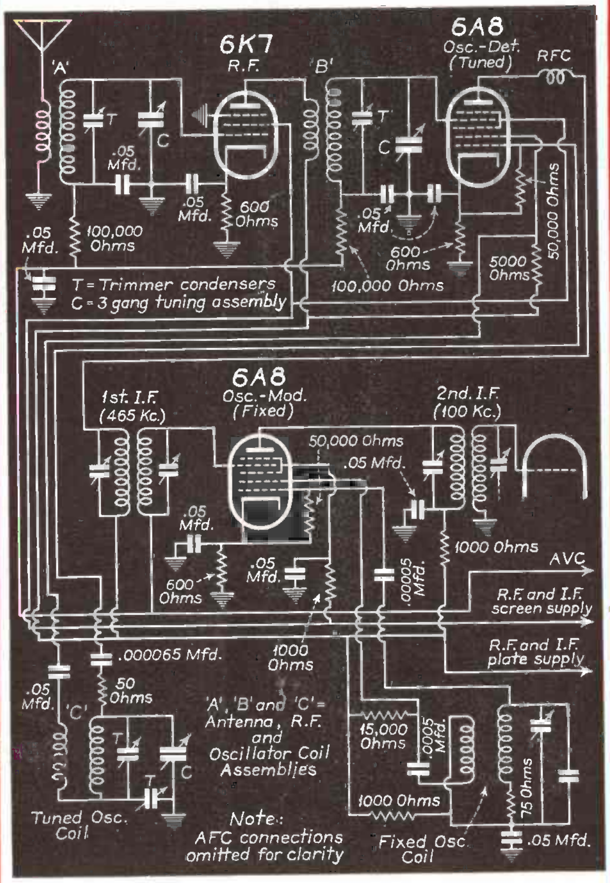
SERVICE

A MONTHLY DIGEST OF RADIO AND ALLIED MAINTENANCE



Double Superheterodyne

(See Page 11)

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JANUARY
1937

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SERVICE

A Monthly Digest of Radio and Allied Maintenance

Reg. U. S. Patent Office. Member, Audit Bureau of Circulations

EDITOR

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THE ANTENNA . . .

NEW SET SALES

THAT THE SERVICE MAN has the opportunity to exert considerable influence on the purchaser of a new receiver, especially when that receiver is used to replace an old set, can not be denied. In many cases the set owner decides to buy because he has just been given a large estimate for repairs to the old set. "Why spend $12.50 to repair that piece of junk when for a few dollars more I can get a new all-wave job?" is a theme we hear continuously. As we have said before, the wideawake Service Man will not lose by this procedure. Estimates should *not* be lowered but rather increased to encourage the purchase of the new set.

Those Service Men who sell receivers will readily agree with us, since their profit on the new set sale will more than offset that lost in service work during the course of the year—and here is a profitable customer for service for the next year (if he is treated O.K. during the guarantee period).

We believe that the other Service Men can readily afford to encourage the purchase of a new set and earn ten or fifteen dollars in commission through a suitable setup with a friendly local dealer. This neat commission should prove easier to earn than the hoped for profits on one or more troublesome jobs servicing an obsolete and fast dying receiver.

• • •

PUBLIC ADDRESS

WE HAVE, IN THESE columns, from time to time stressed the importance of the public-address field and the Service Man's place in that field. We have pointed out that the use of sound amplification is no longer classed as a novelty—it is taking its place among the necessities of life like the automobile and the radio.

Estimates of the p-a business for the coming year show an expected increase of 100 percent over last year. You should get your share of that business. Make it known that you are able to handle p-a installations. Look up prospects.

Many doors were closed for p-a sales because prospects have heard only the poor efforts of earlier outfits. Some even have these relics gathering dust on their shelves. It is up to you to keep your equipment up-to-date—give demonstrations—open these doors once again for added p-a profits. With the increasing improvements in microphones, phonograph pickups, speakers, tubes and other sound equipment few can complain of unsatisfactory reproduction.

Public-address equipment can be used for purposes too numerous to mention. Almost in any type of business it can increase efficiency as a call system. Amplifiers are gradually taking an outstanding place in funeral parlors for playing records during services. On trucks, in stadiums, in lecture halls, in churches and in the theater the p-a system is indispensible. To the Service Man all this spells profits.

• • •

TELEVISION

NOW AND AGAIN IN the daily and Sunday newspapers and in the newsstand magazines, the coming of television is heralded. More conservative magazines have not only refused to announce television's approach but have used considerable space in denying that approach. Up to now SERVICE has merely reported on events in this most interesting field. Until the time that television becomes a Service Man's problem we will do little more.

• • •

RISING PRICES AND THE SERVICE MAN

WE HEAR FROM THE tube manufacturers that tube prices have been increased some 11 percent more or less. This is along the line of predictions in the forecast published in the December issue of SERVICE. If the predictions hold these increases are only the forerunners of general price rises on all parts and accessories.

Although the general rise in tube prices was only 11 percent the average increase among the ten types (80, 24A, 27, 45, 35, 47, 71A, 26, 01A and 112A) which enjoy the most volume in replacement sales is over 20 percent. This means an actual increase of over $3,500,000 in gross profit to dealers and Service Men in the sale of replacement tubes during 1937.

Service Men, for this reason, should welcome these justified price increases in tubes and other replacement components.


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SERVICE

A Monthly Digest of Radio and Allied Maintenance

FOR JANUARY, 1937

MASTER ANTENNA SYSTEMS*

DIRECTLY and indirectly, the enterprising Service Man must be interested in the master antenna system. Directly, it means a new and profitable source of income and the contact with many potential customers. Indirectly, it provides the necessary signal pickup and noise suppression for the satisfactory operation of sets which he installs and services.

It's a logical development. Just as more electric outlets are called for these days to take care of more lamps and appliances, so more antenna facilities and radio outlets are required today to operate the several sets in a better type household, let alone the requirements of the apartment house building. Also, there are hospitals, hotels, club buildings and other institutions as prospects. And no saturation point is ever likely to be in sight.

Easy to Sell

Any large or small apartment house or public building in which a plurality of radio sets are to be operated without their owners coming to blows, is ripe for a master antenna system. In the case of the apartment house owner, the main sales argument is reduced maintenance costs. The roof happens to be a real sore spot. Available figures indicate that 9 per cent of total maintenance costs goes for roof repairs and upkeep. Take away that jungle of poles and wires and insulators and roof maintenance costs take a nose dive. There is no longer reason for tenants trooping over the roof, straining standpipes, fumbling with flashings and otherwise causing damage. But tenants will insist on good radio reception. And that is where a master antenna system comes in, with its trim, neat, permanent steel masts, its simple aerials and its inconspicuous downleads connecting with outlets throughout the building.

Local ordinances are also coming to the rescue in making sales. Some municipalities have already passed and are enforcing stringent laws regarding those radio jungles. Fire authorities are frowning on wire mazes that may cause loss of life and limb to firemen working on the roofs. Insurance companies are none too fond of the general mess. All these factors help create a market for master antenna systems.

In a nutshell, the apartment house owner or management is sold first on the idea of saving money by reduced maintenance costs, second on the idea of coaxing in new tenants and keeping old ones satisfied. The investment is trivial especially when compared with the advantages. Also, the many installations already in use will help sell more. It's the old game of "follow the leader." One radio-wired house in a locality sets the pace for others.

The home-builder can be sold on the idea of convenience at an insignificant increase in total building costs. Even the standing house can be radio-wired for very little, greatly adding to its comfort and resale value.

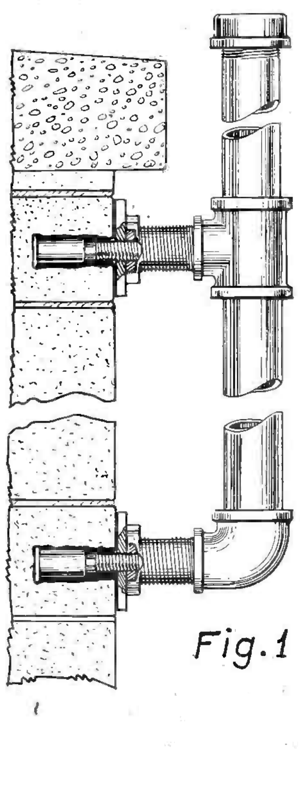


Fig. 1

The Preliminary Survey

The prospect naturally wants to know "how much?". That information must be based on a preliminary survey.

In the case of an apartment house the building is checked for floor plans; locations of radio outlets; available super-structures that can serve as supports; required masts; stringing the aerial wires; running of transmission lines along walls or through walls, and other essential details.

For estimating purposes and layout of an installation the starting point is the determination of the number and the location of the radio outlets. In the usual apartment house the living-room is the customary place for the outlet. With the help of a floor plan, it is easy to locate the most convenient placement of the transmission line or downlead. This line in turn determines the direction and arrangement of the aerials. Full advantage is taken of super-structures such as water tanks, elevator-shaft houses, penthouses, and so on, that can be pressed into service as supports for the aerial wires swung high above these bases, as clear of the building as possible. Elsewhere, masts must be employed for supports.

Fortunately, there is a cold mathematical basis for arriving at an estimate. Guesswork is reduced to a minimum. Standardized components and materials are available at set list prices and trade discounts. Labor costs are readily figured because of the comparative simplicity of the installation work.

The System At A Glance

The master antenna system consists of the aerial proper with its necessary supports; the transmission line or downlead, and the required number of outlets. That's all there is to it.

More detailed, the aerial foundation kit consists of two lengths of aerial wire

* The material for this article was supplied by the engineering department of the Technical Appliance Corp.

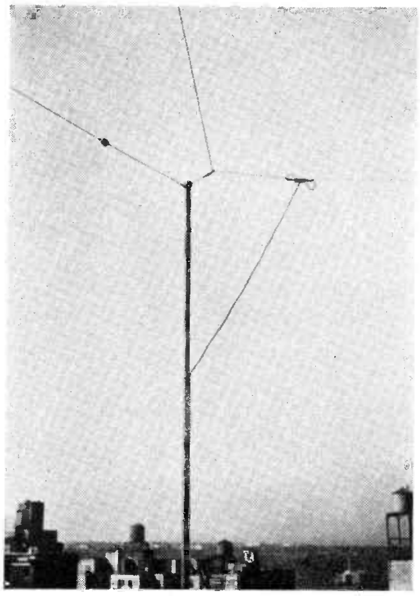


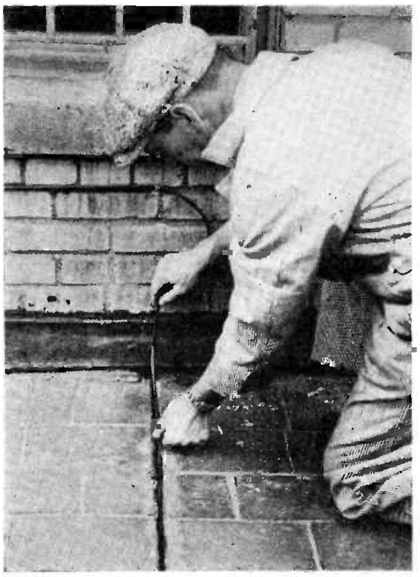
Fig. 2. Typical iron-pipe mast for master antenna system.

for a di-pole or doublet antenna; a transfer unit and any length of twisted-pair cable for the transmission line; the necessary heavy-duty insulators and the strain insulators.

The recommended masts are 1½-inch galvanized iron pipe, capped at top for protection against weather. The mast is supported by an elbow at the bottom, and by a tee reamed out to receive the pipe. The suggested arrangement is shown in Fig. 1. The necessary pipe and fittings may be obtained from a local plumbers' supply house, eliminating most of the guesswork of arriving at a cost. A couple of hours should suffice to erect and anchor a mast.

With the aerial strung up and supported, the twisted-pair transmission line is led to the lightning arrestor conveniently located on a parapet or side wall. The ground connection is made to the roof flashing or to a standpipe known to be properly grounded.

Fig. 5. The wire is being laid in a groove cut out of the tiled roofing. It should be covered up with pitch, effectively sealing it in place.



The transmisison line then continues over the parapet or cornice and down the side wall in the case of exposed wiring, which is generally followed particularly in existing buildings.

Permanency the Keynote

Every precaution must be taken to make the job permanent and maintenance free. The sloppy workmanship that distinguishes many ordinary aerial installations simply won't do when it comes to the master antenna system. Any Service Man who is not a good mechanic may as well forget this master antenna proposition here and now unless he intends to reform his ways.

Thus iron pipe masts, as already explained, take the place of flimsy and bent wooden poles, the use of which is discouraged on most city buildings if not actually prohibited by building code. The twisted-pair transmission line is carefully protected from wear and tear where it touches the roofing or masonry. In crossing over the parapet wall, for instance, the transmission line is covered with copper tubing for protection. Better still, it is passed through a slot or cleared out joint which can be filled with pitch or caulking compound. In passing over a penthouse terrace the cable (with additional protection covering), is buried in an expansion joint and sealed with pitch.

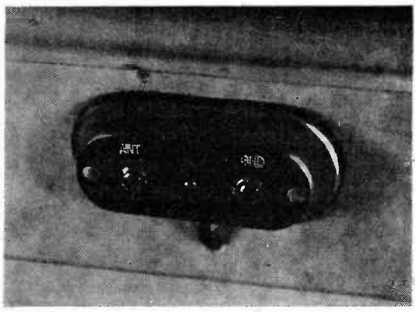


Fig. 4. Exposed type outlet unit mounted on window sill.

The transmission line along side walls is firmly anchored by knobs or other means. Available in black or neutral to blend into the wall color scheme, the transmission line is quite inconspicuous.

At the point closest to a coupler or outlet, the transmission cable is bared. The coupler leads are passed through a hole in the window frame and soldered to their respective transmission line conductors, outside the wall of the building. The joints are taped and varnished to prevent corrosion. The coupler or outlet of the exposed-wiring type is mounted on the inside window frame or on a baseboard. It provides two binding posts marked "Ant" and "Gnd" for set connections.

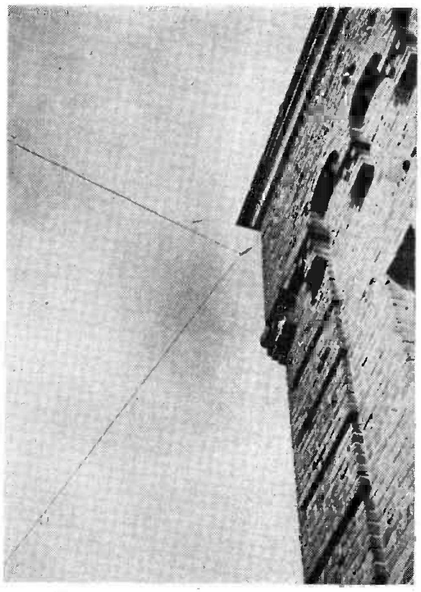


Fig. 3. Best aerial is in the clear.

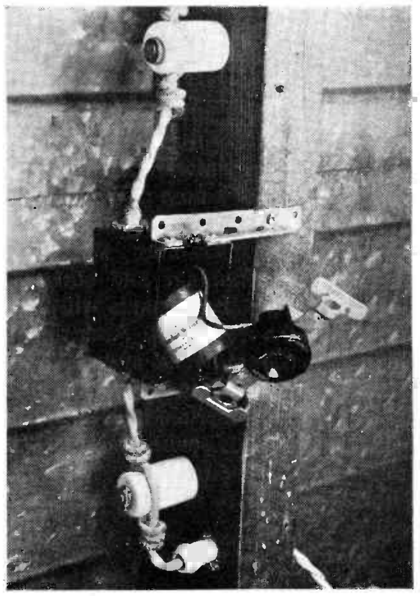
Test As You Go

By means of an ordinary midget receiver of average sensitivity and selectivity, each coupler or outlet is tested for reception as connections are completed. If each coupler tests O.K. as installed, the entire installation will test O.K. when completed: Thus there is no time lost trying to run down bugs which would be troublesome in the completed job.

The Concealed Wiring Job

So far we have dealt with the exposed-wiring job, which isn't much more than any all-wave noiseless antenna system installation. With a con-

Fig. 6. Single radio outlet box, showing coupler unit. This is the knob and tube kind of wiring for private dwellings shown on incomplete wall.



cealed wiring job the roof end remains exactly the same as for the exposed-wiring job. The transmission cable passes from the aerial and lightning arrestor to a conduit tube leading into the building. The transmission cable may be passed through conduit or BX, or even strung on knobs and passed through tubes between walls. After all, there isn't any current or voltage involved, so that the wiring is not hazardous in the slightest degree. But then the underwriters and local inspectors may be leary of such free and easy wiring and may insist on the usual conduit or BX variety.

In place of the exposed type outlet, the concealed job makes use of standard outlet boxes to take the outlet coupler. In some jobs the outlet is for radio alone. A regular gem box serves to hold the small coupler coil whose red and black leads go to the transmission line, while other leads connect with "Ant" and "Gnd" of the receptacle binding posts or pinjacks. In other jobs where the power outlet is to be combined with radio, the coupler coil fits on one side and is separated from the power receptacle by a simple metal shield. A 4-inch (square) box does nicely for a combined outlet.

For The Private Residence

When it comes to private homes, the story is much the same, except simpler and easier to sell and do. The aerial is either of the outdoor kind, swung between roof and a tree or other building in the shape of a double V to obtain sufficient length in limited space. The transmission line is run down between partition walls and suitably held by knobs and tubes. In the new building this wiring may be done when the studding is still exposed. But even in the existing building, the wiring may be readily snaked about.

Outlets, either of the exposed or outlet box type, can be installed wherever a radio program may entertain or enlighten the household.

Profit for Service Man

Once again the Service Man steps in as the logical salesman. The master antenna system can be recommended and talked up in many quarters. A nice profit awaits him on the completed installation.

There's money in that master antenna system idea. And it takes less effort to get some of that money than is the case with sets and repairs and other phases of the servicing game. So the Service Man may as well climb on the bandwagon now.

DOUBLE SUPERHETERODYNE

(See Front Cover)

THE circuit diagram shown on the front cover gives the essential circuit of a typical double superheterodyne. The parts values given are those in the Westinghouse model WR-315 12-tube receiver.

The Circuit

In the all-wave, double superheterodyne, with an r-f stage, the incoming signal is fed to an r-f coil and tuning condenser through a suitable band-switching arrangement. Here the signal is pre-tuned and fed to the grid of an r-f amplifier, a 6K7 in the circuit shown on the cover. The amplified signal from the plate of the r-f tube is fed (through the band switch) to a second r-f coil and tuning condenser which tunes it further and passes it on to the grid of an oscillator-detector stage which mixes it with a locally-generated signal 465 kc above it in frequency. The tuned, local signal is generated in the oscillator section of this tube (a 6A8 in the circuit shown) and its frequency difference is maintained through tuning the respective oscillator coils with one section of the main tuning condenser and its associated network of padders and trimmers. The resulting signal on the plate of the oscillator-detector (if the receiver is properly aligned and tuned) is always 465 kc regardless of the frequency of the station to which the receiver is tuned.

In the double superheterodyne, as in the conventional superheterodyne, this 465-kc signal is fed to a tuned i-f transformer the secondary of which is coupled to the grid of the succeeding stage. The 8-mh choke between the first modulator and the primary of the first i-f transformer is for the purpose of attenuating the variable oscillator frequencies. If these are passed to the grid of the second modulator, a series of tweets will be heard; these tweets are produced whenever the variable oscillator frequency differs by about 100 kc (the second i-f) from a harmonic of the fixed oscillator. At the grid of this succeeding stage the double superheterodyne differs materially from the conventional superheterodyne. In the conventional super the grid in question is that of the usual i-f amplifier—in the double superheterodyne this tube is an oscillator-modulator which mixes the 465-kc i-f signal with a locally generated "fixed" frequency signal of 365 kc to produce on the plate of this tube (another 6A8 in the circuit shown) the second intermediate frequency of 100 kc. The local 365-kc signal is generated in the oscillator section of this oscillator-modulator tube. The 100-kc signal obtained from the oscillator-modulator plate is further amplified by one or two tuned i-f stages.

Careful Shielding Essential

The "fixed" oscillator stage, with its coils, condensers, resistors and associated wiring, must be carefully shielded and isolated to prevent its signal, or the harmonics of its signal, from straying to the r-f circuits of the receiver. Pick-up of these signals would cause tweets at the respective points on the dial (365 kc, 730 kc, 1095 kc, etc.).

The automatic frequency control tube (not shown in the diagram) is connected across the "fixed" frequency oscillator stage. The afc circuits are similar to those described in previous issues of SERVICE.

Advantage of Double Superheterodyne

The chief advantage of the double superheterodyne lies in that it provides a "fixed" frequency oscillator upon which the automatic frequency control may be applied. Since the afc can be applied apart from the tuning circuits of the receiver its use can be obtained without affecting the frequency coverage of any tuning range of the receiver. Uniform control action can be more easily obtained on every frequency range of the receiver.

It is thus possible to tune from a strong local signal to a weak distant signal on the adjacent channel with the afc switch in its on position. If two strong signals are 20-kc apart, a blank interval will appear between them when tuning from one to the other, in the absence of a signal on the channel be-

(Continued on page 43)

A CATHODE-RAY OSCILLOGRAPH

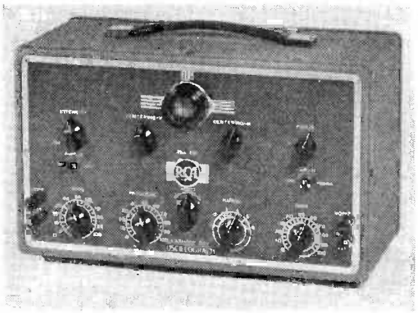


Fig. 1. The RCA model 151 cathode-ray oscillograph in its portable carrying case. Front view showing calibrated screen and controls.

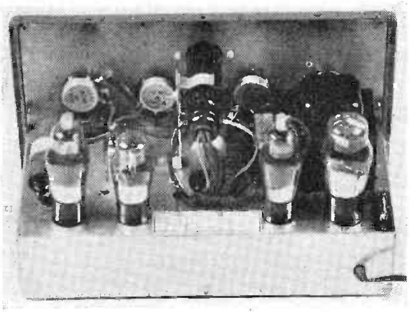


Fig. 2. The rear of the RCA model 151 cathode-ray oscillograph with the case removed, showing positions of parts and tubes.

ALTHOUGH some 18 to 20 per-cent of the full-time Service Men have already purchased cathode-ray equipment, the devices have, in the past, been essentially laboratory equipment. However, with the advent of the type 913 cathode-ray tube the oscillograph become a typical service tool.

The 913 Tube

The heart of the new oscillograph, shown in Figs. 1 and 2, is the 913 high-vacuum cathode-ray tube which utilizes the all-metal construction and has a viewing screen approximately one inch in diameter.

The electron source of the 913 is a substantial cathode indirectly heated. The cathode, control electrode (grid) and focusing electrode which functions also as an accelerating electrode, constitute an electron gun for projecting a beam of electrons upon the fluorescent screen. The resulting luminous spot, easily visible in a well-lighted room, can be regulated as to size and intensity by suitable choice of electrode voltages.

The two interconnected sets of electrostatic plates in the 913 produce fields at right angles to each other, and consequently deflections at right angles. One set serves to reproduce the phenomena under observation; the other is used for the time sweep.

Because of its small size and its ability to produce a bright image at low voltages, the 913 is suited for compact, portable oscillographic equipment. These features, in addition to the relatively low cost of the 913 and its asociated apparatus, make this tube practicable for use in many types of test equipment where a larger cathode-ray tube would not ordinarily be employed.

The base pins of the 913 fit the universal eight-contact octal socket, which may be installed to hold the tube in any position. The metal shell is connected to anode No. 2 within the tube.

The heater is designed to operate at 6.3 volts. The cathode is connected within the tube to one side of the heater.

