic connection to the circuits of any radio receiver, whether a.c. or d.c. The a.c. voltmeter has three ranges, 150/8/4 volts, the

*Weston Model 537 A.C.-D.C. Radio Set Tester*

lower ranges measuring the filament voltage of a.c. tubes and the highest range the line voltage. The d.c. volt-milliammeter has four voltage ranges, 600/300/60/8 volts with a resistance of 1000 ohms per volt, and two current ranges, 150 and 30 m.a. The set is furnished with a complete instruction book and necessary socket adapters so that any current or voltage in the set can be measured without need of power other than that supplied to the radio receiver.

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The Jewell No. 199 radio set analyzer has been designed to give a rapid indication of the circuit conditions in any radio set, whether a.c. or d.c. It is arranged to read all the various values of current and voltage in connection with each tube and its socket by plugging an adapter into the tube socket

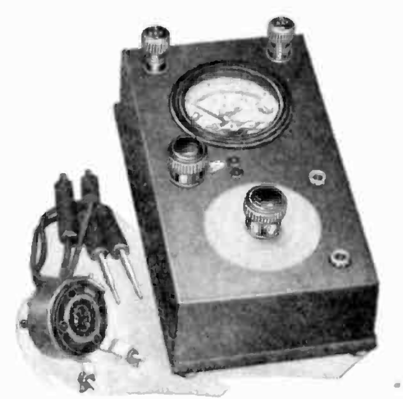
*Jewell Pattern No. 199 Radio Set Analyzer*

and pressing special push button switches on the tester panel. The a.c. voltmeter has ranges of 0-4-8-16-160 volts. The d.c. instrument has ranges of 0-7½-75-300-600 volts with 1000 ohms per volt and 0-15-150 m.a. Special leads are provided for making continuity tests. It gives a cathode voltage test for a.c. tubes for which it has a five-prong plug. Each instrument is provided with a complete instruction book and a pad of test charts.

The Hoyt universal service set tester is a compact, accurate instrument for making rapid tests of wiring, power supply and tubes, in all kinds of radio sets, without disturbing connections or accessories. Tubes may be tested with this instrument under actual working conditions and a.c. line voltage of "electric sets" checked as well. It is equipped with a d.c. precision moving coil volt-milliameter and a three-range a.c. volt-

*Hoyt Universal Service Set Tester.*

meter. The d.c. voltmeter has a resistance of 1000 ohms per volt and has five d.c. scales—10, 100 and 500 volts, 25 and 100 m.a. Three scales are available on the a.c. voltmeter—3, 9, and 150 volts. It contains a tube socket and has a flexible four-wire lead terminating in a plug which, with the furnished adapters, fits all tube sockets. Plainly marked



*Hoyt A.C. Attachment.*

push-buttons and switches provide easy operation during each test.

The Hoyt a.c. attachment for d.c. tube testers consists of a heavy-duty rheostat and a 0-3, 3-9 voltmeter responsive to either a.c. or d.c. It is equipped with a special adaptor for '27 tubes and a pair of leads with terminals to fit tubes having top connection. A similar instrument is also made with a 0-3, 4-15 volt range. Full directions for attachment and use accompany each instrument.

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The Hoyt Universal a.c. and d.c. tube tester provides a means for testing all types of tubes, including those with top heater connections. Power for its operation may be obtained either from the receiving set socket by means of socket plug base and cable, from batteries, or from transformers.

The Sterling Junior A.C. Tube Checker is designed primarily to test short circuits between the elements of any vacuum tube and also to check the emission of '26, '27, '99, and '20 tubes. When the device is connected to a 110-volt socket its arrow indicates the existence of a short between the filament and

*Sterling Junior A.C. Tube Checker.*

grid, plate and grid, or plate and filament of the tube inserted in the socket. The relative emission is also indicated by throwing the switch.

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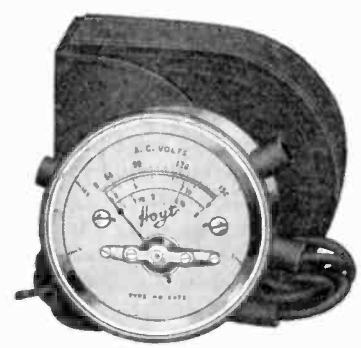
The Hoyt pocket voltmeter for a.c. sets has three scales—0-3, 0-8, 0-150—the dial being marked in red at the important points, 1½, 3, 5, 7½, and 110 volts. On special order the second scale is supplied for 4-15 volt



*Hoyt A.C. Pocket Voltmeter.*

readings. The resistance on all scales is more than 20 ohms per volt. It reads without appreciable error on d.c. above 90 volts. It is supplied in a nickel case 2¼ inches diameter with a pair of special leads and a leather carrying case.

## NEW RADIO CATALOGS

Catalog No. 16 from the Jewell Electrical Instrument Company, Chicago, is one of the most helpful guides published for users of measuring instruments. In its 112 pages are illustrated and described all the portable and switchboard instruments made by this company, including voltmeters, ammeters, ohmmeters, galvanometers, wattmeters, power factor meters, frequency indicators and relays. Most of these are of interest to industrial and power company engineers, but many of them, including various radio test sets, are especially designed for radio men. The constructional features of various types of movements are also shown.

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"The Gateway to Better Radio" is a 32-page booklet from American Mechanical Laboratories, the manufacturers of the Clarostat, a micrometric variable resistance whose construction and various radio applications are clearly shown. Interesting suggestions are given for getting the most out of your radio, how to make it reach farther, how to control volume and improve tone quality, and how to build battery eliminators.

# Radio Frequency Amplifying Equipment

The Sterling Pre-Amplifier is a complete tuned r.f. stage using a shield-grid tube to be connected ahead of any set using d.c. tubes. It adds greater distance, selectivity, and better tone without the necessity of rebuilding

*Sterling Pre-Amplifier*

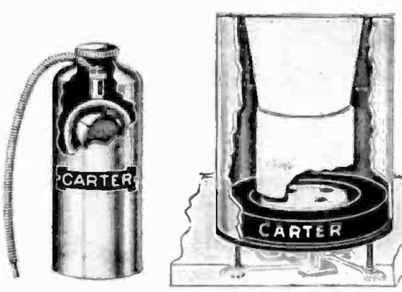
an existing set. It is equipped with switch and power cable having marked leads. It is especially adapted for use with short aerials, thereby reducing static.

The Braxton-King impedance unit is designed for use with shield-grid tubes in a 350 k.c. amplifier. It consists of a plate coil with its tuning condenser, a filament resistor,

*Braxton-King Impedance Unit and Oscillator Coil.*

blocking condenser, and grid condenser, completely shielded and fitted for plug-in to a standard socket. The oscillator coil for use with a matched set of three or four of these impedance units consists of a balanced plate and grid winding with a variable pick-up coil and is tuned by a .00035 mfd. variable condenser in series with a .0005 mfd. fixed condenser.

Carter accessories for '22 type of shield-grid tubes include a metal shield which completely covers the tube and base, a brass




*Carter Tube Shield, Connector, and Adapter*

connector and shielded wire for the grid terminal of the tube, and an adapter ring to hold the tube shield in place on the socket. The connector is slotted to make a firm spring contact. While these devices are designed for joint use, each may be bought and used separately.

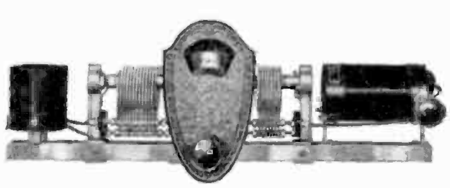
Carter also has a small and conveniently mounted 25-ohm resistor which is tapped at 10 ohms, so as to provide 3.3 volts filament current from a 6-volt battery, and to give *C* bias to the tube. A similar 15-ohm type, tapped at 5 ohms, is designed for use in connection with a rheostat. These are less than 2 in. long and ¼ in. wide.

The new S.-M. "130 Series" plug-in coils and forms are Bakelite moulded, of small dimensions (1⅞ in. high, above prongs;

*Silver-Marshall No. 130 Plug-in Coils*

1 15/16 in. top diameter) suitable for plugging into any 5-prong a.c. tube socket. As compact and efficient as it is economical, the S.-M. 130 unwound coil form is ideal for short-wave experimenting. The S.-M. 131-T, U, V and W coils, space-wound with enamelled copper wire, provide wavelength range from 17.5 to 204.5 meters.

The National single dial tuning unit is made in two types. No. 222 is for use with screen grid tubes and has a high impedance transformer with slot-wound primary. Type b is similar except that it is designed for use with '1A, '26 or '27 type tubes. The unit includes an escutcheon plate drum dial with velvet vernier control and lamp for illumina-

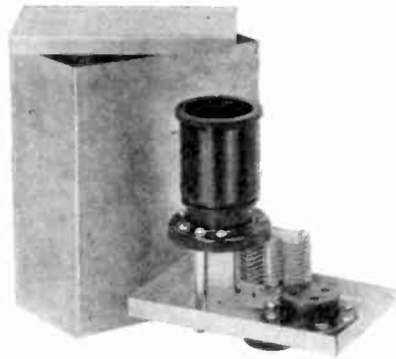


*National Single Dial Tuning Unit.*

tion, two Equitune condensers, and small size, space-wound Browning-Drake type of r.f. transformers. Each of these parts is also available separately. The unit is assembled on rigid aluminum girders which preserve the alignment and make it easy to install and use. The antenna circuit has a built-in induction trimmer which obviates the use of a trimmer condenser and simplifies the wiring when building a receiver.

The Flewelling short-wave adapter is a single stage tuned r.f. amplifier equipped with an adapter to be plugged into a socket of an existing receiver, which is thereby converted into a short-wave receiver without any change in wiring.

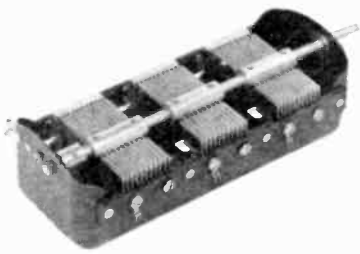
The S-M 638 Stage Shield is made of .014 sheet copper, with removable top and bottom. Its small size (5-9/16 inches high by 4½ inches wide by 2⅝ inches deep) recommends



*Silver-Marshall Shield for R.F. Stage*

it particularly for use with the new S-M five-prong plug-in coils. The bottom is pierced for tube socket, coil socket, and midget condenser assembly.

New Silver-Marshall condensers include a .00035 mfd. two-gang and a "three-gang" bath-tub type equipped with compensators,



*New S-M Three-Gang Condenser.*

and also a single variable condenser to match. There is also a .00014 mfd. model of similar design for short-wave reception.

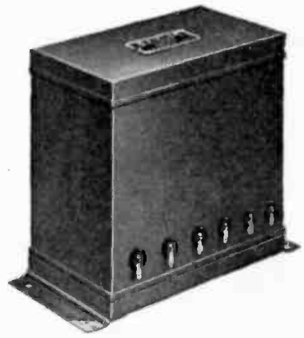
The Lincoln tuned intermediate frequency transformer is of the air core type. By means of a calibrated condenser knob it may be tuned from 350 to 450 kilocycles for use in a special Lincoln 8-tube superhetrodyne cir-

*Lincoln Tuned I. F. Transformer*

cuit using four screen grid tubes. It is completely shielded in a copper case of the same size and appearance as the Lincoln audio transformers.

# New Audio Transformers

The new Remler first-stage audio transformer applies the old-time telephone repeater system to secure greater gain and an approximately straight line amplification curve for *all* frequencies received from a broadcast transmitter. In this system the transformer primary is resonated at about 60 cycles with a fixed condenser in series. The resonance curve is broadened by means of a shunted high resistance which is also effective in by-passing the d.c. component of the audio frequency voltages so that only the a.c. component passes through the primary. The turns ratio is raised to an effective 4½:1 by means of an auto-transformer, of which one part is the primary and the entire winding is the secondary.



*New Remler Output Transformer*

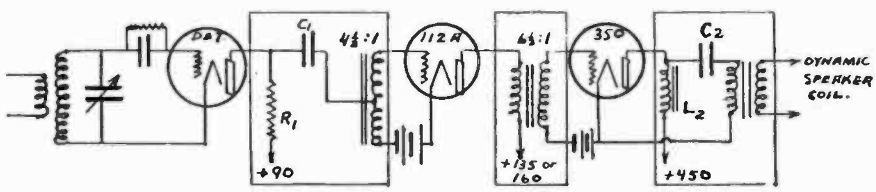



*Fig. 1. Circuit Diagram of New Remler Audio Amplifier System*

Figure 1 shows the circuit diagram for these connections as well as the balance of the audio amplifier system with 112A tube in the first stage. A special 6½:1 transformer and 350 tube in the second stage, and a step-down output transformer preceding a dynamic speaker.

The 112A tube is recommended because of its low plate impedance with respect to its amplification constant. A resistance of 100,000 ohms for $R_1$ gives the proper low-frequency characteristic to offset the drop in the second transformer. This resistance causes a voltage drop in the detector circuit which thus requires 90 volt *B* supply instead of the usual 22½ or 45 volts.


*New Remler Audio Transformer*

The combination of the two audio transformers and 112A tube is sufficient to give a grid swing of 70 volts for a 350-power tube when the detector tube has an output of 1/3 volt, which is about the maximum for distortionless reproduction. The entire system with two tubes is claimed to give a gain of from 55 to 57 TU for all frequencies between 50 and 5000 cycles.

The transformers with resonated primaries are made in two types, one resonated to about 60 cycles for use with d.c. filament tubes and one to about 100 cycles for use with a.c. filament tubes, which otherwise may produce an a.c. hum in a dynamic speaker. The use of the higher resonating frequency is also advantageous when a '71 power tube is used to give the same apparent volume as a '10 tube without overloading or blasting on the low notes.

The Remler audio amplifier system is made complete with an output transformer having a low impedance secondary to match the low impedance of a dynamic speaker's moving coil. D.C. is kept out of the output transformer by means of a choke coil and condenser.

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S.-M. 225 and 226 are first and second stage audio transformers which are claimed to give straight line amplification from 30 to 5,000 cycles, and a voltage amplification 50 to 100 per cent greater than that provided heretofore. This transformer is manufactured in accordance with the Clough invention, whereby the d.c. component of the plate current is carried by a large resistance which is shunted between the *B* battery and plate terminal of the transformer primary, and the a.c. component flows through the transformer primary. The drop in plate potential due to this resistance is overcome by using 180 to 200 volts on the plates of the detector and first audio tubes, using a greater resistance in the detector circuit to give the requisite lower voltage.

By thus keeping the d.c. component out of the transformer primary, any hysteretic distortion due to oversaturation of the core is minimized and the core can be operated at a higher point in its permeability curve. Only the a.c. signal flows through the primary and operates on the iron core. Thereby a greater effective inductance is obtained for a given expenditure of copper and iron.

In order to accentuate the amplification of the very low frequencies, a fixed condenser of proper value is placed in series with part of the transformer primary, causing a resonance hump in the curve. By the auto-transformer connection shown in Fig. 1, the same winding that previously provided a 3:1 turn ratio now

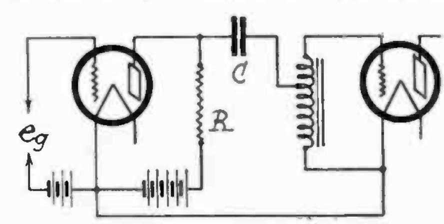
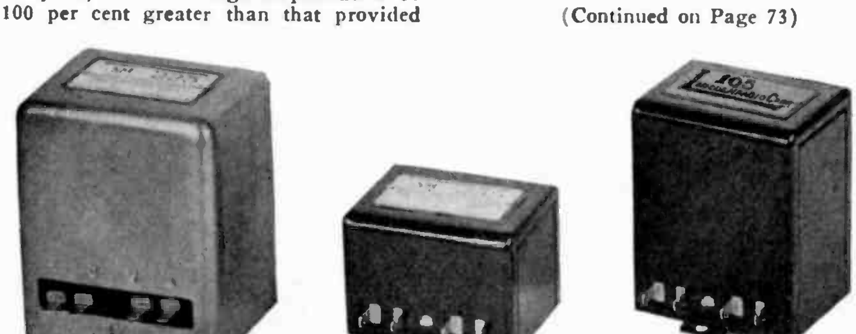



*Fig. 1. Connection for Clough System*

provides an effective 4:1 ratio. This correspondingly reduces the distributed capacity in the secondary and thus gives better amplification of the high frequencies.

Actual curves of comparative tests of a number of high grade transformers are

(Continued on Page 73)




*The New Silver-Marshall 225-226 and The Lincoln 105, all using the Clough System*

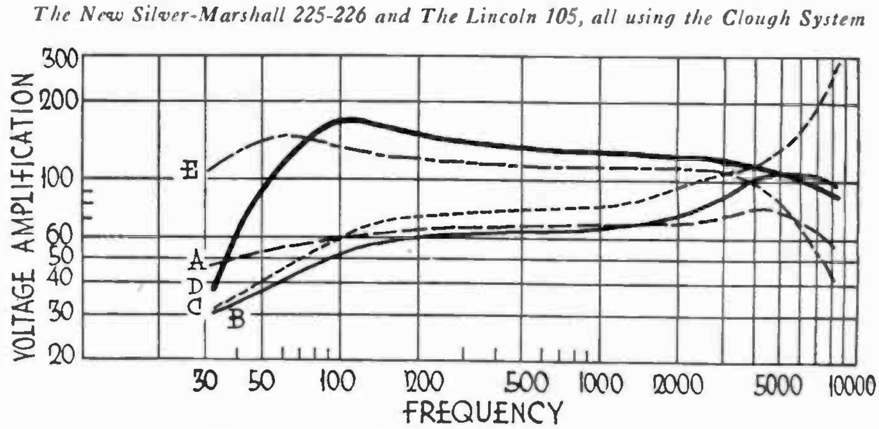
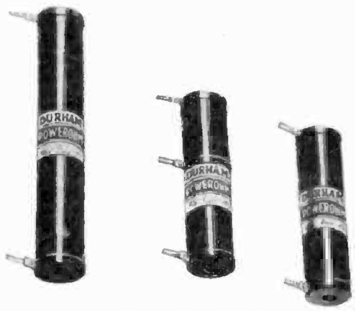



*Fig. 2. Curves of Audio Frequency Amplification*

# Miscellaneous Parts and Accessories

## RESISTORS

Durham Powerohms are fixed resistors ranging in power capacity from ⅛ to 50 watts and in resistance from 20 to 500 megohms. Sizes vary from 1 to 24 in. in length, depending upon their resistance and heat-dissipating ability.

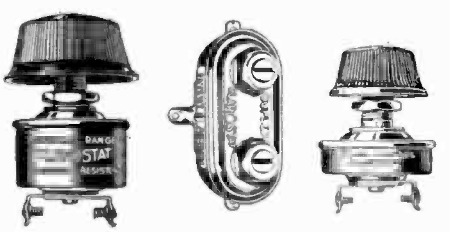


*Durham Powerohms*

The Super-Davohm is a wire-wound high resistance unit which can be furnished in any value from 500 to 5,000,000 ohms. It has practically negligible inductance and a minimum of distributed capacity. Its ohmage rating is claimed to be accurate within 1 per cent plus or minus. It has a safe carrying capacity of 1 watt and a temperature coefficient of .0001. It is especially adapted for use as a plate or grid resistor in radio sets, a multiplier for voltmeters, or as a high voltage regulator.

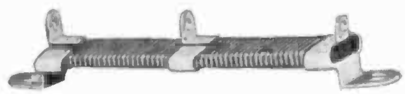
500 OHMS TO 5,000,000 OHMS


A number of novel Clarostats for micrometric control of resistance are now available in addition to the standard model. These include a table type equipped with cords and connector and having a resistance range of 0 to 500,000 ohms and a capacity of 7 watts, and a volume control of similar range and capacity. There is also a grid-leak type with a range of 1/10 to 10 megohms for use in short-wave reception or with a resistance or impedance coupled amplifier. It is also recommended for a.c. detector tubes. One model, the Duplex, combines two units in one, with screwdriver adjustment of resistance for semipermanent use. The power Clarostat with a 40-watt capacity is available in three ranges, 0-10, 25-500, and 200-100,000 ohms. It is intended for voltage tap, line voltage, *C* biasing and other heavy duty control.



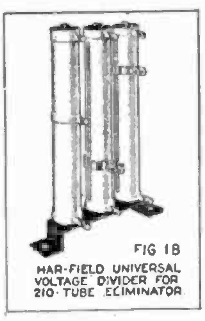
*Volume Control Duplex Grid-Leak.*

Polymet center-tapped resistances in all standard sizes from 10 to 100 ohms are designed to insure proper grid balance for a.c. tubes. They are equipped with a combination soldering and mounting lug at either end and a center mounting hole whose distance can be made to suit requirements. The same form of flat resistance element is also available without center tap in all sizes from one to 2000 ohms for low current carrying capacity use. Flexible resistance elements wound on non-inductive tubing, covered with an insulating sleeve and equipped with a tinned soldering lug are made in sizes from 1 to 5000 ohms.



*Polymet Center-Tapped Resistance*

Har-Field universal voltage dividers for *B* eliminators are made in two types, one for a 180-volt rectifier and the other for the 425-volt type. They consist of a fixed resistor for 90-volt supply with a 45-volt tap and an adjustable resistor for the maximum terminal. They may be adjusted for a specific eliminator and load requirement either by simple calculation or by trial, both of which methods are described in the directions and circuit diagrams which accompany the units. They are designed for use with voltage regulator tubes.

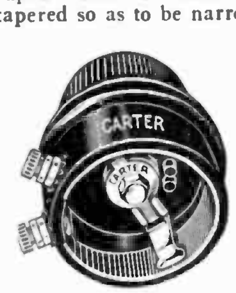



*Har-Field Universal Voltage Divider*

The Electrad Truvolt Divider is a wire-wound resistor having five adjustable contacts for supplying any desired *B* and *C* voltages from a rectifier and filter system. The adjustable contacts can be calibrated and by means of tables and graphs which are furnished with the unit the divider can be adjusted to give specified voltages at a given current drain without using a high resistance voltmeter. It has a bakelite base and knobs and can be mounted in any position.


*Electrad Truvolt Divider*

Carter wire-wound tapered rheostats and potentiometers are designed for circuits where the useful range of adjustment is crowded into a small portion of the knob's rotation. The strip upon which the resistance wire is wound is tapered so as to be narrower at one end than the other, and has a greater spacing between turns at the narrow end. Both rheostats and potentiometers are made in 400, 750, 1000, 3000, 5000, 6000 and 10,000 ohm sizes and have a maximum dissipation of 5 watts.




"Amperite" No. 226 and No. 227 are automatic resistance controls for the filaments of '26 and '27 types of a.c. tubes. They are designed to keep the tubes operating within the proper limits when used on the required transformer taps. They are found to prolong tube life and eliminate distortion. They are to be connected in series with the tube filament and the *A* line from the transformer.


## FIXED CONDENSERS

New Parvolt condensers include complete groupings of filter condensers in metal housings with lead-in terminals designed for use with the more important a.c. and d.c. power supply units. These are of standard mfd. capacities and in ratings of 200, 400, 600, 800, 1000, and 1500 volts. Parvolt by-pass condensers also are available in standard capacities and voltage ratings.

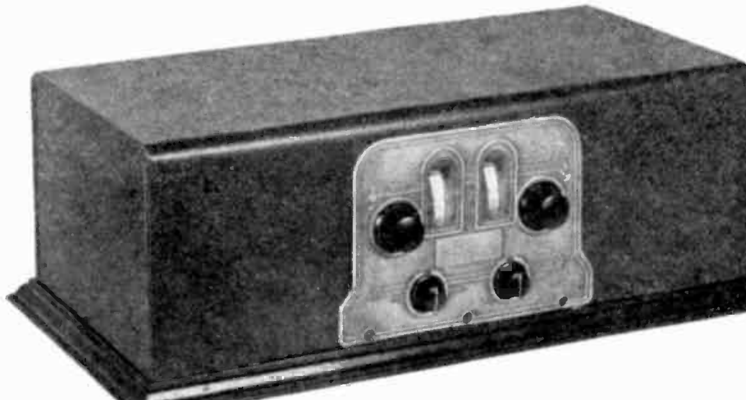

*Grouping of Parvolt Filter Condensers for Power Units.*

Dubilier interference devices are designed to suppress line transmission of interference to radio reception from make-break sparking contact apparatus which produces an inductive kick-back. Models No. 1 and 2 are heavy capacity condensers either of which may be grounded and shunted across the apparatus which is causing the trouble.