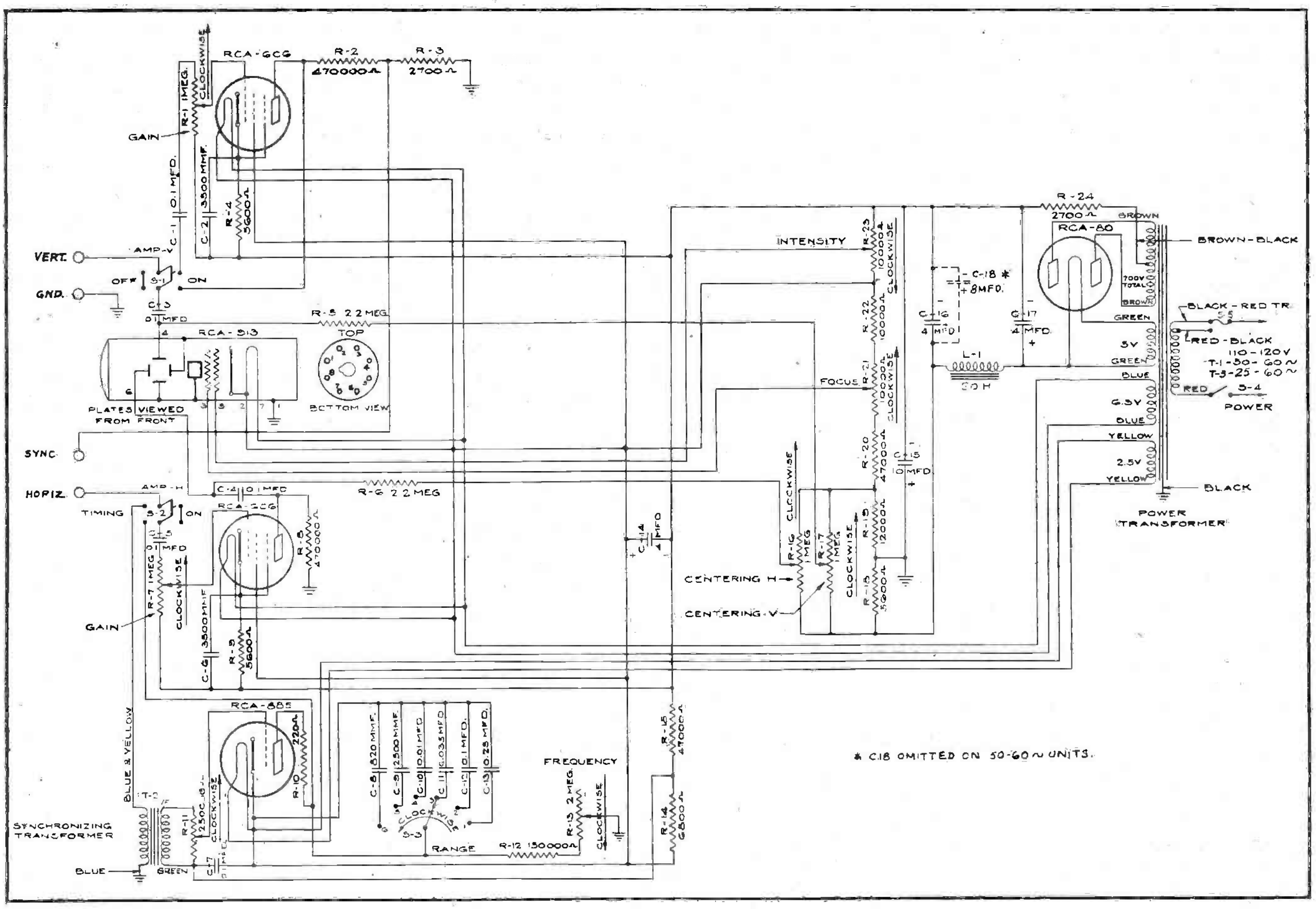


Fig. 3. The RCA model 151 cathode-ray oscillograph circuit diagram.

FOR THE SERVICE MAN

Fig. 4. The RCA model 150 test oscillator in its portable carrying case. Front view showing dial and panel arrangement.

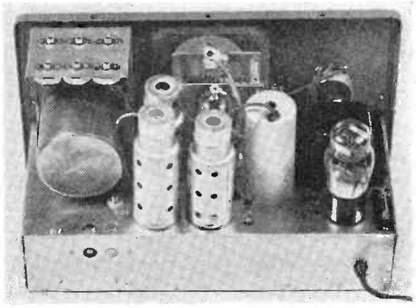


Fig. 5. The rear of the RCA model 150 test oscillator, showing positions of parts and tubes.

The terminal for this common connection is base pin No. 2 to which the grid and anode returns are made.

The fluorescent screen employed in the 913 is of the phosphor No. 1 (medium persistence) type. It has good visual properties as well as high luminous efficiency.

The d-c supply voltages are conveniently obtained from a vacuum-tube rectifier. Since the cathode-ray tube requires very little current the filter requirements are simple. A 4- or 8-mfd condenser provides sufficient filtering.

Two sets of electrostatic plates, producing fields at right angles, provide for deflection of the electron beam. One deflecting plate of one set is connected within the tube to one plate of the other set, to anode No. 2 and to the shell.

The Cathode-Ray Oscillograph

The cathode-ray oscillograph is an instrument adaptable to a wide variety of applications. A few of the more important are: the study of wave shapes; measurement of modulation and peak voltages; adjustment of and location of faults in radio receivers and a-f amplifiers; comparison of frequencies; the indication of balance in bridge circuits, and visual alignment. Due to the relatively low cost of the 913 and its associated apparatus, to the low voltages at which it can be operated and to the small size and portability of equipment in which it is employed, this tube should find very general use by Service Men.

A circuit diagram of the RCA cathode-ray oscilloscope, designed around the 913 tube, is shown in Fig. 3. The electrode voltages are obtained from the rectifier with its associated filter and bleeder circuit. A small value of bleeder current is essential and makes the simple filter adequate. A variable voltage for the control electrode and for anode No. 1 is obtained from potentiometers in the bleeder circuit.

The Deflecting Plates

One set of deflecting plates is used

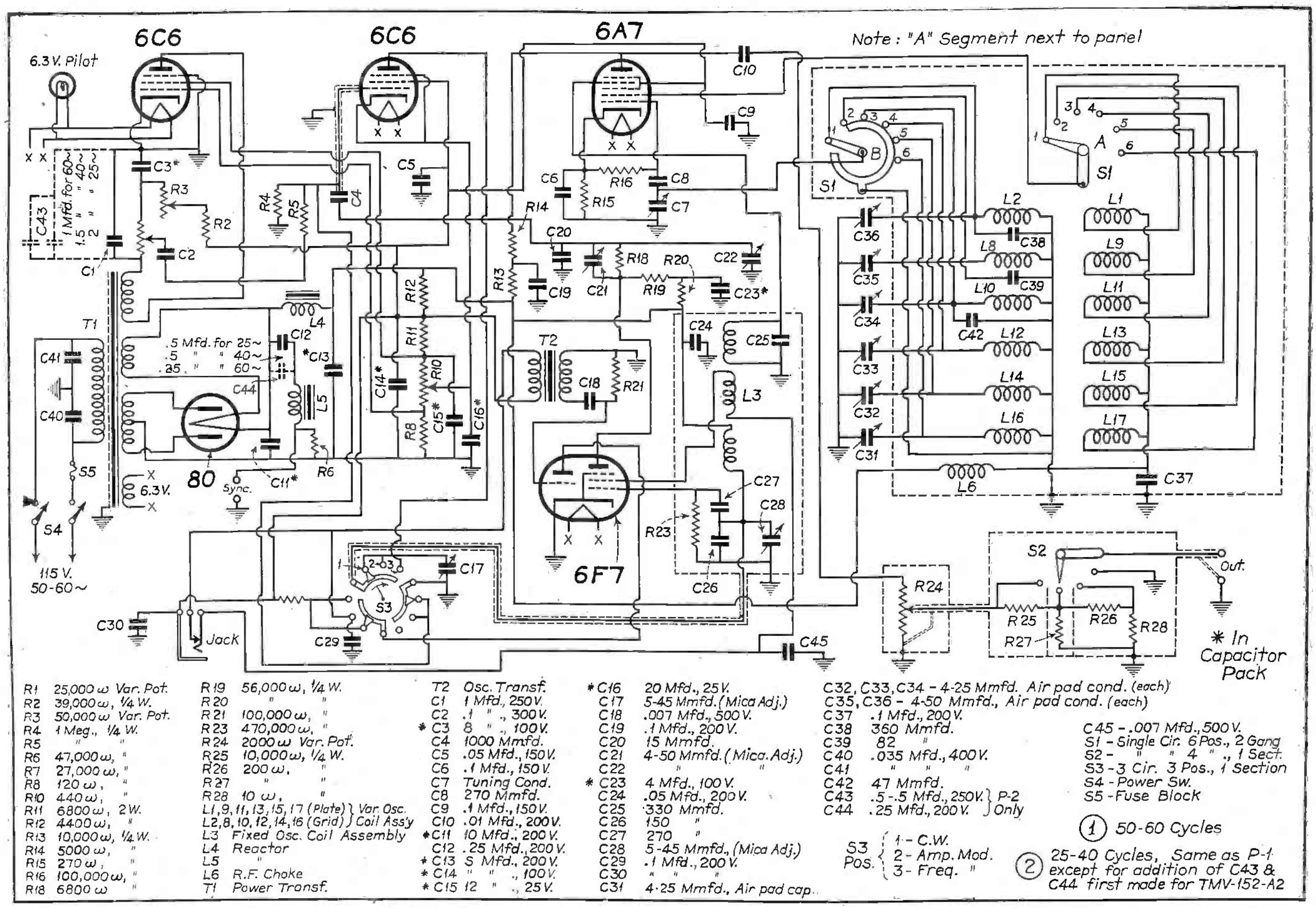


Fig. 6. The RCA model 150 test oscillator circuit diagram.

for the phenomena under observation; the other set, for the time sweep which serves to spread the tracing across the fluorescent screen. In order to maintain the free plate of each set at essentially the d-c potential of anode No. 2, each of these plates is connected through a (high-ohmage) resistor to the anode No. 2 socket terminal. The value of this resistor is such that the electron beam is not distorted by d-c potentials built up on the deflecting plates. In cases where the fluorescent spot is off center, a variable d-c bias is provided in series with each of the deflecting plate resistors. The polarity of each control voltage is such that the spot can be shifted in both directions so as to provide a pattern centering adjustment.

Spot Regulation

Focusing of the fluorescent spot produced by the beam is controlled by adjustment of the ratio of anode No. 2 voltage to anode No. 1 voltage. The ratio is varied by adjustment of anode No. 1 voltage as shown in the circuit diagram.

Regulation of spot size and intensity can be accomplished by varying anode No. 2 current and voltage. The current to anode No. 2 is increased by decreasing the bias voltage applied to the control electrode (grid). An increase in anode No. 2 current increases the size and intensity of the spot. An increase in the voltage applied to anode No. 2 increases the speed of electrons which increases spot intensity and decreases spot size.

In applications involving voltage measurements, the anode No. 2 current should be reduced to the minimum value consistent with the desired brilliance of pattern. Where high brightness is an important consideration, the voltage applied to anode No. 2 may be increased to the maximum rated value. This procedure, however, it not always desirable because the greater speed of the electrons in the beam causes reduced deflection sensitivity.

The 913 is designed to provide as high a current in the electron beam as is consistent with good focusing qualities. This high-current capability is a distinct advantage for obtaining bright patterns covering a relatively large area, but must be used with caution when the spot traverses slowly any portion of a large pattern or when the pattern size is small. Where recurrent phenomena are involved, a pattern, or some portion of it, having too high a power input per unit area may cause the rating of the fluorescent screen to be exceeded. A "slowly-moving spot" is tentatively defined as a fluorescent spot which is traveling slowly enough to be seen *as a spot*, rather than as a trace or line. With patterns of this type, the power input to the screen should be limited as in the case of a stationary spot.

Photographs of recurrent phenomena (producing stationary patterns) appearing on the viewing screen of the 913 can be made with an ordinary camera. Due to the low anode voltage and moderate screen-input power at which the 913 is operated, the photographing should be done in subdued light in order to obtain as much contrast as possible between the fluorescent pattern and the background. The time of exposure will depend upon the speed of the camera lens, the kind of film or plate emulsion used, the magnification of the pattern, and the brightness of the image on the viewing screen. Verichrome film gives excellent results.

Amplifiers and Sweep Circuit

As can be seen from the circuit diagram, Fig. 3, the RCA oscillograph (model 150) is complete in its portable case with amplifiers, sweep circuit and power supply.

A single stage is provided, for each set of deflecting plates, using a 6C6 tube in each stage. The amplifiers have a voltage gain capable of giving full-scale deflection on the 913 screen with only 1¾ volts on the input to the amplifier. The frequency characteristic of the amplifiers is flat from 30 to 10,000 cycles. Gain controls are provided for varying the sensitivity. Switches are also provided so that the input to either plates can be connected directly to these plates.

The linear timing axis provided has a range from 30 to 10,000 cycles and has two controls (one fine and one coarse). These controls, together with the synchronizing control, are used to make the pattern stationary on the 913 screen. An 885 tube is used as the sweep oscillator.

The Frequency-Modulated Oscillator

As a companion to the cathode-ray oscillograph, RCA has produced an all-wave, frequency-modulated test oscillator. The oscillator, like the oscillograph is housed in a gray, crinkle-finished, portable carrying case.

Continuous frequency range from 90 kc to 32 mc is available in six bands. Separate coils are used for each band with individual air-dielectric trimmers for each coil. The entire coil assembly is separately shielded from the oscillator chassis.

A 4-in. diameter dial with 340 degrees of rotation provides over twelve inches of frequency calibrated scale. Two knobs are provided giving both fine and coarse tuning ratios. Indirect lighting and a projected zero line eliminate the possibility of parallax on reading the scale.

Both frequency and amplitude modulation are available. No amplitude modulation is present with the frequency modulated signal.

Internal 400-cycle amplitude modulation is provided and remains constant at 30 percent at all frequencies. The frequency and waveform of the modulation also remains constant throughout the range of the oscillator.

A three-step output attenuator in addition to a continuously-variable attenuator provide minute control of the output signal; variable from 0 to ¼ volt.

Two 6C6 tubes are used, one as the sweep tube and the other as the generator of the sweep voltage. A type 6A7 tube is used as the r-f oscillator and mixer and a type 6F7 is used as an audio and fixed frequency (r-f) oscillator. An 80 tube rectifier provides d-c for the plate, screen and cathode voltages required in the instrument which is completely self-powered from the 60-cycle a-c (or 25-cycle) line.

The Circuit

Frequency modulation, in the RCA model 150 oscillator, begins in the plate coil of the 6C6 sweep tube. This coil is wound on the a-c power transformer (T_1). Frequency modulation is thus introduced into this circuit by the variation in the inductance of this winding because of the amplitude variation of the a-c supply. The winding is tuned by the condenser (C_1) across it.

By suitable rectification and amplification in another 6C6 sweep tube, this modulation, together with a fixed r-f signal generated in the pentode section of the 6F7 tube, is fed to the r-f transformer L_3. A secondary winding on this transformer feeds these signals (when the modulation switch is in the proper position) to the pentode section of the 6A7 mixer tube.

The oscillator section of the 6A7 mixer is used to generate the tunable r-f for the range from 90 kc to 32 mc. The resulting signal on the plate of the 6A7 tube is frequency modulated at a rate of 120-cycles per second over an adjustable band width of from 1 to 40 kc.

When the modulation switch is in the amplitude modulation position a 400-cycle audio frequency note, generated in the triode section of the 6F7 tube, is picked up in the pentode section of the 6A7 mixer and serves to modulate the (amplitude of the) tuned r-f signal.

In the other position of the modulation switch an unmodulated r-f signal, generated in the oscillator section of the 6A7, is obtainable from the output posts of the test oscillator.

Material for this article was supplied by the RCA Mfg. Co., Inc.

General Data . . .

Sentinel-Erla 65B

The Sentinel-Erla 65B is a five-tube battery-operated superheterodyne receiver employing glass tubes of the two-volt series. Two bands are covered with a range of 535 to 1720 kc and 2.3 to 6.3 mc, respectively. A type 19 output tube provides push-pull class B operation with a 30-tube as driver. A 6-inch permanent-magnet dynamic speaker is used in the table models and an 8-inch one is used in the console models.

Alignment Procedure

The procedure outlined below should be followed carefully, otherwise the receiver will be insensitive and the dial calibration will be incorrect. The trimmer and padder condensers are referred to by their function as indicated in Figs. 2 and 3.

I-F Alignment

(a) Connect the ground lead of the test oscillator to the set ground. Connect the other lead to the grid cap of the 1C6 tube through a 0.02-mfd series condenser. Do not remove grid clip.

(b) Set test oscillator to exactly 465 kc and turn receiver volume control on full.

(c) Peak each of the second i-f transformer trimmers.

(d) Peak each of the first i-f transformer trimmers. To assure more accurate trimmer setting repeat above adjustment several times, always using lowest possible test oscillator output consistent with readable output meter scale deflection.

Wave-Trap Alignment

(a) Connect the high output side of the test oscillator through a 0.00025-mfd condenser to the receiver antenna lead and the low side to the set ground.

(b) Set test oscillator frequency to exactly 465 kc and adjust the 465-kc wave-trap trimmer condenser for *minimum* 465-kc signal response.

Broadcast Band Alignment

(a) Adjust band selector switch for operation on 535 to 1720 kc band. Leave test oscillator lead connected to receiver antenna lead through a 0.00025-mfd series condenser.

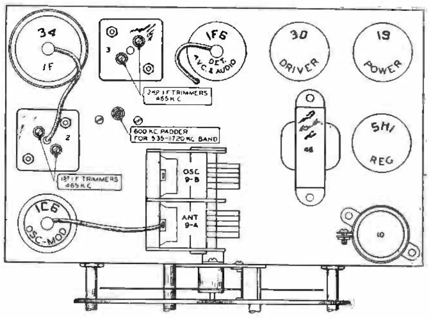


Fig. 2. Tube and trimmer locations.

(b) Check tuning dial adjustment by turning gang condenser until plates touch maximum capacity stop (completely in mesh), at which point the dial needle must be exactly even with the last line at the low frequency end of the dial calibration. If the dial needle does not point exactly to the last line, move needle to correct position.

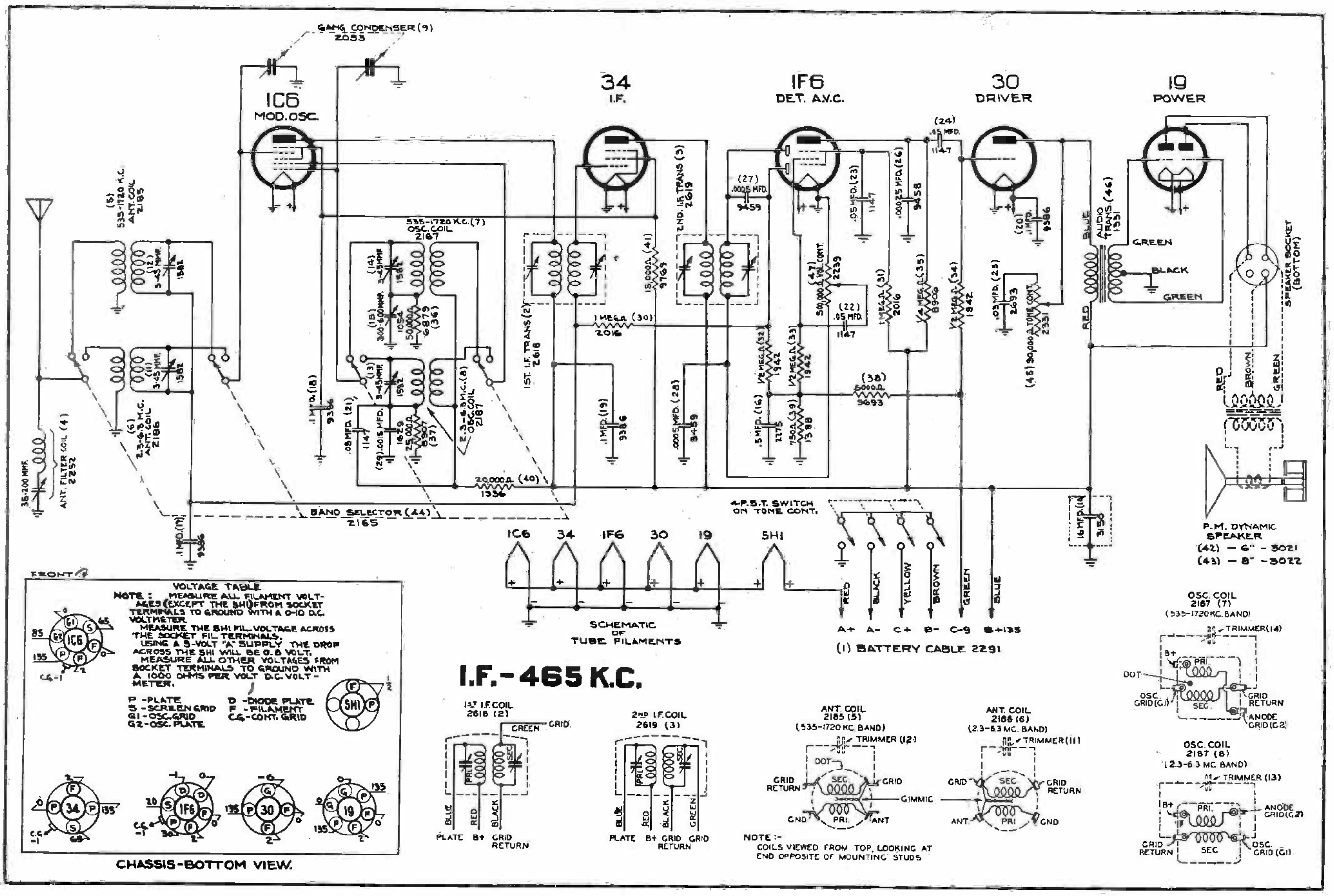
(c) Set test oscillator frequency and receiver dial to exactly 1720 kc.

(d) Adjust 1720 kc oscillator trimmer to bring in 1720 kilocycles test oscillator signal to maximum output.

(e) Tune receiver dial and set test oscillator frequency to exactly 1400 kc.

(f) Adjust 1400 kc antenna trimmer for maximum sensitivity.

(g) Set receiver dial and test oscilla-



Sentinel-Erla 65B circuit diagram.

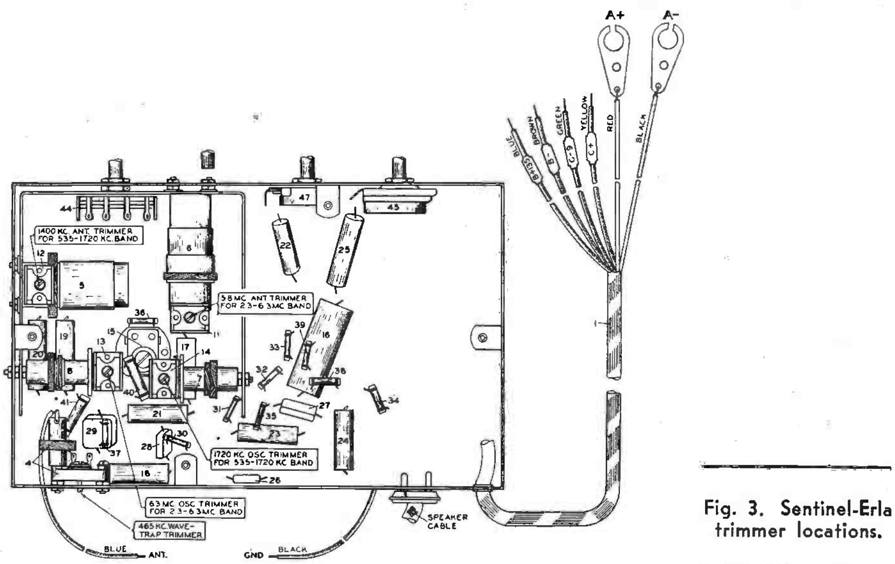


Fig. 3. Sentinel-Erla trimmer locations.

tor frequency to approximately 600 kilocycles.

(h) While rocking gang condenser slightly to right and left adjust 600 kc padder for maximum sensitivity.

SHORT-WAVE BAND ALIGNMENT

(a) Replace 0.00025-mfd test lead series condenser with a 400-ohm resistor. Adjust band selector switch for operation on 2.3 to 6.3 megacycle band, and tune receiver dial and set test oscillator frequency to exactly 6.3 mc.

(b) Adjust 6.3-mc oscillator trimmer to bring in 6.3 megacycle test oscillator signal to maximum output.

(c) Tune receiver dial and set test oscillator frequency to 5.8 megacycles, and adjust 5.8 mc antenna trimmer for maximum 5.8-mc test oscillator signal response.

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General Electric E-129

The model E-129 employs 12 metal envelope tubes to perform the functions indicated on the circuit diagram given in Fig. 1. A superheterodyne circuit is used and the complete frequency range from 535 kc to 70 mc is covered, with ample overlap, in four bands. The average power consumption of the receiver is 165 watts. Over 10 watts of undistorted power output are provided with a maximum of 15.4 watts.

Design features built into this receiver include the "Sentry Box"; separate coils for each frequency band; high-efficiency converter with a separate oscillator; two stages of i-f amplification for high sensitivity and selectivity; automatic volume control; automatic frequency control (afc), silent tuning, bass and treble compensated volume control, music-speech switch operated in conjunction with a continuously variable tone control, and colorama tuning.

THE "SENTRY BOX"

The r-f and oscillator sections of the receiver are contained in the "Sentry Box" which consists of a separately contained and shielded, four-band, antenna, r-f and oscillator tuning unit. Individual coils are employed for each frequency range and are properly selected and connected into the circuit by the range switch. To avoid absorption effects, the range switch shorts all unused coils which might resonate at some frequency in the range being used. The section of the range switch controlling selection of the antenna coil primary also changes the antenna connection to these coils in such a manner as to insure maximum signal transfer in each range. When a "V" doublet antenna system is connected to terminals "A" and "G" at the rear of the "Sentry Box," the range switch provides for true doublet operation in the short wave (D) band where this connection is advantageous, and for operation as a "T" antenna in all other bands. When a doublet antenna providing noise reduction on the broadcast band is used, it is essential that a link be connected between terminals "G" and "GR" at the back of the "Sentry Box" in order to obtain the desired action.

The antenna is coupled to the control grid of the 6K7 r-f tube through the tuned antenna transformer selected by the range switch. Likewise, the output of the amplifier tube is coupled to the control grid of the 6L7 converter tube through the properly selected tuned r-f transformer. The only exception to this procedure occurs when the receiver is operating on the ultra-short-wave "E" band, in which position the r-f tube is disconnected from the circuit and the antenna coupled directly to the 6L7 grid through the tuned antenna transformer.

The oscillator circuit, with the exception of the ultra-short-wave "E" band, employs a 6J7 tube in a conventional tuned grid, plate feedback circuit. In the ultra-short-wave "E" band, the common impedance between the grid and plate circuits provided by the secondary of L12 in the cathode circuit of the 6K7 oscillator tube, is utilized to provide oscillation. An auxiliary feedback circuit composed of the primary of L-12 together with the capacitor, MC-29, is in the plate circuit of the oscillator tubes on the "E" band. These elements resonate slightly below the low-frequency end of the "E" band and tend to improve the oscillator excitation at this end of the band. To minimize capacity effects, the tuned "E" band grid coil L-13 remains in the circuit at all times since its resistance is sufficiently low to permit this procedure. The grid coil of the broadcast "B" band oscillator returns to B plus rather than to ground in order to provide plate voltage for the 6J7 afc tube. The 580-kc padding capacitor, C-20, serves to isolate this voltage from the oscillator tuning condenser section. The oscillator signal which is maintained at a frequency 465 kc higher than the incoming signal is capacity coupled to the injection grid of the 6L7 converter.

The 6J7 afc tube is also located on the "Sentry Box" and is associated with the broadcast "B" band oscillator. The output of the converter is applied to the i-f amplifier.

I-F AMPLIFIER

The i-f amplifier consists of a two-stage cascade section composed of three i-f transformers and two 6K7 amplifier tubes. Each transformer has two tuned circuits which resonate at 465 kc. The third i-f transformer is of special construction having the primary capacity-coupled to the midpoint of the secondary

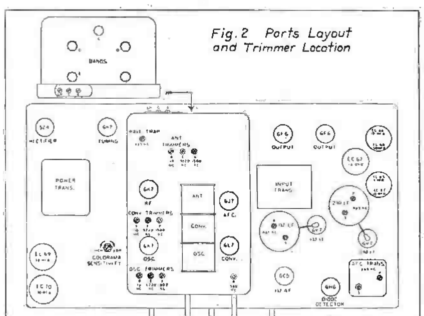
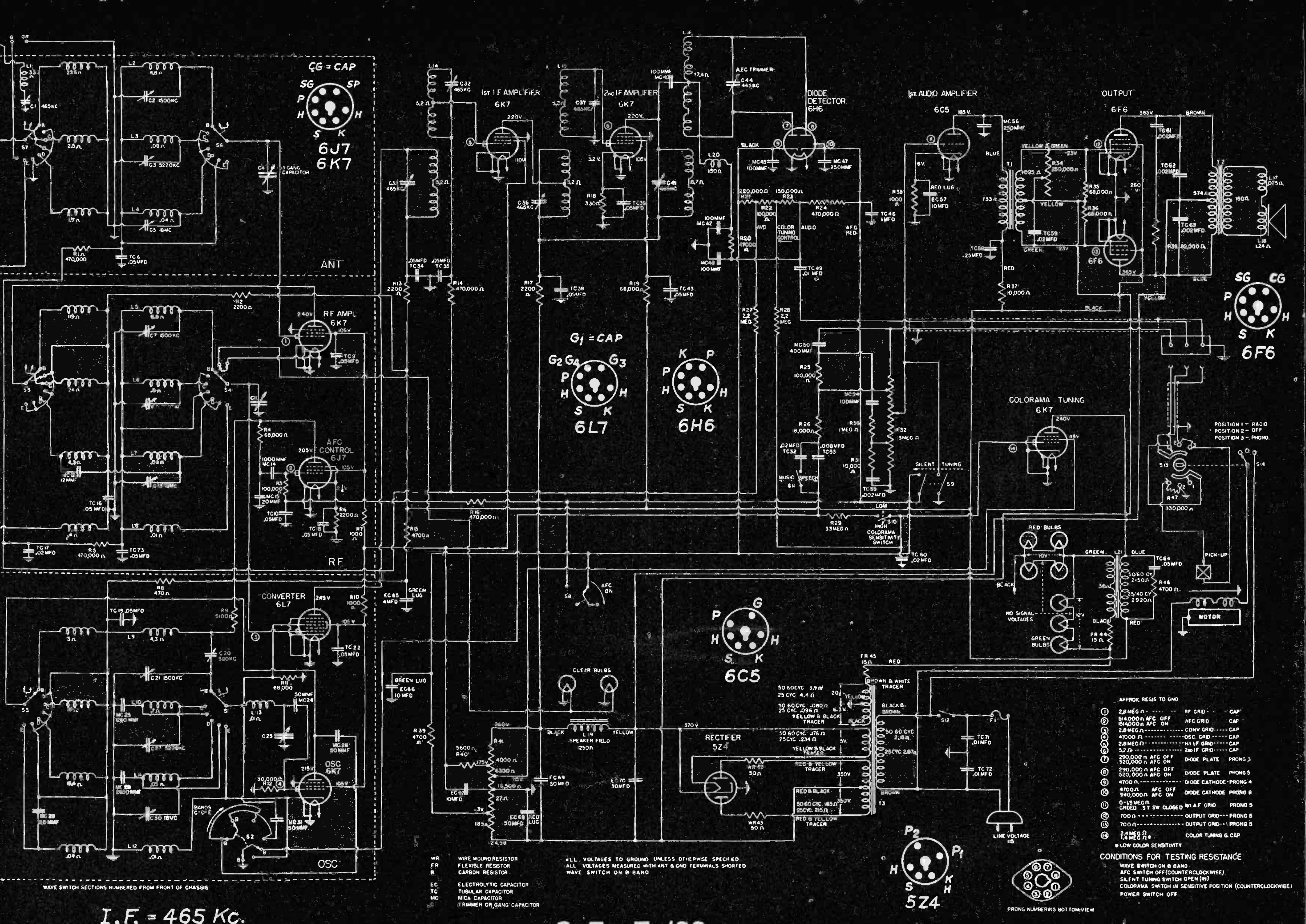


Fig. 2. G.E. E-129 parts layout and trimmer locations.



ANT
RF
OSC
CG = CAP
6J7
6K7
1st I.F AMPLIFIER 6K7
2nd I.F AMPLIFIER 6K7
DIODE DETECTOR 6H6
1st AUDIO AMPLIFIER 6C5
OUTPUT 6F6
RF AMPL 6K7
AFC CONTROL 6J7
CONVERTER 6L7
OSC 6K7
G1 = CAP
6L7
6H6
6C5
6F6
COLORAMA TUNING 6K7
RECTIFIER 5Z4
5Z4
SILENT TUNING
HIGH COLORAMA SENSITIVITY SWITCH
POSITION 1 - RADIO
POSITION 2 - OFF
POSITION 3 - PHONO.
PICK-UP
MOTOR
RED BULBS
GREEN BULBS
CLEAR BULBS
NO SIGNAL VOLTAGES
L19 SPEAKER FIELD 1250Ω
LINE VOLTAGE 115
AFC TRIMMER
AFC ON
BANDS C-D-E
WAVE SWITCH SECTIONS NUMBERED FROM FRONT OF CHASSIS
WR WIRE WOUND RESISTOR
FR FLEXIBLE RESISTOR
R CARBON RESISTOR
EC ELECTROLYTIC CAPACITOR
TC TUBULAR CAPACITOR
MC MICA CAPACITOR
TRIMMER OR GANG CAPACITOR
ALL VOLTAGES TO GROUND UNLESS OTHERWISE SPECIFIED
ALL VOLTAGES MEASURED WITH ANT & GND TERMINALS SHORTED
WAVE SWITCH ON B-BAND
APPROX RESIS TO GND
CONDITIONS FOR TESTING RESISTANCE
WAVE SWITCH ON B BAND
AFC SWITCH OFF (COUNTERCLOCKWISE)
SILENT TUNING SWITCH OPEN (IN)
COLORAMA SWITCH IN SENSITIVE POSITION (COUNTERCLOCKWISE)
POWER SWITCH OFF
* LOW COLOR SENSITIVITY
PRONG NUMBERING BOTTOM VIEW
I.F. = 465 Kc.

in order to provide the differential afc voltage.

Detector and AVC

The plates of the 6H6 twin diode are fed in push-pull by the secondary of the third i-f transformer. Two balanced diode loads consisting of R-24 and the series resistance of R-21, R-22, and R-23 are provided. The afc voltage is developed across the sum of all these resistors, while the audio voltage appears across the sum of R-21 and R-22 and R-23. The audio frequency thus provided is transferred to the a-f system for amplification and reproduction. The direct-current component of the rectified signal produces a voltage drop across the above three resistors. That existing across R-21 and R-22 is employed for operating the 6K7 "Colorama" tuning tube. Switch S-10 permits the application of either full or partial voltage to the tube, thereby permitting control of the color indication in accordance with prevailing receiving conditions. The d-c voltage developed across R-21 is utilized for automatic volume control action by employing the same to bias the r-f amplifier, converter, and first i-f amplifier tubes. Initial bias for these tubes is obtained by returning resistor, R-21, to the minus 3 volt tap of the voltage divider. The second i-f tube receives no avc and is self-biased. This minimizes the possibility of non-linear distortion on strong signals.

Audio System

The audio voltage developed across the diode load is applied to the volume control, R-32, through the isolating capacitor, TC-49. This control is compensated by means of dual resistance—capacitance networks to provide the proper balance of high and low frequencies at different volume control settings. The movable arm on the volume control selects the amount of audio signal applied to the control grid of the 6C5 audio amplifier tube and thus regulates the output of the receiver. The output of the 6C5 audio tube is transformer coupled to the control grids of the two 6F6 output tubes which operate in a push-pull connection.

The music-speech control consists of a switch actuated at one extreme of the tone control rotation corresponding to that providing maximum high note response. This provides better speech clarity by decreasing the bass compensation which is accomplished by shunting capacitor TC-53 with TC-52. The bass compensation is removed entirely on the short-wave bands by the switch S-2; hence the music-speech control is only effective in the broadcast "B" band. Continuously variable tone control is provided by capacitor TC-59 and variable resistor R-34 shunting the grids of the push-pull output tubes.

Silent Tuning

Silent tuning is provided by the switch S-9 which is actuated by the tuning knob of the receiver. Pulling the tuning knob out slightly closes switch S-9 and kills the audio output by grounding the 6C5 grid. The afc is also removed by this operation which permits a sharp indication of resonance by noting the "Colorama" lights. When a station has been satisfactorily located in this manner, the tuning knob is pushed in to its original position and the switch opened.

Power Supply

The d-c power for the operation of the receiver is supplied by a power supply system employing a 5Z4 full-wave rectifier tube which, together with a suitable network of resistors and capacitors, supplies the required voltages and filtering action.

Colorama Tuning

These receivers are equipped with color tuning, a novel method which indicates approach to resonance by means of a change in color of the light illuminating the tuning scale. The technical features of this method of tuning were fully described in the December, 1936, issue of Service.

Automatic Frequency Control

These receivers also employ automatic frequency control (afc) which is a device for automatically controlling the oscillator frequency in such a way that, although the receiver is not exactly tuned to the signal being received, an intermediate frequency of 465 kc will still be produced. The operation of the automatic frequency control as applied to the General Electric receivers was completely described in the October and November (1936) issues of Service.

Alignment Procedure

The receiver should first be allowed to run for fifteen minutes in order to reach its approximate normal operating temperature. Before making any adjustments, it is wise to determine the correctness of the existing alignment. This may be done by supplying a signal from the test oscillator to the receiver and inserting a "Tuning Wand" into the coil involved.

To realize the full advantage of the performance built into these receivers at the factory, circuit alignment using cathode-ray oscilloscope equipment is much to be preferred. The oscilloscopic method is particularly advantageous in aligning the i-f tuned circuits.

See Fig. 2 for the location of all trimmer capacitors.

I-F Alignment

Although the use of the cathode-ray oscilloscope for alignment purposes is to be preferred, it is possible to make the i-f trimmer adjustments with reasonable accuracy using a 465-kc signal generator and output meter.

Place a modulated signal of 465 kc on the grid of the last i-f (6K7) tube with the volume control set at maximum and the afc switch *turned off*. Place a low-range a-c voltmeter or other output indicator across the voice coil of the loudspeaker. Adjust the output of the signal generator so that an indication of not more than two or three volts is obtained on the output meter.

Adjust and readjust the primary trimmer for maximum output and *the secondary for minimum output*. This latter adjustment will be very broad. Apply the signal input to the grid of the first i-f (6K7) tube and adjust both primary and secondary trimmers for maximum output, reducing the input as necessary to obtain approximately the same output indication as before. Apply the signal input to the grid of the converter (6L7) tube and adjust both primary and secondary trimmers for maximum output indication in the same manner.

It is now necessary to make a fine adjustment of the secondary trimmer of the last i-f (afc) transformer which is as follows: without changing the frequency of the signal generator, place the input lead on the rubber insulation of the converter (6L7) grid lead. This will provide a small signal input through the capacity between the leads. Increase the attenuator setting if necessary to make the output audible. If the signal generator is provided with a means of removing the modulation, this should be done. However, the adjustment may be carried out satisfactorily even with a modulated generator signal.

Now tune in any broadcast signal in the usual manner and tune the receiver carefully for zero beat between this carrier and the 465-kc signal generator. It may be necessary to use a short antenna or to remove it entirely if the station is a strong local. Throw the afc on and adjust the last i-f secondary (afc) trimmer to give zero beat.

··Technical Features of 1937 G.E. Radio Receivers··

Model No.	E-51	E-61	E-62	E-68	E-71	E-72	E-76	E-79	E-81	E-86	E-91	E-95	E-101	E-105	E-106	E-126	E-129	E-155	U-50	U-51	U-55	U-70	U-75
Cabinet *	T	T	T	Ce	T	T	Ce	Ce†	T	Ce	T	Ce	T	Ce	Ce	Ce	Ce†	Ce	T	T	Ce	T	Ce
Power Supply	AC/DC	A.C.			A.C.			A.C.	A.C.		A.C.		A.C.			A.C.	A.C.	A.C.	2V. & B Batt.	6V. Batt.		6V. Batt.	
No. of Bands	2	2			3			3	3		3		3			4	4	5	1	2		3	
Range (Kc.)	540-1750 2200-7000	540-7000			540-18,000			540-18,000	540-18,000		540-18,000		540-18,000			540-70,000	540-70,000	140-410 540-70,000	540-1700	540-1750 5500-18,000		540-18,000	
Power Consumption	–	70 W.			80 W.			105W.	100 W.		105 W.		110 W.			155W.	165W.	–	–	–		–	
Audio Power	5 W.	5 W.			5 W.			5 W.	10 W.		10 W.		14 W.			15 W.	15 W.	35 W.	–	–		–	
I.F. Peak (Kc.)	465	465			465			465	465		465		465			465	465	465	465	465		465	
Dynamic Speaker	6½"	8"	6½"	12"	8"	8"	12"	12"	8"	12"	8"	12"	8"	12"	12"	12"	12"	15"	–	–		–	
Tone Control	Yes	Yes			Yes			Yes	Yes		Yes		Yes			Yes	Yes	Yes	Yes	Yes		Yes	
Music-Speech Control									Yes		Yes		Yes			Yes	Yes	Yes				Yes	
Silent Tuning																Yes	Yes	Yes					
Personalizer													Yes			Yes	Yes	Yes					
Sentry Box									Yes		Yes		Yes			Yes	Yes	Yes					
High-Low Speed Tuning					Yes			Yes	Yes		Yes		Yes			Yes	Yes	Yes				Yes	
Bass Compensation		Yes			Yes			Yes	Yes		Yes		Yes			Yes	Yes	Yes	–	–		–	
Wave Trap or Preselector		Yes			Yes			Yes	Yes		Yes		Yes			Yes	Yes	Yes	–	–		–	
Variable Condensers	2	2			2			2	3		3		3			3	3	3	2	3		3	
Number of Tuned Circuits	6	6			8			8	9		9		9			9	9	9	6	7		9	
Colorama Tube											6C5		6C5			6K7	6K7	6K7					
R.F.									6K7		6K7		6K7			6K7	6K7	6K7		34		34	
1st. Det.	6A8	6A8			6A8			6A8	6A8		6A8		6A8			6L7	6L7	6L7	1A6	1C6		1C6	
Osc.																6K7	6K7	6K7					
Intermediate Freq.	6K7	6K7			(2) 6K7			(2)6K7	(2) 6K7		(2) 6K7		(2) 6K7			(2)6K7	(2)6K7	(2)6K7	34	34		(2) 34	
2nd. Det.	6Q7	6H6			6H6			6H6	6H6		6H6		6H6			6H6	6H6	6H6	30	1B5		30	
AVC																							
1st. Audio		6F5			6F5			6F5	6F5		6F5		6F5			6C5	6C5	6C5	30			30	
2nd. Audio																		6F6					
Output	25A6	6F6			6F6			6F6	6L6		6L6		6L6			(2)6F6	(2)6F6	(2)6L6	1F4	1F4		19	
Rectifier	25Z6	5W4			5W4			5W4	5Z4		5Z4		5Z4			5Z4	5Z4	(2)5Z4					
AFC													6J7			6J7	6J7	6H6 6J7					

* T = Table Ce = Console † Phono Combination

This adjustment is very critical and must be made with great care. When the adjustment is properly made, there will be no appreciable change from zero beat as the afc switch is thrown off and on. This completes the alignment of the i-f and afc circuits.

The alignment of the oscillator and r-f circuits may be carried out in the usual manner. The afc switch must remain in the "off" position.

I-F Wave Trap Alignment

Leave the band switch at band "B" and tune receiver to about 1000 kc.

With the test oscillator set at 465 kc apply this signal to the antenna terminal through a dummy antenna consisting of a 400-ohm resistor and 250-mmfd capacitor in series. With the 465-kc signal applied to the antenna terminal, adjust the i-f wave trap trimmer for *minimum* output indication.

R-F Alignment

First, check the position of the dial pointer by rotating the tuning condenser to maximum capacity position, i.e., plates fully meshed. At this position, the pointer should coincide with the end mark at the left-hand end of the scale. If it does not, it may be set by loosening the pointer set screw and setting the pointer to its correct position. During r-f alignment the afc switch *must* be set in its off (counter-clockwise) position.

Band B Alignment

Set the test oscillator for operation at 1500 kc and connect its output to the antenna terminal of the receiver through the dummy antenna described under wave trap alignment. Tune the receiver until the pointer is at 1500 on the scale. Set the tone control for minimum high response and reduce the volume control setting so as to avoid excessive noise response. Adjust the band "B" oscillator, r-f, and antenna trimmers respectively (location shown on Fig. 2) to give maximum deflection on the output meter. Maintain the test oscillator output at the lowest level which will give an easily readable output indication.

Now set the test oscillator at 580 kc and tune the receiver to resonance with the signal. Adjust the 580-kc padding capacitor, C-20, rocking the tuning condenser back and forth through resonance as the padding capacitor is adjusted and note the deflection of the tuning meter each time the receiver is tuned in this manner. Leave the padding capacitor at the setting which gives greatest deflection.

Retune the receiver to 1500 kc and set the test oscillator for this frequency. Check the alignment by again adjusting the band "B" oscillator, r-f and antenna trimmers for maximum deflection on the tuning meter.

Band C Alignment

With the test oscillator connected to the receiver as above, tune the receiver until the pointer is at 5220 on the "C" band scale. Set the test oscillator for operation on this frequency and, with the volume and tone controls set as above adjust the band "C" oscillator, r-f and antenna trimmers respectively (See Fig. 2) to give maximum deflection on the output meter.

Band D Alignment

Turn the band switch to band "D." Set the test oscillator at 18,000 kc (18.0 mc) and tune the receiver until the pointer coincides with the 18.0 mark. Adjust the band "D" oscillator trimmer to give maximum output indication. It will probably be found that there will be two settings of the oscillator trimmer that will give an output response. The lower capacity setting of the trimmer is the one that should be used. To be sure that correct adjustment has been obtained, tune for the image signal at 17.07 mc with the test oscillator at 18.0 mc. It may be necessary to increase the test oscillator output to obtain response at this point.

Retune the receiver to 18.0 mc and adjust band "D" antenna and r-f trimmers, respectively (C-5 and C-13) for maximum output indication. When adjusting the r-f trimmer, C-13, rock the tuning condenser back and forth through resonance as in the 580-kc padding capacitor adjustment.

Alignment of the receiver is now complete as no adjustments are provided on band "E."

Philco 37-116 (Codes 121-122)

The Philco model 37-116 is a 15-tube superheterodyne, using metal-glass tubes, with magnetic tuning; fidelity-selectivity control in the i-f circuit, and push-pull class A audio output. The code 122 receiver uses the Philco automatic dial tuning system. The receiver is designed for operation on 115-volt a-c, 60-cycle lines and draws 165 watts. Fifteen watts of undistorted power output are available from the high-fidelity "cathedral" type speaker employed in this model.

The complete range from 530 kc to 18.2 mc is covered, with ample overlap, in five bands. A complete circuit diagram is given in Fig. 1, with the tubes used and their functions lettered on the diagram. An underchassis view is given in addition, in Fig. 2, showing the location of the various tubes as well as the voltages encountered on the numerous socket prongs. These voltages were measured with a 1000-ohm-per-volt voltmeter with the volume control at *minimum,* the range switch in the broadcast position and the line voltage reading 115 volts (a-c). The antenna was shorted to the chassis during the measurements.

Alignment Procedure

Connect the output meter to the plate and cathode of the type 6F6G tube through a 0.1-mfd condenser. Turn on the receiver and the signal generator. Allow both to warm up for at least 15 minutes before attempting any adjustments.

It is usually advisable to test the correctness of the existing alignment with

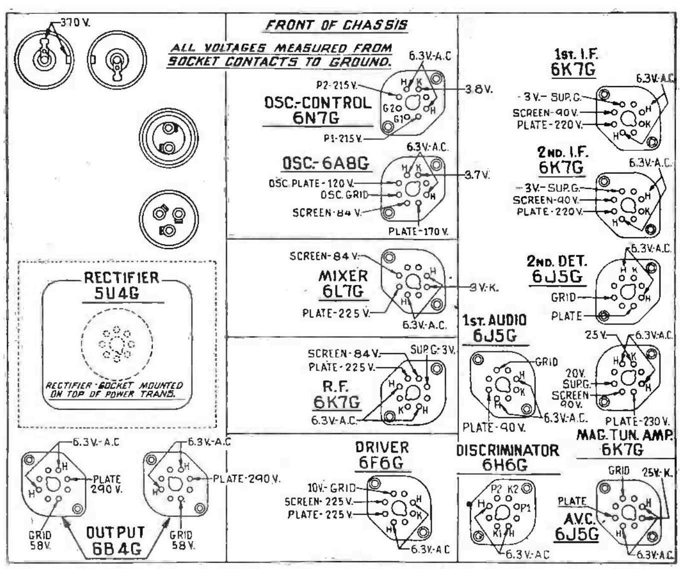
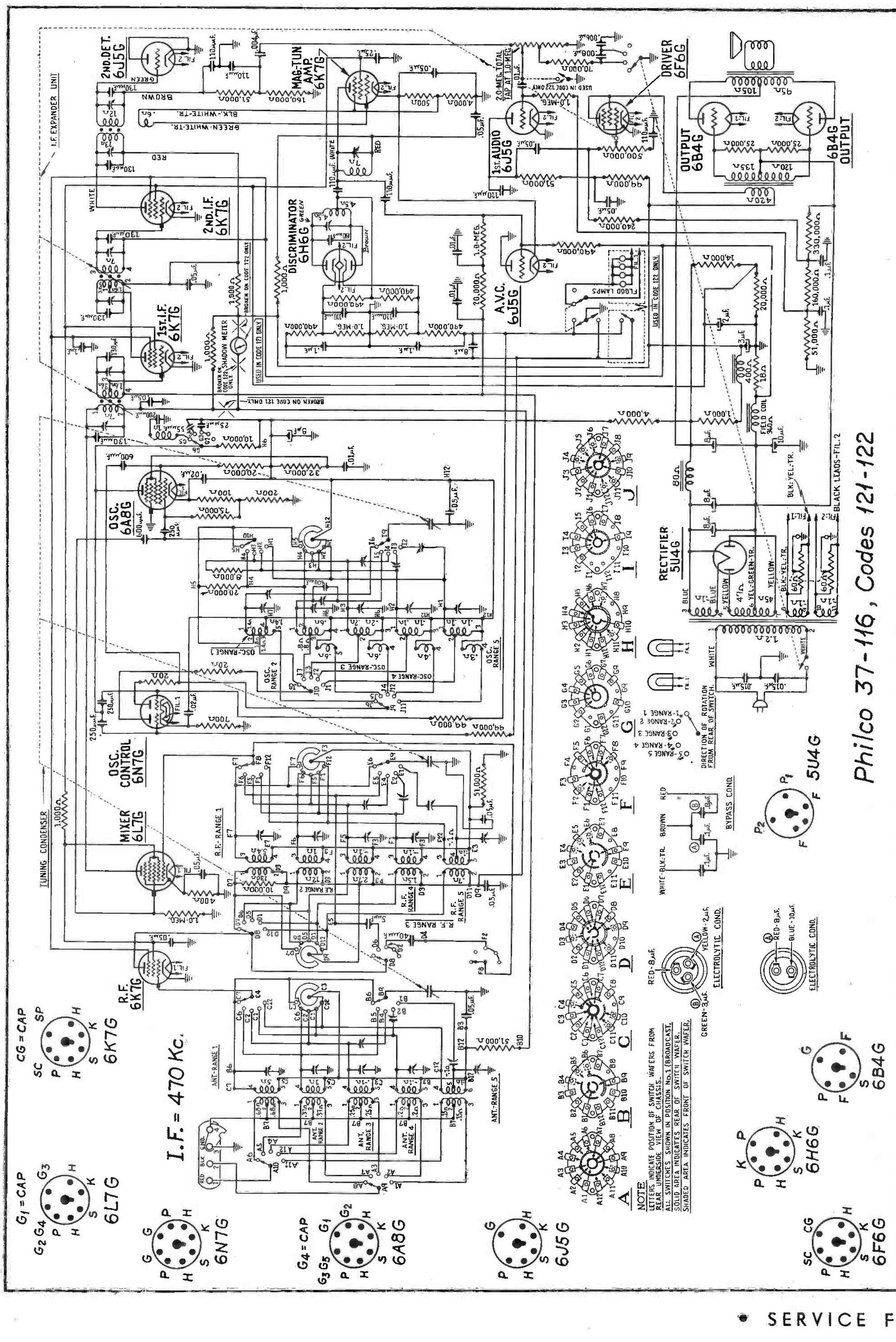


Fig. 2. Philco 37-116 socket voltages.