(Continued on Page 70)

# Radio Kit Reviews

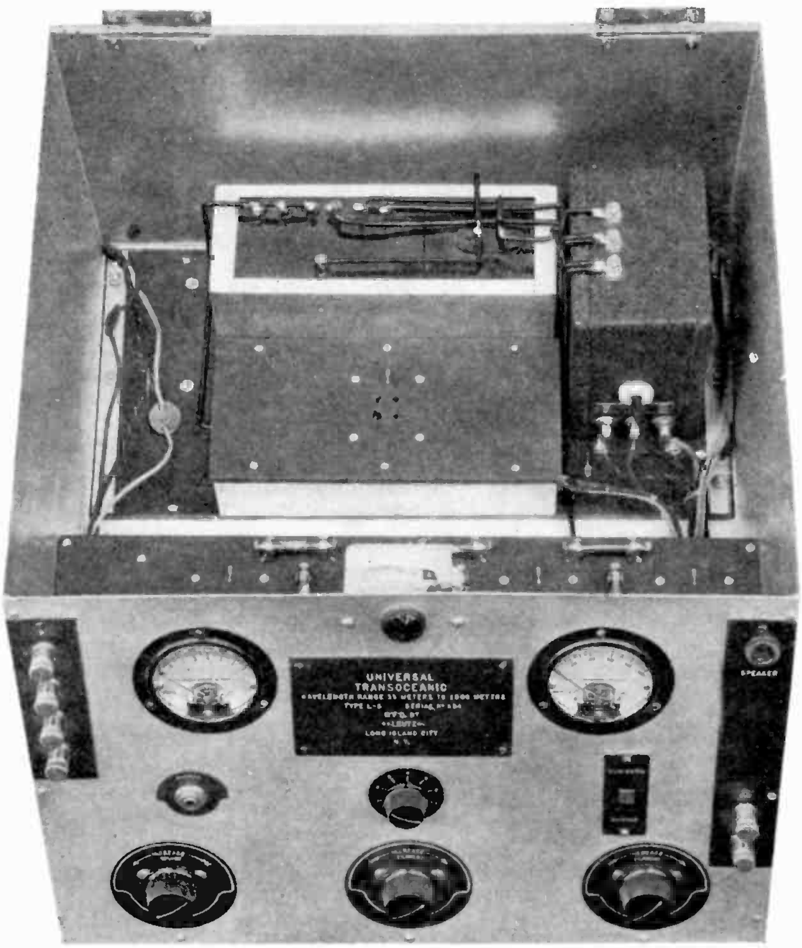
## "Silver Ghost" Universal Transoceanic



*Silver-Marshall Screen-Grid Eight*

This is a nine-tube receiver using four stages of tuned r.f. amplification with shield grid tubes, gassy detector tube, two resistance coupled audio with high-mu tubes and one push-pull audio with two '10 or '50 tubes. It also has a *BC* eliminator using two '81 rectifiers capable of supplying 180 m.a. at 450 volts. Provision is made for an external *A* eliminator.

Interaction in the r.f. stages is prevented by liberal shielding and spacing between stages and by the use of small transformers with concentrated fields. Individual control is provided for each r.f. stage and the detector, but these can also be connected together for two-dial tuning with auxiliary vernier adjustments. One dial then controls the antenna series condenser, which, with the three-point selector switch of its coil, is claimed to give 10 k.c. selectivity. Plate voltage to the r.f. and detector tubes and grid bias for the r.f. tubes are regulated from the front panel. The broadcast band transformers are interchangeable with those for long waves up to 3600 meters and short waves down to 35 meters.



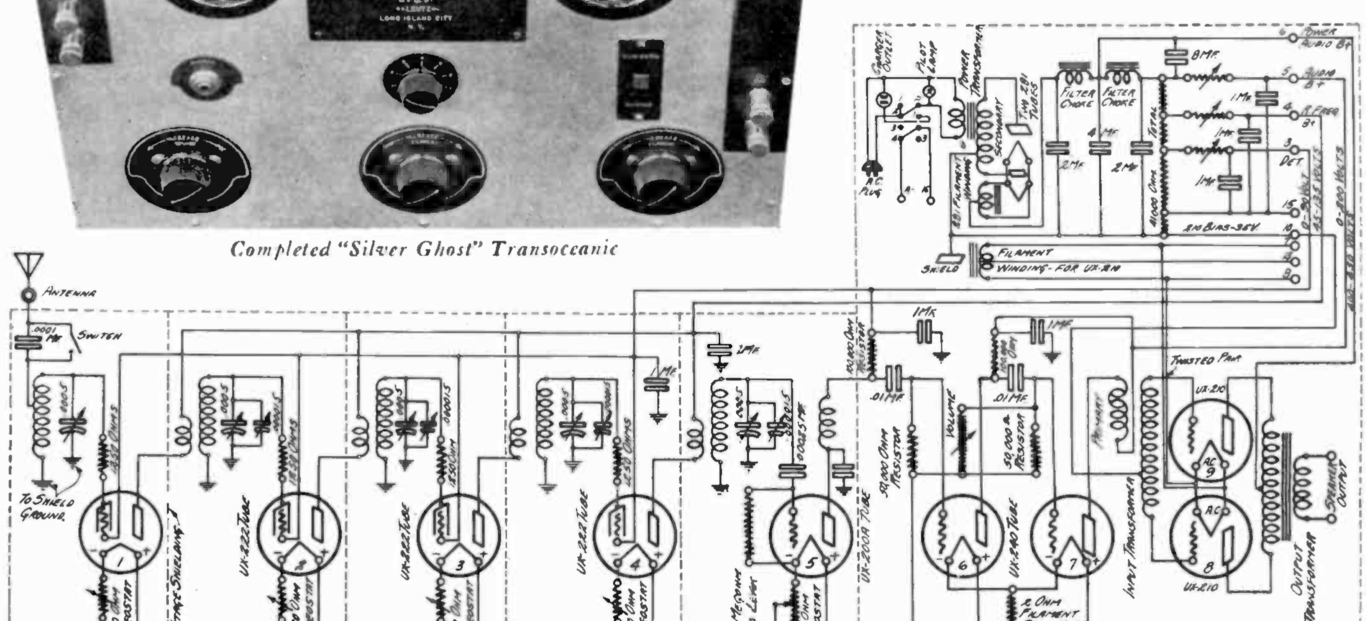

*Completed "Silver Ghost" Transoceanic*

The undistorted audio output is 7000 milliwatts with two '40 tubes in the resistance coupled stage and two '10 tubes in the push-pull stages. With '50 tubes this approaches 20,000 milliwatts which can be properly handled only by a dynamic speaker. If such is used its field serves as the filter choke coil in the *BC* eliminator.

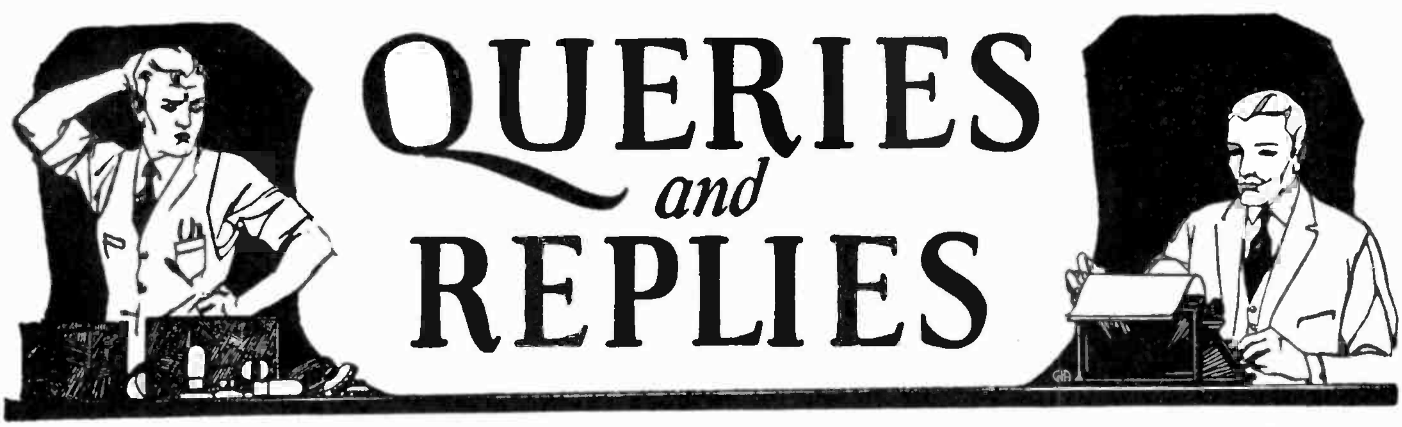
A two-scale volt meter with nine-point switch is provided for reading all *A*, *B*, and *C* voltages and a milliameter to measure the total plate current of all except the power tubes. A single switch turns on or off the entire equipment, as indicated by a pilot light.

Great care has been taken in the details of design. All parts are of rugged construction and the kit is packed to avoid breakage in transit. Amazing records of satisfactory long distance reception are cited from the

(Continued on Page 74)




*Circuit Diagram of New "Silver Ghost" Receiver*



# QUERIES and REPLIES

Questions of general interest are published in this department. Questions should be brief, typewritten, or in ink, written on one side of the paper, and should state whether the answer is to be published or personally acknowledged. Where personal answer is desired, a fee of 25c per question, including diagrams, should be sent. If questions require special work, or diagrams, particularly those of factory-built receivers, an extra charge will be made, and correspondents will be notified of the amount of this charge before answer is made.

**I wish to improve the selectivity of my Best 45 k.c. superheterodyne, and would like the circuit diagram for a r.f. amplifier of one or two stages, to be placed ahead of the first detector, and which will retain the loop antenna feature. Should straight line frequency condensers be used in preference to the older straight line wavelength condensers originally installed in the set?—F. W. K., Cleveland, Ohio.**

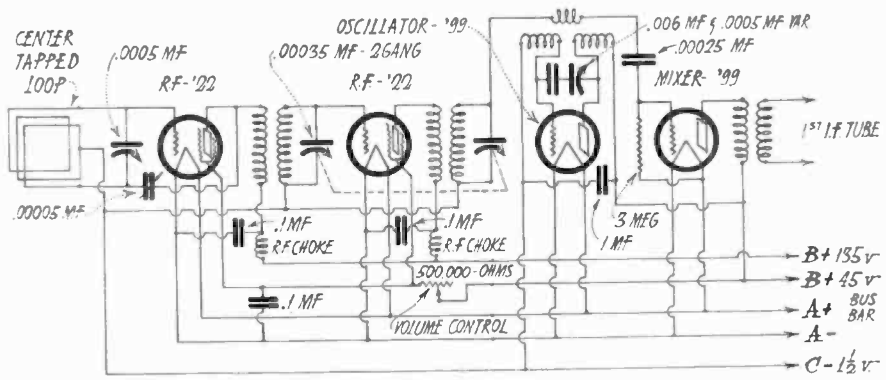



*Fig. 1. Circuit of R.F. Amplifier for 45-Kilocycle Superheterodyne*

In Fig. 1 is incorporated a diagram of a two-stage tuned r.f. amplifier, using a loop antenna for input, and feeding into the first detector circuit of the 45-k.c. superheterodyne. This amplifier has shielded grid tubes, and the r.f. transformers may either be those used in the new Best 115-k.c. superheterodyne, or any other shielded grid r.f. circuit now on the market. It is important that each stage be individually shielded, for otherwise, the selectivity will be poor, and there will be a tendency on the part of the amplifier to oscillate badly. The loop antenna requires a separate .0005 mfd. tuning condenser, which cannot easily be ganged to the condensers tuning the two r.f. transformers. This is because the tuning curve of the loop antenna, and that of each r.f. transformer are different, and a large trimmer condenser, which would be inconvenient to operate, would be needed. The set would have three dials, one for the loop antenna, one controlling a two-gang condenser tuning the two r.f. stages, and one for the oscillator condenser.

**I have a half-wave "B" eliminator built after plans published in RADIO about two years ago. The output voltage seems to be lower and lower each time I measure it and I think the tube is wearing out. Is there any better tube than the 316-B, and what changes in the circuit must be made if a new tube is advisable?—E. L. A., Terre Haute, Ind.**

A type CX-381 half-wave rectifier tube is much better than the 316-B, which is now obsolete. The filament voltage for the new tube is the same, and no changes need be made in the circuit to accommodate it.

**Please publish the circuit of the Kennedy Model 15 set, and what is the address of the Kennedy Company?—C. W. Y., Alhambra, Calif.**

This receiver is no longer made, and as far as we know, the company is out of business. Circuit diagrams of obsolete receivers are often very difficult to obtain, and we have been unable to locate an authentic diagram of the Model 15 set.

**What is the circuit of the Northern Electric 9-tube superheterodyne, and can it be operated from a.c.?—H. R. C., Cleveland, O.**

The circuit is shown in Fig. 2. It consists of the usual superheterodyne arrangement of oscillator, mixer, three i.f. stages, detector and first audio, with type R-215-A peanut tubes in a series-parallel combination to work from a 6 volt storage battery. The second audio stage is push-pull, with tubes having 6 volt filaments, and the entire set is designed to operate from storage *A* and not directly off the lighting socket. Of course, standard types of *A* and *B* eliminators can be used to supply the d.c., so that the set can be run without batteries, except for the *C* batteries used in the first detector and power stage.

**In connection with the Best 115 k.c. superheterodyne, are chokes and by-pass condensers of advantage, in the shield grid leads? Would larger by-pass condensers than the present .1 mfd. size improve results? Would a choke of 125 mh. be of value in the plate of the second detector?**

(Continued on Page 67)

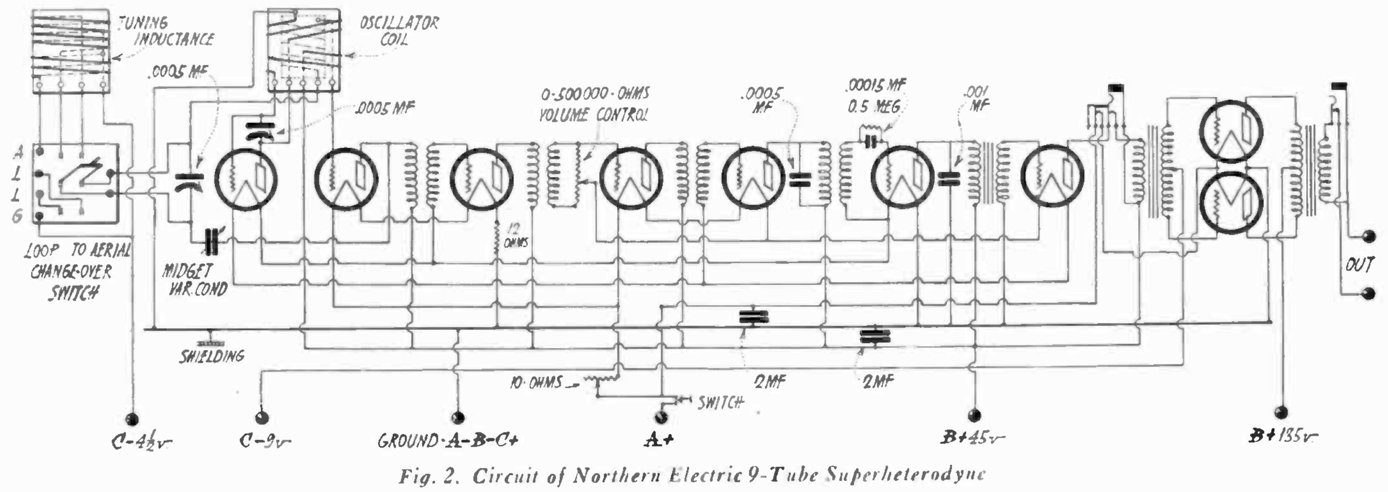



*Fig. 2. Circuit of Northern Electric 9-Tube Superheterodyne*

# With the Amateur Operators

## A PRACTICAL C W KEYING SYSTEM

*By* Frank C. Jones

Many amateurs are confronted with the problem of eliminating the key click and maintaining a steady note when using a C W transmitter having pure d.c. plate supply. Ordinarily a bad click occurs unless the plate voltage is applied to the oscillator gradually and any change of load causes a chirp unless the oscillator is crystal-controlled. Even a slight change of plate voltage changes the capacity between the plate and the filament and between the grid and the filament, thus causing a chirp when the transmitting key is depressed.

This defect can be partially remedied by placing a large condenser across the transmitting inductance so as to counteract the change in tube capacity. Values of from .0001 mfd. for 20 meters up to .0005 mfd. for the highest amateur band are recommended. The *L C* circuit should then be designed for very low resistance since the closed circuit r.f. current will be high when a small inductance and a large capacity are used. This means short heavy leads between the condenser and the tuning inductance. The latter should be of copper tubing.

Key clicks can be minimized by finding a proper keying location, such as a combination of plate and grid keying.

But the real solution for the problem of preventing chirps and clicks is a constant voltage supply so that the oscillator frequency is not varied. This may be secured by maintaining a constant load, which also gives a longer life to the transmitting tube.

Fig. 1 shows a method for accomplishing this with a Hartley or other circuit using a grid leak. *R* is a 0-100,000-ohm variable potentiometer. $R_8$ is a variable resistor capable of dissipating 25 watts, as it takes most of the load when the key is up, the remainder of the load being absorbed by one or two *A* tubes, which have a positive bias when the key is up.

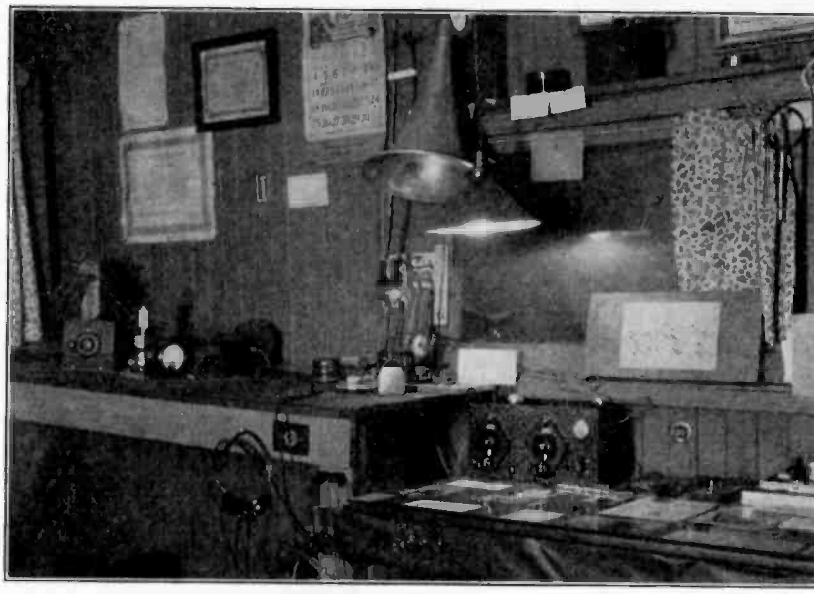
This positive bias is obtained through a 13½ volt *C* battery with the positive side towards the grid through $R_2$. This makes the plate impedance extremely low and so large current values are obtained. $R_3$ and *R* should be adjusted until the current through jack *2* measures the same as that through jack *1* when the transmitting key is up and down respectively. The current as measured in jack *3* should be constant at all times. The resistor $R_1$ should generally be in the neighborhood of 25,000 ohms when using a 210 oscillator. The corresponding value of $R_2$ will be around 75,000 ohms.

A 1 or 2 henry choke $L_1$ in series with the key and a key shunt $C_1$ $R_4$ reduce the key click to a negligible value.

$L_1$ can be made by winding 1500 or 2000 turns of No. 22 wire on an iron core having a cross-section of about 1 square inch, or the 110-volt winding of a good-sized toy step down transformer may be used. The condenser should be of a high voltage type of about 1 mfd., and the resistance about 400 ohms. This combination slows down the application of the plate voltage, and grid leak current return also, a few thousandths of a second; enough to stop the key click.

When the key is open there is a large positive bias on the grids of the *A* tubes, causing normal load current to flow through the absorbing resistance $R_3$ and tubes. The grid leak return and negative plate lead are practically open, that is through a 100,000-ohm resistance and a negative bucking battery. This is more than sufficient to stop oscillations for most tubes.

When the key is down, the oscillator is normal, but there is a closed grid circuit network on the absorbing tubes which puts a high negative potential on the grids. With the values of $R_1$, $R_2$, $E_1$ and $E_2$ shown, the effective negative potential is about 65 volts. For higher negative potentials, a greater ratio than 3 to 1 for $R_2$ to $R_1$ should be used, and a larger value of $E_1$. This applies to the case of higher plate potential for the oscillator.



*NU-6BXD, Altadena, Calif.*

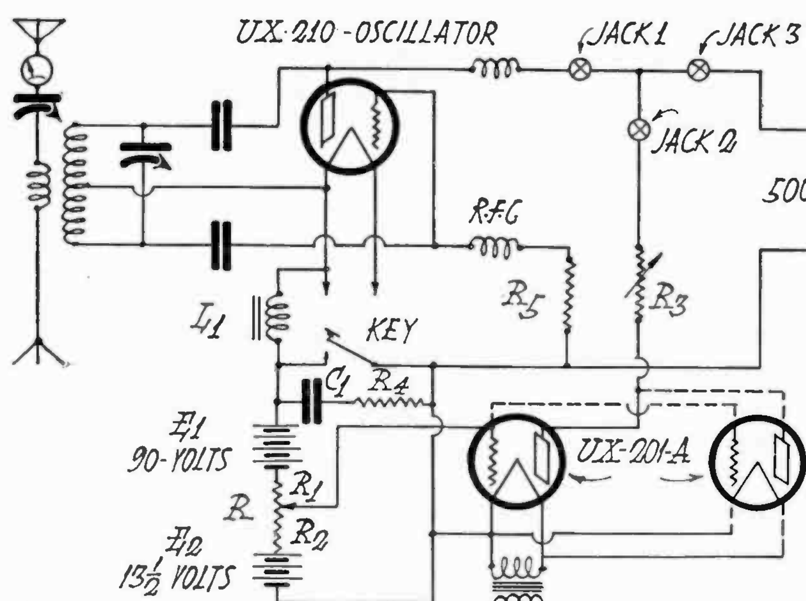



*Fig. 1. Hartley Circuit Arranged to Minimize Chirps and Key Clicks*

## NU—6 BXD

Station 6 BXD, illustrated herewith, is owned and operated by Walter F. Scott, 223 Terrace Avenue, Altadena, California. Since it started operations in 1923 it has passed through all the stages from an A tube to a 50 Watter Hartley with 1000 volts on the plate supplied by two 281 tubes. It has a 40-ft. antenna and counterpoise. The station has worked every continent except Europe, including 25 countries and 47 states. The receiver is a throttled condenser type with a UX-226 a.c. amplifier tube used as a detector.

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The "Radio Guide" from Amalgamated Wireless (Australasia) Ltd. of Sydney, Australia, is an illustrated description of all the widespread activities of this corporation. These include the beam service to Great Britain, the coastal and island radio service given by 29 stations, marine wireless, police wireless, short-wave broadcasting and research, the Marconi school, and their manufacturing facilities. Catalog descriptions are also given of various broadcast receivers and accessories as well as of circuits for home construction. Price one shilling and six pence.