Philco 37-116, Codes 121-122
I.F. = 470 Kc.
2ND. DET. 6J5G
MAG-TUN AMP. 6K7G
DRIVER 6F6G
OUTPUT 6B4G
OUTPUT 6B4G
1st. AUDIO 6J5G
2ND. I.F. 6K7G
DISCRIMINATOR 6H6G
A.V.C. 6J5G
1st. I.F. 6K7G
OSC. 6A8G
RECTIFIER 5U4G
OSC. CONTROL 6N7G
MIXER 6L7G
R.F. 6K7G
TUNING CONDENSER
I.F. EXPANDER UNIT
SHADOW METER
FLOOD LAMPS
FIELD COIL
BYPASS COND.
ELECTROLYTIC COND.
ELECTROLYTIC COND.
DIRECTION OF ROTATION FROM REAR OF SWITCH.
NOTE
LETTERS INDICATE POSITION OF SWITCH WAFERS FROM REAR UNDERSIDE VIEW OF CHASSIS.
ALL SWITCHES SHOWN IN POSITION No. 1 (BROADCAST).
SOLID AREA INDICATES REAR OF SWITCH WAFER.
SHADED AREA INDICATES FRONT OF SWITCH WAFER.
6K7G
6L7G
6N7G
6A8G
6J5G
6H6G
6B4G
6F6G
5U4G

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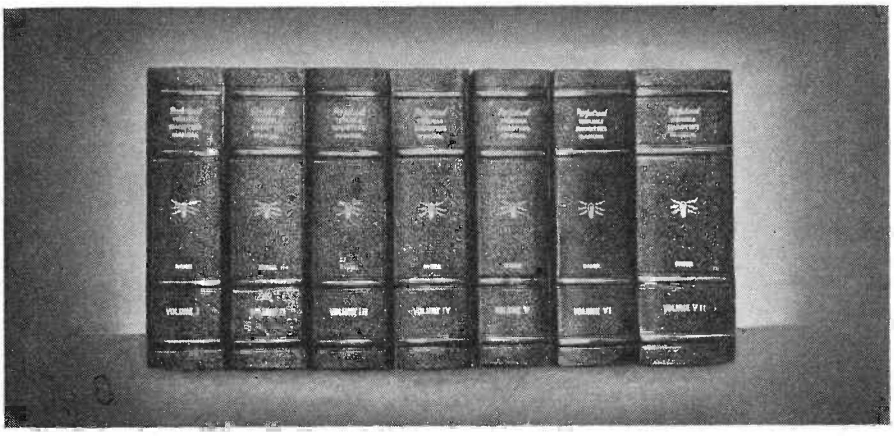

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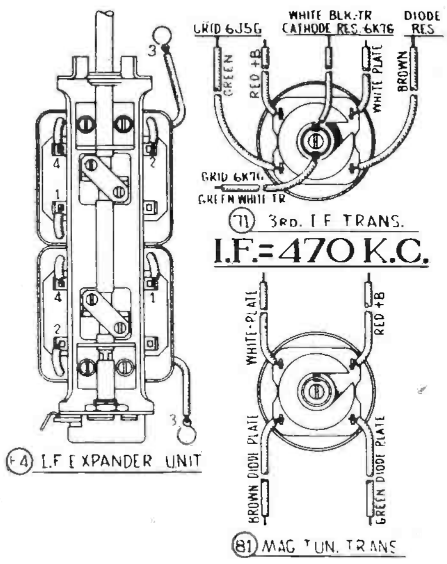


Fig. 3. Philco 37-116 i-f transformer.

a tuning-wand or similar device before making changes.

Dial Calibration

In order to adjust this receiver correctly the dial must be aligned to track properly with the tuning condenser. To do this proceed as follows:

(1) Loosen the set screws on the shaft coupling of the tuning condenser. Then turn the tuning condenser until the plates are in the maximum capacity position. Now set the glowing beam indicator on the index line at the low-frequency end of the broadcast band. With dial and tuning condenser in this position tighten set screws.

(2) Turn the tuning condenser control until the indicator is on the first division from the index line.

(3) With the dial in this position, loosen the shaft coupling set screws. Then turn the dial until the indicator is again on the index line. Tighten the set screws in this position.

Note: Be careful when turning the dial that the position of the tuning condenser is not disturbed.

I-F Alignment

(1) Connect the signal generator output lead in series with a 0.1 mfd condenser to the grid of the 6L7G tube, and the ground connection of the output lead to the chassis.

(2) Set the receiver volume control in the maximum position. Turn the fidelity-selectivity control clockwise; magnetic tuning control in the "off" position (counter-clockwise); range switch in position No. 1 (broadcast); tuning condenser to approximately 580 kc, and adjust the signal generator for 470 kc.

(3) Adjust compensators (64B) first i-f secondary; (64A) first i-f primary; (64D) second i-f secondary; (64C) second i-f primary; (71S) third i-f secondary and (71P) third i-f primary for maximum output.

(4) Turn the fidelity-selectivity control to the expanded position (counter-clockwise). The intermediate-frequency curve is now checked for symmetry as follows: slowly shift the signal generator dial between 460 kc and 480 kc. As the dial is turned two peaks will be indicated on the output meter—one about 465 kc and the other about 475 kc. These peaks should give the same deflection or reading on the output meter. If they are unequal, compensator (71S) must be readjusted slightly to the right or left—depending on which peak gives the lowest reading—until they are equalized.

Each time the compensator is set in another position, rotate the signal generator dial through 460 to 480 kc and note the reading of each peak on the output meter. If the peaks become more equal when compensator (71S) is turned to the left, continue in this direction until they are equal. If they become more unequal turn the compensator to the right. Continue this adjustment in either direction until the peaks equalize.

(5) After adjusting the third i-f transformer, turn the fidelity-selectivity control clockwise (selective position) and adjust the attenuator of the signal generator for maximum output. Now tune the primary compensator (81P) of the magnetic tuning transformer for minimum output.

R-F Alignment

Tuning range 11.5-18.2 *mc*

(1) The signal generator output lead with the 0.1-mfd condenser is connected to terminal No. 1 on the aerial input panel (rear of chassis) and the generator ground lead to terminal No. 3. Terminals 2 and 3 must be connected with the shorting link provided on the panel.

(2) Set the magnetic tuning control in the off position, and the fidelity-selectivity control in the extreme clockwise position. Set the range switch in position No. 5 (11.5 to 18.2 mc). Turn the receiver and signal generator dials to 18 mc and adjust the generator attenuator for a readable indication on the output meter. Now adjust compensator (43D) by turning the screw (clockwise) to the maximum capacity position, then slowly turn it counter-clockwise until a second maximum peak is reached on the output meter. The first peak from maximum capacity is the image signal and the receiver *must not* be adjusted to this signal. On some receivers, however, only one peak will be found, therefore, adjust compensator (43D) to this peak. If the above procedure is correctly performed, the image signal will be found at 17.060 mc by advancing the signal generator input, and turning the receiver dial to this frequency mark on the scale.

(3) Leaving the signal generator and receiver dials at 18 mc the antenna and r-f compensators (7D) and (25D) are now adjusted by connecting a variable condenser, Philco part No. 45-2325 (approximately 0.00041 mfd), across the oscillator compensator (43D) contact (first contact from the left side of the receiver facing rear underside view of the chassis) and ground. Now tune the added condenser until the second harmonic of the receiver oscillator beats against the signal from the generator, resulting in a maximum indication on the output meter. Note: It may be necessary to increase the signal generator output to obtain a signal of sufficient strength for reading on the output meter. Compensators (7D) and (25D) are now adjusted for maximum output. After these adjustments, remove the external condenser and readjust compensator (43D) as given in paragraph 2 above.

(4) Turn the signal generator and receiver dials to 12 mc and adjust compensators (43E), (25E) and (7E) for maximum output.

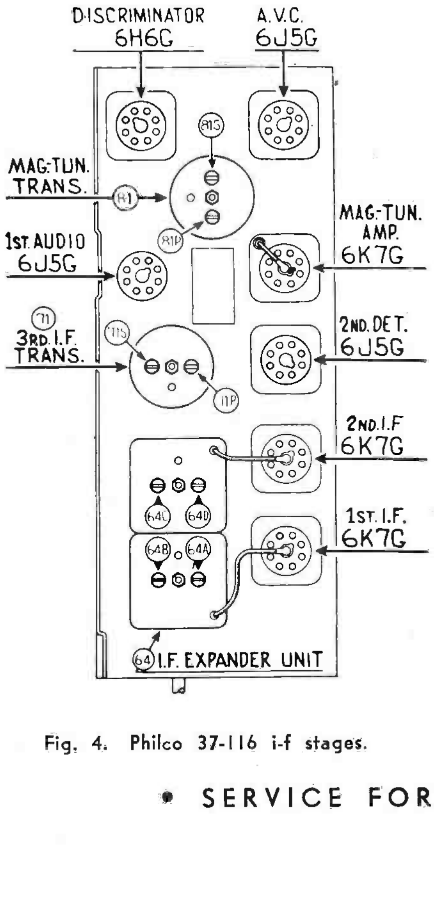


Fig. 4. Philco 37-116 i-f stages.

(5) Readjust compensator (43D) as given in paragraph 2 above, for maximum output.

(6) Readjust compensators (7D), (25D) and (43D) as given in paragraph 3 above. This readjustment is to correct any variation that the low-frequency compensator may have caused in the high end of this range.

Tuning range (7.35-11.6 *mc*)

(1) Turn selector switch to range 4. Set the signal generator and receiver dials to 11.0 mc. Now adjust compensator (43B) for maximum output. Check for image at 10.06 mc.

(2) Leaving signal generator and receiver dial turned to 11.0 mc, connect the external variable condenser across the oscillator compensator (43B) contact (third contact from left side of the receiver facing rear underside view of chassis) and ground. Tune the added condenser for maximum output, then adjust compensators (7B) and (25B) for maximum output. Remove the added condenser and adjust (43B) for maximum output.

(3) Turn the signal generator and receiver dials to 7.5 mc and adjust compensators (43C), (25C) and (7C) for maximum output.

(4) Readjust compensator (43B) as given in paragraph 1 above.

(5) Readjust compensators (7B), (25B) and (43B) as given in paragraph 2 above.

Tuning range (4.7 to 7.4 *mc*)

(1) Turn selector switch to range 3. Set the signal generator and receiver dials for 7.0 mc and adjust compensators (43), (25), and (7) for maximum output.

(2) Rotate the signal generators and receiver dials to 5.0 mc, then adjust compensators (43A), (25A), and (7A) for maximum output.

(3) Readjust compensators (43), (25) and (7) on the 7.0 mc signal.

Tuning Range (1.58 to 4.75 *mc*)

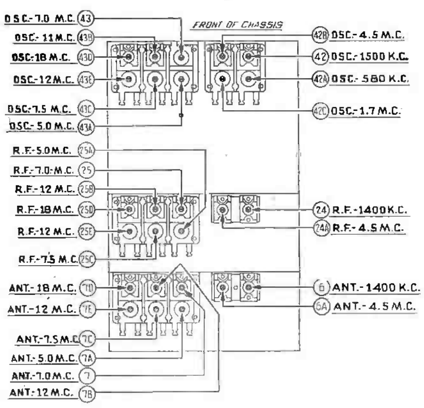


Fig. 5. Philco 37-116 r-f trimmer locations.

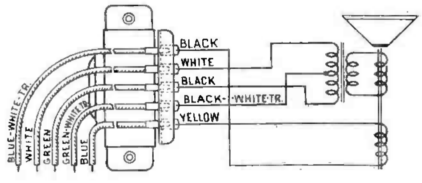


Fig. 6. Philco 37-116 speaker connections.

(1) Turn the selector switch to range 2. Set the signal generator and receiver dials to 4.5 mc. Now adjust compensators (42B), (24A) and (6A) for maximum output.

(2) Rotate the signal generator and receiver dials to 1.7 mc. Compensator (42C) oscillator series is now adjusted for maximum output as follows:

First tune compensator (42C) for maximum output, then vary the tuning condenser of the receiver for maximum output about the 1.7 mc dial mark. Now turn compensator (42C) slightly to the right or left and vary the receiver tuning condenser for maximum output. If the output reading increases, turn compensator (42C) in the same direction a trifle more, and again vary the tuning condenser for maximum output. If the output reading increases, turn compensator (42C) in the same direction a trifle more, and again vary the tuning condenser for maximum output. If the output decreases, set the compensator in the opposite direction. This procedure of first setting the compensator and then varying the tuning condenser is continued until there is no further gain in output reading.

(3) Readjust compensators (42B), (24A) and (6A) for maximum output as given in paragraph 1 above.

Tuning range (530 *to* 1600 *kc*)

(1) Set selector switch in range 1. Rotate the signal generator and receiver dial to 1500 kc. Adjust compensators (42), (24) and (6) for maximum output.

(2) Turn the signal generator and receiver dials to 580 kc. Compensator (42A) oscillator series is now adjusted, using the same procedure as given in paragraph 2 under tuning range (1.58 to 4.75 mc). The only difference in the two adjustments is the frequency and compensator used.

(3) Readjust compensator (42) on 1500 kc and compensators (24) and (6) on a 1400 kc signal.

MAGNETIC TUNING ADJUSTMENTS

(1) Leave the selector switch in position 1. Set the fidelity-selectivity control in the selective position (clockwise). Magnetic tuning in the out position. Turn the signal generator and dial to 1000 kc, then adjust the receiver tuning condenser for maximum output.

Note: It is very important to accurately adjust the receiver tuning condenser, also, adjust the signal generator attenuator to maximum output.

(2) Turn the magnetic tuning control to the on position (clockwise). Compensator (81S) secondary of magnetic tuning transformer is now adjusted for maximum output. If the indicator of the output meter goes off scale, turn the volume control of the receiver toward the minimum position until a readable indication is obtained.

(3) The above adjustment is now checked for accuracy, by turning the magnetic tuning control off. When this is done there should be no change in the tone of the receiver signal. If a change of tone or a hiss develops, it indicates a shift in frequency and the adjustment must be made again.

•

Majestic 21, 22, 23

Inoperative when tone control is in modified position: Caused by shorted 0.022-mfd condenser in this circuit. This defect is plainly indicated when diagram is inspected. However, it is stated on the digaram that six leads must be unsoldered to remove bottom plate, which work is not necessary to replace this condenser, as it may be replaced by unscrewing the right-hand side chassis plate only.

Howard J. Surbey

•

Sparton 57, 57-A, 57-B

Hum and oscillation at resonance: The ground connection to the shielding that covers the 75 grid lead often breaks away from its contact at the volume control. Resoldering the connection will eliminate the condition.

William Sollis

•

Stewart-Warner R-123

Inoperative: Check the 0.1-mfd condenser (No. 24) connected from the 6A7 screen to the chassis for short. Replace with one of higher voltage rating.

Howard J. Surbey

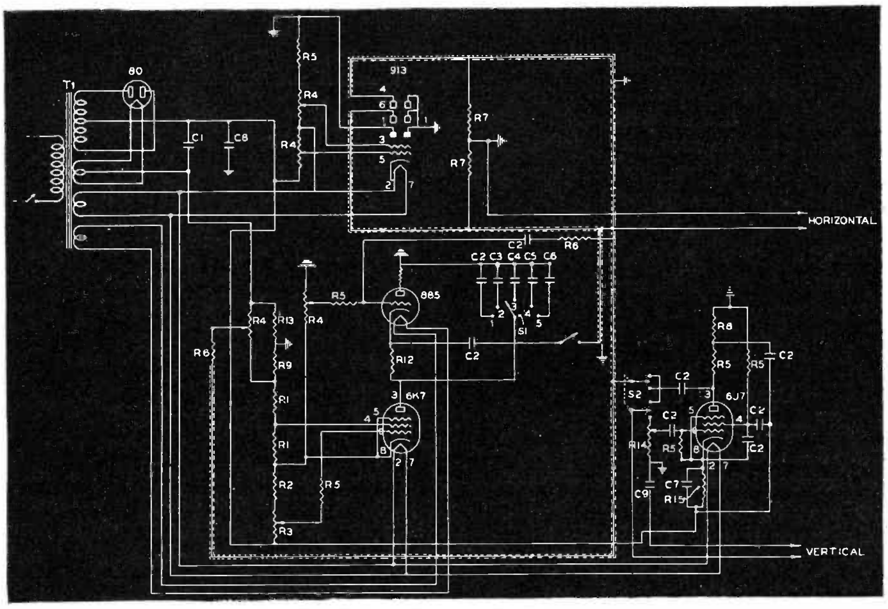
•

Truetone 80A

Inoperative: Test the 0.1-mfd condenser used to by-pass the plate return of the three type 24 tubes to the ground. This condenser is designated as C-12 on the circuit diagram furnished with the receiver. These receivers are manufactured for the Western Auto Supply.

Howard J. Surbey

The UTC PA913 transformer is the key unit in a *really stable* 913 oscilloscope



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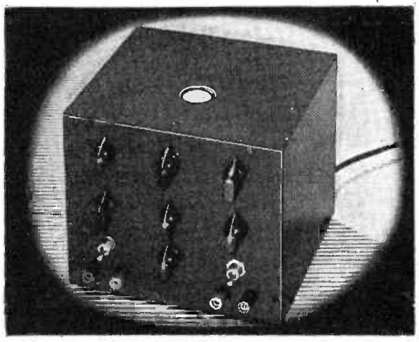
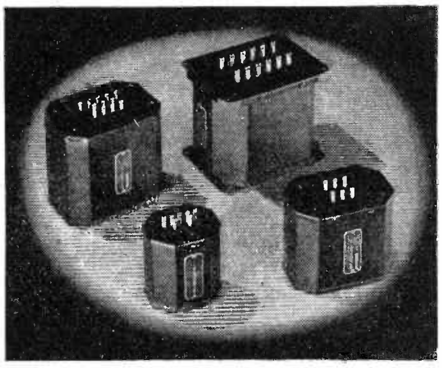


PARTS FOR 913 OSCILLOSCOPE

C-1	8 mfd. filter
C-2	.1 400 volt
C-3	.2
C-4	.005
C-5	.001
C-6	.0005
C-7	10 mfd.
C-8	2 mfd.
C-9	.25
R-1	30,000 ohms
R-2	750 ohms
R-3	10,000 potentiometer with switch
R-4	½ meg. potentiometer with switch
R-5	½ meg.
R-6	1 meg.
R-7	2 meg.
R-8	¼ meg.
R-9	25,000 ohms
R-10	50,000 ohms
R-12	1,000 ohms
R-13	10,000 ohms 10 watt
R-14	1 meg. pot.
R-15	5,000 ohms
S-1	Single pole five position
S-2	DPDT
T-1	PA 913

Each PA 913 transformer comes with a complete data sheet covering oscilloscopes for service and amateur applications.



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The UTC PVM items are companion units to the UTC VARIMATCH amateur transformers which match any modulator tubes to any RF load.

PVM-1

For all audio tubes up to 10 watts audio. Output 500, 200, 15, 8, 5, 3, 1½ ohms. Some typical tubes single or push pull: 19, 31, 33, 41, 42, 43, 45, 47, 48, 49, 53, 59, 71A, 79, 89, 2A3, 2A5, 6A6, 6F6, 6V6, 25A6, 25L6. Net Price **$3.00**

PVM-2

For all audio tubes up to 20 watts audio. Output 500, 200, 16, 8, 5, 3, 1½ ohms. Some typical tubes for single, push pull, or push pull parallel: 19, 31, 33, 41, 42, 43, 45, 46, 47, 48, 49, 50, 52A, 300A, 53, 59, 71A, 79, 89, 841, 843, 1602, 2A3, 2A5, 6A6, 6F6, 6L6, 6V6, 25A6, 25L6. Net Price **$4.80**

PVM-3

For all audio tubes up to 50 watts audio. Output 500, 200, 16, 8, 5, 3, 1½ ohms. Some typical tubes in push pull parallel: 42's, 45's, 46's, 50's, 52's, 300A's, 59's, 2A3's, 2A5's, 6F6's. In push pull self or fixed bias: 6L6's, 10's, 807's, 801's. Net Price **$7.50**

PVM-4

For all audio tubes up to 100 watts audio. Output 500, 200, 16, 8, 5, 3, 1½ ohms. Some typical tubes push pull parallel: 6L6's, 10's, 807's, 801's, push pull 845's, 800's, etc. Net Price **$12.00**

PVM-5

For all audio tubes up to 250 watts audio. Output 500, 200, 16, 8, 5, 3, 1½ ohms. Typical tubes: 211, 242A, 203A, 830B, 852, 838, 4—800's, 4—845's, ZB 120, etc. Net Price **$19.50**

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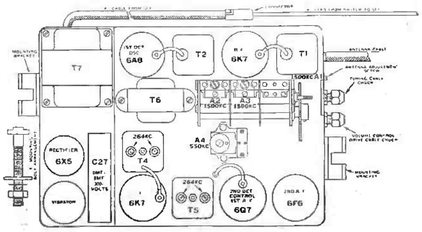


Fig. 2. Tube and trimmer locations.

Atwater Kent 556

The model 556 is a single unit auto-radio receiver using 6 metal or metal-glass tubes. One additional speaker may be used. The set consumes approximately 6.8 amperes with one speaker. If an extra speaker is added the additional drain is approximately 1 ampere. This model is arranged for use *without change* with either positive or negative terminal of the car storage battery grounded.

Alignment Procedure

When adjusting trimmers, keep the volume control and tone control turned full clockwise.

Use an Atwater Kent (No. 42590) i-f coupling unit to couple the signal generator while aligning i-f trimmers.

In order to keep below the avc level, it is necessary to use the weakest possible output from signal generator that will give a reading on a sensitive-output meter.

I-F Alignment

Turn variable condenser until plates are completely out of mesh.

Connect signal generator (264 kc) to cap of i-f tube by means of the coupling unit. Peak two trimmers on top of T5.

Connect signal generator to cap of first detector tube and peak two trimmers on top of T4.

Repeat adjustments for greater accuracy.

Dial Adjustment

With variable condenser fully meshed, the arrow indicator should be adjusted (by means of screw in center of dial lamp opening at rear of tuning unit) to the mark beyond the 550-kc end of dial.

R-F Alignment

Connect signal generator (1500 kc) to antenna and chassis, using a 200 mmfd fixed condenser in series with the antenna lead. With dial at 1500 kc, peak A3 (oscillator), A2 (first detector) and A1 (antenna). Use first peak as A3 is screwed in from a loose position.

With signal generator at 550 kc, peak tracking condenser A4 while rocking tuning control slightly around the 550-kc mark.

Repeat adjustments at 1500 and 550 kc if necessary.

Crosley A-366

The Crosley model A-366 is a six-tube superheterodyne receiver designed for operation with a header speaker, an under cowl speaker or both. The power supply unit is an integral part of the chassis and is completely shielded from the remainder of the receiver.