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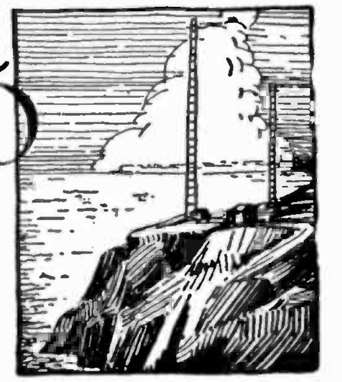
"How to Take Care of Your Radio Tubes" is the subject of a twenty-four-page, 3¼x 6¼ in. booklet from the Sonatron Tube Company. In addition to an explanation of what a vacuum tube is and how it operates, together with hints on the correct control of tubes, it describes the thirty-seven tubes in the Sonatron line.

# The COMMERCIAL BRASSPOUNDER

## A Department for the Operator at Sea and Ashore



*Edited by* P. S. Lucas
R. O. Koch, *Assistant*

### STEVE BRODIE DID

A lot of money has been made in years past by men who have either had the vision to see or have been willing to gamble on some undeveloped industry. A lot of money is being made today by men who took a chance on the horseless carriage twenty years ago, or "wireless" ten years ago, or the aviation industry within the last two years; and a pile of money will be made ten years from now by those who have confidence in some of the budding industries of today, plus a certain amount of the gambling spirit which says, "Take a chance." (Note: We're not trying to sell any stock in a QTE station in Iowa, so don't quit on us, yet.)

Those men who owe their success to this spirit have usually gambled one of two things: their money or their time and talent. Many of our greatest engineers have been men who saw possibilities in a certain line, got down to work and crammed their brains full of information on the subject, and when the time for the "grand opening" came, were ready to step into their rightful places as authorities along their chosen lines. These men are considered "up" in the world of engineering—all because they got their start before the field was crowded; because they gambled their time and effort on an undeveloped industry.

Today, more than ever before, are we offered opportunities for such a gamble, especially in or pertaining to our chosen field of activity: radio. Let us mention a few that are plain enough even for ye humble Department Editor to notice: television, telephotography, wired wireless, motion picture and sound synchronism, aerial beacons, etc., etc., none of which has reached the stage of standardization, but all of which will some day be giant industrial enterprises. Take your choice and take a chance. Your time will come.

### LETTERS TO THE EDITOR

Dear OM,—I don't know whether very many operators have tried the UX-200A as a detector, but I am very sure they will have fine results with it if they try the tube. After reading Forest Ritz's excellent article on RF amplification on 600-2400 meters I decided that my receiver wasn't what it ought to be. Lacking the necessary "dinero" I tried this tube and was greatly pleased with the results. It is not quite equal to the additional stage of RF as the RCA says, but is great stuff for a detector.

The grid return should go to the negative terminal of the *A* battery for smoothest regeneration.

Hoping this to be of some use, I remain,

Yours sincerely,

Harry F. Washburn.

### ORIENTAL NOTES
#### NEW SKEDS

*By* Mickey Doran

*It looks as if the following is to be Mickey Doran's swan song as a North Pacific and Orient correspondent. He has quit us cold, and now hangs his sky-piece on a nail out at Marshall, Calif., where he attends to the incoming oscillations at KPH. Ever since this department started in April, 1926, Mickey has been our mainstay in the Orient. We have come to rely upon him so thoroughly for his regular reports and schedule changes that we are expecting to be lost without him. However, Mickey deserves the promotion that has been given him, and congratulations are in order. He has steadfastly followed the principle that if you want to be a good operator you must do a lot more than is expected of you. So here's to you, Mickey. We hope you'll get as much kick out of your new job as you did out of rambling around the Pacific.*

P. S. T.

2:00 a. m. NPN Guam 2300 Mtrs.
Sends Manila Observatory Weather Report; may start any time up to 2:20 a. m.

2:00 a. m. or later NPG S. F. 36 Mtrs.
Press. Sent as test messages to NPU and NPN; long files, may total several thousand words but is very poor news as a general rule. All "back page" stuff.

4:00 a. m. or later NPN Guam 35 Mtrs.
Press. Same stuff as above; NPN sends to naval vessels as test messages.

4:00 a. m. 'JJC Tokyo 53 Mtrs.
Japanese time signals. (Regular all of February and March.)

6:00 a. m. WUAJ Manila 43 Mtrs.
Repeats NPO time sigs. (Not regular every night.)

#### MISCELLANEOUS

BXY Hongkong time sigs have been discontinued. VPS Hong Kong radio-compass station has been discontinued.

Weather reports formerly sent by VPS are now sent by Hong Kong Observatory, call GOW, on 800 Mtrs. ICW at 0400 and 1200 GMT and repeated at 0500 and 1300 GMT.

### ADDITIONS TO PACIFIC COAST SKEDS

*By* J. H. Payne

In looking over the collection of skeds that I have from Radio, I do not see the following, and am passing them on for what they may be worth to some of the fellows. These skeds may have been in an issue that I missed but here goes.

VAD, Pachina Beach, B. C., is a radio compass station on 800 meters whose bearings are used in conjunction with Tatoosh when going into the straits. No QSJ.

NPD, Tatoosh, sends WX to QST at 9 a. m., 1, 5, and 8 p. m. on 800 meters local and for vicinity of Seattle and straits; also Northern Pacific Ocean.

NPE, North Head, Wash., sends WX and Hydro to QST on 2883 approx. at 9:30 a. m., 1:30, 5:30 and 9:30 p. m., for Seattle and vicinity, Straits of Juan de Fuca and Northern Pacific Ocean.

KFS now sends a fair file of PX starting at 10:05 p. m. on 3300 meters approx.

KPH is now sending his WX and PX simultaneously with 6XI; 6XI on 44.6 meters and KPH on 2200 as usual.

### A NEW ANGLE

*By* W. L. Jepson

Judging by the correspondence from the Brasspounder readers of your department, there is at this time a universal effort to "figure" the operator situation with a view to improved conditions.

Such an "improved condition" might be said to be represented by a substantial increase in all operators' salaries. That phase of the matter covering the esteem (or lack of it) in which the operator is held is largely one of the individual case and unaffected by the proportions of his wages; for example, the average set of officers will accept a man at his own valuation as indicated by his comportment on shipboard, such dignity as may be sensible, the seriousness with which he undertakes his duties and the extent to which he performs those more or less optional.

Approaching the matter of the value of what job on various ships, we must consider what is expected of the operator by the master and steamship people, and whether their estimation of the value of the services expected of the operator (not necessarily those rendered by him) is a fair one.

Considering the case of the usual one-man freighter or tanker, the duties actually expected of the operator are few. The situation varies with the command and the vessel. The following instance suffices to illustrate.

There was some controversy over a certain berth and I had momentarily abandoned any modesty I might have had and was informing the "old man" that I was a "good operator" and could get much dope, and so on, but this speel left the old boy unmoved. He responded that his requirements were met in any man who could handle the set and get off his nightly paid TR report with an occasional time tic. I saw at once that it would be necessary for me to display an aptitude for cribbage or an ability to perform on a mouth organ (these possibly being to his liking) inasmuch as obviously any fairly intelligent chap with a license could hold down the job to his complete satisfaction.

However, in my mind I am certain that the wireless is immensely valuable on shipboard in simple cases of dispatching, not to mention its incalculable value in emergency or distress, and such being the case there is a very evident need for a man exclusively for the responsibility and the care of the wireless. Certainly, too, the berth warrants a salary more nearly on a par with that of the first cook or steward.

As we all are well aware, there are operators of varying proficiency or efficiency. This is painfully apparent to anyone brave enough to negotiate the TR-ridden atmosphere with any traffic around seven of an evening. Further opportunities are afforded ofttimes for observing this phenomenon when about to relieve some tub going on a long cruise. Batteries, brightwork, wiring, tuners, arc chambers, gaskets and others without end insidiously reflect the habits of the former man-in-charge.

Furthermore most operators take pride in their ability to cope with traffic and general QSO situations in a masterly and clean manner. Some go in for considerable relay work which beyond question is of assistance to certain traffic stations in clearing their hook, not to mention the odd messages they gather in through these helpful operators which, otherwise, would be routed via some rival company. It is a source of satisfaction to have at their fingers' ends all manner of schedules and data on the transmissions and peculiarities of traffic and broadcast stations in different parts of the world.

Now all this is very nice and praiseworthy, but the fact remains that it is not, strictly speaking, called for by those in whose employ are the operators. In other words, it amounts to indulging in a hobby. From my experience I'd say it is the only way to do in order to feel contented on the job and derive any satisfaction from the performance of the wireless work.

However, good work and conscientious effort can't fail to help somewhere. I have mentioned its relation to the operator. It is now readily seen that the service company is the party to profit most from this over-zeal on the part of the man at sea. The incongruity of the thing quickly reveals itself. The wireless company's reward usually is a delightful willingness to place the operator whenever the S. S. company demands a man. Those lucky chaps habitually chosen are those whom the service company has found to be depended upon to keep schedules with the company's coastal stations at all hours, harvest traffic, and leave the very least for their inspectors to do in the way of repairs and upkeep. In my opinion this is as it should be, with this one change: that the operators should be in the actual constant employ and pay of the telegraphing companies. Under such circumstances the operator would have greater incentive for special effort as in cases of proven ability the company would have particular assignments carrying with them increased salaries and the consequent greater responsibility to the company.

There is a very excellent series of talks on the possibilities of the radio equipment in the marine field, appearing in these columns by Mr. Dustin. I therefore won't attempt to cover the ground, but will merely say that I believe that a progressive type of radio service company desires to put such ideas of increased uses for the ship's wireless over with the steamship companies and they would find this process simplified and accelerated under some such plan as suggested of non-promiscuous operator employment and assignment.

It has occurred to me, as it has no doubt to others, that possibly the operators and the S. S. companies would be better off under the old plan of ownership and entire control of the radio equipment by said S. S. companies. It might at first seem possible for the operator to assume complete charge of all installation, service and research work. This, of course, would mean a bigger job with compensation.

There are unfortunately enough two major obstacles to such a course. In the first place, it is very doubtful whether the S. S. companies left to themselves would encourage any plans for increased service from the wireless, calling as it would, for greater investment. "We get position reports from our ships and they are able to send out the SOS in case of necessity, so why go to greater expense when we are satisfied?" This attitude, of course, is the customary one being coped with by appliance, equipment and machinery concerns anywhere today. It is natural and to be expected. It is clearly indicated, then, that sales and research organizations exclusively radio are what "the doctor ordered" for the marine radio field.

In the second place, while there are operators with advanced capabilities and ideas, they would nevertheless be handicapped in most cases by inadequate engineering education and training, not to mention the difficulty remarked in the foregoing paragraph.

I realize that when the present system of employing operators, and the one advocated are compared point for point, there is not shown any pronounced advantages for the radioman in the one over the other. But in the one there are greater possibilities for development for both parties concerned—the operators and the service company. It is a matter of indifference to the S. S. companies, I assume, rightly or wrongly, not being familiar with the highlights of the contracts drawn up for the said S. S. people's approval.

I confess I don't see much to hope for in the idea of a union such as is possible for operators to have. The reason for this deprecating sentiment is seen in considering the widely diversified fields in which radio operators hold down jobs, and how complete, usually, is their non-contact with the other fellow. The primary cause for this condition, amusingly enough, is the individual's feeling of smug self-satisfaction in the fancied security of his new birth. How ill-founded is this feeling when it is considered that, should he for any reason at all lose his connection, he must then look for a job as a radio operator wherever there is a vacancy he can fill—in the marine field, at sea or ashore, point-to-point jobs for oil concerns, airplane outfits, fisheries, stores, mines, or what have you?

Some sort of an operators' association of a more or less passive nature is suggested. It at least might have the virtue of a fairly complete and comprehensive membership.

In further support of my advocacy of the direct and actual employment of the operator by the radio service companies, I will say that the customary limited connection with the radio service company has been more satisfying than a connection with an outfit where the radio field is limited to the one or two similar jobs.

## FRIJOLES, TRs & PIGTAILS

*(Being an episode from the life of an American brasspounder who took a chance on a foreign ship.)*

*By* E. J. STENMAN

Curiosity, that dangerous state of mind which is supposed to have once put the ninth count onto the proverbial cat, got me into this scrape, and has satisfied itself along this line for many years to come. (Let's hope!) But it was after a rather uneventful voyage that it happened; and one is not responsible for what happens after uneventful voyages.

Leaving the good ship that had been my home for the few months past, I dragged my weary carcass to the well known static-room of one of the service companies, applying for some kind of a scow that would float and furnish the three squares a day with a few shekels thrown in for a peace offering. At first our friend, the District Supe, gave me the well known line, "Nothing in sight," but after pondering over the matter for a few minutes, (to create the proper respect, I presume) he told me that he had a very good ship which was to sail in an hour, and that he must have an experienced brasspounder for her.

"Really," he said, with a very straight face, "She is a dandy little ship . . . fine captain and officers . . . good grub, etc. Of course, she is under a foreign flag for some private reasons known to the company, but the operator is always an American."

After hearing this speech through I decided to take a run over and give the old

(Continued on Page 48)

# Your Own Audition Test

*When you buy a speaker you judge it—not by what it* is—*but what it* does!

*Jensen Dynamic Units*
TYPE D-4 A. C.
(110 Volt Operation) $55.00

*Console Model*
$85.00

THERE are many good speakers on the market today. To choose merely a good speaker is easy. To choose the really outstanding performer of the year is much more difficult.

But if you put various speakers to the test of actual comparison, you will come to one certain conclusion. Your own audition test will prove that the Jensen Dynamic Speaker gives a fidelity of reproduction, a tone-clarity, which is far ahead of all competition.

OF COURSE THERE IS A REASON

We start with the Dynamic Principle, we add perfection of design, we follow with perfection of craftsmanship, and we finish with a series of tests far more exacting than any Audition Test you would make. Every speaker that wins a final "O.K." in our laboratory is sure to win an enthusiastic "O. K." from you.

*Now—as Radio's Greatest Season opens—is the time to equip with the finest radio speaker. Only in the Jensen can you find the tone-fidelity which completely satisfies.*

*Jensen Cabinet Model*
TYPE D-44 (6 Volt Operation) . . . $55.00
TYPE D-45 (90 Volt Operation) . . $58.00
TYPE D-44 A.C. (110 Volt Operation) $70.00

*Jensen Dynamic Units*
TYPE D-4 (6 Volt Operation) $40.00
TYPE D-5 (90 Volt Operation) $43.00

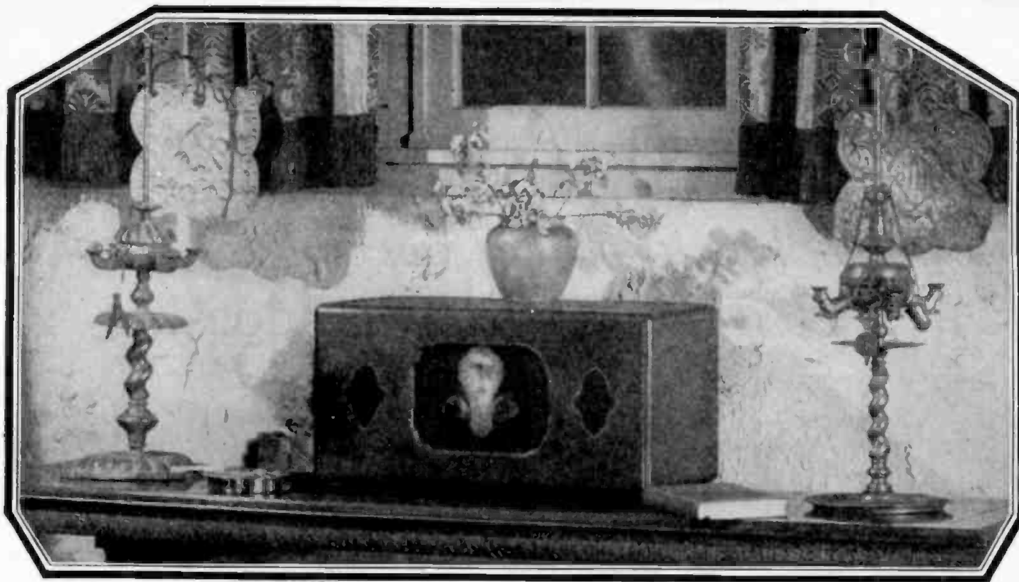
JENSEN RADIO MANUFACTURING COMPANY
212 Ninth Street, Oakland, Calif. 338 North Kedzie Avenue, Chicago, Ill.

# JENSEN
## DYNAMIC • SPEAKER

*"The Finest in Radio"*

*A special two-color folder describes the complete line of Jensen Dynamic Speakers. Write for a copy.*

Licensed under Magnavox Patents



## What Others Say

Salt Lake City, Utah.
Oct. 13, 1927.

My Bremer-Tully Receiver has given entire satisfaction and I am of the opinion that I have just a little better outfit than the other fellow.

It has been my experience to bring in stations within a radius of 2,000 miles. This is considered very good in this locality.

C. P.

---

Ft. Worth, Tex.
Dec. 27, 1927.

I know nothing about radio other than to state that the Bremer-Tully which I purchased in 1925 is still the best I ever saw. I am using the same tubes that came with it, and getting results.

---

Livingston, Mont.
Dec. 23, 1927.

Out here in Montana far away from broadcasting stations, we have to have a good radio to bring them in. Although I have heard many I never heard one that I could say I wanted until my friend brought me down to hear his Bremer-Tully. I now have one like it and have been able to get the best kind of reception every night and everybody says it is the best set they have ever heard.

J. V.

The 6-40 is furnished in two cabinet styles—Model "R" illustrated at the top of the page and Model "S" illustrated above. Both are of equal size.

# Bremer-Tully

# RADIO

SINCE the earliest days of commercial broadcasting every Bremer-Tully radio product has been a continued outstanding success.

Six years of progress—and a reputation second to none—Bremer-Tully start their seventh season with the finest receiver in its class, the new 6-40.

It is the culmination of these years of experience, the result of many months' intensive effort and development.

Simple, compact, self-contained, the 6-40 embodies all those features and refinements that are responsible for the traditionally fine Bremer-Tully quality—and at the amazingly low price of $136.00.

A radio set that surpasses everything at anywhere near its price in musical reproduction—a set that excels in general performance as well.

See it, hear it, compare it—you will be convinced that here is the greatest radio value ever offered.

*The coupon will bring descriptive literature and name of our dealer in your community.*

## Bremer-Tully Mfg. Company

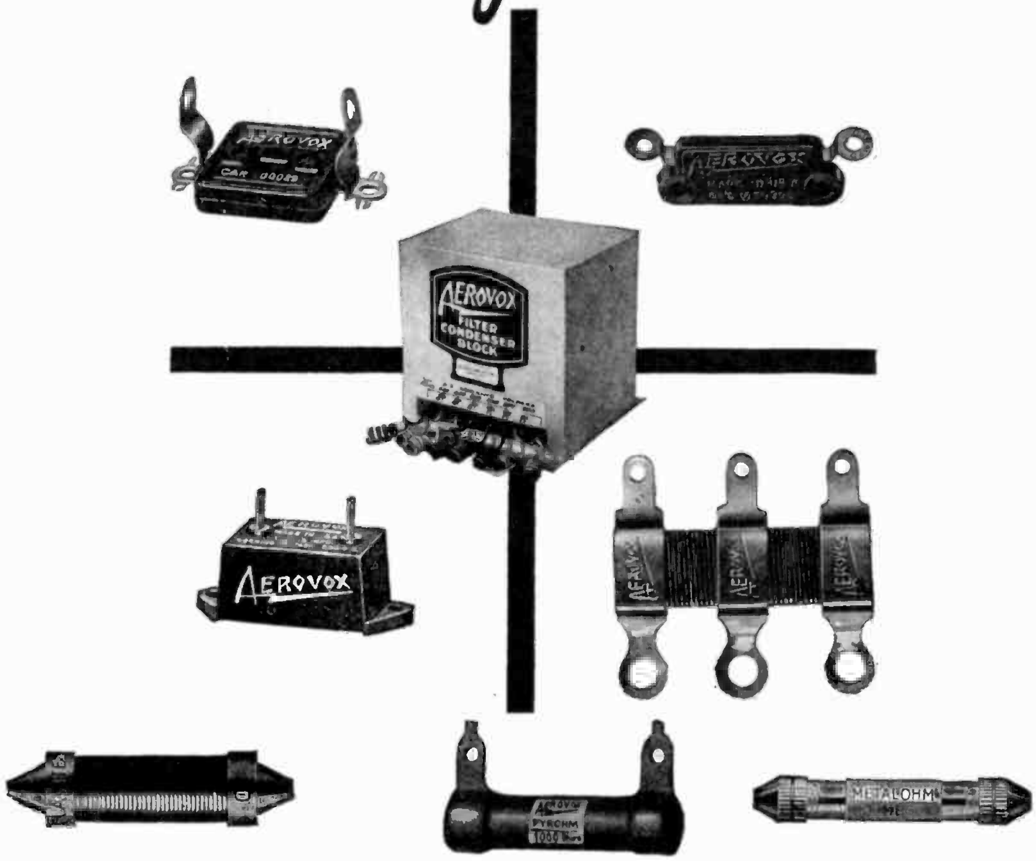
520-532 SO. CANAL ST., CHICAGO

*Name*.............................................

*Address*.............................................

*City*.............................................*State*....................

# Quality PLUS




**E**XCUSES and alibis will not satisfy the customer whose equipment has been ruined because of the use of unreliable parts.

Whether the units required be resistors, mica condensers, socket power condensers or filter condenser blocks, you will find a suitable one in the Quality Products line of Condensers and Resistors made by Aerovox.

*Build customer Good Will with Aerovox Products.*

*The Aerovox Research Worker is a free monthly publication that will keep you abreast of the latest developments in Radio. A postcard will put your name on the mailing list. Write today.*

**AEROVOX**

*"Built Better"*

68-A Washington St., Brooklyn, N. Y

## COMMERCIAL BRASSPOUNDER

(Continued from Page 44)

tub the O.O., so grabbed a sea-goin' hack for the docks. I looked her over from fo'c's'le to stern, sizing her up in detail. Finally I felt the old curiosity getting the best of me and knew that I might as well let it have its way, so back I went and signed the papers.

Thanks to good luck the weather was fine, going South. Four days out one of the blades of our propeller gave up the ghost, but the little sewing machine engine kept up her plunkety plunk with renewed vigor. The officers (we shall call them such for lack of better titles) were not sure whether part of the propeller had actually left us or was just dragging along behind, so, of course, we had to stop the ol' scow to let the chief engineer and mate go over the side with the little work boat. After peeking and poking around the stern post for awhile they were finally convinced that one of the blades had really deserted us. Well, full speed ahead and let the devil take the hindmost. We made our port in due time, discharged the cargo and loaded up with copper bullion for the return trip.

Everything went along smooth as silk on the homeward voyage. As long as we were able to sight some light or landmark ashore we knew just about where we were. When we were out of sight of land for twelve hours at a stretch out would come all three time-corroded sextants, and the sun would be peppered from all angles. Then the three snipers would rush into the pilot house where they would use up a few tablets of scratch paper, chew up a couple of volumes of Bowditch, and submit three different positions. Then, with a shrug of six shoulders, they would start gazing shoreward for sight of land. (I'll bet old C. Columbus never looked for land more anxiously.)

Getting my 8 p.m. TR was a delicate matter for the O. M. He must have considered it more important than the ship, as it would always take him anywhere from 15 to 45 minutes to dope it out. Then he would proudly tell me in halting, half Spanish, half English, the exact number of miles we were from the Golden Gate. I would then proceed to check it with that of the previous night, usually finding it "slightly" off (not more than one or two hundred miles), so would tell the grand OM, politely, that the ship was making very good time; about sixteen knots or more.

"No possible," he would groan, and start the grinding all over again. A few more pages would fly from the scratch tablet, and we would have another TR, putting us somewhere near our exact position (maybe). On one occasion the TR gave us a 24-hour run of approximately 465 miles, which was pretty good for a nine-knot ship, so I again called the OM's attention to it. Much scratch paper, more perspiration, and finally another TR, this time giving us a run of 340 miles. Well, I hated to bother the old gent again, but could not send in a TR like that, so once more I invaded the domains of the mighty. After figuring it up and down, sideways and a few other ways, he dramatically announced that there would be no TR that night. Mañana; and that's that.

I finally decided to mind my own business with regards to these high class TRs, and promptly set the home office in a whirl of excitement. This time it was 42 miles in 24 hours, and immediately brought a *rush* msg from the officials demanding to know what the trouble was. The old gent in command replied briefly that we were making nine knots per hour. They could take it or leave it.

Getting around to the more important points of interest let me say a few words about our celestial cucinero and his concoctions. The supply of frijoles never gave out, of course; but they were good ones, and accompanied by a lot of other good dishes. One dish in particular seemed to be ever present, and although I have never been able to find out what all was in it, I'm here to tell you it contained everything available, including several different kinds of meat and some fish, numerous vegetables and whatever else was around handy. Several times my eye was caught by a peculiar looking piece of meat, but I hesitated to take a chance (oh, yes, there are limits) until I knew what it was. Finally, I discovered that it was the hindermost extremity of a pig. Well, I've tried oxtail joints at various times, but that's where I stop. Pigtails might be O.K. Quién sabe?

And still we sailed northward, even though them as has the say refused us another propeller blade when we stopped at 'Frisco. Two days out of Seattle I roused myself from the horizontal exercises in which I had been indulging, and discovered that we were lost. Due to the exceedingly heavy swells and westerly gales we had been compelled to haul off shore during the night and our valiant imitators of Columbus had no idea where we were or why. They had shot all the stars in the heavens, and when the sun had come out they had shot that, but still they were baffled. I asked one of the "moites" as to our position and was graciously informed that neither he nor anyone else knew. I suggested the use of radio compass bearings but he said that he did not put much faith in them. After awhile, however, the captain told me to get some on general principles, so I got to work. Bien, luck was with me, the ops at the QTE stations were right on the job, and I received three bearings, giving us a good cross bearing which tickled the whole bunch almost to death.

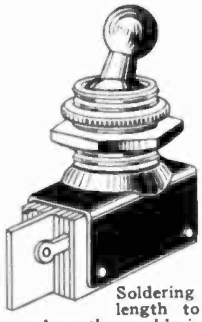
At last we reached the "Sound," safe and sound, and as I write this I am hoping that we keep afloat until we reach Seattle.

# FROST-RADIO LEADS AGAIN!

## With a COMPLETE LINE of Parts for 1928-29 for the use of the Amateur and Professional Set Builder

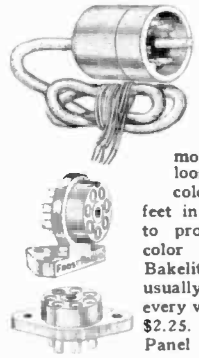

### NEW MOULDED MICA CONDENSERS

Their small size cuts down dielectric losses and gives greater ease of mounting. Equipped with well designed terminal lugs and integrally moulded Bakelite flanges for subpanel mounting. Made in seven capacities from .0001 to .006. Price, 45c to 90c.



### NEW A. C. SNAP SWITCH

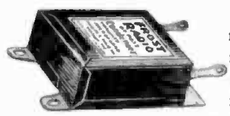
Its positive contacts easily carries 3 amps. at 250 volts. Inspected and passed by Underwriters' Laboratories. Entire switch is inclosed in nicely finished metallic housing. Soldering lugs are of sufficient length to make soldering easy, and are thoroughly insulated from each other. Single hole mounting. The finest small A.C. switch made. Price, 75c.



### NEW CABLE PLUG

A moulded Bakelite Cable Plug that possesses unique advantages. Terminals, being moulded in Bakelite, cannot come loose. Cable itself is best quality colored rubber covered wire five feet in length. Springs are designed to provide permanent tension, and color markings are moulded into Bakelite, doing away with paper chart usually employed. A quality plug in every way. Plug, complete with cable, \$2.25. Baseboard socket, 75c. Sub-Panel Socket, 75c.

### NEW BY-PASS CONDENSERS



Conservatively rated, accurately manufactured and designed to give many years of trouble-free service. Linen and flax paper stock and finest grade foil are used in their construction. Vacuum impregnated and enclosed in hermetically sealed metal cases. Five capacities from .1 to 2 MFD. all tested to 400 volts D.C. and rated at 200 volts working voltage. Prices, 80c to \$2.00.

### POWER AMPLIFIER
#### Universal Resistance Kit

Consists of 3 fixed resistors of 2,000 ohms each of the Frost A series, wound on flexible Bakelite strips 1 inch wide and 5½ inches long, and four 2,000 ohm heavy duty wire wound Frost Potentiometers, and one 1,500 ohm series A Fixed Resistor. Fixed resistors are equipped with sliding connections to give the variable 135 and 180 volt taps and the fixed resistor for the C bias is variable to give the proper bias for the number and type of tubes used. Complete, **\$9.00**.

### NEW HEAVY-DUTY FILTER CONDENSERS


Designed for use in B eliminators, power amplifiers and other power devices for general experimental work, for transmitting circuits and with other spark discharge apparatus. Conservative voltage ratings, and built of the finest materials. We guarantee them to give complete satisfaction when used according to instructions. Capacities: .5 to 2 MFD. \$2.00 to \$7.00.

### OTHER NEW ITEMS ARE:

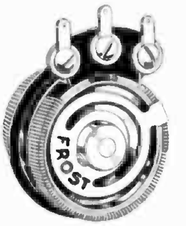
- Frost Variable High Resistance Units with A.C. Snap Switch
- Frost Gem Hum Balancer
- Frost Center Tapped Resistances
- Frost UX Base Socket for Sub-Base Mounting
- Frost Panel Brackets
- Frost Hook-Up Wire
- Frost Medium Duty Filters
- Frost Convenience Wall Outlets

### NEW FROST-RADIO UNIVERSAL "B" BLOCKS

The finest "B" Blocks made, with conservative voltage ratings and superior construction. Encased in hermetically sealed metal cases, and fitted with tinned soldering lugs. Consists of 3 sections of 2 Mfds. each 1 section of 1,000 working volts; other two sections of 600 working volts; 1 section of 4 Mfds., 400 working volts and 1 section of 1 Mfd., 400 working volts. Price, \$18.00.


### THESE OLD FRIENDS ARE KNOWN TO THOUSANDS

FROST-RADIO VARIABLE HIGH RESISTANCES



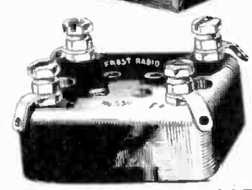

FROST-RADIO GEM RHEOSTATS "A Good Little Rheostat"


FROST-RADIO FIXED RESISTANCES

Ample current carrying capaity and wound on die cut threaded flexible Bakelite. Fitted with terminals enabling them to be mounted either under sub-base or on terminals of sockets, etc. .4 to 50 ohms, 15c. 100 to 1000 ohms, 25c.

FROST-RADIO AIR COOLED BAKELITE RHEOSTATS

One of the most famous rheostats ever built. Winding strip is die-cut threaded Bakelite, flexible. German silver contact arm and nickel plated metal parts. Plain type, \$1.00. With switch, \$1.35.



FROST-RADIO UX BASE BAKELITE SOCKET

Contact springs grip tube prongs for almost entire length. Holds all UX and CX base tubes in a "bulldog" grip. Genuine moulded Bakelite. Plainly marked terminals. Complete, \$.40.

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Send me your new 16 page Data Book, containing complete wiring diagrams, data and much other valuable information.
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If not, please inclose 10c stamps or coin.

Name ..........................................

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City .......................... State ..................

## FACTORY BUILT RECEIVERS

(Continued from Page 30)

d.c. tubes. It has three stages of tuned r.f., detector, and two stages of audio, with an output transformer. Matched coil inductances are used with individual copper compartments for each coil. It may be obtained in either a walnut cabinet 20½ x 8⅛ x 11 in., or in a metal cabinet in hammered silver effect with bronze escutcheon plate framing a volume control and single tuning control, with internally illuminated dial.

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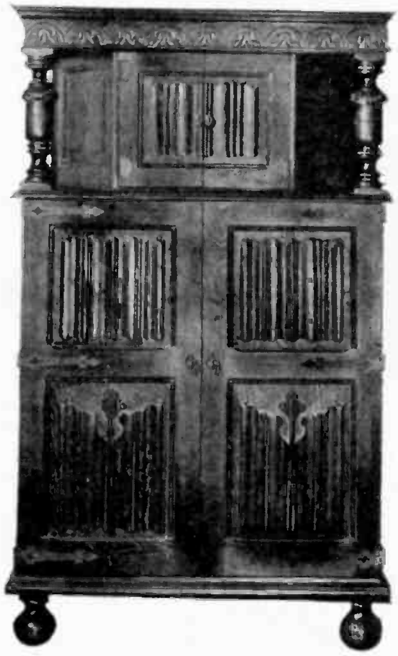
The Splitdorf line of six-tube a.c. receivers are announced in ten models, five of which use one '50-tube in the last audio stage with one dynamic reproducer and five of which



*Devon Model of Splitdorf A.C. Receiver*

use two '50 tubes in push-pull and double dynamic speaker. The models include a table cabinet and various elaborate consoles and have a jack for a phonograph pick-up plug.

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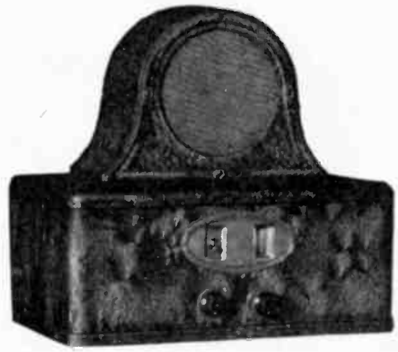
Stewart-Warner have four new models of tuned r.f. receivers, three for a.c. tubes and one for d.c. tubes. These are available in handsome metallized cabinets with or without a 6-in. magnetic cone speaker in a similar



*Stewart-Warner A.C. Receiver with Cone Speaker*

case. The receivers have one tuning control with illuminated drum dial, one volume control and an on-and-off switch.

(Continued on Page 52)

## FACTORY BUILT RECEIVERS

(Continued from Page 50)

Workrite new 7 and 9-tube models using a.c. tubes are equipped with illuminated drum dial for single control of tuning and with an additional control for volume. The 7-tube No. 18 cabinet and No. 28 console have three stages of tuned r.f., detector, two of audio, and one rectifier tube. The console is equipped with a Type B speaker. The 9-tube models have four shielded stages of tuned r.f. detector, push-pull audio, and rectifier tube. They are available in either a table cabinet or in a console with Type B speaker.

*Workrite Nine-Tube Console*

The Grebe CR-19 short-wave receiver uses a screen grid tube as an r.f. amplifier, '01A tubes as detector and first stage audio, and '12 tube as second stage audio. Its regeneration control is continuously variable from zero to the point of oscillation. It is designed for the reception of short-wave broadcasting, CW and ICW telegraphy, and other special purposes requiring either a wide or a narrow frequency band. Every important unit is heavily shielded.

*Grebe CR-19 Short Wave Receiver*

The new Steinite line of a.c. receivers include four models, a table cabinet, and three consoles, two of the latter being arranged to receive the cabinet into a drawer. The consoles are equipped with a long air-column speaker with a matched unit to take the output of a '71 tube. The cabinet has three r.f. stages with '26 tubes, '27 detector, one audio with '26 tube and one audio with '71A tube, together with an '80 rectifier tube.

*Steinite A. C. Table Cabinet*

Tuning with a gang condenser is accomplished by means of a single control of an illuminated drum dial. The escutcheon plate also carries an "on-and-off" switch and a combined oscillation and gang control. The power transformer is adjustable to line voltages of from 85 to 135 volts by means of pin jacks connected to taps on the primary. There are also pin-jack connections for a phonograph pick-up unit.

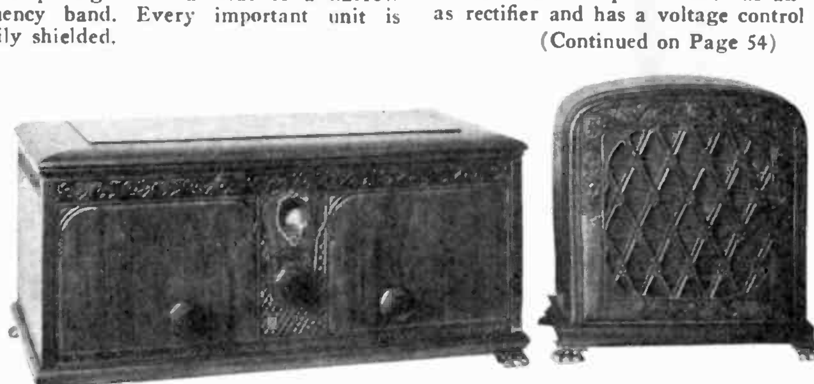
The Apex Model 36 is a six-tube Neutrodyne using a.c. tubes and supplied complete in a metal cabinet with plate supply rectifier and filter. It has three r.f. stages with '26 tubes, detector stage with '27 tube, first audio with '26 tube and second audio with '71 tube, together with '80 tube for rectifier. It has illuminated drum dial with single tuning control. Its 17½ by 7 by 12-in. case will fit any standard table cabinet or console.

The Walbert 77 is an electric receiver with seven a.c. tubes and four stages of inductively tuned r.f. amplification with single control. It has a self-contained power plant for plate and filament supply.

The sixteen new Kolster models include sets designed for 60-cycle and 25-cycle a.c. operation, for d.c. supply, for battery current, magnetic speakers, dynamic speakers, and a *B* eliminator. The receivers are in four, five, six, and seven-tube models. Each uses a tuned r.f. circuit with antenna variometer. Each has single tuning control with an illuminated drum dial. A single volume control varies the filament current. A.c. hum is reduced to a minimum by a special filter system. Various table and console models are available.

The new Sleeper A.C. Monotrol is a six-tube set using three '26 tubes as r.f. amplifiers, '27 tube as detector, '26 as first audio and '71 as last audio. Its power unit has an '81 tube as rectifier and has a voltage control to care

(Continued on Page 54)



*Kolster Seven-Tube Table Model with Magnetic Speaker*

# CROSLEY

New Dynamic Speaker
DYNACONE
$25

The first AC set of any type ever offered at so low a price. Highly selective; coil-shielded; illuminated dial; genuine Neutrodyne; powerful, efficient, proven! .... $65

## The crowning achievement in a history of successes!

6 tube AC Electric
GEMBOX
$65

### Features of the 1928-29 Crosley Radio Receivers

Genuine Neutrodyne radio amplification with all the increased efficiency this superior circuit introduces.

Complete shielding which adds so greatly to the amazing selectivity of Crosley receivers.

Full voltage delivered to the plates of the tube. Tone and volume assurance.

A sensitivity that delights the "old" radio fans and thrills the new ones by the ease with which weak, distant stations are brought in.

Positive volume control reduces volume without detuning set.

Adaptability to any type of console. Simple construction permits quick and easy installations.

Modern illuminated dial eliminates the annoyance of shadows, searching for lights in the dusk, etc.

Beautiful gold and brown finish of receivers and matching Musicone and Dynacone delight the eye.

Here, in a new line of radios for the season of 1928-29, Crosley presents VALUE such as Radio has never seen .... an engineering triumph in *quality* .......... a production miracle in *price*.

Crosley presents fine radio—perfect performance and utmost enjoyment of broadcasting at seemingly impossible prices. These prices are possible only through years of experience, a skilled organization and the resources of a financially sound and economically operated company.

These values are yours today because of the powerful advantage gained through study, work and development acquired in the Herculean task of building and selling nearly 2 million pieces of radio apparatus.

Satisfied by laboratory and actual home installation comparisons that Crosley radio has NO equal, Crosley NOW makes it possible for every prospective radio owner to know how well Crosley radio will perform in his or her home before they buy. Try, test and prove the amazing Crosley receiving sets before you buy!

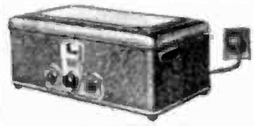
## 5 Days FREE Trial In Your Own Home

This is the NEW way .... the CROSLEY way to buy radio. First advertised nationally by Crosley last April.

Study the sets shown at the right. Then go to the nearest Crosley dealer. Ask for a FREE trial. Learn in the quiet and privacy of your own home what wonderful sets the 1928-29 Crosley's are. Enjoy their performance! Delight in their beauty! Congratulate yourself on their prices!

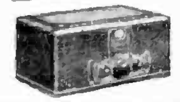
Over 18,000 Crosley dealers serve the United States, but if you cannot locate one near you send us this coupon and we will arrange a home demonstration for you at once.

**The 8 Tube AC Electric JEWELBOX**
Genuine Neutrodyne; full 180 volts on output tube plates; 2 171 output tubes, push pull.......... $95



**The 8 Tube AC Electric SHOWBOX**
A new completely shielded genuine Neutrodyne, illuminated dial; full 180 volts on the plates of 2 171 output tubes, push-pull. .......... $80

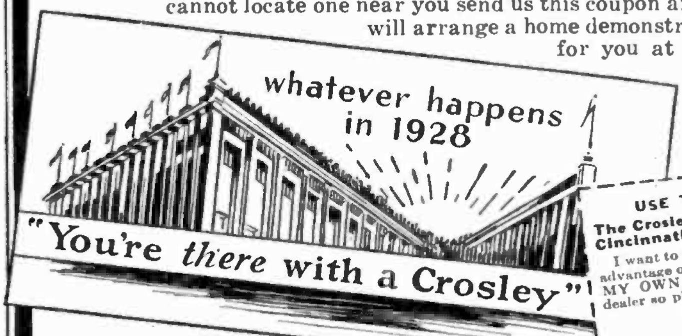
**The 6 Tube Improved Battery Type BANDBOX**
Proven star of Crosley radio .... Neutrodyne; shielded; illuminated dial; Acuminators .......... $55



**The 5 Tube Dry Cell Operated BANDBOX Jr.**
Modern radio reception for places where electric current is not available or storage battery recharging is inconvenient. .......... $35

**DYNACONE** $25 **MUSICONE** $15

New dynamic DYNACONE reproduces every note with remarkable fidelity, naturalness and realism.

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**The Crosley Radio Corporation, Cincinnati, O. Dept. 19.**
I want to know more about Crosley Radio. I want to take advantage of your offer to let me try one 5 DAYS FREE IN MY OWN HOME. I cannot locate the nearest Crosley dealer so please arrange a demonstration for me.
Send Set ( ) Send literature ( )
Name..........
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THE CROSLEY RADIO CORPORATION
Cincinnati, Ohio. Powel Crosley, Jr., Pres.
Montana, Wyoming, Colorado, New Mexico and West, prices slightly higher.

(Continued from Page 52)

for line fluctuations. A ballast resistance protects the detector tube against over-voltage at the start. A special connection is provided for a dynamic speaker and for phonograph pick-up unit. A local-distance switch reduces power of local stations. This equipment, mounted on an aluminum chassis, is offered in a table set and two consoles with built-in Temple Air-Chrome speakers. The escutcheon plate, in addition to single tuning control, volume control, and throw switch also contains an electric clock.

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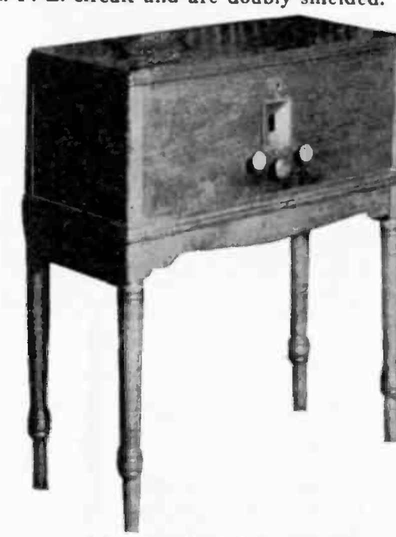
The Eveready a.c. set is a seven-tube antenna type receiver with three stages of neutralized tuned r.f. using '26 tubes, detector with '27 tube, one audio stage with '26 tube and one push-pull audio with two '71 tubes, the audio stages being transformer coupled and having an output transformer. The r.f. stages are bridge-balanced by the R. F. L. circuit and are doubly shielded. The



*Eveready A.C. Set in Maple Cabinet Set on Supporting Stand*

tuning is by single control of a gang condenser with illuminated drum dial. Auxiliary tuning is accomplished by an antenna trimmer or variometer tuned by one of the gang condensers. Volume is controlled by a potentiometer shunted across the detector input. The detector plate circuit includes a filter system to minimize feed-back through the *B* supply and to simplify the wiring. The detector plate voltage is tapped from the 90 volt lead and reduced to 45 volts by a 50,000-ohm resistor which is part of the filter system. Eight by-pass condensers are used to improve stability and tone quality.

The last audio stage and output transformer are contained in the separate power plant unit whose power transformer has a three-tapped primary to compensate for difference in line voltage. Connection between the power unit and receiver is made by a multiple plug and socket. The power unit uses an '80 rectifier tube, has ample condenser capacity, and employs *C* biasing resistors.

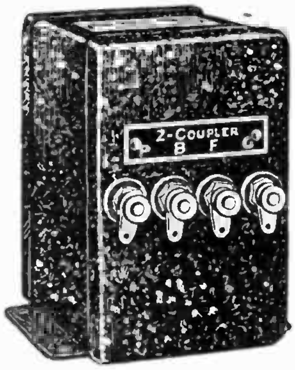
The chassis is of steel and is housed either in a maple cabinet with natural finish or in an aluminum case finished in dark green with silver lines. The cabinet may be either set on a table or upon a special knock-down stand.

The Eveready d.c. set is a six-tube single dial antenna type of receiver especially designed to conserve *B* battery current. Hi-mu tubes, '40 type, are used in the three stages of neutralized tuned r.f. detector, and first audio. A '12 tube is recommended for the last audio stage because of its low plate current consumption, although a '71 tube may be used. The r.f. stages use a special R. F. L. bridge circuit, doubly shielded.

# Thordarson's New Units Meet With Instant Success

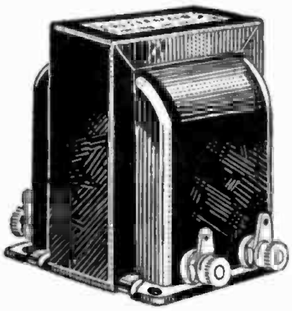
FOR the 1928-1929 season the Thordarson Electric Manufacturing Company of Chicago, Illinois, has introduced several new transformers and power supply devices to meet the pressing demand for such items. It has been Thordarson's policy in the past to be the first on the market with worth-while new items to operate in conjunction with new tubes and circuits as they are announced by the designers. With the overnight popularity of the dynamic speaker Thordarson introduced the proper transformers to most effectively deliver perfect tone quality in connection with these speakers. For years the Thordarson R-200 audio transformer has been the standard among dozens of leading set manufacturers, professional set builders and home constructors. Every Thordarson item has made good. Zenith, Howard, Magnavox, Willard, Sparton and other manufacturers of note have been consistent users of the Thordarson product. In the highest priced sets you will find Thordarson audio transformers. Hardly an amateur operator in the country is without something made by Thordarson.

Ever alert to the exacting requirements of those who demand nothing short of perfect reproduction, the Thordarson engineers have developed the new R-300 audio transformer. In this new R-300 transformer the high impedance windings are wound on a core of D-X metal, a recent development of the Thordarson laboratories. This new material for core building has a very high A.C. permeability and an inductance that is 50% greater than that of the highest grade silicon steel. The entire frequency band is reproduced faithfully with this new transformer and the same degree of amplification is obtained throughout. Its ratio is 3 to 1.



Z-Coupler

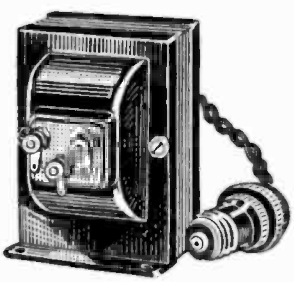

Amateur Plate Supply


New R-300 Audio Transformer

The new 250,350 power tubes and the new dynamic speakers capable of reproducing frequencies of extreme ranges, will function at the peak of efficiency when the new Thordarson R-300 transformers are used. Other new items in the Thordarson line for the coming season include a Voltage Changer, Amateur Plate Supply Unit, Filament Supply Transformer and the Push-Pull Output Transformer. These units are shown in the pictures on this page.