Alignment Procedure

All the circuits in this receiver are very accurately adjusted at the factory

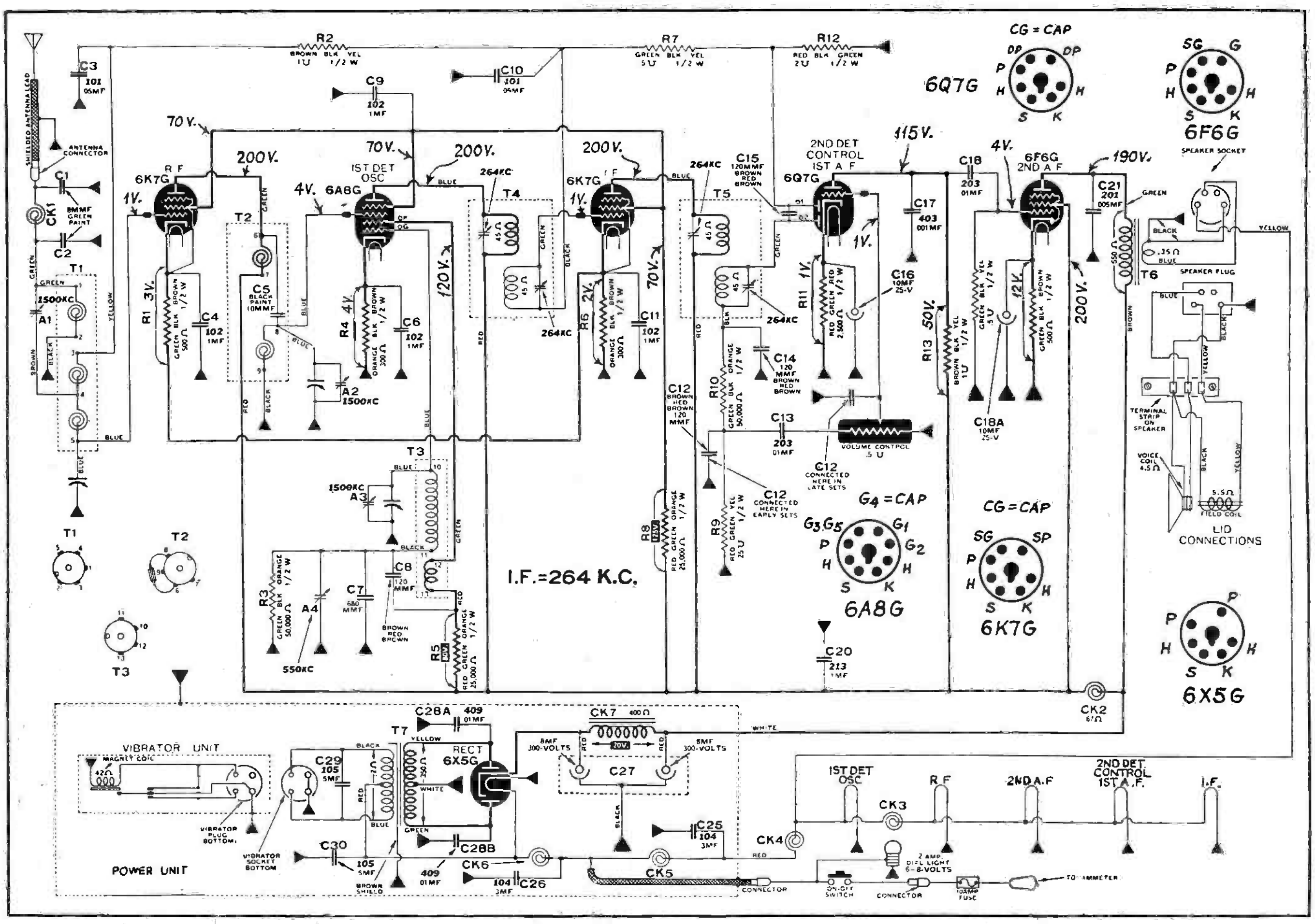
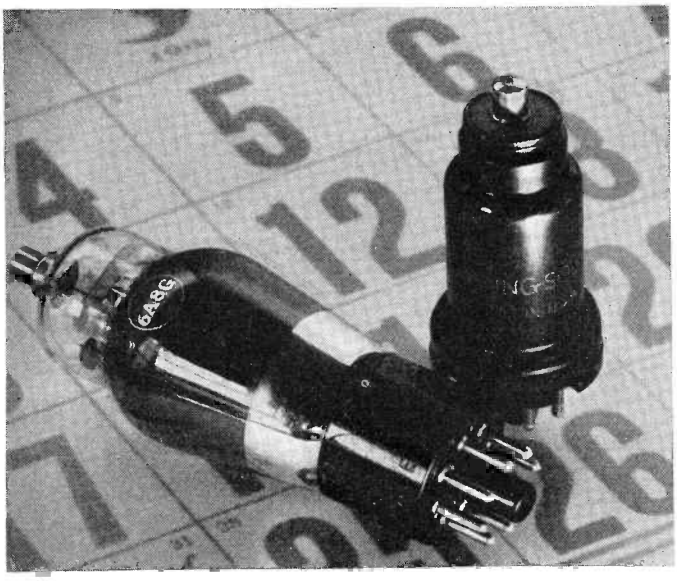


Fig. 1. Atwater Kent 556 circuit diagram.



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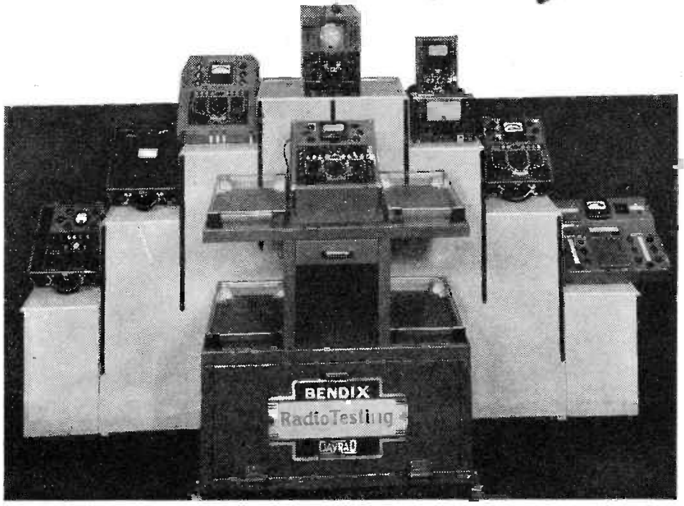

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and normally should need no further adjustment. However, if it is definitely known that an adjustment is necessary the circuits can best be properly aligned with the use of a modulated signal generator and an output meter.

Connect one terminal of the output meter to the plate and the other terminal to the screen of the 42 output tube. Be sure the meter is protected from d-c by connecting a condenser (0.1 mfd or larger—not electrolytic) in series with one of the leads.

Note: The receiver chassis must be in its case and a speaker similar to one used with the receiver must be connected to the chassis before making any adjustments. It is also advisable to use a spare control unit for making adjustments of the volume control and tuning condenser. A standard control unit with short cables (6 to 8 inches) makes a very convenient and useful tool. If it is desired to shorten a pair of long cables it will be absolutely necessary to heavily tin the cables before cutting them.

I-F Alignment

(a) Connect the output of the signal generator through an 0.02-mfd. condenser to the top cap of the 6A7 osc-mod tube, leaving the tube's grid clip in place. Connect the ground lead from the signal generator to the receiver chassis frame. Keep the generator leads as far as possible from the grid leads of the other screen-grid tubes.

(b) Adjust the station selector so that the rotor plates of the tuning condenser are completely in mesh.

(c) Turn the volume control of the receiver full on and turn the tone control to the treble position.

(d) Set the signal generator to 262 kc.

(e) Adjust both trimmers located on the second i-f transformer for maximum output. (See Fig. 2).

(f) Adjust both trimmers located on the first i-f transformer for maximum output.

(g) Repeat operations (e) and (f) for more accurate adjustments.

Always use the lowest signal generator output that will give a reasonable output meter reading.

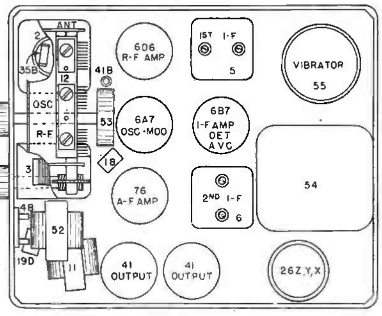


Fig. 2. Tube and trimmer locations.

R-F Alignment

(a) Connect the output lead from the signal generator through a 0.00025-mfd condenser to the antenna connection of the receiver.

(b) Set the signal generator to 1400 kc.

(c) Adjust the station selector to 140 on the dial.

(d) Adjust the trimmer on the oscillator section of the tuning condenser for maximum output.

(e) Adjust the trimmer on the r-f section of the tuning condenser for maximum output.

(f) Adjust the trimmer on the antenna section of the tuning condenser for maximum output.

(g) Readjust the station selector for maximum output. Do not readjust the oscillator trimmer.

(h) Repeat operations (e) and (f) for more accurate adjustments.

(*Continued on page* 59)

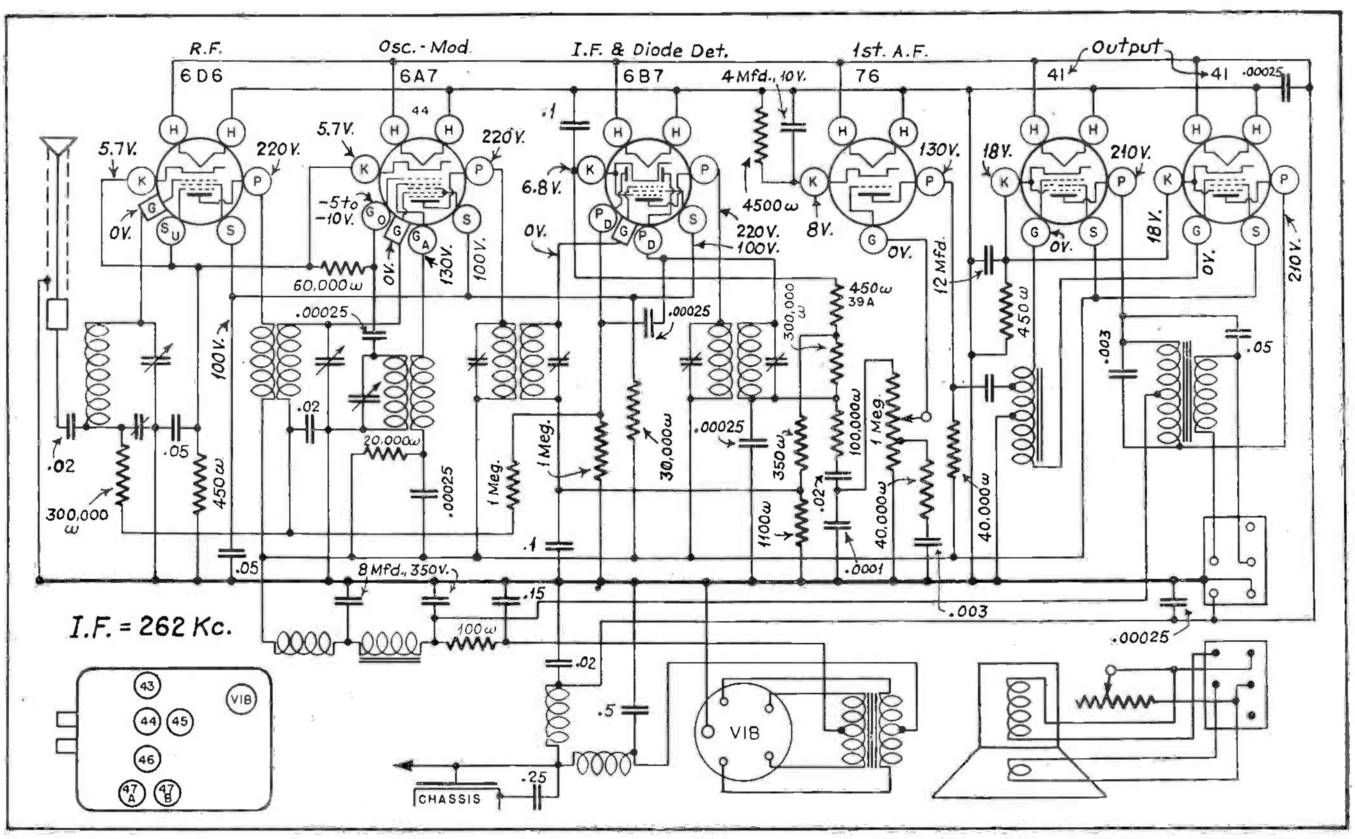


Fig. 1. Crosley A-366 circuit diagram.

ON THE JOB . . .

Individual Batteries for Philco Sets

Many owners of Philco battery receivers have desired to use individual A, B, and C batteries but have had no information to guide them in making the changeover.

THE "AIR CELL"

The earlier models were equipped with either ballast tube for use with a 3-volt dry A battery, or with a circuit-closing plug in the ballast tube socket for use with a 2-volt storage battery. Later models have neither ballast tube nor ballast tube socket. In either case no provision is made so that the owner can use an "Air Cell" A battery. While some owners have used this battery with the ballast tube, this is not recommended. In the first place, the ballast tube is designed to regulate the voltage of a 3-volt dry A battery to suit 2-volt tube filaments, whereas the "Air Cell"

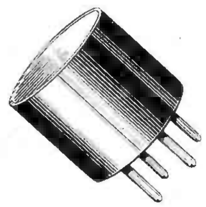


Fig. 1. Conversion resistor plug.

is a 2.5-volt battery. Furthermore, its voltage is so nearly constant as to require no regulation, so that a fixed resistance in the filament circuit is all that is required.

CONVERSION RESISTORS

These fixed resistors are available in the form of a plug and are known as conversion resistor plugs. They are made by most of the resistor manufacturers. There are seven types, four of which are used with Philco sets. A data sheet, covering the use of conversion resistor plugs, is available.

Some of the later models of Philco battery receivers have no provision for a ballast tube. In these sets the battery voltage may be reduced by the attachment of a fixed resistor of the proper value in series with the connection to either of the terminals of the battery. These resistors can be purchased already made up. Five ranges of filament current drain are covered, three of which are used on Philco receivers.

THE B AND C BATTERY ADAPTER

Philco battery receivers are equipped with a B and C battery cable which terminates in a single seven- or eight-prong plug. This plug is designed to fit into the socket of a combination B

*The material for this article was supplied by the National Carbon Co., Inc.

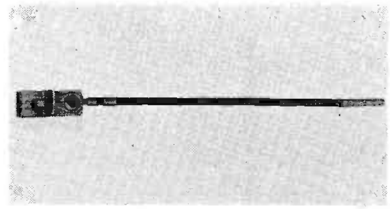


Fig. 2. Eveready "Air Cell" resistor.

and C battery usually called the "BC" pack. Where the set owner prefers the economy of individual plug-in B and C batteries the changeover may be accomplished through the use of a B and C battery adapter. This adapter consists of a cable having either a seven-or an eight-prong socket on one end and suitable battery plugs on the other. The plug on the receiver cable is connected to the adapter socket, and the individual battery plugs connect into the sockets of standard types of B and C batteries.

For use with table models, where the B and C batteries would ordinarily be exposed, a battery container can be obtained. This container in external appearance is much the same as the "BC" pack, but enables the use and replacement of the B or C batteries in individual sections.

CONVERTING PARTICULAR MODELS

For the conversion of each model of Philco battery receiver proceed as follows:

Philco 34 *and* 34-*A*: Use type 7 conversion resistor plug in the ballast tube socket. Use a No. SA-850 "Air Cell" A battery. Attach a B and C battery adapter No. 5394-8 to the battery cable. Use three 45-volt B batteries and three 4½-volt C batteries. A battery container may be used to house the batteries for the table models.

Philco 38 *and* 38-*A with type* 15 *converter tube*: An SA-850 may also be used with this model through the use of a type 7 conversion plug in the ballast tube socket. However, a type A-600 "Air Cell" may be used if the dial lamp is removed and a type 4 conversion resistor plug is inserted in the ballast socket. Adapter No. 5394-7 is necessary in order to convert to the use of three 45-volt B batteries and two 4½-volt C batteries. A battery container may also be used with table models if desired.

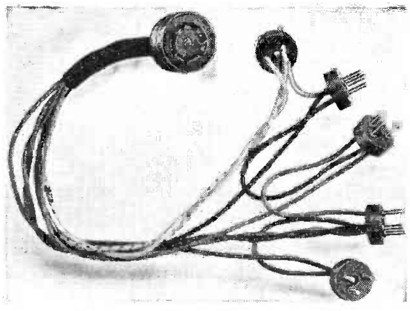


Fig. 3. B and C battery adapter.

Philco 38 *and* 38-*A with type* 1*A*6 *converter tube*: Use a type 5 conversion resistor plug in the ballast tube socket with a type A-600. Attach adapter No. 5394-7 to the battery cable. Use three 45-volt B and two 4½-volt C batteries.

Philco 38 *and* 38-*A with type* 1*C*6 *converter tube*: Use a type 6 conversion resistor plug in the ballast tube socket with a type A-600. Attach adapter 5394-7 to the battery cable. Use three 45-volt B and two 4½-volt C batteries.

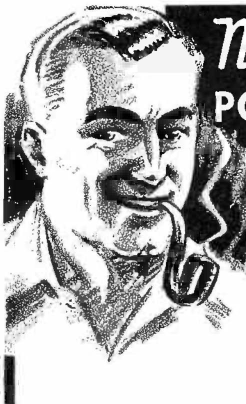
Fig. 4. Eveready B-C battery container.

Philco 39 *and* 39-*A*: Use a type 7 conversion resistor plug in the ballast tube socket with a SA-850, or remove the dial lamp and use a type 4 plug and an A-600. Adapter No. 5394-8 should be used to accommodate three 45-volt B and three 4½-volt C batteries.

Philco 623 *and* 623-*A*: Use a type 7 conversion plug with No. SA-850, or remove the dial light and use a type 6 plug and a No. A-600. Attach adapter 5394-7 to the cable for use with three 45-volt B and two 4½-volt C batteries.

Philco 37-33: Use an "Air Cell" resistor No. 540-560 connected to either terminal of a No. A-600. Adapter 5394-7 accommodates three individual 45-volt batteries and two 4½-volt C batteries.

Philco 37-38: Use resistor 740 connected to either terminal of a No. SA-850, or use resistor 660-680 and battery A-600 and replace the 120-ma dial lamp with a 60-ma light. Adapter



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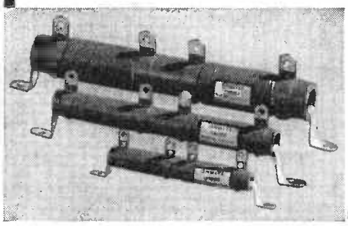

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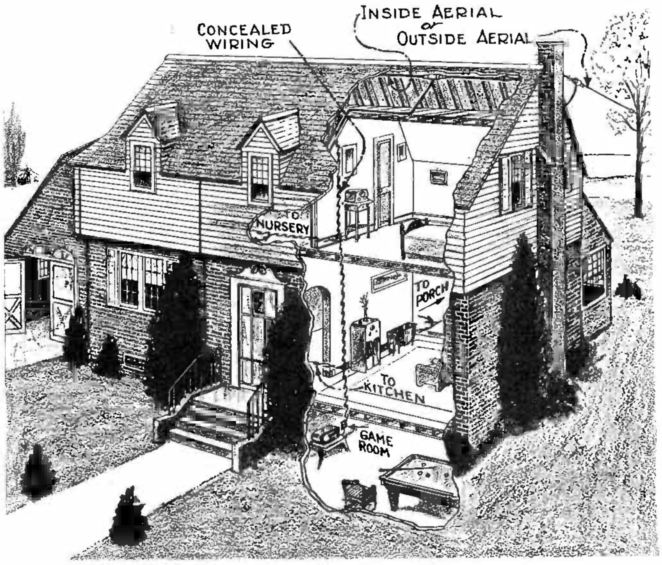

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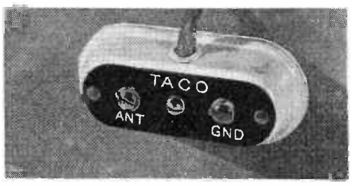

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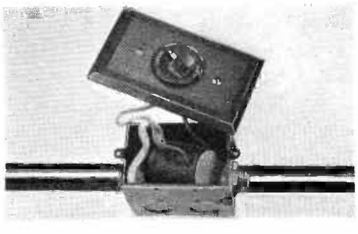

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5394-7 connected to the battery cable will accomodate three 45-volt B and two 4½-volt C batteries in individual sections.

Philco 37-623: Same procedure as for the model 37-38.

Philco 37-643: Use resistor No. 660-680 connected to either terminal of a No. A-600. Attach an adapter No. 5394-7 to the cable and use three 45-volt B and two 4½-volt C batteries.

•

Reducing Code and Image Interference

The "image" of a station appears at a point on the dial of twice the i-f peak subtracted from the fundamental frequency of the station causing the "image" to appear. For example, twice 465 kc is 930 kc, and this subtracted from 9,530 kc (the fundamental frequency of W2XAF) gives a reading of 8600 kc on the dial, if the receiver is accurately calibrated and aligned.

The amount of "image response" in a superheterodyne receiver depends upon a number of factors. The inherent design, the number of radio-frequency stages used ahead of the first detector, the amount of shielding used around the oscillator and intermediate amplifier tubes and circuits, and the power (indirectly) of the transmitting station, are among the few of these factors.

Several complaints have been recently received from listeners to International Broadcast Station W2XAF regarding the subject of code or telephone radio stations operating on or near the assigned frequency of W2XAF or 9530 kilocycles.

Upon investigation, however, it was found that the stations mentioned as the cause of the interference were not operating within this channel assigned internationally for international broadcast stations, namely, from 9500 to 9600 kilocycles, but were operating in full accordance with and abiding by the international agreements on frequencies between 10,440 to 10,460 kilocycles which lie within the 9600 to 11,000 kilocycle band assigned for commercial fixed services.

Interference on W2XAF from such stations in a superheterodyne receiver is generally due to the "image response" of the receiver itself when tuned to a desired signal. If the desired station is operating on 9530 kilocycles (W2XAF), the oscillator, in many modern receivers, operates at a higher frequency, namely, 9530 kc plus the intermediate frequency (usually about 460 kc or 9990 kc.) If the r-f selectivity for frequency conversion is inadequate, an incoming signal above the oscillator frequency at 9990 kc plus 460 kc, or 10,450 kc, may produce an audible beat note with the desired signal.

The image response ratio for a receiver without a radio-frequency amplifier preceding the converter averages about 4 at 10,000 kc. This means that the image signal would have to be 4 times as strong as the normal desired signal to produce the same audio output from the receiver. With a r-f amplifier preceding the converter, the image response ratio increases to about 140 at the same frequency in typical all-wave receivers. An additional r-f amplifier would increase the image response ratio to about 5000. Therefore, one or more r-f stages before the converter adds radio-frequency selectivity to discriminate against a signal at the image frequency. In addition, increased sensitivity also results and this may be desirable for improving the signal-to-noise ratio in a receiver not having an r-f amplifier.

A tuned preselector, added for the high-frequency band used, should reduce the interfering signal by a factor of 35. Adding such a device requires an additional tuning control.

Shifting the intermediate frequency about 10 kilocycles either way will eliminate interference only from a particular signal, and requires careful re-alignment of all circuits of the receiver to hold substantially the same scale calibration. This change may be made by competent Service Men who have the necessary instruments and equipment.

When the intermediate frequency is shifted 10 kilocycles, the image frequency is shifted 20 kilocycles. This should be sufficient except for very high speed keying of the interfering signal. It is important that the intermediate frequency is not shifted too much, as this may seriously affect the tracking of the r-f and oscillator tuned circuits.

Probably the simplest method for reducing image frequency interference is to add a wave trap in the antenna circuit. This will be fairly effective if the intermeditae frequency is above 450 kilocycles. The trap may consist of a good quality midget variable air condenser having a maximum capacitance of 100 micromicrofarads, and an inductance of about 4.5 microhenries. The inductance should be of the "low-loss" type. It has been found that a 1-inch diameter thin bakelite threaded form (12 turns-per-inch) wound with 14 turns of No. 18 B & S bare copper wire to be about right for tuning out interfering signals from 7000 to 18,000 kc. Depending upon the antenna used and receiver coil constants, the trap may be connected with the coil and condenser in series from the antenna post to the chassis, or the coil and condenser may be connected in parallel. This shunt circuit is then connected in series with the antenna load.

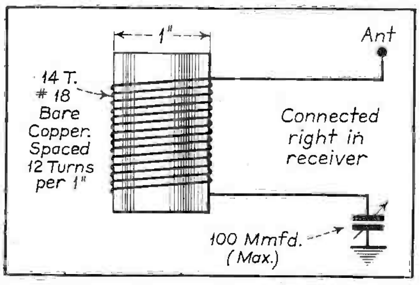

Fig. 1. Series wave trap.

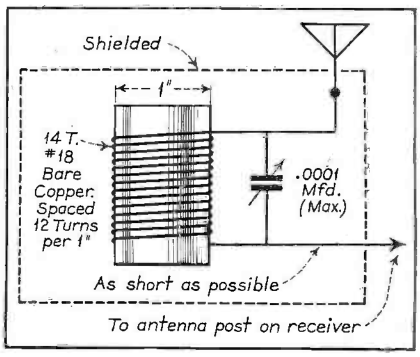

Fig. 2. Shunt wave trap.

In either case, it is desirable to shield the coil and condenser, and if a midget air condenser is used, the entire trap may easily be mounted in a can such as used to shield the intermediate-frequency coils. For best results the trap should be mounted very close to the antenna terminal using short leads, in order to prevent undesired signal pickup in the lead extending from the trap to the antenna post.

The trap may be adjusted by tuning in the desired signal on the receiver and adjusting the midget trap condenser for minimum interference from a station on the image frequency. Or, the interfering station may be tuned in at two times the intermediate frequency above the desired signal and then adjust the trap tuning for minimum response. A slight decrease in the strength of the desired signal may be found when the trap is tuned to the image, depending upon the losses in the wave trap coil.