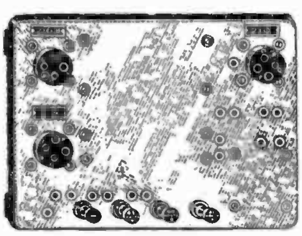
Production has been increased to take care of the large demand for the Thordarson "Z" Coupler and the metal base boards for mounting "B" eliminator and power amplifier parts. The Thordarson metal base board is equipped with insulating bushings for passing the connecting wires through the plate for sub-panel mounting, thereby giving the unit a professional factory-built appearance when completed. All parts are grounded to the metal base thereby avoiding any danger to the power supply apparatus.

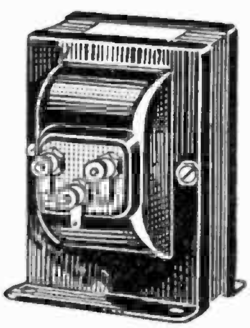

Voltage Changer


T-3081 Filament Supply Transformer

The Thordarson "Z-Coupler" is a special audio impedance coupler for use with screen grid tubes. One stage of this form of coupling is equivalent to two or more stages of ordinary coupling. Signals barely audible, ordinarily, can be heard at normal room volume when this coupler is used. The Z-Coupler replaces the second audio transformer. The screen grid tube is used in the first audio stage. Remarkable tone quality is had when this coupler is used. Both high and low notes come through with the same volume increase. At 60 cycles the amplification is over 95% of maximum.

The standard line of Thordarson R-171 and R-210 power supply transformers and chokes are giving unusual satisfaction to the many thousands of people who are building sets for sale and to those who are satisfied with nothing short of the last word in sound reproduction.


R-211 Metal Base Board


Push-Pull Output Transformer

## LOUDSPEAKERS

(Continued from Page 31)

New items from Temple, Inc., include two table models, one of which incorporates the Air Chrome principle with a large surface diaphragm so arranged that the larger or

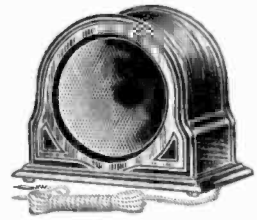
*Temple Model 15 Air Column Speaker.*

front half is tuned to the lower frequencies of the musical scale, and the smaller or back half to the higher frequencies. The unit is enclosed in a walnut cabinet, the sides of which have a grained leather effect. The

*Temple Model 20 Air Chrome Speaker.*

other model is an air column speaker, having an effective length of 54 in. This column fits into a space only 11½ in. wide, and offers an unusually effective response to the useful audio frequencies.

Trimm speakers are made in five models: 7-in., 14-in., and 17-in. cone, 18-in. and 23-in.



*Trimm 7-in. Cone Speaker*

horn, and a balanced armature unit for use in a cone. The picture shows the Entertainer clock type of cone speaker, Model 58.

The "Ferranti 1928 Year Book" presents a detailed description of audio frequency transformer and choke coil construction and characteristics and gives circuit diagrams and pictures of their use in four tube d.c. and a.c. receivers, push-pull power amplifiers, and *A B C* eliminators. Of special interest is the material on output transformers for dynamic speakers. A nominal charge of fifteen cents is made for the 60-page booklet.

Farrand dynamic speakers are designed to operate with any make of set using a power tube. They are made in three handsome models, each of which is available for three different types of current supply. One type uses 6-volt d.c. for field excitation, one takes

*Farrand Dynamic Console Grande.*

50 to 125 volts d.c. and a minimum of 40 m.a., and a third has a self-contained rectifying unit for 110-volt a.c. supply. All types are equipped with a 25-1 step-down input transformer. Each type is also supplied in chassis form. The Gothic model is a table speaker, the Tiffany is an upright console of two-tone walnut, and the console grande is embellished with carvings. Seven attractive models of Farrand balanced armature magnetic cone speakers are also available.

The Peerless dynamic speaker equipped with rectifier element for light socket operation is offered either as a chassis, as a mahogany cabinet or as a complete built-in speaker table. There is also a new model of a cone speaker installed in a table.

*Racon Speakers*

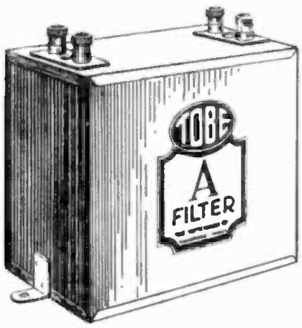
Racon magnetic speakers are made in a variety of styles, including cones and exponential horns of the long air-column type.

Quam cone speakers are made in two types, a 9-in. for manufacturers and a 13-in. for consumers.

*Quam 13-in. Cone Speaker.*

TOBE

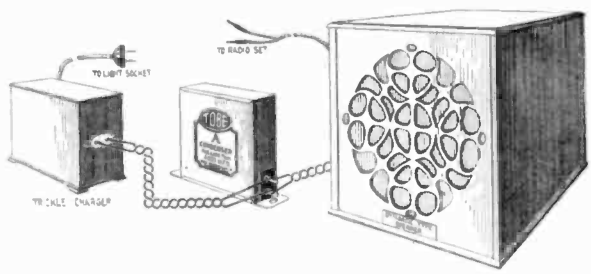
# Simplified-A-Supply




This New Tobe Device combined with any good two ampere charger, does away with the need of the messy A Battery completely.

# Dynamic Speaker Energizer

Any trickler charger capable of delivering 4/10 of an ampere with this TOBE-A-CONDENSER connected as shown, will furnish the proper power to energize your Dynamic Cone Speaker.



*FOR SALE BY ALL THE BETTER DEALERS*

## Tobe Deutschmann Co.

ENGINEERS, MANUFACTURERS AND IMPORTERS OF TECHNICAL APPARATUS

CAMBRIDGE, MASS.

Tobe Deutschmann Co.

## POWER UNITS AND AMPLIFIERS

(Continued from Page 32)

steel container. Under average load it draws 22 watts, supplying a maximum of 135 volts. It is capable of supplying sufficient plate current for eight tubes.

Kuprox *A B C* combination power pack consists of two units, both using contact rectifying elements and filters and each of which

*Kuprox "A B C" Combination Power Pack.*

is available separately. The *A* section will supply 1 ampere at 6 volts. The *B C* section may be had in any one of four models which supply plate and grid tubes to meet the requirements of various sets and tubes.

The S. M. *A B C* power supply, model 670, delivers a.c. filament current and d.c. plate voltage to an a.c. receiver from a 110-volt a.c. source. It delivers 4 amp. at 1.5 volts, 3.5 amp. at 2.25 volts, or .5 amp. at 5 volts.

*Silver-Marshall "A B C" Supply*

By means of an '80 rectifier tube with filter system it delivers a total of 60 m.a. to fixed taps for 22, 90, 135 and 180 volts and for a variable 3-voltage tap for 22-90 volts. Another model without filament transformer delivers the same *B* supply. Both models are available in either kit or wired form.

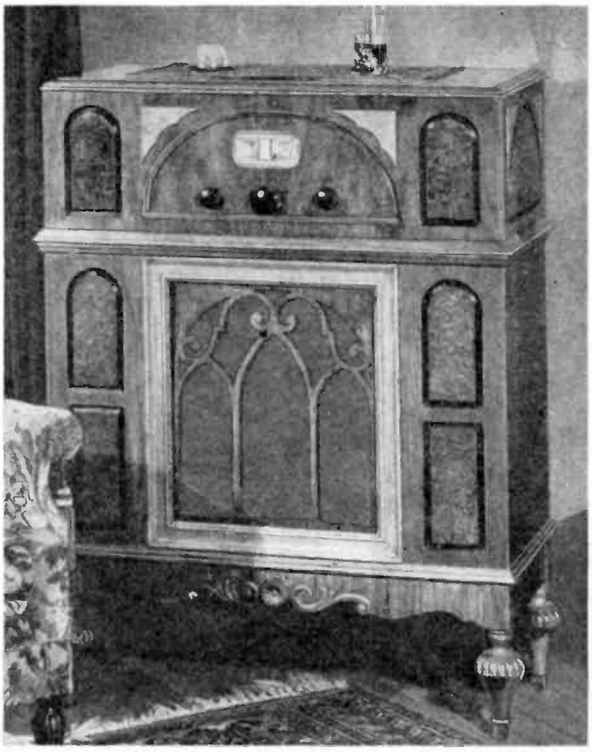
The Acme line of rectifier-filter systems includes an *A*-power unit, a *B*-power unit, and a combination of the two to supply all the current needed by a set having seven 6-volt tubes or less. The *A* unit uses a contact rec-

*Acme Dry "A B C" Unit.*

tifier and high capacity condenser. The *B* unit uses an '80 tube rectifier, filter, and 12,000-ohm voltage divider to supply 22½,

(Continued on Page 62)

# A New and Finer Appreciation *of* RADIO



The Model 32 Console

TO BROWNING-DRAKE engineers, the new Model 30 and Model 32 receivers are the embodiment of characteristics long sought for perfect radio satisfaction.

Complete recognition of the art demands admission for telegraphy, radio telephony, television and a long list of other branches. For the present the greater number of us are interested in the translation of living entertainment to lifelike reproduction.

For years an audio amplifier system incorporating pure resistance coupling has given Browning-Drake receivers first claim in the realm of tone quality. Distance reception has always been the recognized companion of the Browning-Drake name. The careful thought and design applied to the first Regenaformer has held Browning-Drake receivers far in the lead through a turbulent sea of broadcast interference.

The new Model 30 and Model 32 receivers are based on the firm foundation of success and sound technical design. This year's contribution includes increased selectivity through the use of four tuned circuits, real power amplification, mechanical improvement and cabinet work of the highest order. A new balanced tension speaker of the Whitmore type is built into these all-electric receivers, adding to the perfect reproduction of the amplifier system alone.

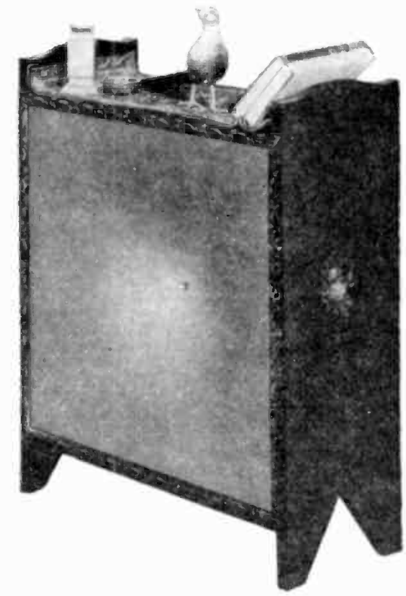
[ *DEALERS: Browning-Drake exclusive dealer franchises are now being granted. Write direct to the factory before your territory is closed.* ]

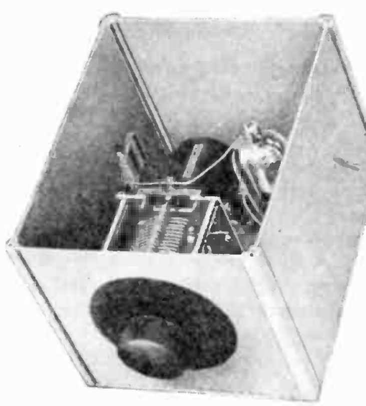
BROWNING-DRAKE

# Two Good Friends Present---
# *Another!*

THE new Model B Browning-Drake loud speaker combines a beautifully designed cabinet with the new balanced tension speaker developed by W. B. Whitmore, and manufactured by Browning-Drake under the Air-Chrome patents pending. The cabinet, in addition to providing an attractive appearance, adds to the reproduction because of its acoustical characteristics.

This loud speaker is noteworthy among the models produced by Browning-Drake because of its unusually even response to the entire audible scale. Low notes are produced with fidelity and definition which mark the speaker as a great advance over contemporary designs. Actual comparison with the average cone or exponential speaker definitely proves the superiority of the Model B.

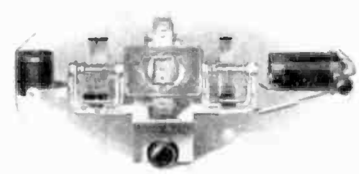




The new Model B loud speaker is 26″ high at the ends and is 18″ wide. The depth is 9″. The top is, therefore, sufficiently large to accommodate many of the smaller receivers, if desired. It can be had in a walnut brown or ebony finish with hand decorated touches which give it pleasing individuality. The list price is $35.00. Other speakers ranging in price from $25.00 to $75.00 will be demonstrated by our dealers this season.

The Browning-Drake shield grid Booster is a development parallel to that of the shield grid tube. Most of the receivers constructed or purchased prior to the introduction of this tube cannot be readily adapted to use it. The Booster offers all of the advantages of the shield grid tube without changes in the receiver proper, and is therefore ideal for use with all older machines. Selectivity and volume are appreciably increased and distance reception is greatly improved when the Booster is used. Connections are extremely simple and no complication in tuning is introduced.

The Booster is inclosed in an attractive aluminum shield cabinet 7″x7″x10″. It can be had for use with the standard D.C. shield grid tube or with the new 15 volt and 2½ volt shield grid alternating current tubes. The list price without tube is $25.00. The Booster is also available in Kit form at $17.00.



The single control Browning-Drake Kit and the assemblies using it are well known to Browning-Drake fans throughout the world. The universal characteristics of the Kit make it possible to use dry cell, the standard 5 volt D.C., or shield grid tubes in either A.C. or D.C. types in the radio frequency amplifier. If the experimenter plans to use only the shield grid tube in the R.F. amplifier, a special shield grid type Kit may be had. The selectivity and great sensitivity available with Browning-Drake receivers constructed with the Official Kit are equal to those characteristics in the finest and most expensive factory-built receivers. Plans for construction are complete and the most inexperienced builder can be assured of excellent results. The list price of the single control Official Kit is $26.00 in either the regular or special shield grid types.

BROWNING-DRAKE CORPORATION
CAMBRIDGE , , , MASS.

BROWNING-DRAKE

## POWER UNITS AND AMPLIFIERS

(Continued from Page 58)

45, 67, 90, 135 and 180-volt taps; one type also supplies 4½ and 45-volt *C* bias. The *A B C* unit supplies all these voltages and comes in a metal case 9½ by 12 by 9½ in., weighing 42 lbs.

A Lincoln *ABC* power unit for a.c. sets is available in a steel shielding case 13 in. long, 3⅜ in. wide and 5½ in. high. Besides supplying 22½, 90, 135 and 180-volts d.c. from a

*Lincoln "B" Power Unit*

'80 rectifier and filter, it furnishes 1.5, 2.25 and 5 volts a.c. for filament heating from a transformer. The same d.c. voltages are supplied from a separate *B* unit of the same size for use with d.c. filament tubes.

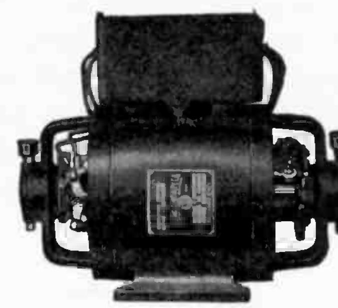
The Abox A.C. converter supplies 6 volt d.c. for 110 volt a.c. through a step-down transformer, liquid rectifier, and complete

*Abox A.C. Converter*

filter system. It is equipped with a receptacle for the *B* unit and has a master control switch. Its output is adjustable for sets using from 3 to 8 tubes.

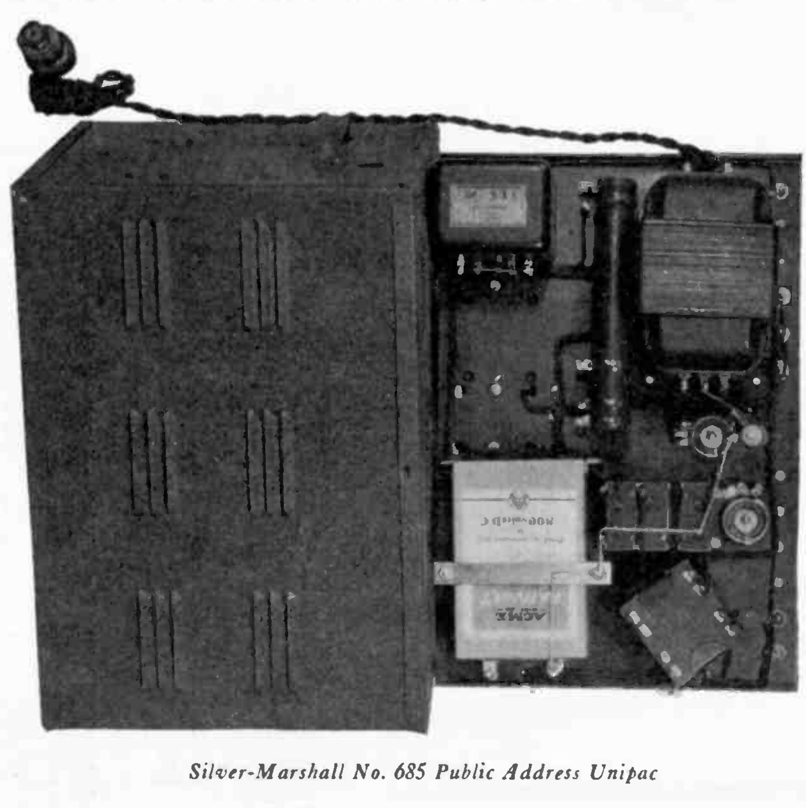
The new S-M 685 Public Address Unipac is a 3-stage amplifier for permanent or portable use, and may be operated with microphone, radio receiver, or phonograph record pick-up. Developing nearly 5 watts of undistorted power, this unit is capable of operating 10 to 12 loudspeakers for adequate coverage of theatres, churches, fairs, and outdoor gatherings. It incorporates one UY-227 first stage, one UX-226 second stage, and one 250 power output stage, with two UX-281 rectifiers. It is offered completely wired in steel cabinet or in kit form.

Esco dynamotors and motor generators are now designed especially to operate a.c. receivers, speakers and phonographs in locations where only d.c. power is available. These are equipped with filters so as to give results which are claimed to give results as good or better than secured from 60-cycle



*Esco Dynamotor with Filter for Radio Receivers*

lighting sockets. Dynamotors are recommended except where adjustment of the secondary voltage is desired, when a motor-generator should be used. These machines are quiet running and require a minimum of attention. A small rotary converter without filter is also available for the operation of a.c. electric phonographs, without radio attachment, from a d.c. source.



*Silver-Marshall No. 685 Public Address Unipac*

## What Goes Into the Detector Tube Is Delivered to the Speaker

When You Use the

# New REMLER

## AUDIO-TRANSFORMERS

Ten years of Remler Radio Reliability are behind this modern system of audio-transformers. So much ahead of the old-time transformers that every tone-enthusiast will substitute these new Remler Units for his present, inefficient equipment.

The Remler Transformer Team for Dynamic Speakers — 920, 921, 923


Types 900, 901, 920, 921, 922

ALL the wide range of frequencies which the dynamic speaker can reproduce—from the lowest rumbling notes of the organ, to the trill of the flute—will be faithfully transmitted to it by Nos. 920, 921 and 923. They are especially designed to produce maximum undistorted power output from the CX350 (UX250) Power Tube without overload of the detector or first audio tubes. Their unique construction results in isolation of the audio frequency currents from the plate supply unit and in a high gain stable amplifier entirely free from the annoying phenomenon known as "motor boating."

**No. 920** Resonated Primary. A 4½ to 1 ratio first stage transformer with primary resonated to give a slightly rising frequency characteristic at the lower end of the scale to compensate for the falling frequency characteristic of the higher-ratio second-stage transformer No. 921. List Price........ **$12.00**

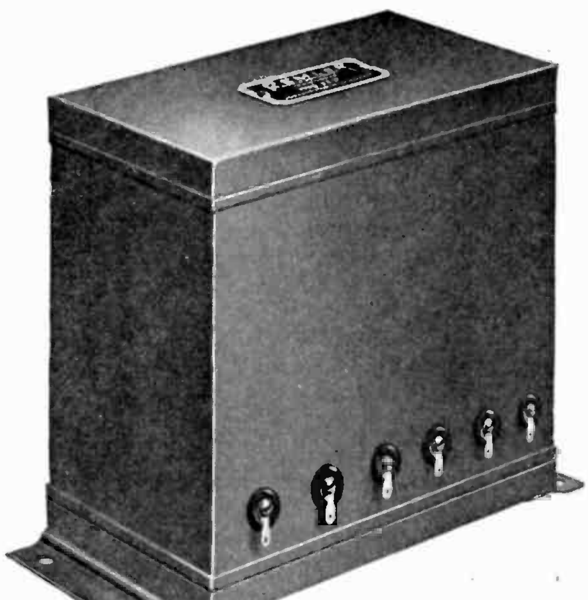
**No. 921** High-Gain. A 6½ to 1 ratio second-stage transformer designed for use with Transformer No. 920 to produce an amplifier having a flat frequency characteristic over the entire band of transmitted frequencies. List Price........ **$12.00**

**No. 923** No Saturation. An output impedance-compensating transformer primarily designed for use following the CX350 (UX250) Power Tube. Consists of choke, blocking condenser and transformer whose primary is tapped for best results from either the CX350 (UX250) tube, or the CX371A (UX171A) or CX310 (UX210) tube. Secondary tapped for either magnetic-drive cone speaker or dynamic speaker. Isolates audio current from plate supply unit, assuring stable operation. Power tube plate current isolated from transformer windings, eliminating direct-current saturation and providing faithful reproduction of full frequency band. Current-carrying capacity 100 milliamperes. List Price........ **$20.00**

**No. 900** A 3½ to 1 ratio first-stage transformer having a resonated primary and giving special emphasis to the lower frequencies to compensate for the falling characteristic of the No. 901 Transformer. Transformers Nos. 900 and 901 have frequency characteristic falling sharply just above 60 cycles, making them ideal for use in receivers employing A.C. tubes in radio frequency, detector and first audio positions. Designed for use with the No. 901 Transformer in an amplifier employing a CX112A (UX112A), CX371A (UX171A) or CX310 (UX210) Power Tube. List Price........ **$8.00**

**No. 901** A 3½ to 1 ratio second-stage transformer for use with Transformer No. 900 to produce an amplifier having an overall characteristic flat over the desired band of transmitted frequencies. List Price........ **$8.00**

**No. 922** An output transformer intended to follow a CX112A (UX112A), CX371A (UX171A) or CX310 (UX210) Power Tube. Primary tapped to permit best operation with power tube used. Safe current-carrying capacity 40 milliamperes. List Price........ **$10.00**



Type 923

*Remler Audio Transformers ready for shipment about September 1.*

SOLD THROUGH JOBBERS

Write for four-page, two-color Bulletin No. 15, completely describing the new Audio-Transformer.

**REMLER**

*Division of*

GRAY & DANIELSON MANUFACTURING COMPANY

260 First Street

Chicago — SAN FRANCISCO — New York

Eastern Warehouse, Elkhart, Ind.

# Summary of R. M. A. Show Exhibits

(Continued from Page 35)

The electro-dynamic speakers are available in three units, for a.c. or d.c. operation and are installed in four console cabinets, ranging in size from a telephone stand to large folding door types. The air column reproducers are available in four console types, and the magnetic cone reproducers are in table models only.

O'NEIL MFG. CORP., West New York, N. Y., loud speakers of the magnetic cone type in various attractive models, also dynamic type with or without rectifier.

OPERADIO MFG. CO., St. Charles, Ill., three types of exponential, electro-magnetic loud speakers, and two styles of electro-dynamic speakers, including a unit for installation in console cabinets.

PACENT ELECTRIC CO., New York City, Phonovox phonograph pickup unit, equipped with a supporting arm, or for separate attachment to present tone arm. Among the features are ability to use fibre needles, and an arrangement whereby detector tube in radio receiver need not be removed when changing from radio to phonograph. A line of radio parts and accessories completes their new items.

PERRYMAN ELECTRIC CO., New York City, a.c. and d.c. tubes, for all purposes.

PRECISION PRODUCTS CO., Arborphone radio receivers and loud speakers.

PHILADELPHIA STORAGE BATTERY CO., Philadelphia, Pa., five a.c. models of six-tube neutrodyne receivers and two speakers, a magnetic cone and a dynamic. All receiver models have the same type of chassis with single control drum dial tuning, trimmer, and volume control. Each has a built-in power unit with '80 rectifier tube. The table models are in colored metal cabinets with golden floral decorations, gray, green, red and brown. There are three consoles, a low-boy, a high-boy, and high-boy with phonograph. The consoles have a self-contained loop or may be connected to an aerial. The speakers are in clock and console models, the latter being designed to support a cabinet receiver.

PIONEER RADIO CORP., Plano, Ill., three types of tube a.c. receivers, called the Peerless A.C Seven. Available in either metal or wooden cabinets, or the shielded chassis may be obtained separately

POLYMET MFG. CORP., New York City, moulded Bakelite fixed mica condensers, as well as wire wound resistances, by-pass and filter condensers, grid leaks, potentiometers, and rheostats.

POTTER MFG. CO., No. Chicago, fixed paper condensers from .0001 to 50 mfd. for by-pass and filter also 10 mfd. electrolytic filter condenser for 250 volts.

Q. R. S. CO., Chicago, Ill., radio tubes for all purposes, especially heavy current rectifiers for series filament current supply to either type 99 or A tubes.

RACON ELECT. CO., exponential horns of the long air column type, as well as horns for large halls and service where great volume and range of sound is required.

RADIO RECEPTOR CO., New York City, Powerizers, for furnishing *B* current to any radio receiver, as well as supply a.c. for the filaments of a large number of factory built receivers, by means of an adapter harness. The new Powerizers include a power stage employing a type 210 power tube, and use a type 280 rectifier.

RADIO CORPORATION OF AMERICA, New York City, R. C. A. Radiolas, radiotrons, loud speakers, *B* eliminator.

RAYTHEON MFG. CO., Cambridge, Mass., rectifying tubes, BH full wave 125 m.a., BA full wave 350 m.a. at 250 volts; A cartridge 2½ amp. at 6 volts; neon Rino lamp, photo-electric cell, hard vacuum or gas-filled.

R. B. M. MFG. CO., Logansport, Ind., a voltage regulator device for attachment to a.c. sets so as to regulate the input voltage to the set. Consists of a transformer with eight taps, controlled by a switch, with indicating buzzer which operates when the correct voltage is reached.

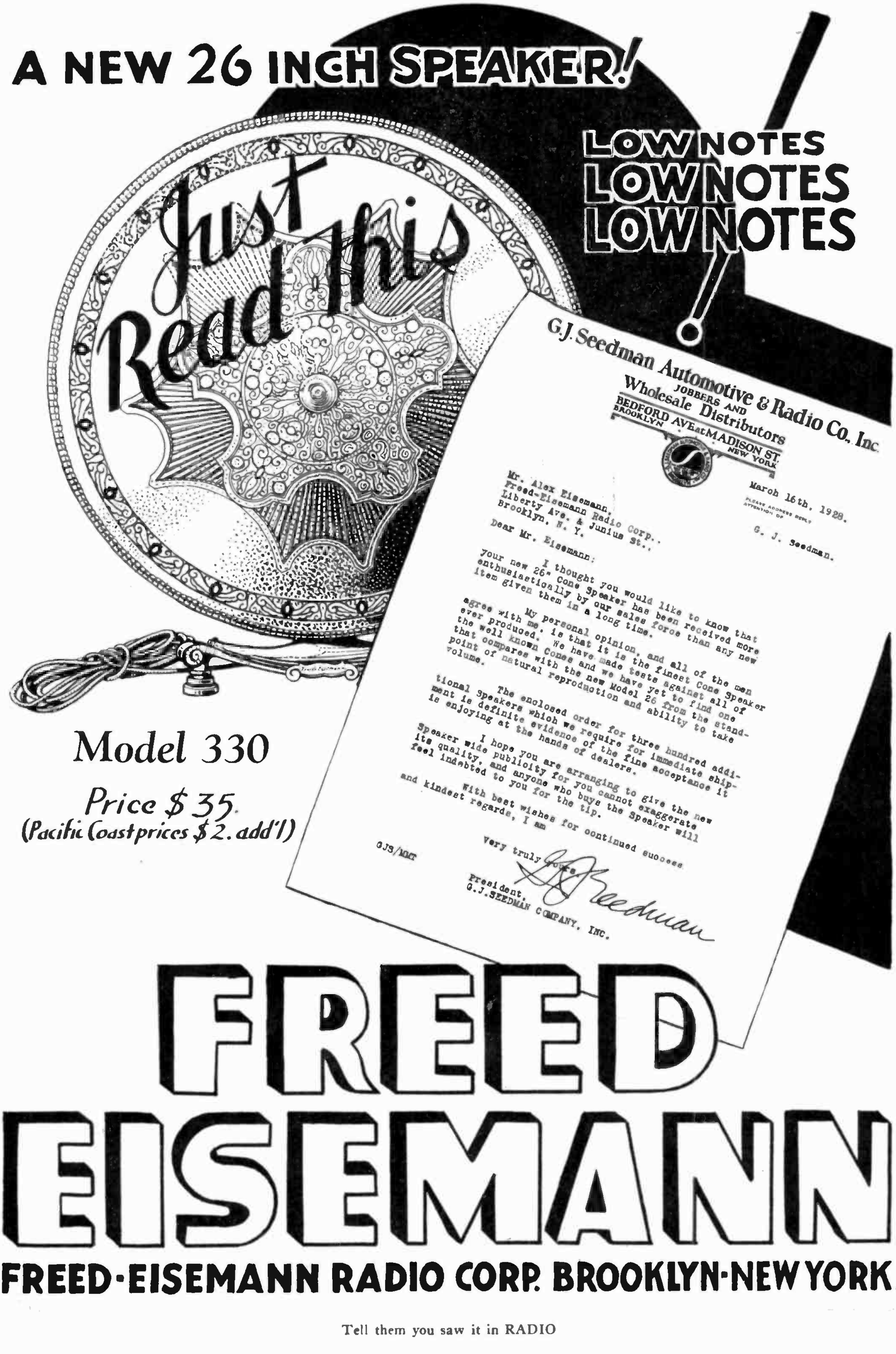
REICHMANN CO., Chicago, Ill., makers of the Thorola receiver, a new line of a.c. and d.c. sets, as well as new electro-dynamic units and cabinet models, together with electro magnetic cone speakers.

REMLER DIVISION OF GRAY & DANIELSON MFG. CO., San Francisco, Calif., several types of new audio frequency transformers, and a special output transformer for use between the 250 power tube and electro-dynamic speakers. A complete line of parts for shielded grid circuits, single and gang variable condensers, drum dials and other accessories.

ROLA COMPANY, Oakland, Calif., table and console models of magnetic-armature and electro-dynamic speakers with step-down transformer and Marathon rectifier for d.c. field supply.

SAMSON ELECTRIC CO., Canton, Mass., full line of standard and Symphonic audio transformers, including push-pull and output types; one. two and three-stage power amplifiers for phonograph or radio sets, *A*, *B* and *C* elim-

(Continued on Page 66)




G.J. Seedman Automotive & Radio Co. Inc.
JOBBERS AND
Wholesale Distributors
BEDFORD AVE. at MADISON ST.
BROOKLYN NEW YORK

March 16th, 1928.

PLEASE ADDRESS REPLY ATTENTION OF
G. J. Seedman.

Mr. Alex Eisemann,
Freed-Eisemann Radio Corp.,
Liberty Ave. & Junius St.,
Brooklyn, N. Y.

Dear Mr. Eisemann:

I thought you would like to know that your new 26" Cone Speaker has been received more enthusiastically by our sales force than any new item given them in a long time.

My personal opinion, and all of the men agree with me, is that it is the finest Cone Speaker ever produced. We have made tests against all of the well known Cones and we have yet to find one that compares with the new Model 26 from the standpoint of natural reproduction and ability to take volume.

The enclosed order for three hundred additional Speakers which we require for immediate shipment is definite evidence of the fine acceptance it is enjoying at the hands of dealers.

I hope you are arranging to give the new Speaker wide publicity for you cannot exaggerate its quality, and anyone who buys the Speaker will feel indebted to you for the tip.

With best wishes for continued success and kindest regards, I am

Very truly yours,

G J Seedman

President.
G.J.SEEDMAN COMPANY, INC.

GJS/MMT

## SUMMARY OF R. M. A. SHOW EXHIBITS

(Continued from Page 64)

inators; chokes, r.f. and eliminator, condensers fixed and variable, filters, couplers.

SANDAR CORP., Long Island City, N. Y., a division of the Farrand Mfg. Co., four electro-magnetic and three electro-dynamic models, in table and console cabinets, and with the units available separately if desired.

SANGAMO ELECT. CO., Springfield, Ill., a new line of audio frequency transformers in addition to their well known group of fixed mica condensers.

SENTINEL MFG. CO., Chicago, a six-tube a.c. receiver with three tuned r.f. stages, two transformer coupled audio, rectifier tube and a.c. power unit.

SHAMROCK DYNAMIC ELECTRIC, Newark, New Jersey, a new table model equipped for a.c. tubes with built-in power unit, single dial control, various types of cabinets, Chinese green lacquer, ebony, gold, ivory, mandarin red or antique walnut.

SILVER MARSHALL, INC., Chicago, a new six-tube kit designed by Sargent-Rayment, employing S. M. specially wound coils for three shield grid tubes, a single dial control receiver with individual trimmer condenser for each tuning stage; new S. M. audio amplifying system (3 transformers), main tuning with National single dial 10 k.c.; selectivity in congested areas. Receiver is mounted in and on solid heavy aluminum framework with aluminum mounting base, shield cases, and housing. Style name SM-710, Sargent Rayment Six. In addition to this kit Silver-Marshall displayed a complete line of radio parts which are described in detail elsewhere in this issue.

SLAGLE RADIO CO., Fort Wayne, Ind., two new consoles, both of large size and utilizing the Technidyne circuit. All electric operated receivers with dynamic power speakers in the console models and provision for phonograph pick-up connection as well as for loop operation.

SLEEPER RADIO & MFG. CORP., Long Island City, three models of a.c. electric receivers equipped with electric clock, one 6-tube d.c. electric set.

SONATRON TUBE CO., Newark, N. J., 33 types of tubes for all purposes, including a new model a.c. shielded grid tube.

SPARKS-WITHINGTON CO., Jackson, Mich., five Sparton "Equasonne" receivers and one cone speaker. Three use seven a.c. tubes and two use eight, one is a table model and the others are consoles, with or without speakers. These are especially designed to give good reproduction for all stations between 200 and 550 meters.

SPLITDORF RADIO CORP., Newark, N. J., nine types of a.c. receivers, three of which have 9 tubes, while the remainder are 7-tube models. They are made in two table models and seven console types, the latter having electro-dynamic loud speakers. The sets are all single dial control, illuminated scale, with duplex control so that regeneration can be employed to obtain great sensitivity when extreme distance reception is wanted. The sets are available with type 250 tube power amplifiers as well as the smaller sizes of power tubes.

STEINITE RADIO CO., Chicago, Ill., table and console model a.c. sets, including a compact table model with single dial control, illuminated drum dial, and completely shielded apparatus. The console models have built-in loud speakers, and the latter are also available separately, as a table or console speaker.

STERLING MFG. CO., Cleveland, O., a series of meters and test sets for testing all types of receivers and tubes; also a group of dry and bulb type *A* and *B* power units.

STEVENS MFG. CORP., New York City, four new models of cone type electro-magnetic speakers, including two cabinet styles with the cone concealed, and two with exposed cone, all for table mounting.

STEWART-WARNER SPEEDOMETER CORP., Chicago, Ill., a new a.c. standard chassis, and five console cabinets and one table cabinet into which this chassis is fitted. The table model has a loud speaker built into the top of the cabinet. All of the console cabinets except one are for a.c. or d.c. models, and there is a d.c. chassis to supply the demand for that type of set. Both models are single dial control, with illuminated drum dial, calibrated in wavelengths, and the table model is housed in a metal cabinet.

STROMBERG CARLSON TELEPHONE MFG. CO., Rochester, N. Y., a new AC receiver, known as the No. 635 Treasure Chest, employs 7 AC tubes; chassis and base of sheet steel to enclose all wiring. New audio amplification system giving uniform amplification throughout the entire broadcast band. Wires enclosed in casing filled with sealing compound to prevent moisture and mechanical damage. Phonograph pick-up jack. Volume control, single knob varying two resistor units. Range 200 to 550 meters. Cabinet in American walnut.

SYLVANIA PRODUCTS CO., Emporium, Pa., radio tubes, for a.c. and d.c. service.

TELEVOCAL CORP., Newark, N. J., radio tubes.

TEMPLE, INC., Chicago, air column and Airchrome speakers.

THORDARSON ELECT. MFG. CO., Chicago, Ill., power transformers, including filament lighting transformers for a.c. sets, audio frequency coupling units for the shielded grid tubes, and a complete line of other audio frequency coupling devices, and output transformers.

TIMMONS RADIO PRODUCTS CORP., Philadelphia, Pa., loud speakers of cabinet and unit type, eliminators and power amplifiers.

TOBE DEUTSCHMAN Co., Cambridge, Mass., a new high capacity condenser for *A* eliminator service, new styles of vacuum type grid leaks, resistors, and a complete line of paper condensers for bypass and filter service.

TOWER MFG. CORP., Boston, Mass., four types of electro-magnetic loud speakers, all of the cone type, with decorative exterior effects in metal.

TRANSFORMER CORP. OF AMERICA, a.c. transformers for manufacturers and professional set builders, as well as chokes, audio frequency transformers, power packs and other parts for the manufacturer.

TRAVELER MFG. CORP., Chicago, Ill., portable radio set.

TYRMAN ELECTRIC CORP., Chicago, Ill., type 50 five-tube portable receiver, with a shielded grid tube; also audio frequency transformers, drum dials, sockets and other parts for the set builder.

ULTRATONE MFG. Co., Chicago, air column magnetic speakers.

UNITED RADIO CORP., Rochester, N. Y., Peerless loud speakers, three types of electro-magnetic cones, and two electro-dynamic units, the latter having two sizes of cones, one 7 in., and one 9 in. Speakers are available in table and console models.

UTAH RADIO PRODUCTS Co., Chicago, Ill., six new speakers of the cone and dynamic types; also speaker units for console mounting.

VICTOREEN RADIO CORP., for an a.c. superheterodyne, including intermediate frequency transformers and associated equipment, as well as parts for d.c.

WALBERT MFG. Co., Chicago, a complete self-contained eight-tube a.c. receiver with power unit. Operation is controlled by single dial without supplementary controls. It has four tuned stages of radio frequency with inductance tuning.

WEBSTER ELECTRIC Co., Racine, Wis., an electric phonograph pickup in two models, one with supporting arm, and the other designed to fit in place of old reproducer on any phonograph, volume control and terminal connector block accompany each unit.

WESTON ELECT. INST. CORP., Newark, N. J., test meters and sets for a.c. or d.c. receivers; a.c. meters for flush panel mounting, as well as the table types, including a three range a.c. voltmeter having ranges of 4, 8 a 150 volts, enabling the complete checking of an a.c. receiver from the input line voltage to the filaments of the various tubes.

YAXLEY MFG. Co., Chicago, Ill., resistors, switches, jacks, rheostats and other parts for the radio set builder; also convenience outlet flush-plates for house wiring of radio installation.

ZENITH RADIO CORP., Chicago, Fifteen new models, table and console types. Model 33 is a six-tube set with single dial control; transparent dial illuminated from underneath; walnut cabinet; uses AC tubes; self-contained power plant. Dial control of this receiver set in circular recess in cabinet. Model 31, same as Model 33 but for battery operation. Model 34, low-boy 6-tube receiver with built-in cone speaker. Completely electric. Model 32, same as 34 but for battery operation. Model 35, a more elaborate hi-boy with standard 6-tube AC receiver and built-in cone speaker. Model 39, a massive console with 8 a.c. tubes loop operated; power speaker.

## QUERIES AND REPLIES

(Continued from Page 41

**Will the oscillator work on 45 volts plate? Would there be any advantage in shielding the plate lead from each shield grid tube to its associated r.f. transformer?—W. H. F., East Ely, Nev.**

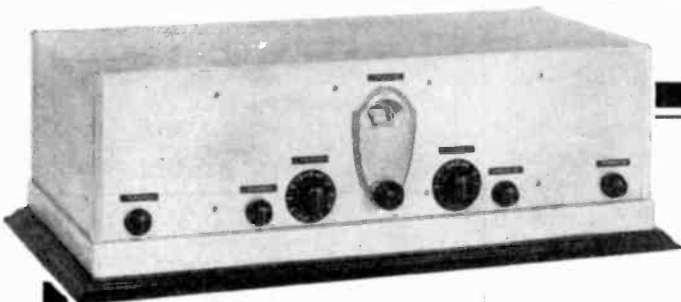
It was found that so little difference could be noted, in the operation of the 115 k.c. superheterodyne, with or without the r.f. chokes in the shield grid leads, that they were omitted for the sake of economy. Actually, there is a total of .105 mfd. connected between the 45-volt lead to the shield grid tubes, and ground, so that additional capacity would be unnecessary. Larger bypass condensers in the present arrangement might help if the *B* voltage supply had high internal resistance, but when using a high grade *B* eliminator, or a set of *B* batteries in good condition, the larger condensers are superfluous. An r.f. choke can be placed between the primary of the first audio transformer and the plate of the detector tube, with the .0005 mfd. bypass condenser connected between the plate and the negative filament. It would help in case there was regeneration in the detector tube circuit, due to parallel leads, but if directions for building the set are carefully followed, this should not be necessary. There would be a slight advantage in shielding the plate leads.

**Power Tube Data**

| Tube | | Plate Volts | Grid Volts | D-C Plate Current (Milli-amperes) | Voltage Amplification Factor | Plate Resistance | Load Resistance | Max. Output (Watts) |
|---|---|---|---|---|---|---|---|---|
| CX-350 | UX-250 | 450 | 80 | 55 | 3.8 | 1800 | 4000 | 4.6 |
| | | 400 | 67.5 | 52.5 | 3.8 | 1850 | 3700 | 3.5 |
| | | 350 | 58.5 | 44 | 3.8 | 2050 | 4100 | 2.45 |
| CX-310 | UX-210 | 400 | 35 | 16 | 7.5 | 5400 | 11000 | 1.34 |
| CX-371A | UX-171A | 180 | 40.5 | 19 | 3.1 | 1900 | 3800 | 0.8 |
| CX-112A | UX-112A | 180 | 13.5 | 8.5 | 8.4 | 4850 | 9700 | 0.273 |
| CX-220 | UX-120 | 135 | 22.5 | 7 | 3.3 | 6600 | 13200 | 0.105 |

SM

# A STATION EVERY TEN KILOCYCLES



A STATION tuned in for every ten kilocycles—an average of one hundred stations heard in one evening—that is the performance record of the Sargent-Rayment Six, operated in the heart of Chicago interference on a warm summer evening.

Silver-Marshall, Inc., is proud to announce the completion of arrangements with the designers, Messrs. Sargent and Rayment, whereby their latest radio development can be offered in complete kit form as the S-M 710 Sargent-Rayment Six kit. This remarkable receiver will be distributed by the Radio Constructors Corp. of Oakland, Calif., in the territory west of the Rockies, and elsewhere by regular Silver Marshall distributors.

It is unnecessary to introduce Messrs. Sargent and Rayment, whose past work on a unique receiver system, invented by them has made their names well known to every experienced radio fan. Their new receiver, developed in conjunction with the Silver-Marshall engineering laboratories, needs no other recommendation than the names of its designers, and the full and complete endorsement of Silver-Marhsall, Inc., which it carries.

By the seasoned fan, anxious for the finest in radio, the true excellence of the 710 Sargent-Rayment Six will be fully appreciated, for it is the precision product of two seasons of laboratory research work. It is truly a finer radio set than has ever been offered to the discriminating fan before, for in it no compromises have been made with quantity production methods, and none with the taste of those who buy furniture and not radio performance.

The designers set out to make six tubes do full one hundred percent work. Their success proves that the ideal radio set of 10 kilocycle selectivity, ample volume, and 2000 to 3000 mile distance range does not require more than six tubes—if all six are worked at full rating. This contention, acknowledged theoretically and mathematically correct, remained for Sargent, Rayment and S-M to actually prove for the first time in practice. How well they have done it is told in the opening sentence of this advertisement.

The 710 Sargent-Rayment Six is a precision laboratory radio receiver. It has been designed thruout as such. It is like a battleship stripped for action, shorn of every piece of surplus gear. The thick aluminum shielding and chassis, finished in satin silver and trimmed by black instrument name plates with white engraving gives to the appearance a beauty and dignity in keeping with the set's fine performance. Electrically the receiver consists of four sharply tuned circuits in a three stage screen grid R. F. amplifier, all tuned by a single illuminated drum, and provided with individual verniers. One knob turns the set on and off, and adjusts battery voltage. A second controls volume from zero to maximum. There are no other controls. Following the R. F. amplifier are the detector and the A. F. amplifiers, using the new Clough audio transformers which provide unequalled tone quality and high volume. Each circuit is individually shielded, bypassed and isolated from all others. The set goes together simply and positively, with clear direct wiring. It is a joy to build, so workmanlike is its design and layout.

To the fan who appreciates and values really fine performance, in a truly precision receiver of great individuality and distinction, Silver-Marshall unhesitatingly recommends the 710 Sargent-Rayment Six. The kit for this receiver is approved by the designers and exclusively manu factured by Silver-Marshall, Inc., is priced at $120.00 complete with cabinet.

*Exclusive Distributors West of the Rockies*
RADIO CONSTRUCTOR'S CORPORATION
357 12th Street, *Oakland, Calif.*

SILVER-MARSHALL, INC.
852 West Jackson Blvd.
CHICAGO, U. S. A.

A complete booklet written by Messrs. Sargent and Rayment, aided by the S-M engineering staff, is in preparation. It describes the design, construction, operation and maintenance of the Sargent-Rayment Six. It contains an ample number of large, clear plates, diagrams, and working drawings illustrating every angle of the set, as well as amplification and selectivity charts. It is a treatise of such a generally informative nature as to be a liberal education in precision receiver design.

It will be mailed on receipt of 50c in stamps as soon as off the press.

SILVER-MARSHALL, INC., 852 Jackson Blvd., *Chicago*

Please send me booklet on the Sargent-Rayment Six, as soon as available, for which I inclose 50c.

*Name* ____________________

*Address* ____________________

*City* ____________ *State* ________

# *Special Announcement!*

## TO THE RADIO TRADE

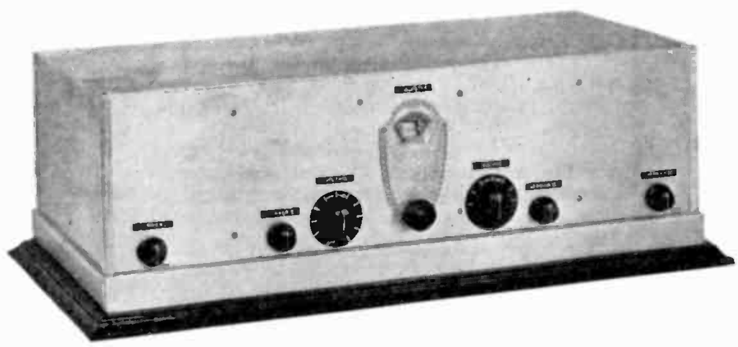
In order to assure the best possible service to the radio trade west of the Rockies, Silver-Marshall have made Radio Constructors Corporation their exclusive distributor to the trade on the SM-710 Sargent-Rayment Six Receiver. A large Pacific Coast Stock will be maintained throughout the season, assuring immediate deliveries. The set will be furnished to the trade either knock-down, in kit form, or built up, wired, tested, ready to operate.