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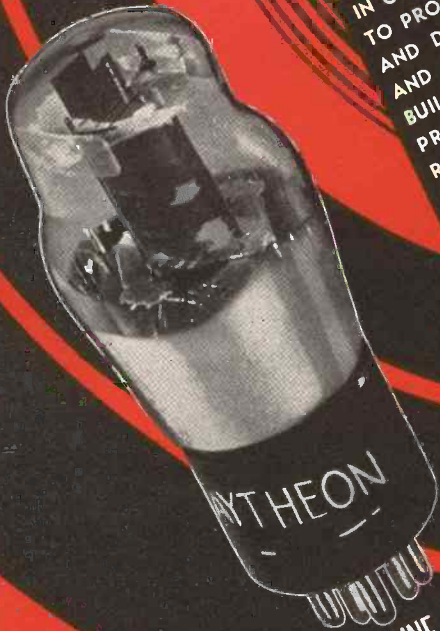

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TEST EQUIPMENT...

A-C BRIDGE MEASUREMENTS IN SERVICE PROCEDURE

By GLENN H. BROWNING*

WITH the increasing complexity of radio servicing, the tools of the Service Man have become more and more those of the laboratory technician and engineer. In 1934 and '35, the popularization of the oscilloscope was definitely indicative of this tendency. Today the Service Man is beginning to appreciate the utility of the a-c bridge—particularly in capacity measurements.

The superiority of the bridge over the conventional forms of capacity meters are the wide range (10 micromicrofarads to 100 farads in the bridge to be described), and the highly significant advantage of power-factor determination. In the case of capacity meters the determination of capacity is made by means of the equivalent impedance of a condenser without considering its power factor with the result that if the power factor is very high the capacity as indicated on the meter is incorrect. In the past, power factor has been pretty much the concern of the design engineer, despite the fact that considerations involving power factor have been responsible for baffling service problems (such as apparently incurable loss of sensitivity), impermanent and otherwise unsatisfactory repairs. This has been partially due to the fact that the importance of power factor has not been appreciated. Its treatment has been largely neglected in service literature, and in engineering texts it has been usually considered in terms of phase angle—terms that have little meaning to the Service Man.

*Chief Engineer, Tobe Deutschmann Corp.

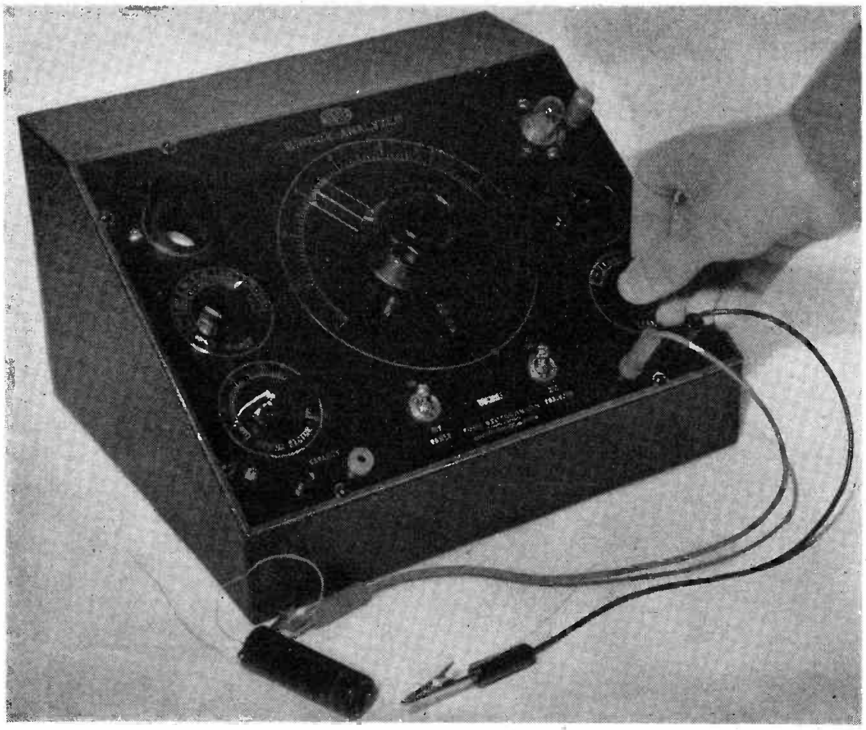
POWER FACTOR

The power factor of a capacitor (which may be a conventional condenser, or represented by the capacity between twisted leads, or between the shield and the wire in a shielded cable) is pretty much just what the term implies. In charging, a certain amount of electrical power is stored in a condenser. In a perfect condenser all of this power would be returned on discharge. Unfortunately there are no perfect condensers, and the power factor is an index of the amount of loss. In the perfect condenser the power factor would be zero—i.e., there would be no loss.

The power factor of a condenser is really a measurement of the power loss in condensers of fixed size; more precisely, it is the energy loss at a given voltage per unit capacity. Naturally if the condenser has a large value—for instance, 2 mfd—there is more energy loss than there would be in the same type of condenser whose capacity was only 0.2 mfd. However, the power factor of these two condensers would be the same since power factor takes into account the size of the condensers as well as the energy loss (watts loss). In paper or mica condensers the power factor of a good condenser is extremely low, ranging from about one one-hundredth of one percent power factor in the case of a mica condenser to one-half of one percent power factor in the case of paper condensers. The increase in power factor of a condenser of the paper type with age indicates, in all probability, deterioration due to the presence of moisture, consequently rising power factors in this type of condenser indicate that failure is imminent. From a Service Man's standpoint this indication of failure in a condenser before it actually takes place is extremely valuable, for it forestalls a repeat repair job for which the Service Man may have difficulty in collecting.

The power factor of electrolytic condensers is, of course, very much higher than paper, mica, or similar materials, for two reasons: first, the aluminum oxide film which makes up the dielectric in the electrolytic condenser has a higher power factor than either mica or paper; second, the electrolyte which is in contact with the negative terminal of the condenser may have considerable resistivity. Any current flowing in and out of the condenser must pass through this electrolyte and as a consequence the energy dissipated per unit capacity is high. As has been said, increasing power factor in a paper condenser foretells that the condenser is deteriorating. This is not in general true with electrolytic condensers whose normal power-factor range is from 4 to 20 percent. If the Service Man finds a filter condenser whose power factor is less than 20 percent measured at 60 cycles (the 60-cycle and 120-cycle measurements are very nearly the same) he will find that the filtering efficiency is not a great deal impaired. However, condensers which have power factors over 20 percent will show a marked deficiency in filter circuits.

Probably the simplest electrical circuit for understanding power factor is



Tobe a-c bridge-analyzer.

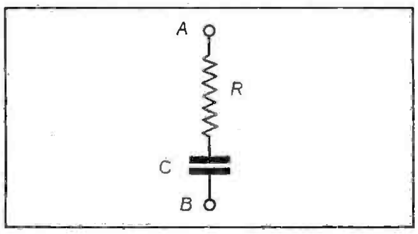


Fig. 1.

that shown in Fig. 1, where R is a resistance inherent in the condenser C. A and B are considered as the condenser terminals. Obviously not all of the energy impressed across the terminals of this condenser upon charge will be returned on discharge as there will be a loss in the resistor proportional to the square of the charging current. Referring to Fig. 1, the power factor of the condenser will be equal to

$$\text{p.f.} = \frac{R}{\sqrt{R^2 + \frac{1}{C^2\omega^2}}}$$

where R is the equivalent series resistance of the condenser whose capacity is C and where ω is 2π times the frequency. The above equation, however, reduces to RCω for practical purposes in cases where the power factor is less than 10 percent. Of course, for mathematical purposes the circuit shown in Fig. 1 may be reduced to a condenser which is practically perfect (i.e., has no loss) in parallel with a resistance R_p in which case the power factor of the condenser may be expressed as

$$\frac{1}{\sqrt{1 + R_p^2C^2\omega^2}}$$

where C is the capacity of the condenser as before, R is the equivalent parallel resistance, and ω is 2π times the frequency.

An inspection of Fig. 2 would indicate that a d-c measurement made on R_p would be sufficient to determine the power factor of the condenser. However, such is not the case, for in a condenser made up of a thick dielectric as shown in Fig. 3 where pockets of moisture were present, the d-c resistance of the condenser might be practically infinite while the power factor of the condenser might be very appreciable. The reason for this is that every time the condenser is charged up by an alternating voltage there is energy dissipated due to the resistance present in the moisture pockets. As a consequence, Fig. 1 actually gives a very much clearer picture of what is meant by power factor.

It might be said in passing that if the d-c leakage of a condenser is high (i.e., the equivalent parallel resistance of the condenser is low) that the power factor is always higher than normal. However, the reverse is not true—i.e., just because the power factor of a condenser is high does not necessarily mean that the d-c leakage is high.

The A-C Bridge

The a-c bridge gives the Service Man a tool which enables him to not only measure the capacity of a condenser but also determine its power factor. Combined with the capacity bridge a d-c analyzer for determining leakage values up to more than 1400 megohms

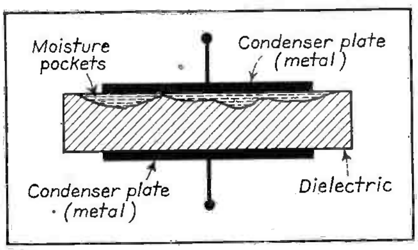


Fig. 3.

is included in the analyzer shown in Fig. 4. It will be noted that the bridge is of a conventional type with the 6G5 tube as the null indicator. The 6G5 is a variable-mu electron-ray tube which, when no voltage is impressed on the grid, has a dark shadow angle of approximately 90 degrees. It makes an excellent null indicator, for when an a-c voltage is impressed on the grid the shadow angle is reduced.

An amplifier consisting of a 6C6 tube

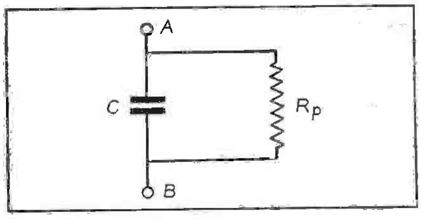


Fig. 2.

is employed ahead of the 6G5 which insures obtaining adequate sensitivity over the entire range of capacity and resistance measurements. A considerable amount of sensitivity is required when the power factor of a condenser is to be determined with accuracy. The capacity range of the bridge is from 10 mmfd to 100 farads while the power-factor range is from 0 to 50 percent. A switch is incorporated so that the standard condenser used as one arm of the bridge may be switched to a standard resistance in which case the bridge measures the values of resistors from 0.1 ohm to 1 megohm. Both the resistance and the capacity measurements are made at 60 cycles. A decade range switch which is used as a multiplier is incorporated so that a linear scale calibrated from 0.1 to 1.0 is used for the balance determination. This is an important feature contributing to the accuracy and ease of operation of the instrument, for there is no bunching of the capacity or resistance readings at one end of the dial. Further improvement in accuracy results from the use of the decade switch which provides a

(Continued on page 52)

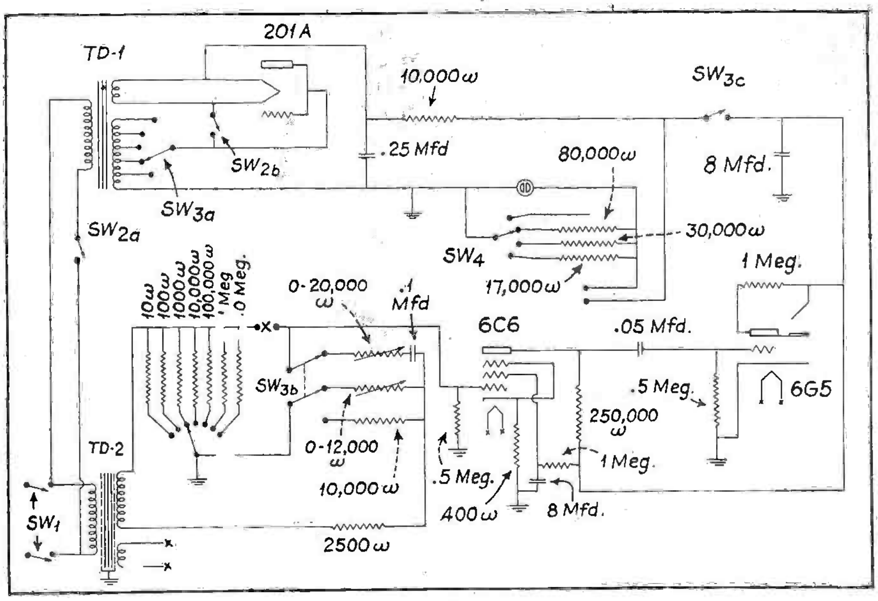


Fig. 4. Tobe a-c bridge-analyzer circuit.

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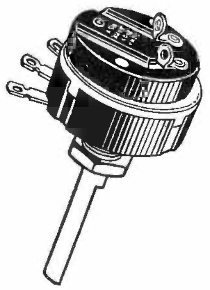

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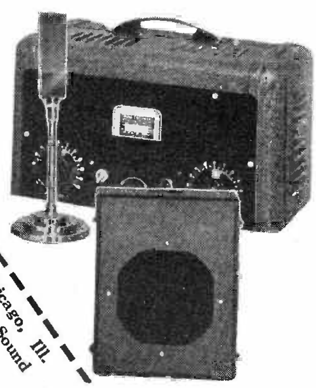


RECEIVER CASE HISTORIES

A-C, D-C Receivers

Intermittent fading: Intermittent fading and erratic operation of small a-c, d-c sets is often nothing more than a defect in the resistor feeding the screen grid of the detector. Many sets feed the detector screen directly from B positive through a 2-5 meg resistor by-passed with 0.05-0.25 mfd. The least defect in either resistor or condenser will be shown if a high resistance voltmeter is connected between B positive and screen as this will give a great increase in volume.

Francis C. Wolven

•

Grunow 501, 520, 530, 550 (Chassis 5B)

Speaker rattle: This is often caused by the leads from the output transformer which may touch the cone. Moving the leads further back and fastening them to prevent them from returning to the cone should clear the difficulty.

Howard J. Surbey.

•

Philco 111, 111A

Intermittent operation: After checking the set thoroughly and making change after change the stubborn brute would continue to fade after several hours of playing.

The real cause of the fading was poor contacts on the tube sockets. The set uses eleven tubes and a speaker plug with four contacts. These contacts are of the single spring type and loosen easily. The remedy is to bend each spring until the contacts grip tightly. None of the springs should be neglected because they are under condensers and difficult to reach.

Jim Kirk

•

Philco 805, 806, 807, 808, 809

Weak signals: After checking the coupling condensers check the i-f trimmers for low resistance wax. It is advisable to remove all wax or replace the trimmers. Realignment is necessary, of course.

Allan Siepman

•

Silvertone 1840, 1842

Inoperative: The 2A5 grids glow a bright red. This is caused by an open primary on the output transformer.

To assure against the recurrence of this defect the plate current of the 2A5 can be reduced (without materially affecting the response of the receiver) by connecting a low value resistor (about 100 or 200 ohms) in series with the cathode of the 2A5.

Richard C. Clapp

Stewart-Warner R-147

Hum: Several simple circuit changes have been developed which are effective in reducing hum where it is excessive and is not caused by defective tubes or parts.

For residual hum: (Between station hum) Remove the 0.5-mfd condenser connected from the chassis to the mounting nut of the input electrolytic condenser (the one nearest the power transformer). Replace the 0.5-mfd condenser with a 10-mfd 25-volt electrolytic condenser. The positive terminal of this condenser must be connected to the chassis. This change should always be made in combination with the following one, since either change may increase the hum if made alone.

Locate the 210,000-ohm resistor connected from the plate of the 6C5 tube to one of the 5Z4 socket terminals.

(a) Disconnect the end of this resistor going to the 5Z4 socket.

(b) Connect a 51,000-ohm resistor in series with the disconnected end of the resistor and the lug on the 5Z4 socket from which it was unsoldered.

(c) Connect a 0.25-mfd condenser from chassis to the junction of the above two resistors.

Remove the twisted green and brown wires connecting to the tone control and replace them with a shielded twisted pair. Ground the shield at *both ends*. Route the shielded wire so that the shielding does not ground the mounting nut on the electrolytic condenser nearest the power transformer.

Separate the single green volume control wire from the transformer and a-c leads.

In all cases of either residual or modulation hum, tighten down the power transformer mounting screws after the set is hot.

Early production sets did not have the resistance-capacity filter consisting of a 260,000-ohm resistor and a 0.1-mfd condenser in the grid circuit of the 6F5. In these early sets a 1.1 meg resistor was connected from the 6F5 grid to the bias resistor network. The later sets used a 760,000-ohm resistor connected from the grid to the filter resistor and condenser. On any of the early sets which do not have the filter, a 260,000-ohm, 1/4 watt resistor should be added in series with the end of the 1.1-meg grid resistor which connects to the bias network. A 0.1-mfd, 150-volt condenser should be connected from chassis to the junction of the 260,000-ohm and 1.1-meg resistors.

For modulation hum: (On stations only) Make this change even though no modulation hum is heard in the shop. Replace the 0.1-mfd screen-grid by-pass condenser (diagram No. 28) connected to the 6A8 socket with the 0.5-mfd, 150-volt by-pass condenser which was disconnected from the mounting nut of the input electrolytic condenser.

Important: If there is still too much hum after making the above changes be sure to check for defective tubes.

•

Stewart-Warner R-148

For modulation hum: (On stations only) Make this change even though no modulation hum is heard in the shop.

Remove the 0.1-mfd, 150-volt condenser connected to the screen-grid circuit of the 6K7 r-f tube. Replace it with a 0.5-mfd 150-volt paper condenser.

For residual hum: (Between station hum) Locate the red-blue wire running from the 5V4G socket heater terminal to the speaker socket. Disconnect one end of the wire and re-route the wire along the back of the chassis so that it is at least two inches above the 6H6 and 6C5 sockets when the chassis is upside down. Reconnect the wire.

A twisted pair should be placed along the front of the chassis so it can be used to connect the heater terminals of the 6K7 r-f and the 6L6 sockets. First connect a black wire to the grounded heater terminal of the 6K7 r-f socket (the heater terminal near the front of the chassis) and a blue wire to the hot heater terminal of the same socket. The other end of the black wire must be connected to the grounded heater terminal of the 6L6 nearest the *front* of the chassis and the other end of the blue wire must be connected to the hot heater terminal of the other 6L6 socket (the one nearest the 6C5).

Remove the input audio transformer mounting screw nearest the front of the set. Rotate the transformer around its other mounting screw until the free end is toward the rear of the chassis. There is a hole in the chassis at the proper point to mount the transformer by means of the small machine screw, lockwasher and nut. Pull the transformer leads away from the tube sockets. Sometimes an intermediate position of the transformer will result in less hum but this necessitates drilling either one or two new mounting holes.

Tighten down the power transformer mounting bolts preferably when the set is hot.

Stromberg-Carlson 68

Alignment: In aligning this model the avc amplifier trimmer (C57) should be tuned for *minimum* between the two peaks on the output meter.

Additional service data: With the selector unit on its right side, the top row of trimmers are for the A band; the second row for the B band: the third row for the D band and the fourth row for the C band. The A band low-frequency padder is on the front-left side, the lower condenser. The B band low-frequency padder is the left upper; the C band padder is on the lower right side—the D band has no padder. A tuning wand is practically the only way to check the bottom trimmers since even an all fibre rod will detune them slightly.

The fuse clips in these models should be checked for corrosion and noise.

H. M. Bell

•

Stromberg-Carlson 125

Replacing dial lamps: Facing the rear of the chassis, remove the 6K7, 6A8, 43 and 25Z5 tubes. With the right hand passed to the right of the nearest i-f transformer, remove the nearest pilot lamp from the bracket. Pull the lamp to the right side of the i-f transformer where the bulb can be removed.

Insert left hand to the left of the other i-f transformer and lift lamp socket from bracket. The bulb can now be removed from the socket by supporting socket with right hand inserted over gang condenser. To remove bulb from socket, *do not* place thumb or finger directly under the bulb. Support ends of black insulator wings between the first and second fingers of the right hand. Push in on the bulb and turn slightly to left and release pressure—grasp bulb and pull out.

After replacing the pilot lamps by methods similar, but opposite to the above, the tubes should be replaced in their respective sockets.

•

Stromberg-Carlson 130

Replacing dial lamps: Turn the pointer to about 0.9 on the broadcast band. The lamp for illumination of the pointer will be found just above the gang condenser. The other lamp is found on a fixed bracket above the gang condenser.

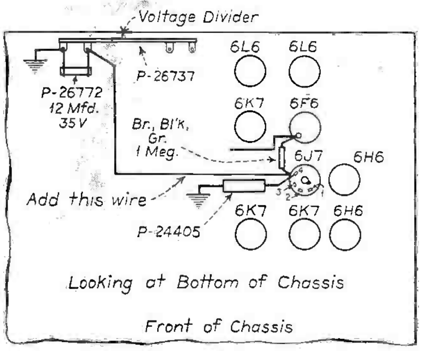
•

Strömberg-Carlson 140

Replacing dial lamps: Turn the pointer to about 1.1 on the broadcast band. The lamp for the illumination of the pointer will be found between the gang condenser and the nearest i-f transformer. The other two lamps are on fixed brackets just above the gang condenser.

Stromberg-Carlson 160-L

Service note: Variations in new 6J7 tubes have occasionally caused distortion in the automatic tone control circuit of the 160-L receiver, as first released. These tubes function correctly after aging a few hours. Also it has been found possible to eliminate this possibility of distortion with new or aged tubes by adding a wire, as shown below, to stabilize the screen voltage.



This modification was put in effect at the factory in all 160-P and 180-L receivers, and in all 160-L produced after October 23, 1936.

•

Stromberg-Carlson 160-L, 160-P

Rushing noise: Background hiss or rushing noise, when encountered in a 160-L or 160-P receiver, can usually be cleared by replacing the 6A8 modulator tube.

Incidentally, the 6A8 tube removed from a 160 can frequently be employed with full satisfaction in a Stromberg-Carlson 125, 130, 140, 145, 150 or 180 receiver. Thus, clearing noise in a 160 becomes simply a matter of swapping 6A8 tubes with another Stromberg-Carlson.

The trouble is thought to be due to a slight defect in the weld in the second grid, occurring in a small percentage of 6A8 tubes. It does not show up on tube checkers, and causes no noise where the tube is used with potential on this grid as in the latter models.

•

Stromberg-Carlson High-Fidelity Models

Tuning: (Broadcast band) Set owners often complain that the high-fidelity control detunes the receiver, or that tuning can be sharpened appreciably after adjusting for high fidelity. This indicates lack of attention to the instruction books accompanying each of the receivers, which specifically state that "On the broadcast band, a high-fidelity Stromberg-Carlson radio should *always* be tuned with the fidelity control set for standard fidelity. *Never* retune the set after advancing to the high-fidelity position."

The change in tuning meter swing or in the shadow on the tri-focal eye tube, noticed when adjusting from standard to high fidelity, indicates a broadening of the sidebands to give a wider frequency response. If the operator retunes the radio after adjusting to high fidelity —or if he then tunes in another station without returning to standard fidelity— the receiver will invariably be tuned to one or another of slightly off-resonance peaks, resulting in distortion.

Standard fidelity position on Stromberg-Carlson models employing the big bronze dial is indicated by half-red and half-white showing in the fidelity-tone control aperture and a small white dot appearing on the red side. At standard position the tone control is fully operative.

Tuning: (Short-wave bands) For short wave reception, the above instructions do not apply. Turn the high-fidelity control so that the red part of the indicator covers approximately three-quarters of the aperture. This provides maximum sensitivity on the short-wave ranges and at the same time spreads the tuning a little for easier location of short-wave stations. At the present time, there is practically no high-fidelity broadcasting on short waves, but this partial use of the fidelity control will help to find and hold the short-wave stations.

Stromberg-Carlson Telephone Mfg. Co.

•

Wells-Gardner 2DL

Hum: If a-c hum is encountered in this model check the following:

Be sure that the volume control lugs are not grounding on the flat portion of the metal chassis wall which supports the rubber mounting foot.

The bottom plate under the chassis must be under the r-f end of the chassis and away from the filter choke. If it is in the center or left side (from the back of the chassis) move it to the right side about a half inch from the mounting bolt holes.

•

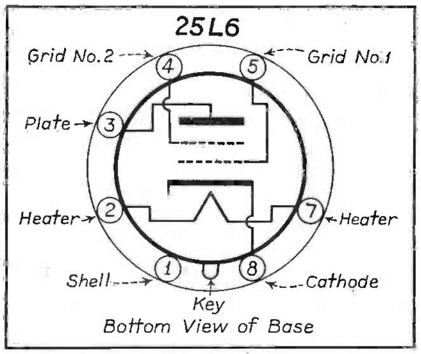
Wells-Gardner All Models

Shipping bolts: (All models except 5K and 4C) If these bolts are not removed, the chassis will not float freely on the rubber cushions and microphonic noises will result, especially on the short waves. Not only must the bolts be removed when the set is installed, but also in the stores if a good demonstration is to be made.

Service Department
WELLS-GARDNER & Co.