Our plans call for distribution via the jobber. Jobbers are requested to communicate with us at once for details. Names of all jobbers will be carried in our advertising throughout the season. Local advertising will be done by us in co-operation with the local trade.

This is the greatest opportunity ever offered to the Western Radio Trade to identify itself with a national tie-up. Write us at once.

### Outstanding Features

1. Ten Kilocycle Selectivity, even on locals.
2. All Distance Records Smashed. Sets a new standard.
3. One Dial Control. Easy to operate.
4. Will absolutely outdemonstrate any other set, regardless of number of tubes or type of circuit.
5. Every model absolutely guaranteed.



*Exterior View of Sargent-Rayment Six*

### PRICE
### $120.00

This includes everything necessary to build the complete set. Note that, due to its unique construction, no "cabinet" is required. The set when put together forms itself into a handsomely decorated, silvery finished container.

Full instructions for assembling, wiring, and operating accompany each kit.

## WRITE FOR FREE DESCRIPTIVE BOOKLET

The limited amount of space in this ad does not permit us to go into details about the new features of this circuit. We have therefore prepared a special 16 page descriptive booklet,—"RADIO PAR EXCELLENCE—1929"—which tells about the Sargent-Rayment Six from start to finish. This booklet, written in plain, understandable language, explains the design of the receiver and shows conclusively just why we are able to make such wide claims for distance, selectivity and tone on the Sargent-Rayment Six. We would appreciate the opportunity to mail you a copy. Just send in your name and address.

## A Statement by the Designers

"It has long been a recognized fact that too many tubes were being used in radio sets to accomplish a given result. In the past, lack of proper tubes has made this necessary, but with the coming of the shield grid tube the last obstacle in the way of a perfectly designed radio set has been removed.

"It has many times been shown mathematically and theoretically that six tubes, operating at 100% efficiency would do more than any radio set ever has in the past, no matter how many tubes it used. In the Sargent-Rayment Six, we have proved in practice that this is so. Coils of the highest efficiency, careful shielding, and correct design throughout have resulted in a receiver giving radio results little short of amazing. Ten kilocycle selectivity on local stations becomes an accomplished fact. Distant stations are brought in with unusual clarity and volume, and the concentrated power of the set pulls weak stations right up through the noise level, making their announcements fully audible.

"This set closely approaches the ideal for which radio designers have striven for years, and we take pleasure in offering it to the discriminating radio owner,—the one who likes radio entertainment that is not necessarily confined to local reception."

(Signed) E. M. Sargent, L. C. Rayment

**Exclusive Distributors West of the Rockies**

**RADIO CONSTRUCTORS CORPORATION**
**357 Twelfth St., Oakland, California**

## SPECIAL DEALER OFFER

**Expires August 1st**

This radio season is opening early and we want our dealer outlets to get lined up at once. In order to make sure that dealers on the Sargent-Rayment Six get off to a good start we have arranged a SPECIAL CONCESSION for those dealers who communicate with us at once. Everyone who contemplates selling the Sargent-Rayment Six (and those who do not will be missing the best bet of the season) should fill out the coupon below and send it to us by return mail. These coupons positively will not be honored after August 1, 1928. Meanwhile, they are worth REAL MONEY.

**COUPON—Pin to Your Letterhead and Mail at Once**

RADIO CONSTRUCTORS CORP.,
357 Twelfth St.,
Oakland, Calif.

I am a dealer in radio parts or a professional set builder as shown by the attached letterhead (if no letterhead, give name of jobber from whom you buy), and am interested in your special offer to dealers on the Sargent-Rayment Six. Without any obligation on my part, please send me at once full details on this offer.

Name..............................

Address..............................

City and State..............................

## MISCELLANEOUS PARTS AND ACCESSORIES

(Continued from Page 39)

Model No. 3 embodies a complete filter network for correcting extreme cases where the load may be as much as five amperes. These devices by-pass the inductive kick-back


*No. 3 Dubilier Interference Device*

caused by any make-break sparking contacts that may exist in motors, transformers, heaters, etc. They are intended for use on a.c. or d.c. 110-220 volt circuits. They do not suppress interference which is radiated into space.

The Polymet small moulded bakelite condenser has all the electrical and constructional features of the large sizes combined

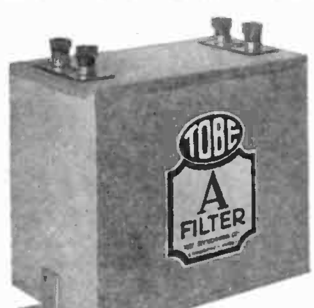

*Polymet Small Moulded Bakelite Condenser*

in a light, compact unit for easy mounting in any position. It is made in all standard sizes.

The Tobe Tipon vacuum mica condenser is of standard grid-leak size, fitting the ordinary clips for subpanel mounting. It contains a mica condenser, accurately calibrated to the desired capacity, sealed into a glass tube in a high vacuum.

*Tobe Tipon Condenser*

The Tobe-A-Filter consists of a 7600 mfd. dry condenser cased with two choke coils of

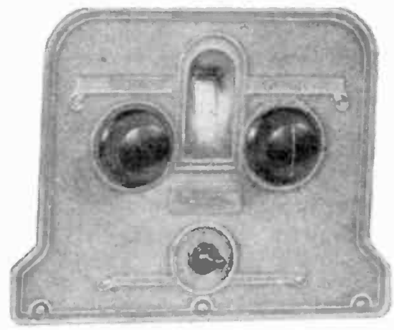



*Tobe-A-Filter*

proper size to supply humless *A* current when connected to a two-ampere charger.

The Rayfoto picture recorder kit consists of a three-tube unit which is plugged into the loudspeaker output terminals of a broadcast receiver in order to receive still pictures as broadcast by the Cooley system. The unit consists of the received electrical impulses into light which is radiated as a corona discharge from a needle point and is recorded on sensitive paper mounted on a revolving cylinder driven by a spring or electric motor. The kit includes a precision printer unit, selective synchronizing relay, a phonograph record of a picture transmission for demonstration purposes in the lack of broadcasting, and a complete instruction book. It fits into any standard cabinet with 7x21 in. panel.

The new S-M single and double escutcheon plates with windows provide an attractive mounting for custom-built sets. The general appearance of the single plate is shown herewith, and of the double plate in the picture



*Silver-Marshall Single Escutcheon Plate and Drum Dial*

of the S-M screen grid eight. Each plate is 6 5/16 inches high, the single being 8 inches wide, and the double 8 7/8 inches wide. These pictures also show the dials of the S-M 806 illuminated drum which is controlled by a drum operating a friction drive. Both right-hand and left-hand models are provided for 180-degree rotation, 0-100.

The Fritts Phono-Consolette, illustrated herewith, is one of a number of new designs in radio furniture. This model has a sliding drawer equipped with an electrically-operated phonograph turn-table. The lower shelf on the stretcher is designed for a cabinet speaker. The upper apparatus compartment with drop-door is of ample size to hold any standard make of radio receiver. It stands 41½ in. high, 29 in. wide and 17 in. deep. It is made of dark walnut with burl overlay.

*Fritts Phono-Consolette*

The A-C 171 Pierce-Aero chassis is designed to fit into a desired cabinet or chassis. It provides three stages of tuned r.f., detec-

*A-C 171 Aero Chassis*

tor and one stage of audio with a.c. tubes and one push-pull power stage with two '71 tubes. It has a complete a.c. power plant with filament transformer and '80 rectifier tube. The panel is 7x18 in. and is fitted with a bronze escutcheon and illuminated single drum dial.

The Acme VR-1 is a line voltage regulator designed to give an almost constant 110-volt output from an input which may vary from 90 to 150 volts. It is rated for a 60-watt output and has a variation of less than 2 per

*Acme VR-1 Line Voltage Regulator*

cent regardless of its load up to rating. It is to be inserted between the power socket and the radio set and is equipped with a plug and cable, switch and cable, and receptacle for set plug. It contains no tubes or liquids and its dimensions are 4½ by 7½ by 6¼ in.

The Acme B-8 is a double choke coil of 125 m.a. capacity and having an inductance of 18 henries in each section. It is designed for use in power amplifier *B* supply units and low power transmitters.

The Acme BH-1 is a power transformer with 110-volt 60-cycle primary designed for use with high voltage rectifiers and filters for plate supply to power tubes. It has a secondary winding for 510 volts and tertiary connection for 255 volts, all windings being center-tapped. The secondary current-carrying capacity is 125 m.a., and the tertiary 4.5 amperes. The transformer is enclosed in a metal case approximately 8 inches over all.

The Sonatron Type X401 detector and amplifier tube is of the a.c. heater type drawing 1.05 amperes heater current at 3 volts and using a maximum of 180 volts plate current.


*Sonatron X401*

It has a standard four-prong base and cap top connections for heater current. Its plate impedance is 8000 ohms and its amplification factor is 10.

The CECo hi mu tube has an amplification factor of 16 and is designed for use in a resistance coupled amplifier. The filament draws 1.05 amp. at 1.5 volts.

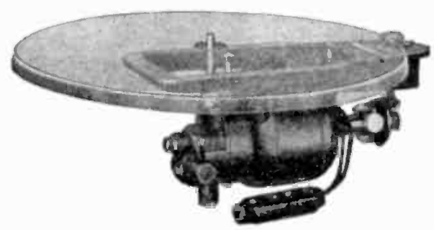
The CECo shielded grid tube is of the separate heater type drawing 1.5 amp. at 2.25 volts. It has a 5-prong socket, with a control grid terminal at the top. It has a high mutual conductance and other characteristics comparable to the d.c. shielded grid tube.

The Dongan filament transformer is designed to supply 4.2 amp. at 1½ volts, 1.75 amp. at 2½ volts, and ½ amp. at 5 volts for

*Dongan Filament Transformer*

the filaments of a.c. tubes. It is mounted in a lacquered case equipped with lamp, cord and plug outlet, and tap for control switch.

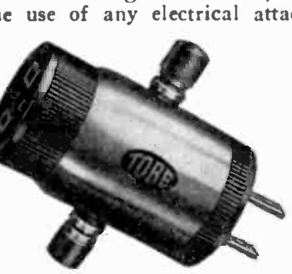
The Bodine electric turn-table is designed for use in radio phonograph combinations. It is equipped with a single phase induction



*Bodine Electric Turn-Table*

motor which has no commutator or brushes and so causes no interference from sparking.

The Tobe socket aerial not only utilizes the light circuit wiring as an aerial, but also allows the use of any electrical attachment




*Tobe Aerial Socket*

or appliance while serving as an antenna. It is safe and neat in appearance.

The Clarostat light socket antenna plug is a mica condenser which permits the passage of r.f. current but does not pass 60 cycle


*Clarostat Light-Socket Antenna Plug*

current. Hence it utilizes house-wiring as an aerial, being connected to the radio set with a flexible cord.

# Nema Annual Meeting

During its annual meeting in Chicago the week of June 4, the Radio Division of the National Electrical Manufacturers' Association went on record as favoring the increased use of higher power by broadcasting stations. They also recommended to the Secretary of Commerce that the radio inspectors, working under the Secretary of Commerce, be supplied with adequate apparatus for the accurate measurement of the carrier frequencies of broadcasting stations.

During the last session of Congress, many voices were raised against the use of high power by broadcasting stations, the loudest of which was that of Representative Edwin L. Davis of Tennessee, who boldly announced that 10,000 watts was the largest power which should be permitted any broadcasting station. The scientific basis for his stand was not indicated. The attitude of the transmitter section, National Electrical Manufacturers' Association, expressed at their annual June meeting is in direct opposition to that of Representative Davis and those others who sympathized with him.

"The radio manufacturer and the radio listener have a strong parity of interest," said Louis B. F. Raycroft, vice president of NEMA, "It is to the interest of the radio manufacturer to see that the radio listener is not only supplied with the best possible radio receiver, but that he is also supplied with the best possible broadcasting stations. He cannot generally receive satisfactory broadcasting signals at all hours of the day and night, winter and summer, in most locations, unless the broadcast stations which furnishes him his programs is of sufficient power to provide him with a strong signal under all conditions. We shall have to revise our ideas of the power of broadcasting stations if the listener is to have generally the signals to which we believe he is entitled.

"We all know the radio art is changing rapidly and it is as surely changing in respect to the power required from our broadcasting stations to suit modern ideas and conditions as it has changed in respect to receiving apparatus in the past seven years. Some voices have been raised against the use of higher power, but those are the voices of those who will not see the situation as it is. As the general level of power is increased, just so will the general satisfaction of the listener improve."

The NEMA recommendation to the Secretary of Commerce and to the Federal Radio Commission on the questions of higher power follows:

"Whereas the question has been discussed publicly as to what if any power limits should be placed on broadcasting stations, and whereas the gradual increase of the power of many well-known broadcasting stations has resulted in better broadcast service to radio listeners generally and whereas, the increase of power is in the public interest, convenience and necessity: therefore, the radio transmitter section of the National Electrical Manufacturers' Association hereby expresses its opinion that the increase of power broadcasting stations is highly beneficial and feel that this betterment of the radio broadcasting art should not be hampered by undesirable restrictions."

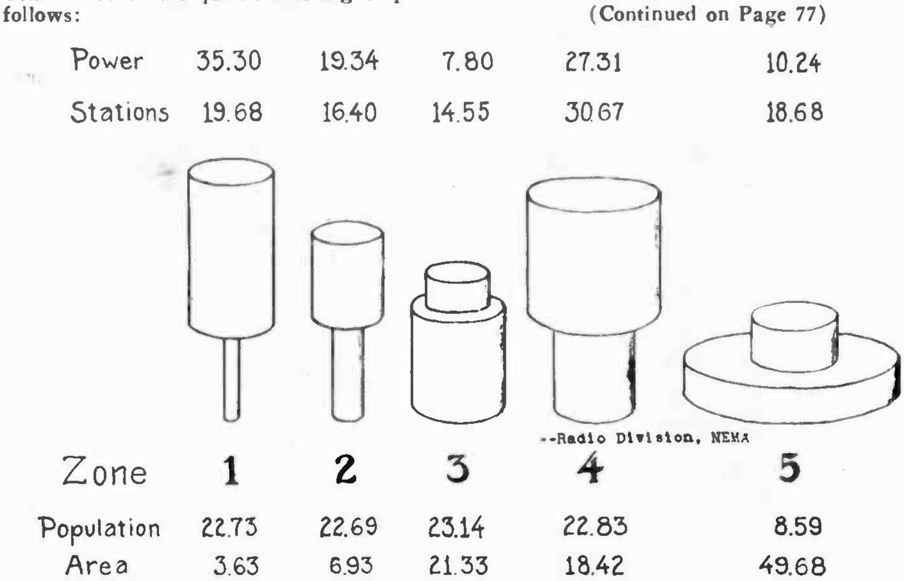
In proposing that the Department of Commerce be allowed adequate technical apparatus for the proper checking of broadcasting stations, disapproval of the action of the director of the Budget at the last session of Congress is seen. Only a fraction of the financial budget requested by the radio section of the Department of Commerce was allowed.

The radio service, Department of Commerce, charged as it is with the detail work of administering the radio act requested sufficient funds for additional personnel and apparatus to properly carry out the provisions of the Radio Act. The full recommendations of the NEMA radio transmitter section committee follow:

"WHEREAS, in many cases, measurements made of the carrier frequencies of broadcasting stations are not based upon comparisons with recognized and respected standards of frequency, and whereas many of the broadcasting stations do not regard the present equipment of the radio supervisors of the Department of Commerce as suitable for the purpose of accurately measuring the carrier frequencies; THEREFORE, the radio transmitter section of the National Electrical Manufacturers' Association expresses hereby its sympathy with and support of the efforts of the Department of Commerce to obtain suitable equipment for checking the frequency of broadcasting stations. Further, that NEMA urges that the Radio Supervisors be supplied with such equipment at the earliest possible date."

In order to show in a graphic way the exact comparisons by radio zones of broadcasting facilities proportionate to the population, area, power and number of licenses, the accompanying chart has been prepared by Ralph H. Langley of the Crosley Radio Cor-

(Continued on Page 77)




*Comparison of Broadcast Facilities by Zones*

## AUDIO TRANSFORMERS

(Continued from Page 38)

shown in Fig. 2, Curve "E", showing the amplification obtained with S-M 225 and 226 transformers and one standard audio tube, or the amplification between the detector output and the power tube grid circuit. Curves A, B and C show the results with three other makes of high grade transformers and Curve D the performance of two low-priced transformers employing the Clough system.

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The Clough idea for audio frequency transformers is used by the Lincoln Radio Corporation in the types which are uniformly housed in copper cases 3½ in. high, 2 11/16 in. wide and 3 3/16 in. over two mounting feet. No. 105 is a first audio with 4½:1 effective ratio and with practically a flat curve from 200 to 8000 cycles and rising characteristicly between 65 and 200 cycles. No. 106 is a second stage with effective ratio of 3½:1 and a frequency characteristic like that of No. 105. No. 107 in an output transformer for power tubes. No. 106 has been found to give, in conjunction with a screen grid tube, an amplification of forty-two times for frequencies between 32 and 8000 cycles.

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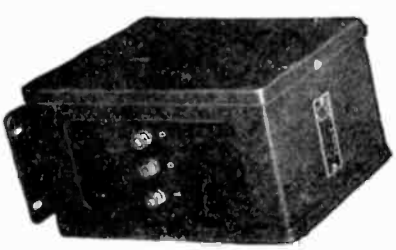
The Transformer Corporation of America transformers include medium and large size designs of 2:1, 3:1, and push-pull models as well as 1:1 output transformers. They have



*T.C.A. Audio Transformer*

clean-cut laminations of silicon steel and their coils are vacuum-impregnated. They are capable of reproducing the very low notes. The T. C. A. Amplipack No. 631 sup-

*T.C.A. Amplipack*

plies 5.3 amp. at 1.5 volts, 1.75 amp. at 2.25 volts, 5 amperes at 7.5 volts, and 100 m.a. at 500 volts for a 210 push-pull amplifier and for an a.c. electric set. This company also manufacturers a complete line of small step-down and step-up power transformers for professional set builders. They specialize on the manufacture of chokes for use in battery eliminators as well as in r.f. circuits.

## RADIO KIT REVIEWS

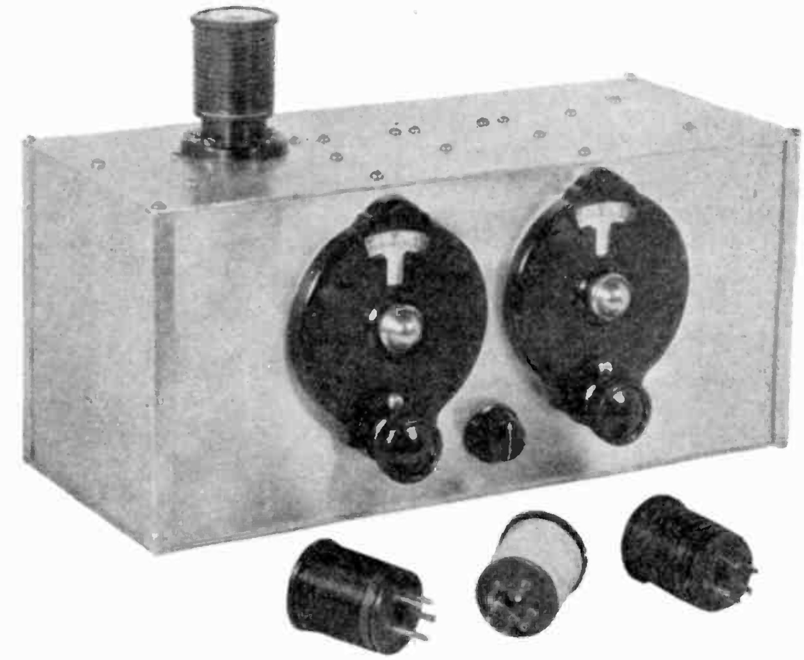
(Continued from Page 40)

recorded results obtained from those who have constructed this receiver.

The new S-M "Screen-Grid Eight" is a custom receiver kit, has five screen-grid r.f. tubes, detector, and two-stage audio amplifier. The steel cabinet, finished in rich coloring, is included in the kit. Every necessary part is supplied wherewith to custom build one of the finest receivers that can be had.

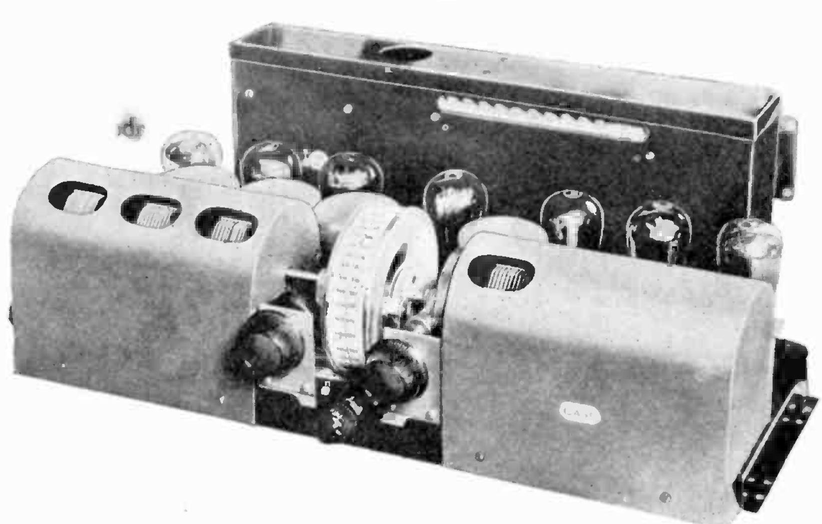
The new S-M 730 "Round the World" short-wave receiver, with one 222-type screen-grid tube in the r.f. stage, employs the new S-M 131 plug-in coils. It is most ingeniously assembled upon aluminum plates which, when erected, comprise the cabinet, size 14 inches long, six inches deep, and 6 inches high. Four separate coils provide a wave-length range from 17.5 to 204.5 meters. Both a complete kit No. 730 and an essential kit No. 732 are provided. Or by dropping the two-stage audio amplifier a two-tube Short-Wave Adapter (S-M Kit No. 731) of remarkable efficiency is available.

The new S-M No. 740 "Coast to Coast" screen-grid a.c. receiver kit has one stage of 222-type screen-grid radio-frequency with 227-type detector; one 222-type screen-grid audio amplifier and 171-type second-stage power tube, providing enormous amplification and permitting complete light socket operation. Two drum dials and unusually large coils permit hair-line tuning and selectivity. The tone quality is of the highest order, by virtue of the new S-M 255 and 256 audio transformers. In conjunction with the S-M 670-ABC power supply and S-M No. 700 cabinet and chassis, a complete a.c.-operated receiver is provided.



*S-M 730 Short-Wave Receiver and Plug-In Coils*

Case Neutrodynes are made in two types, each using standard a.c. filament tubes. The six-tube type has three stages of neutralized tuned r.f. amplification and the seven-tube has four stages. Each is fitted for a '71 tube in the last audio stage. The six-tube set is supplied with a cabinet and the seven-tube with either a spinet console with cone speaker or deluxe console with air column speaker. The entire tuning system is mounted on a rigid aluminum casting. The condensers are shielded and "floated" on the same shaft. The power plant, with its '80 tube, is a separate unit.



*Chassis for Seven-Tube Case Neutrodyne*

## PUBLIC ADDRESS SYSTEM

(Continued from Page 24)

in the overall frequency characteristic as is apparent from the curves of Fig. 2. This is caused by the input capacity of the *A* tube, 50 mmf. or more, moving up or down along different points to the potentiometer. This capacity combines with the transformer leakage reactance to cause a resonant peak at some high frequency. The arrangement shown tends to smooth out the rising characteristic of the transformers shown.