Type 25L6 Beam-Power Amplifier

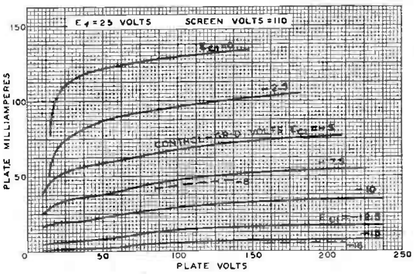
The RCA-25L6 is a power-amplifier tube of the all-metal type for use in the output stage of transformerless (a-c, d-c) radio receivers, especially those designed to have ample reserve of power-delivering ability. This new tube provides high power output at the relatively low plate and screen voltages available for transformerless receivers.



Type 25L6 base connections.

The high power output is obtained with high power sensitivity and high efficiency.

These distinctive features have been made possible by the application of directed-electron-beam principles in the



Average plate characteristics.

design of the 25L6. The design is similar to that of the RCA-6L6 with the difference that the 25L6 is intended especially for operation in a-c, d-c receivers.

Courtesy RCA Mfg. Co., Inc.

Wells-Gardner 7L, OEL, 2DL

Rectifier tube: A 5Z4MG (metal glass) rectifier tube is used in these models. It is not advisable to replace this type with the metal equivalent the 5Z4. The latter tube will not operate satisfactorily at the voltages used in these models.

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DOUBLE SUPERHETERODYNE

(*Continued from page* 11)

tween. If a weak, fading signal is between two strong signals on the adjacent channels, it can normally be held under control even during severe fading, as the control is not subject to capture by the strong adjacent signals unless the detuning is near the extreme limit of control. All the above statements apply equally to the entire range of an all-wave receiver.

Choice of I-F

The choice of the two intermediate frequencies was influenced by a number of considerations. The first i-f, as in the conventional superheterodyne, should be as high as possible from the standpoint of image ratios; it should be on a channel which will be relatively free from feed-though interference. The second i-f should be low in order that the percentage frequency differences handled in the afc discriminator be as large as possible; however, if it is too low, difficulty may be encountered in providing adequate bandwidth for high-fidelity reception. The relative frequencies of the two i-fs must be such that high-order beats do not arise when the receiver is tuned over a signal channel. As compromise values from these considerations the first i-f of the WR-315 was chosen as 465 kc, while 100 kc was adopted for the second i-f, giving a normal fixed-oscillator frequency of 365 kc.

TENTATIVE CHARACTERISTICS

Heater voltage	25.0 volts
Heater current	0.3 ampere
Maximum overall length	3¼"
Maximum diameter	1 5/16"
Base	Small Octal 7-Pin

Single Tube Class A, Amplifier Operating Conditions and Characteristics

Subscript 1 indicates that grid current does not flow during any part of input cycle.

Heater voltage	...	...	...	25.0	volts
Plate voltage	110 max.	110 max.	110 max.	110 max.	volts
Screen voltage	110 max.	110 max.	110 max.	110 max.	volts
Grid voltage	—7.5	—7.5	—8	—8	volts
Zero—signal plate cur.	49	49	45	45	milliamperes
Max.—signal plate cur.	55	51	52	48	milliamperes
Zero—signal screen cur.	4	4	3.5	3.5	milliamperes
Max.—signal screen cur.	8	10.3	8	10.5	milliamperes
Signal input voltage	5.3	5.3	5.65	5.65	volts (RMS)
Plate Resist. (approx)	10,000	10,000	10,000	10,000	ohms
Transconductance	8.200	8,200	8,000	8,000	Microohms
Load resistance	1,500	2,000	1,500	2,000	ohms
Distortion:					
Total harmonic	11	10	13	11.5	percent
Second harmonic	10	3.5	12	4.5	percent
Third harmonic	4	8.5	4.5	9.5	percent
Power output	2.1	2.2	2.2	2.2	watts

Public Address . . .

A DIRECT-COUPLED BEAM-POWER AMPLIFIER

By A. C. SHANEY*

AN amplifier using the direct-coupled circuit is capable of producing equal potential amplification at all frequencies, within the limits set by the interelectrode capacity of the tubes, and equal frequency amplification at all potentials within the audible band.

Although the idea of direct-coupled amplifiers is not new (it was first introduced by Messrs. Loften and White about the time the first type 24 screen-grid tube made its appearance) it has from time to time been revived and built in quantity, only to fall by the wayside whenever the announcement of a new supertriode or pentode served to hold the technicians' interest.

The circuit as originally introduced had two major drawbacks. The amplifiers were subject to trigger action and in spite of considerable research no adequate push-pull circuit was available.

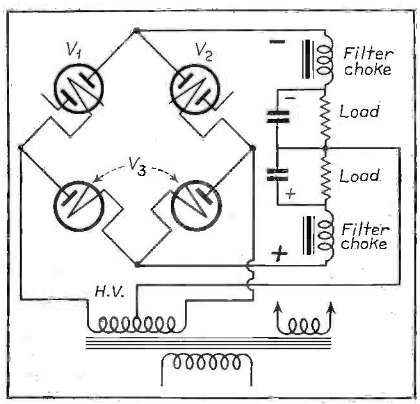

Fig. 1. Stabilized bridge type rectifier system.

Trigger Action

Trigger action is a term applied to the phenomenon occurring when an amplifier is blocked or becomes inoperative due to a strong and maintained signal fed to its input. This effect is caused by a surge in the plate current which in turn lowers the grid bias voltage sufficiently to shift the stage off its normal E_g—I_p curve and maintain itself in this blocked state. Naturally, the amplifier was inoperative during these periods and often had to be shut off in order to release the trigger action. This effect is avoided, in the amplifier de-

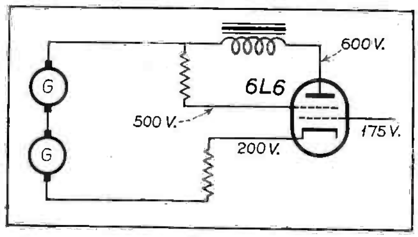

Fig. 2.

scribed herewith, through the use of a bridge type stabilized rectifier and filter system. For simplicity the rectifier circuit is segregated in Fig. 1.

Push-Pull Attempts Poor

After the circuit had gained in popularity many attempts were made to convert the single-ended direct-coupled amplifier to one of the push-pull variety and with varying degrees of success. Few lived up to their anticipated performance. As all of these inverter systems used a coupling condenser true inversion did not take place at all frequencies and amplitudes.

Critical adjustments were particularly annoying to the many experimenters who first attempted to build the amplifier. Little attention was paid to the regulation of the power supply or compensation for variations in plate current of different output tubes. These factors all contributed to the unjust condemnation of this truly revolutionary high-fidelity circuit.

A New Version

With the advances made in amplifier design it becomes a relatively simple matter to design a stabilized bridge type rectifier capable of supplying a fixed voltage to a three-stage direct-coupled amplifier utilizing a signal divider (this

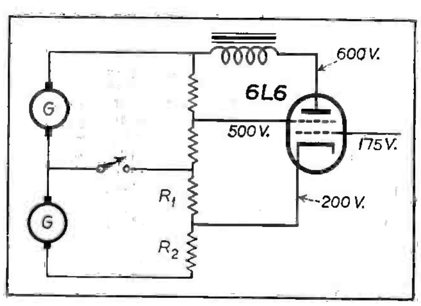

Fig. 3.

is not to be confused with a phase inverter) which is capable of driving two 6L6 tubes in true push-pull fashion.

In order to simplify the discussion of the circuit each portion will be treated individually.

The Rectifier System

A uniform load resistance connected across a conventional bridge type rectifier will have no potential difference between its center tap and the center tap of the a-c voltage winding supplying the system. If these two points are connected as shown in Fig. 1 no current (other than the normal load currents) will flow.

The use of a choke in each leg of the rectifier output with appropriate filter condensers produces the stabilized bridge rectifier as shown in Fig. 1.

The advantages of this rectifier system are manifold. The pivot of the circuit (the voltage at the mid-point of the load) is always kept at a constant potential and detrimental trigger action is avoided. Over 600 volts (d-c) is available from a 650-volt center-

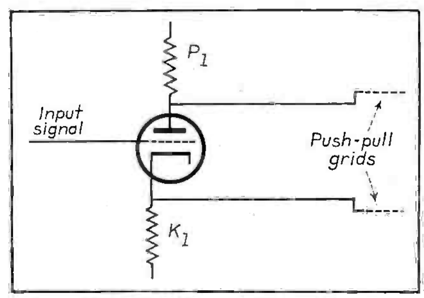

Fig. 4. Direct-coupled signal divider circuit.

tapped transformer. Hum potentials are cancelled because of identical choke coils and by-pass condensers in each output leg of the rectifier. The hum potentials picked off each leg are equal but opposite in phase and cancel when fed to the zero potential mid-point of the bridge rectifier.

Since mercury vapor tubes (83 type) are not available with isolated filaments for each half of the tube, two tubes must be used for rectifying one of the voltage phases while the third rectifier is used in the conventional manner. In order to keep the regulation of each side perfectly balanced, only one plate of V_1 and V_2 should be used.

Stabilized Circuits

The analysis of the stabilizing action of the entire system can best be illustrated by redrawing the rectifier diagram and one of the output tube circuits as indicated in Fig. 2. For purposes of simplicity, the rectifier has been drawn as two d-c generators connected in tandem.

One of the 6L6 tubes is shown con-

(*Continued on page 47*)

*Amplifier Co. of America.

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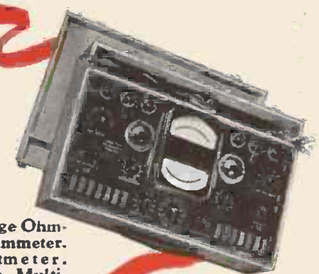
Combines 12 essential servicing instruments: A. C. Tube Quality Checker. Tube Hot Leakage, Short and Open Tester. Electrolytic Filter Capacitor Leakage Tester. Paper and Mica Capacitor Leakage Tester. Complete Point-to-Point Radio Analyzer. Multi-Range D. C. Voltmeter. Multi-range Ohmmeter. Multi-range Megohmmeter. Multi-range A.C. Voltmeter. Multi-range Decibel Meter. Multi-range Milliammeter. Multi-range Output Meter. $7.50 Down—$6.61 per Month for 10 Months. Cash price . . . $66.95



550 RADIO TESTER

Performs the operations of 13 essential servicing instruments with 43 functions and ranges: Radio and P. A. Analyzer. Electrolytic filter and electrostatic capacitor leakage, also Electrolytic and Electrostatic capacitor tester. Multi-range ohmmeter. Multi-range D. C. Voltmeter. Multi-range A. C. Voltmeter. Multi-range milliammeter. Multi-range decibel meter. Multi-range output meter. D. C. ammeter. $6.00 Down—$5.55 monthly for 10 months. Cash Price . . . $55.95

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GREENWOOD, MISSISSIPPI, U.S.A.

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nected through ½ of the output transformer to the high voltage terminal.

It will be noted that although 200 volts is applied to the cathode, the grid is 25 volts less negative (175 volts is applied to the grid) while the plate is 400 volts above cathode (600 volts above ground) and the screen 300 volts (500 volts above ground). Under these conditions the no-signal current is 50 ma for the plate and 5 ma for the screen. Approximately a 2700-ohm bias resistor will be required.

At full-signal conditions an increase of 19 ma (combined increase of plate and screen current) flows through R_2 so that the cathode voltage would be raised 51.3 volts. This degenerative effect not only lowers the available power output but discriminates against the low frequencies so that these would be practically lost. If the circuit of Fig. 2 is altered slightly as in Fig. 3 (a form of stabilized power supply) the cathode voltage remains constant at all values of plate and screen current.

The reason for this is that an external bridge circuit is formed and the cathode current divides equally, half flowing through resistor R_1 while the other half flows through R_2. Voltage equalization takes place with the division of current, so that a constant cathode potential is maintained above ground. All plate and screen circuits of the amplifier are of the bridge circuit self-neutralizing type. Some of them are more complex and utilize the current flowing through two or more tubes to effect voltage stabilization.

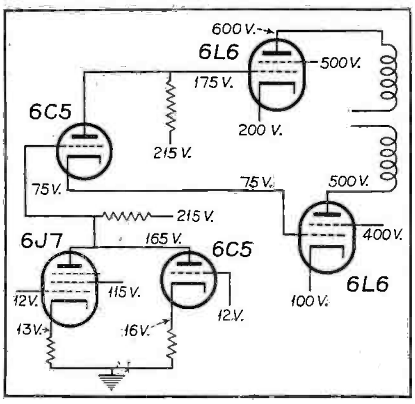


Fig. 5. Voltage distribution in the amplifier.

The Signal Divider

The ideal phase inverter will equally divide the amplitude of a signal and separate their phases by 180°. Naturally, this action must take place equally for all frequencies and amplitudes within limitations set by the tube itself. Any circuit utilizing a coupling condenser cannot accomplish this because of the varying capacitative reactance presented by the condenser to the varying audio frequencies. Transformers are similarly limited in their phase inversion action because of the varying inductive reactance of both of the primary and secondary windings. In the face of these handicaps, circuits utilizing conventional phase inverters may be adjusted for inversion *at one frequency* and amplitude. As the frequency decreases, inversion is retarded and conversely as the frequency increases, phase inversion is accelerated. Thus, only within very narrow frequency limits will the inverted signal be 180° out of phase with the original signal. Amplitude distortion is, of course, predominant in transformer inverters unless unusual care is exercised in the design and construction of the transformer.

The phase-inverter circuit shown in Fig. 4 typifies the simplest voltage divider and inverter available. It is entirely devoid of all capacitative and inductive reactance (excepting for the interelectrode capacitance of the tube element) and is capable of dividing a signal into two equal amplitudes and at the same time inverting one of the signals (180° out of phase) with the other.

The plate load of the tube is divided into two equal non-reactive parts and one section (pure resistance) is inserted in the cathode circuit forming the cathode load resistor. During the positive cycle of the input signal, the plate current increases with a subsequent drop in plate voltage because of

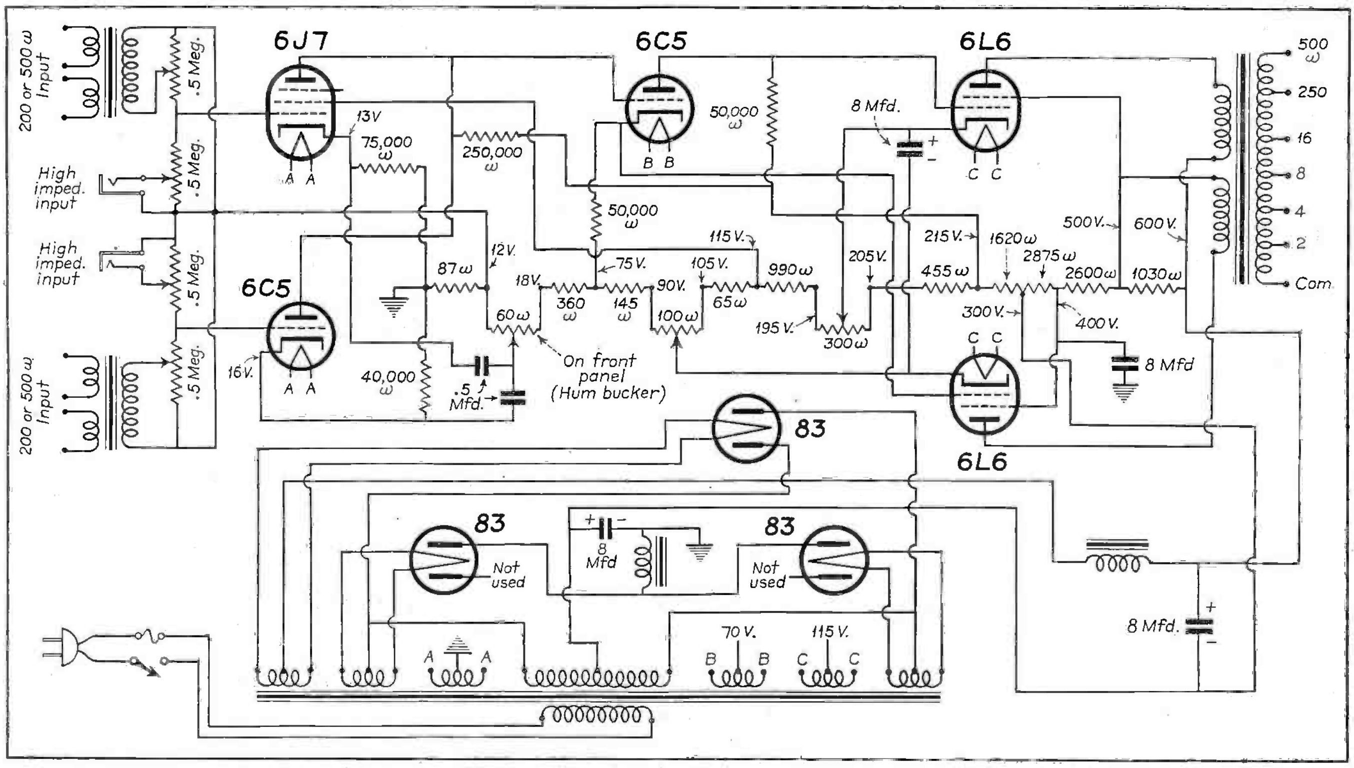


Fig. 6. The complete beam-power amplifier.

the increased voltage drop in the plate resistor (P_1). The increase in cathode current raises the cathode voltage because of the increased current flowing through the cathode resistor (K_1). Therefore, the potentials appearing across the plate and cathode of the tube are opposite in phase. Since P_1 and K_1 are equal in value at all frequencies the amplitude of the signals developed across them is always exactly alike. Hence, this tube functions as the ideal phase inverter because of the total absence of capacitative and inductive reactance variations.

Voltage Distribution

A casual study of the amplifier schematic circuit will disclose a distribution of voltages ranging from 600 volts on the plate of one 6L6 to 65 volts on the grid of the signal divider. If a careful analysis is made it will be found that the relative voltages from cathode to control grid, plate or screen grid, are all in accordance with accepted tube ratings.

Of course, when the plate of one tube is coupled directly into the grid of the next tube, both grid and plate have the same applied potential as measured from ground. It then becomes necessary to adjust the cathode and plate voltages of each tube so that, in relation to its grid, all voltages are as recommended.

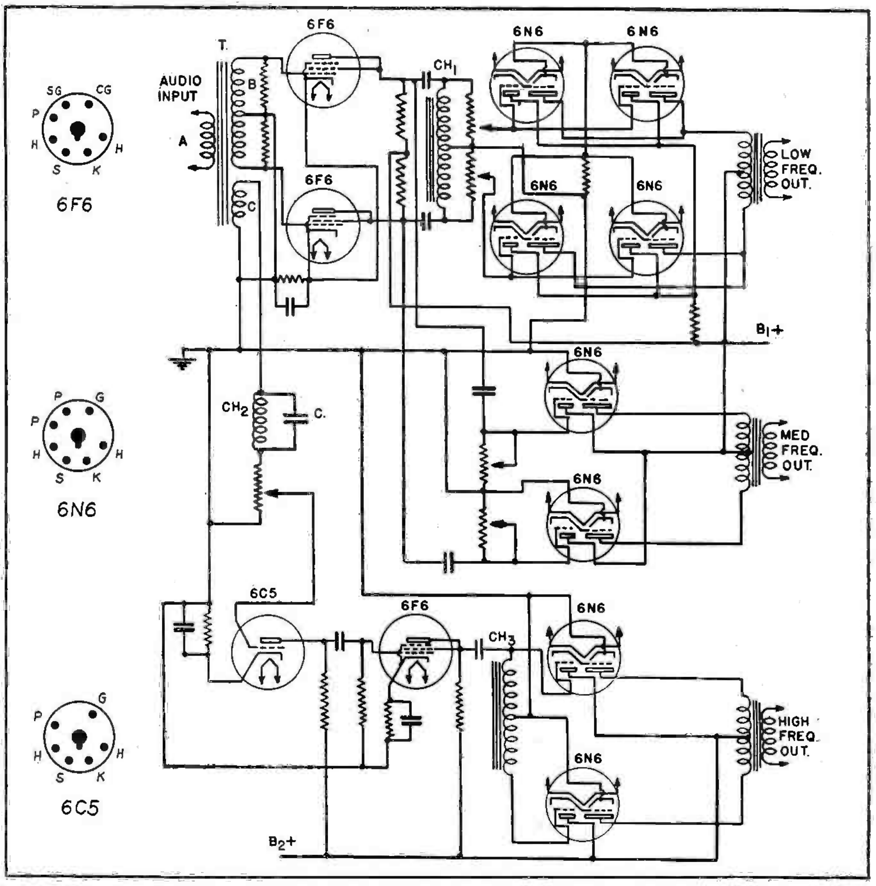
In a three-stage direct-coupled amplifier of this type, all voltages are additive. This accounts for the high voltage (600) applied to the plate of one of the 6L6 power output tubes.

Fig. 5 simplifies the basic circuit arrangement and indicates the voltage distribution. To determine the exact plate or grid voltage on any tube, simply subtract the cathode voltage from either the grid or plate voltage.

The Complete Amplifier

In Fig. 6 the complete circuit of the direct-coupled amplifier is given. The completed amplifier, as previously stated, is capable of linear amplification over a wide frequency range—limited only by the interelectrode capacity of the tubes and wiring.

Crosley WLW Audio Amplifier



Crosley WLW Audio Amplifier.

Four chassis and six loudspeakers are used in the 37-tube Crosley model WLW radio receiver.

The first chassis incorporates a superheterodyne receiver with a pre-audio amplifier in which is included the auto-expressionator. A second chassis incorporates the audio power amplifier with a microphone pre-amplifier. A third chassis furnishes the necessary B power supply for the audio power amplifier and a fourth chassis furnishes the necessary d-c power supply for the speaker field. Incorporated in the first chassis are all the features present in larger models of the 1937 Crosley line and therefore will need no explanation here.

Technical Description

Referring now to the amplifier circuit diagram, the input to the audio amplifier is supplied from the pre-amplifier of the receiver itself and in order to get auto-expressionator action it was necessary to use power tubes in the output stage of the receiver. The impedance of this is reduced to 6 ohms which matches the first winding A of transformer T, the input transformer for the audio power. Winding B of this transformer terminates in 900 ohms so that the impedance ratios of the input winding to winding B are 6 ohms to 900 ohms.

Operating out of winding B are two 6F6's connected as triodes and used as drivers for both the low-frequency and mid-frequency audio channels.

In the low-frequency channel four 6N6 output tubes operating in parallel push-pull are driven by the above-mentioned 6F6's by means of audio choke coupling. In the mid-frequency channel there are two 6N6s in push-pull which are also driven by the 6F6s.

The third winding C of the input transformer T terminates in 500 ohms and forms the high-frequency audio channel of the power amplifier.

The choke CH_2 with the condenser C in parallel forms a high-pass filter which is augmented further in the circuit.

Working out of winding C there is a 6C5 tube resistance coupled to the 6F6 connected as a triode, which in turn drives two 6N6s push-pull through audio choke CH_3.

The low-frequency channel has a range of from 20 cycles to approximately 400 cycles, part of the filtering being in the output transformer and part of it through the condenser, choke and resistor combination ahead of the parallel push-pull 6N6 tubes. This channel has a maximum output of approximately 40 watts.

The mid-frequency channel has a range from about 300 cycles to approximately 3,000 cycles with a maximum power output of about 18 watts. Again filtering action here is obtained through the output transformer and the con-

(*Continued on page 59*)

ASSOCIATION NEWS . . .

RADIO ASSN. OF CALIFORNIA

Three cheers for Mr. John Powers of Techna, who spoke at the last meeting in 1936 and gave an informative, interesting and understandable talk on acoustics, speakers, impedance matching, etc. Mr. Downy of the Techna sales department displayed some fine equipment. President Digby's plea for pictures brought forth only one snapshot. We sure ought to be able to do better than that. Carl won the turkey, and another meeting and another year goes into the records.

Mr. L. C. Rayment spoke on "Vacuum-Tube Applications in Medical Diagnosis" at the meeting held January 4 at 921 Harrison Street, in Oakland. Mr. Rayment is doing some outstanding work in this field and his talk brought forward many interesting items. He brought along some equipment and gave actual demonstrations.

The question box wanted to know something about the infinite impedance detector. Carl Penther had the dope handy and gave a brief explanation.

At the January 18 meeting, Mr. Frank Kesser, marine editor of the Tribune, will speak on "Mysteries of the Sea."

As in the past, radio and service dealers may be admitted directly to regular membership. Service Men are admitted after examination and may obtain information and dates for examination from Gordon Braun who has been appointed as agent for the examining committee. Applications for examination should be with Mr. Braun not later than any Monday, meeting night.

The treasurer has become plumb militant. Dust off your membership card and bring it along—or else!

H. R. Anderson, Secretary

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PRSMA

On Tuesday, January 5, on the twenty-fourth floor of the Architects' Building at 17th and Sansom Street, in Philadelphia the new officers of the PRSMA were installed. With plans pretty well shaped up, the motor warmed up, just waiting to spin the propellor and zoom away!

The new officers are as follows: Charles Wrigley, president; Jesse Ehly, vice-president; Stanley W. Myers, treasurer; F. B. Guthrie, recording secretary and John Breichner, corresponding secretary. The new members of the advisory board are as follows: E. F. Benson, Joseph W. Bishop, E. S. Walker, E. M. Oldach and Frederick A. Meyers.

The newly elected officers are making a plea for the full cooperation of every member of the PRSMA.