The plate of the second tube works into the next transformer $T_3$ through a special circuit to raise the low frequencies. This circuit consists of a 25,000-ohm shunt resistance $R_6$ for feeding in the plate d.c. supply, and a series condenser $C_3$ used to resonate the primary of the transformer $T_3$ to about 50 cycles. Resonating the primary with this condenser causes a larger voltage to be set up across the secondary of $T_3$ at the resonant frequency. By this means it is possible to put an actual bump in the gain frequency curve which will be higher than at say 1000 cycles. By using a 0.2 mfd. condenser here a bump is put in which tends to make up for the small drop in the other three input transformers, leveling out the frequency characteristic on the low end.

The secondary of the transformer $T_3$ has another equalizer in the form of $R_7$ which puts a droop in the high frequency characteristic. Its action is explained by the following: there is a capacity between the two windings, primary and secondary, which is charged by the induced voltage set up in the secondary. The charging current flows to ground through the resistance $R_7$ causing an emf opposite to that of the secondary induced voltage in its effect on the grid of the tube. At low frequencies the charging current is very small, due to the small capacity, so its effect is negligible, but at high frequencies the current is high so the bucking emf is high. This reduces the hump in the high frequency characteristic of the transformer and if the resistance is large enough, it may actually drop the high frequencies down lower than at say 1000 cycles. This is what has been done by means of $R_7$ in order to make up for the rising characteristics of transformers $T_2$, $T_3$ and $T_4$. There are tricks to all trades, including the equalizing of audio frequency amplifiers.

As can be seen from the curves of Fig. 2, the amplifier is very good up to over 7000 cycles per second, which may be desirable for some purposes but is not when a phonograph is used. In fact, it is doubtful whether it is desirable to go above 5000 cycles in any case, so a "scratch filter" $L_1$ $C_7$ is shown dotted across the output of the third tube. Personally, I use this filter at all times as it reduces some of the microphone hiss or phonograph needle scratch. With a ½ henry choke and a .002 mfd. condenser, it resonates between 5000 and 6000 cycles, cutting this off and in effect all above the resonant frequency. The choke can be 1600 turns of No. 36 wire wound on a small iron core ½ in. cross section. An adjustable air gap in the core should be provided, and for ½ henry value, the gap should be about 1/64 in.

The transformer $T_4$ is a push-pull input type, having a very good frequency characteristic. Its slight ill effects are compensated by the equalizers previously mentioned. The transformer center-tap connects through a resistance to the center of the filaments of the power tubes. The plate current of the two power tubes flows through this resistance $R_8$, giving a negative bias to the grids of the power tubes. The 2 mfd. bypass condenser $C_4$ is connected across $R_8$ in order to prevent this stage from howling if the two tubes are not exactly matched. In practice, for maximum undistorted output, a value of resistance of from 1000 to 1200 ohms for $R_8$ is correct for 310-power tubes. For the type C X 350-power tubes, a 750-ohm resistance should be used. This resistance should be capable of dissipating 10 watts in heat in order to safely carry the required current.

The output of the push-pull tubes is connected through a double choke as shown and through two 4 mfd. condensers to the loud speaker jacks. For most loud speakers, more power in sound can be obtained by means of a series connection when a pair of 310-power tubes are used. A better impedance match will result when two or three, or even four loud speakers are connected in series as the load, than when only one is used. If only one speaker is to be used in the final installation, a push-pull step-down output transformer should be used in place of the double choke and two 4 mfd. condensers.

A short-circuiting switch $S_2$ across the output of the speakers is used in turning the amplifier on or off in order to avoid loud cracks or bats that occur when any changes are made in microphone current, or such adjustments.

Little needs to be said about the power supply. The power transformer having the plate supply winding and two filament windings, is in the same case with the two chokes $L_2$ and $L_3$. One type 381 rectifier tube is used and it supplies the load quite easily without overheating. The condensers $C_5$, $C_6$, $C_9$, $C_{10}$, and $C_{11}$ should be rated for 1000 volts d.c. working voltage, and of approximately the values shown. The condenser $C_8$ and also the other condensers can be of a lower rating, say 500 volts. The values of the resistances $R_9$ were worked out for the combination of tubes used. These resistances should be able to dissipate about 25 watts or so in order to provide a good margin of safety. A set of six 5000-ohm resistances makes a good combination.

In wiring up such a set or system, the filament and plate battery leads should be cabled. All high voltage leads as well as the output leads from the 310 tubes to the loudspeaker jacks should be of heavy rubber-covered wire. No. 14 ground wire is quite satisfactory. The 7½-volt a.c. filament leads to the push-pull tubes should be twisted and kept away from all other leads in order to prevent a.c. induction. With the transformer layout as illustrated, the wiring is quite simple and direct, most of the leads being less than 2 in. in length. The microphone lead from the connecting block to the current measuring jacks, and from the jacks to the input transformer, should be shielded. This can be done most readily by running a pair of No. 18 DCC "bell wires" inside of a copper meshing. This copper meshing or tubing should be grounded to *-A* battery, as should all transformer and condenser cases also.

The output leads from the 310 tubes should be twisted together, and kept several inches away from the preceding amplifiers. For the same reason the plate current jacks should be mounted in the shelf beside the output transformer or choke.

When the system has been completed, a very careful check of the wiring should be made. When the power is turned on, the plate current for each 310 tube should be between 20 and 30 milliamperes. The 112 should draw about 8 to 10, the *A* tubes each about 2½ to 4, and each button of the microphone should not be unbalanced more than 50 per cent. Generally a little tapping or gentle shaking of the "mike" will restore the balance to reasonable values. Incidentally, be sure that the current is turned off from the "mike" before touching it if you want it to last for a long time. These two-button microphones cost from $75 to $150, so it behooves one to be extremely careful in handling it. The "mike" should be suspended on 8 small springs and a flexible three-conductor cord run to the amplifier connecting block. If this microphone lead is over 25 ft. long, it should be shielded, using the latter as the third or common return. In most "mikes" the common return is to the heavy metal casing with the two button connections, one to the "bridge" and the other to the center button on the opposite side. A glance at a "mike" will clear up this matter.

The loudspeakers should not be located near the amplifier or microphone, because of feedback. Unless directional horn type loudspeakers are used, it will be necessary to have the microphone 50 to 150 ft. from the loudspeakers, or what is preferable, in a separate room. This is necessary in order to prevent sound from the loudspeakers coming back into the "mike" and setting up a howling or singing tone. Needless to say that in any installation, the volume control should be set below the beginning of the howling or singing point.

Usually a good ground connection should be made to the *-A* battery lead in order to reduce hum and to stabilize the amplifier. Because of the very high gain of the complete amplifier, it may be desirable to shunt the volume control at the transformer secondary with a 100,000 or 250,000 ohm metalized leak. This depends a good deal on the sensitivity of the microphone which is used. Perhaps it should be emphasized here again than an ordinary telephone transmitter cannot be used because of its poor frequency characteristic.

### LIST OF PARTS FOR PUBLIC ADDRESS SYSTEM

$T_1$—Microphone input transformer 200: 100,000 ohms.
$T_2$ and $T_3$—3:1 ratio audio transformers.
$T_4$—Push-pull input transformer.
$T_5$—Push-pull output choke.
$L_1$—½ henry choke.
$L_2$ and $L_3$—30 henry chokes (in power transformer case).
$C_1$=1 mfd. (500 volt type).
$C_2$=2 mfd. (500 volt type).
$C_3$=0.2 mfd. (500 volt type).
$C_4$=2 mfd. (500 volt type).
$C_5$=4 mfd. (1000 volt type).
$C_6$=4 mfd. (1000 volt type).
$C_7$=.002 mfd. (mica).
$C_8$=6 mfd. (500 volt type).
$C_9$=2 mfd. (1000 volt type).
$C_{10}$=2 mfd. (1000 volt type.)
$C_{11}$=2 mfd. (1000 volt type).
$R_1$=0-200 ohm potentiometer.
$R_2$=0.1 megohm.
$R_3$=.25 megohm.
$R_4$=25000 ohms (heavy duty).
$R_5$=0-500,000 ohm volume control potentiometer.
$R_6$=25000 ohms (heavy duty).
$R_7$=0.1 megohms.
$R_8$=1000 ohms (heavy duty).
$R_9$=20,000 ohms (heavy duty).
$R_{10}$=10000 ohms (heavy duty).
S-S=Straps between binding posts.

## VOLUME CONTROL

(Continued from Page 26)

frequency choke. If the resistance is connected between antenna and ground, volume control may be obtained very nicely by connecting the grid of the first tube to a slider on this resistance, thus using more or less of the voltage drop along this resistance as the input voltage to the tube. For smooth control, the resistance should not be greater than about 2000 ohms. An ordinary 2000 ohm potentiometer can be used here very satisfactorily.

Summarizing, then, we see that filament, plate, and grid voltages should be left at their rated values in the detector and audio frequency amplifier circuits to avoid distortion. The control should be ahead of the detector, so that distortion will not be introduced through overloading a tube handling audio-frequency currents. The control should not affect the damping of the radio-frequency tuned circuits.

## NEMA ANNUAL MEETING

(Continued from Page 72)

poration, and chairman of the NEMA committee on section activities.

On this chart, there are ten cylinders. The bottom cylinders show the area and the population of the five zones created by the Radio Act of 1927. The diameter of the cylinders is proportional to the area of the zones, while the height of these cylinders is proportional to the population.

Note that the first four zones are closely alike in population but that the fifth zone is much lower than any of the other four. The areas of the zones differ greatly. For instance, the fifth zone is *thirteen* times the area of the first zone. The upper cylinders show the number and total power of the broadcasting stations assigned to each zone. The diameter is the number of stations and the height is the total power.

The results of balloting for officers gave to Louis B. F. Raycroft of the Electric Storage Battery Company the vice-presidency and leadership of the radio group for another year. This is Mr. Raycroft's third term in office. In the division dealing with trade and merchandising problems, George A. Scoville was re-elected chairman of the Merchandising Council, and H. Curtis Abbott was chosen vice chairman. Mr. Scoville is with the Stromberg-Carlson Company, and Mr. Abbott is general sales manager of the Crosley Radio Corporation.

In the important technical committee sections, L. W. Chubb of the Westinghouse Company was chosen chairman of the radio receiver section; George Lewis, Arcturus Radio Company, head of the vacuum tube section; H. L. Olesen, Fansteel Products Company, head of the power supply section, and Julius Weinberger, Radio Corporation of America, head of the radio transmitter section.

The merchandising and technical sections of the NEMA meet twice annually to settle upon standard radio technical and commercial practices. The technical section has published the only commercial radio manufacturing and engineering standards now in existence in the United States. The member radio manufacturers of NEMA make more than 80 per cent of all the radio receivers sold in the United States annually.

At the June Chicago meeting of NEMA, the important radio market analysis "The Radio Market" was issued, the first accurate study of radio market statistics ever made. It is already in use by most of the radio manufacturers and distributors and advertising men in the industry and has been hailed as one of the most important contributions to the merchandising and advertising of radio products ever made.

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The Raytheon BA rectifier tube is of ionized helium type and is designed to supply *A*, *B* and *C* voltages for a complete radio set. It has an output rating of 350 m.a. at 210 volts and has regulating characteristics which tend to compensate for variations in load current. It is designed for a maximum input voltage of 350 R. M. S. per anode. It has standard tube-base anode connections to the usual filament prongs. Cathode connection is to the usual plate prong.

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The Muter a.c. power unit utilizes an '80 rectifier tube to supply 40 m.a. at 220 volts from a 110-volt a.c. source. It also supplies 1.5, 2.5 and 5 volts for filament current from a step-down transformer. It is equipped with five positive *B* leads for 45, 67, 90, 135 and 180 volts. Similar units supplying 30 m.a. at 180 volts or 40 m.a. at 220 volts are also made for use with either Raytheon or '80 tube rectifiers, but without transformer for filament supply.

## STATION KFYS

United Fruit Steamer, "La Perla."

*By Its Operators*

The shack on the *La Perla* is laid out about amidships on the boat deck, with a large battery room on the port side, operating room in the middle and operators' quarters on the starboard with doors opening out to either side of the boat deck.

The transmitting equipment consists of an R. C. A. ET 3626 750 watter with QSYs covering everything between 600 and 2500 meters. It is panel mounted and the set itself is in the battery room. A ½ kw wireless specialty QS-500 spark completes the transmitters. These outfits are probably the best sets of their size manufactured. They, also, are panel mounted and very compact, taking up only a space of approximately 2 by 6 ft. We average 9 amps radiation on 600 with this baby outfit, which has every other ½ kw outfit I've ever seen beaten to a frazzle, as the majority of them are lucky if they put out 6 amps.

The receiver is also W. S. apparatus, consisting of receiver and two stage amplifier unit. It resembles the old SE type Navy Standard with a few improvements.

The emergency equipment consists of 100 Edison cells stacked neatly away in a rack in the corner of the battery room; the charging panel being mounted between the tube transmitter and the spark. This panel is as high as the shack walls and divided into two portions, the upper half having switches controlling the emergency lighting circuits while the bottom half's switches control the ship's juice to the shack and regulating rheostats for charge and discharge of battery unit, 220 volts d.c. being used for charging.

The whole layout is handy, as almost everything can be controlled from a seated position. The table is at the forward end of the operating room and stretches from wall to wall. On the extreme right is the starter control of the tube set which consists of start and stop buttons, rheostat for adjustment of filament voltage, and filament voltmeter. Next is the receiver with a spacing of about six inches between it and the amplifier unit, a small hand key for use on the spark outfit being placed between the two units. Following the amplifier unit come the rest of the keys; a straight one for the tube, and a cootie and bug with connections for use on either spark or tube. The file is in the extreme right-hand corner of the table with the horn, and a small desk is attached to the table on the right which accommodates the mill. Table lamps are in use over the receiver and mill. A desk for the filing of passenger traffic and a settee complete the furniture. The entire shack is laid out in white enamel with mahogany trimming and furniture.

Two ops hold down the job, maintaining a continuous watch, and most of the traffic is handled on schedule with our own stations, working Castilla, Honduras (UA), and Cartago, C. R. (UR), daytimes, on 1800 and 2400 meters; and Miami, Fla. (WAX), and New Orleans (WNU), on 750 meters at night. We are practically QSO with these during the entire voyage from KPH to Puerto Limon, Costa Rica. We also have hourly schedules with T.R.T. ships on 750 meters, but these are not so good along the northern part of the run, as considerable QRM is experienced around that wave. However, this doesn't mean a lot with the bunch of QSYs that practically all T.R.T. ships can cover. With local business KPH can usually be carried about 1000 to 1200 miles south on long waves daytimes, so the files are usually kept pretty clean. Guess that's about all, so shall close with an invitation to any of the gang to come down and look us over.

## QUESTIONNAIRE FOR RADIO ENGINEERS

(Continued from Page 28)

ameter of the grid wires. The distance between grid and plate also has an effect, but not as much as the plate to filament. If the plate load impedance is equal to the plate impedance, the maximum transfer of energy will take place, and as the load impedance becomes less, the energy transfer becomes proportionately smaller. In r.f. amplifiers, the load impedance is usually much smaller so as to permit the proper degree of selectivity being attained, since with a very high plate impedance and high load impedance, the selectivity would probably be poor.

**10. Upon what does the voltage amplification factor of a three-element tube depend, and where does this factor appear in the equation for the amplification in an audio frequency amplifier?**

Depends on the number and spacing of the grid wires, their position with respect to the filament and plate, and is known as the amplification constant, represented by the Greek letter Mu ($\mu$). This factor appears in the formula for the mutual conductance of a tube where $G_m=\mu/R_p$, $R_p$ being the plate resistance. When defining the voltage amplification of a tube, it is usually expressed as Mu times the input voltage, and when a transformer is also to be figured in the result, its turns ratio is multiplied by the amplification factor of the tube, to get the total amplification per stage.

**11. What factors internal and external to the vacuum tube affect its input impedance?**

The inter-electrode capacity and the load in the plate circuit are the chief factors.

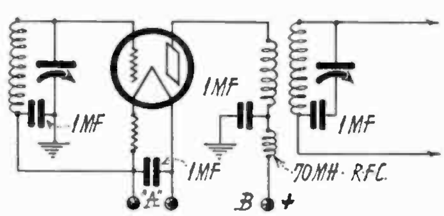


*Fig. 5*

**12. In Fig. 5, is shown one stage of a "broadcast band" amplifier. Discuss the circuit with respect to the technical features, keeping in mind the problem of cost reduction.**

The 1 mfd. bypass condensers shown in the diagram are all unnecessarily high in capacity. Economical design consistent with satisfactory operation would call for the elimination of all these condensers, and the substitution of a condenser of not more than .1 mfd., between the plate side of the r.f. choke and ground. It is quite probable that a condenser of .006 mfd. would do at this point. The condenser in series with the tuning condenser is superfluous. Admitting that the filament circuit is not grounded, as shown in the diagram, it would be better to ground the filament, and save the cost of the condenser. The r.f. choke in the plate circuit is larger than need be, and in most factory built sets is omitted, unless it is part of an impedance coupled scheme.

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An "electric set," according to the R. M. A. standard nomenclature, is a radio receiver operating from the electric light line, without using batteries. If it employs tubes which obtain filament or heater current from an a.c. line without the use of rectifying devices, but with built-in tube rectifier for plate and grid voltages, it is an "a.c. tube electric set." If it uses current supplied by a d.c. line it is a "d.c. tube electric set." If it is designed to be operated from batteries it is a "battery-operated set." If the latter is connected from a power unit operating from the electric light line and supplying filament and plate potentials to the tubes, it is a "socket-powered set."

## RADIOADS

### A CLASSIFIED ADVERTISING SECTION READ BY BETTER BUYERS

The rate per word is eight cents net. Remittance must accompany all advertisements. Include name and address when counting words.

**Ads for the August Issue Must Reach Us by July Fifth**

NAVY BARGAINS: 50,000 volt Leadin insulators, new $4.50 each, cost $30.00. 18-inch aerial insulators, new, $1.25 each; new Leyden jars, .002 Mfd., 12,500 volts, Pyrex Glass, $1.50 each; Motor-generators and generators, 500 cycles, 900 cycles and D.C. Attractive prices, all sizes up to 5 K.W. New Navy Ship Transmitting sets, tube and spark. Lot used 3 phase A.C. motors from 30 to 450 H.P. Write. Tell what you want, can get anything. Commercial or Navy radio. D. B. McGOWN, 1247 Forty-seventh Ave., San Francisco, Calif.

SUPERHETERODYNE (1927 model Best) neatly built to specifications; black crystalline aluminum panel; "Radio" Laboratory matched parts; new tubes; without audio stages. $95, or in attractive walnut finish console $120. With audio, filter, add $20. Priced less than wholesale for quick sale. Particulars: Harold Reavis, 1373 Laveta Terrace, Los Angeles, Calif.

SELL: Magnavox Dynamic. Kolster Six. Citizen's Super Nine. Radiola's Eighteen and Twenty. Radiola hundred A Loudspeaker. Radiola 26 Portable Superheterodyne. Ithaca Trap Gun. Century Camera. BRACKENRIDGE, HARRISON, OHIO.

SET BUILDER SELLING OUT offers All Electric Super, Western Electric Intermediates, all electric screen grid 4. Many parts, sets, kits, meters. Sell at half regular prices. H. A. Newby, San Rafael, Calif.

GENUINE WESTERN ELECTRIC VT1 TUBES $1.00; DeForest 201A tubes, $1.00; General Electric G-10 standard base Neon lamps, as described in May QST, "Amateur Television." Sent C.O.D. Wm. Wagner, 819 DeKalb Ave., Brooklyn, N. Y. C.

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MAKE MONEY WITH PATENTS! We offer patents with money-making possibilities; circular free. Floyd Clymer, Denver, Colo. (3T)

YOUR RADIO TROUBLES are over with Hoff's Radio Trouble Finder, Log and Station Book, also Dictionary, illustrated. Write for circular. John McQuade, 129 North Port St., Baltimore, Md. Desk 2. (7T)

WANTED—Two Complete Files of "RADIO" for 1927. Must be in perfect condition. Write, stating price. Box 400, "RADIO," Pacific Bldg., San Francisco.

# I Will Train You at Home to Fill a Big-Pay Radio Job

If you are earning a penny less than $50 a week, send for my book of information on the opportunities in Radio. Its FREE. Clip the coupon NOW. A flood of gold is pouring into this new business, creating hundreds of big pay jobs. Why go along at $25, $30 or $45 a week when the good jobs in Radio pay $50, $75 and up to $250 a week. My book "Rich Rewards in Radio" gives full information on these big jobs and explains how you can quickly become a Radio Expert through my easy, practical home-study training.

### Salaries of $50 to $250 a week not unusual

Get into this live-wire profession of quick success. Radio needs trained men. The amazing growth of the Radio business has astounded the world. In a few short years three hundred thousand jobs have been created. And the biggest growth of Radio is still to come. That's why salaries of 50 to $250 a week are not unusual. Radio simply hasn't got nearly the number of thoroughly trained men it needs. Study Radio and after only a short time land yourself a REAL job with a REAL future.

### You Can Learn Quickly and Easily in Spare Time

Hundreds of N.R.I. trained men are today making big money —holding down big jobs—in the Radio field. Men just like you —their only advantage is training. You, too, can become a Radio Expert just as they did by our new practical methods. Our tested, clear training makes it easy for you to learn. You can stay home, hold your job, and learn quickly in your spare time. Lack of education or experience is no drawback. You can read and write. That's enough.

### Many Earn $15, $20, $30 Weekly on the Side While Learning

My Radio course is the famous course "that pays for itself." I teach you to begin making money almost the day you enroll.

My new practical method makes this possible. I give you SIX BIG OUTFITS of Radio parts with my course. You are taught to build practically every type of receiving set known. M. E. Sullivan, 412 73rd Street, Brooklyn, N. Y., writes: "I made $720 while studying." Earle Cummings, 18 Webster Street, Haverhill, Mass., "I made $375 in one month." G. W. Page, 1807 21st Ave., Nashville, Tenn., "I picked up $935 in my spare time while studying."

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I'll give you just the training you need to get into the Radio business. My course fits you for all lines—manufacturing, selling, servicing sets, in business for yourself, operating on board ship or in a broadcasting station—and many others. I back up my training with a signed agreement to refund every penny of your money if, after completion, you are not satisfied with the course I give you.

### ACT NOW—64-page Book is FREE

Send for this big book of Radio information. It won't cost you a penny. It has put hundreds of fellows on the road to bigger pay and success. Get it. Investigate. See what Radio has to offer you, and how my Employment Department helps you get into Radio after you graduate. Clip or tear out the coupon and mail it RIGHT NOW.

J. E. SMITH, President,
Dept. 6-R,
National Radio Institute
Washington, D. C.

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**Made $588 in One Month**

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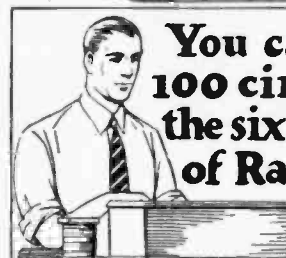

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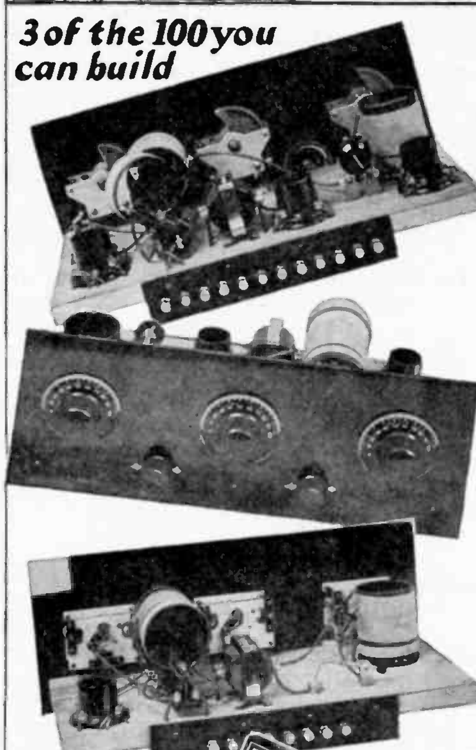

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