Brother Scroggs' new address is now in care of Schuck Electric Co., Germantown. Treat him well, Fred—He's a nize boy.

There are a lot of fellows who are now out of the woods and are looking forward to a new year that will see the profits going toward a bulwark for the future instead of being used for mending fences and paying debts.

All except Bob Andrassy. He went in hock again for a new car. P. S.: So did Hen Dornheim.

We extend our sympathy to Mr. T. J. Tucci for the loss of his mother on November 21, 1936.

New Year's resolutions: To stay away from revolving doors, Dave Krantz; To stay home on foggy nights, Elmer Benson; To stay off committees, Ben Doan; To never drink any more beer, Paul Keller; To never give a sucker an even break, De Long; To talk back to his wife, Mike Rogers; To wear a fedora the year 'round, Jesse Ehly; To get my "stuff" to the Editor on time, Willie De W.; To pay my dues on January 5—and attend every meeting on time, Every Member.

Roy Lowe is walking around on air sporting his new title. Good luck and a lot of big business, Roy!

Repair and trouble men are cordially invited to our open meetings—first Tuesday of each month at 17th and Sansom Streets. Also anyone else who is interested in our technical talks.

To say that the recent election was a hotly contested one would be putting it too mildly—but we hope that everyone is satisfied. To the winnah! . . . Lots of luck and success! *J. T. Gallagher*

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RADIO TECHNICIANS GUILD

Big doings are again expected at RTG headquarters as the newly elected officers buckle down to work. The new regime is as follows: S. S. Malo, president; G. L. Chapman, vice-president; Frank L. Kennes, treasurer and George W. Feldman, secretary. The new board members are: A. C. Saunders, Mr. H. Lahey and Mr. B. Roessel.

A campaign for membership has already been outlined and surpasses everything attempted so far. It is the Guild's aim to help the Service Man out of the doldrums and to aid him in obtaining a living wage.

All interested Service Men are invited to attend the open meetings held the fourth Monday of each month, at the Hotel Lenox in Boston.

We have been bragging to one of the other magazines about the fine job SERVICE did with the recent articles on automatic frequency control. Keep up the good work. *George W. Feldman*

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ASSOCIATED RADIO TECHNICIANS

Vancouver, B. C. Chapter

A meeting of the ART was held on November 4, at the D. V. A. Hall. Thirty members were present.

The door prize was won by Mr. Wheatcroft.

A financial statement for the dance was submitted by Mr. A. Johns.

The secretary's correspondence included a very interesting letter from the R. M. A. service division in which they extend their full cooperation to this organization, and the newly formed branch in Victoria.

Mr. T. Brown then gave a detailed report on the committee's activity in Victoria, stating that the branch is now fully formed, and has a membership of 25 Service Men.

Mr. Paine, owing to pressure of work, resigned from the publicity committee. Mr. D. Clark was appointed to take his place.

An examination for admission to membership in the ART will be conducted in the D.V.A. Hall on January 17, 1937. All associated are expected to write at this sitting.

Wilf Munton, the librarian, gave an interesting review of the recent magazines and books added to the library at the last meeting.

On Friday, December 4, the Sparton Co. and their B. C. Distributors, Canadian Fairbanks-Morse, tendered a dinner to the Associated Radio Technicians of B. C. There were 75 present and no chicken was left when Mr. Geo. Foster of London, Ont., rose to speak, on "Why the Factory Does Not Build Sets as the Service Men Think They Should." His story of production methods and of triumph over the problems that beset the building of a modern radio held his audience attentively. And at the conclusion he was invited to speak on refrigeration at the regular meeting of the ART on December 8.

A word of thanks is due Messrs. Smith and Salter of the sales staff for arrangements they made; also, Mr. Doug Flower, who is an old member of the ART, and was introduced as new local service manager for Sparton.

The fine attendance at the December 8 meeting surprised everyone as nobody realized the interest that existed in refrigeration, and if all who heard it are not now qualified refrigerator mechanics, they at least know the why and how of it. Thanks, Fairbanks-Morse and Sparton—may the benefits of this fine gesture be mutual.

A special meeting of the Vancouver Chapter was held in the D. V. A. Hall on December 29. After two postponements Mr. A. T. Johns of Marshall-Wells delivered his talk on automatic volume control. An interesting and profitable evening was enjoyed by all present.

At the meeting on January 12, Mr. A. Birnie, instructor at Sprott-Shaw, is to lecture on Automatic Frequency Control.

It has been decided to have one or more special talks at every meeting for the next three months. Service Men really interested in advancing themselves cannot afford to miss these lectures.

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Victoria, B. C. Chapter

On November 16, in the Eagles Hall, a meeting of the Victoria Chapter was held, with Jack Allison in the chair.

The meeting was turned over to Mr. Monte Lennox of Vancouver, who outlined details which would have to be arranged for incorporation, etc.

The date of incorporation was set as January 2, 1937.

Mr. Lennox then gave a brief report on the annual meeting of the ART in Vancouver. Following this he explained the use of the "microvolter" and also gave a condensed talk on avc.

linear sweep for each of the ranges. This decade switch is so marked that the value indicated by its pointer multiplied by the value indicated on the main dial at balance gives the capacity of the condenser under test or the value of the resistor under test as the case may be.

The Analyzer Section

The analyzer part of the bridge places a d-c voltage on the condenser under

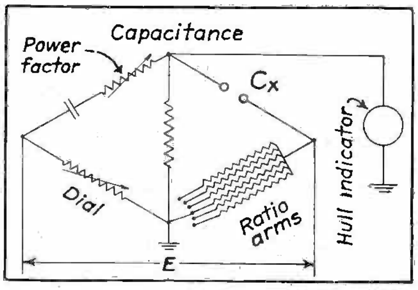

Fig. 5. Condenser analyzer part of bridge circuit.

test. This voltage may be varied from about 35 volts to 550 volts. The d-c leakage of the condenser is then determined under actual operating conditions. For by-pass condensers, etc, a d-c test of this nature is extremely valuable, for high leakages in a coupling condenser in a resistance-coupled amplifier will cause the quality of the set to be greatly impaired, and many times this d-c leakage cannot be determined at low voltage. The writer has known of cases where a condenser is practically a complete short circuit at operating voltages and has a high resistance (resistance approaching a good condenser) on a low-voltage test. This was due to the fact that a hole was burned in the paper as the result of the initial breakdown. However, insufficient power was developed by the breakdown voltage which was fed through a resistor to carbonize the paper. Lower than working voltage was not sufficient to jump the minute gap between the condenser foils with the result that the condenser tested good at 45 volts. In passing it might be stated that this same condenser had about a 3 percent power factor, which was not considered sufficiently high to cause it to be removed from the circuit. As a consequence of this and similar investigations, it is felt that from a service standpoint it is advisable to test certain by-pass condensers at or near operating voltage.

The condenser analyzer part of the bridge (circuit diagram in Fig. 5) uses a neon tube for indication of all leakages so that the Service Man can determine the serviceability of any condenser used in the radio receiver.

Intermittent open condensers which are one of the worst bugaboos in servicing may be determined by obtaining a balance on the bridge and then manipulating the leads to the condenser. If the eye tends to close or "wink" when the leads are manipulated, it indicates an intermittent condenser. Naturally open-circuit condensers are detected by obtaining a bridge balance which is near the minimum capacity of the bridge.

Grid Leak Measurement

The writer has had some experience with grid resistors which checked perfectly on an ohmmeter, yet when placed in a radio receiver caused a considerable amount of distortion after the set had been on for fifteen or twenty minutes. This distortion was finally found to be due to an increase in the resistance of the resistor for some undetermined reason, probably due to the heat radiated from the power transformer. It has been found that the analyzer part of the bridge gives an excellent method for checking such resistances for their constancy with an appreciable voltage across them, for the Service Man may place the resistor across the analyzer terminals of the bridge and adjust the voltage and leakage switches so that the neon tube just lights. Any increased

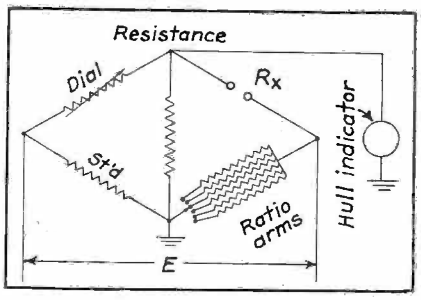

Fig. 6. Resistance measurement with the bridge.

resistance with heating will cause the neon tube to be extinguished.

All in all, the combination instrument provides facilities for complete condenser analysis—with advantages possessed by neither bridge nor analyzer alone—plus provision for resistance measurements over a range and with a permanency of calibration heretofore not incorporated in service apparatus.

In conclusion, it might be well to state for the benefit of the Service Men who have considered the operation of a bridge complicated, that, with the aid of the electronic eye, adjustments can be made with greater facility than tube tests on the average equipment.

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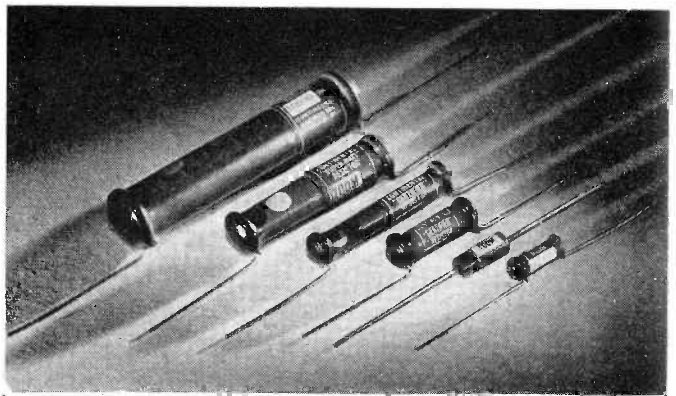

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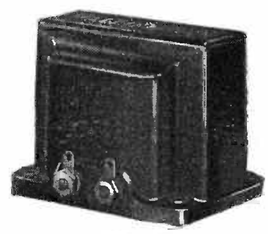

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All Halldorson transformers are vacuum-sealed. The vacuum sealing is positive in action and insures uniform impregnation of all windings. The process was developed by Halldorson engineers both as to manufacturing procedure and selection of impregnating material. The result is an effective skin tight covering that does not crack, flake off or open up, even in tropical climates. It is one transformer that is really impervious to moisture.

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HIGHLIGHTS . . .

RAYTHEON INCREASES TUBE PRICES

As a result of changes in type costs due to increased material and labor costs, variations in the proportional demands for the different types and need for additional revenue in every branch of the tube business, the Raytheon Production Corp. has announced an increase in tube prices effective immediately.

Raytheon has believed for a long time that tube prices have been too low to provide a proper profit for the distributor, dealer or Service Man. It is expected that the distributors, dealers and Service Men will welcome the new list prices. They should result in greater profits to all concerned in the sale of receiving tubes during 1937.

•

WEBSTER SALES REPRESENTATIVE

The Webster Electric Co., Racine, Wis., announces the appointment of the Kay Sales Co., Tulsa, Oklahoma, as district sales representative for the states of Oklahoma, Arkansas and the extreme western section of Tennessee, to include Memphis.

J. P. Kay, manager of the Kay Sales Co., has had many years' experience in the radio and sound equipment field and is well known to the trade. He will personally supervise the merchandising of Webster Electric sound equipment, phonograph pickups, and the "Teletalk" intercommunicating system.

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SUPREME EQUIPMENT MANUAL

The Supreme Instruments Corp., Greenwood, Miss., has prepared a 60-page manual on tube tester and radio tester design. The manual contains complete descriptive material on the 1937 Supreme line, their circuits, their functions and their ranges.

Copies of this manual may be had directly from the manufacturer. The price is 15c.

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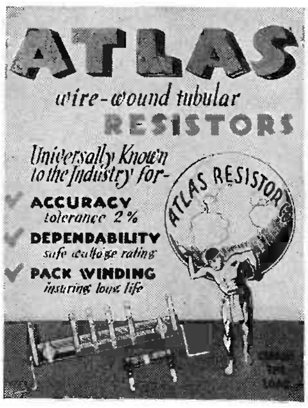
ATLAS RESISTOR DISPLAY

The Atlas Resistor Co., 423 Broome St., New York City, are distributing to dealers



and jobbers a colored display board designed to help sell Atlas Resistor products. These cards may be obtained directly from the manufacturer.

SPEEDEX SALES AGENT

D. R. Bittan Sales Co., Inc., 27 Park Place, New York City, has been appointed sales agent for the Speedex Manufacturing Co., of San Francisco, manufacturers of amateur and professional keys and buzzers.

•

CLOUGH-BRENGLE 1937 CATALOG

A new and complete description of over twenty C-B instruments, including r-f signal generators, oscillographs, audio oscillators, analyzers, and vacuum-tube voltmeters is now available. Shows down payment and monthly payments for each instrument on the new C-B "Pay-As-You-Earn" Plan. Address your request for a copy to The Clough-Brengle Company, 2815 W. 19th St. Chicago.

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SOLAR REPRESENTATIVES

Mr. James Schoonmaker, 4133 Shenandoah Ave., Dallas, has been made district sales manager for the Solar Manufacturing Corp., for the Texas territory.

Mr. E. P. Demarest, 1127 Venice Blvd., Los Angeles, has been made district sales manager for California.

Both executives are favorably known to merchants and Service Men in their territories.

The Solar Manufacturing Corp., 599 Broadway, New York City, manufacturers of radio and electrical parts has just announced a 5 per cent wage increase to its 750 employees.

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RCA RADIO TUBE PRICES UP

After years of steadily declining prices, the RCA Radiotron Division of the RCA Manufacturing Co. has announced an increase in the prices of practically all types of receiving tubes, effective January 2, 1937.

Eugene N. Deacon, general sales manager of the RCA Radiotron Division, pointed out that the large number of different types of tubes, for many of which there is now only a limited demand because of the obsolescence of the radio sets in which they are used, and mounting material and labor costs have made a complete review of costs necessary. Mr. Deacon believes that the newly announced prices, which represent an overall increase of 11 per cent over former tube prices, will be welcomed by dealers and Service Men as a step in the right direction of increasing dollar unit sales on radio tubes from the all-time low to which they had fallen. In its announcement, RCA has suggested that its wholesale distributors quote dealers on a net unit price basis, rather than on a discount basis, a procedure which simplifies quoting, billing and record keeping, and gives the dealer his cost and profit margin at a glance.

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ARLAB MOVES

The Arlab Manufacturing Co., manufacturers of magnetic and dynamic speakers have rented the plant at 430 S. Green St., Chicago.

The Arlab Manufacturing Co. has recently acquired the Baritone Radio Co.

NATIONAL TRADE SHOWS

The Radio Parts Manufacturers National Trade Show, Inc., meeting in Chicago on December 16, named the dates of two industry shows to be held during 1937. They

S. N. SHURE

will be sponsored by the Radio Manufacturers Association and the Sales Managers Club through the vehicle of the above-mentioned show organizations.

Managing director of both shows will be Kenneth A. Hathaway of Chicago.

The spring shows will be held in Chicago over a four-day period, June 10-13, inclusive, at the Stevens Hotel. The fall show will be held in New York City, October 1-3, inclusive. The hotel for this show has not yet been selected.

It is anticipated that the annual Radio Manufacturers Association convention will be held in Chicago immediately preceding the National Trade Show. Three other meetings are definitely set for the period of the show—those of the Sales Managers Club, the Institute of Radio Service Men, and "The Representatives."

Industry leaders have been struggling with the formation of a show organization, which would be all inclusive, for more than six months. Appointed representatives of RMA and the Sales Managers Club, meeting at various times in Chicago and New York, finally concluded that greatest good would result by the creation of a non-profit corporation for the special purpose of conducting the shows, with both groups having representation on the board.

S. N. Shure, of Shure Brothers Co., Chicago, was elected president of Radio Parts Manufacturers National Trade Show, Inc., by the Board of Directors on December 16.

Other officers of the show corporation are: A. A. Berard, Ward Leonard Electric Co., Mt. Vernon, N. Y.; Arthur Moss, Electrad, Inc., New York City. Directors are Fred D. Williams, International Resistance Co., Philadelphia, and Messrs. Berard and Shure.

(Continued on page 58)

THE MANUFACTURERS . . .

UNIVERSAL RECORDING AMPLIFIER

The Universal Microphone Co., Inglewood, Cal., is producing a medium-priced recording amplifier which incorporates a phase-inverter system; a low- and high-pass filter arrangement operated by a single control knob and a neon volume indicator.

The 120-db gain makes the amplifier suitable for use with any type of microphone or pickup and the combination high- and low-pass filter allows the adjustment of the frequency characteristic.

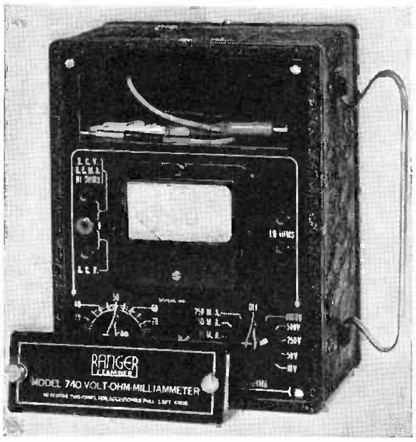
All metal tubes are used in the circuit; the output is 8 watts. A switch is provided for changing the output from the loudspeaker to the recording head.

•

RANGER-EXAMINER ACCESSOR

The Readrite Meter Works, Bluffton, Ohio, has introduced a portable model 740 volt-ohm-milliammeter, one of the Ranger-Examiner single testers.

The unit has a Triplett precision instrument with scales reading: 10-50-250-500-1,000 a-c and d-c volts at 1,000 ohms per



volt; (d-c accuracy 2 per cent, a-c, 5 per cent) 1-10-50-250 d-c milliamperes; 0-300 low ohms; high ohms to 250,000 at 1½ volts. Provision for higher resistance readings by addition of external batteries.

Sturdy metal case with black electro-enamel finish is 5⅞ in. x 7⅞ in. x 4⅛ in. Built-in compartment with snap-on cover holds all accessories. Panel is silver and black. Carrying handle folds against the side of the case when not in use. Model 740 volt-ohm milliammeter.

•

CENTRALAB "SWITCHKIT"

Centralab has made switches available to the trade in knocked-down form. Switch requirements vary greatly, and it is obvious that a relatively few types of switch sections and mechanical parts can be assembled in a great many different combinations.

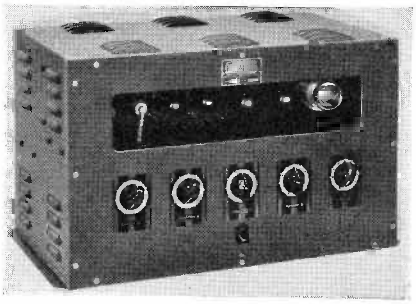
The Centralab Switchkit is a 75-drawer steel cabinet containing sufficient parts to assemble 35 switches. The assortment of parts included, however, is sufficient to assemble 161,700 different types of switches.

A descriptive bulletin, describing the "switchkit" in detail, is available upon request to Centralab, 900 E. Keefe Ave., Milwaukee, Wis.

•

ELAMCO SERIES B AMPLIFIERS

A series of moderately priced amplifiers ranging from 10 to 28 watts output has



been introduced by the Electric Amplifier Corp., 135 W. 25th St., New York City.

The Elamco series B, as these amplifiers are called, are obtainable in three forms, standard, portable and rack-panel models. Six high impedance channels are provided on each amplifier as well as multiple line connections. Field supply is also provided for one or two speakers.

•

TRIAD 6AB6G

Triad Manufacturing Co., Inc., has added the 6AB6G to the "Triadyne" series. The new tube has the universal octal type base and a small ST-12 bulb. Its filament current is 0.5 ampere at 6.3 volts. Its characteristics are similar to the 6B5, the 6N6G and the 6N6-MG.

•

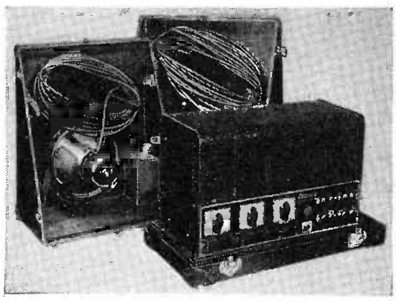
ARCTURUS ADDS NEW TYPES

The Arcturus Radio Tube Co., Newark, N. J., has added the following types to their line: 1A4, 1B4, 6E5, 6G5, and the following "G" tubes (glass tubes with octal bases): 1C7G, 1F5G, 1H4G, 1H6G, 1J6G, 5U4G, BV4G, 5X4G, 5Y4G and the 6B8G.

•

CLARION SOUND SYSTEM

The Transformer Corp. of America has made available to Service Men a brochure



describing their Clarion model C55 portable sound system. The C55 has a rated output of 25 watts and 35 watts peak. Output terminals are provided for various voice coil impedances as well as for 50, 250 and 500 ohm lines.

For this brochure and other technical data, address the Transformer Corp. of America, 69 Wooster St., New York City.

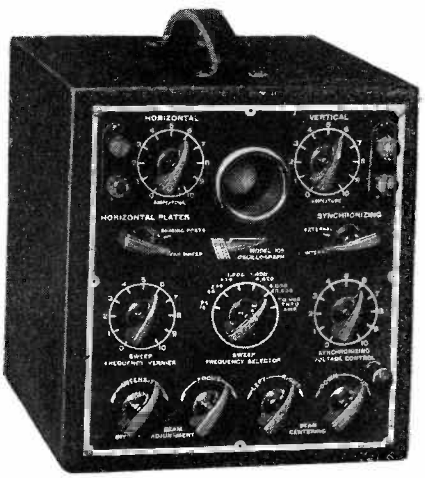
CLOUGH-BRENGLE OSCILLOGRAPH

The new type 913 cathode-ray tube has made possible a new form of cathode-ray oscillograph, the model 105, which has just been announced by the Clough-Brengle Co. of 2815 West 19 St., Chicago.

Except for physical size and screen area, this instrument is identical to the larger oscillograph, the model CRA. Performance features such as the built-in linear sweep, separate high sensitivity amplifier for both horizontal and vertical inputs and beam centering controls on the front panel have been retained in the model 105.

The entire unit is contained in a carrying case, 8⅞ inches high, 8¼ inches wide and 9⅜ inches deep. The finish is baked black crystalac with an etched silver and green front panel. An adjustable hood surrounds the cathode-ray tube and may be extended several inches out from the front panel to keep all direct light off the tube screen.

The model 105 is supplied complete with tubes for direct operation from 110-volts,



60-cycle power supply. Special models for other voltages and currents are available.

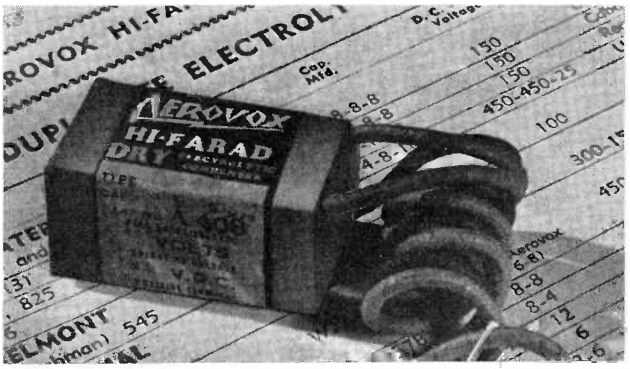
The instrument is complete for all servicing, transmitting, and general laboratory applications. For visual alignment, the model OM-A frequency modulated signal generator or model 81-A separate frequency modulator may be connected directly to the oscillograph by means of a plug-in cable.

Complete descriptive bulletin and price may be secured by writing the manufacturer.

•

SYLVANIA MAKES TUBE PARTS

Sylvania's radio tube parts building, measuring 200 feet by 60 feet, employs a group of workers whose effort is concentrated on the manufacture and inspection of over 175,000,000 parts during the year. These parts include cathodes, collars, plates, hooks, grid leads, anchors, cages, diode shields, etc. Mica is procured from British India and is carefully inspected for gas content, iron and thickness. It is then fabricated.



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Exact replacements for all standard sets.

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Most extensive listing available.

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New CATALOG: Contains several pages of exact-duplicate condenser listings. Also other condensers and resistors of AEROVOX line. Copy on request.

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BRUSH
Sound Cell MICROPHONES

BR2S Spherical Microphone

BR2S

This Brush sound cell microphone has blazed a new trail in the fields of "P. A.," remote pick-up and amateur applications.

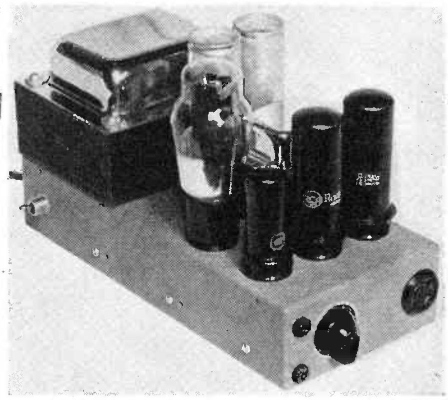
The BR2S is one of 12 types of sound cell microphones manufactured by Brush. Hundreds of Brush Microphones go into service each month. Supreme performance plus mechanical perfection and dependability in the BR2S are now AVAILABLE AT . . .

A NEW LOW PRICE

$37.50 This new price has been made possible by the constantly increasing popularity and demand for this type of Brush sound cell microphone. Join the Brush enthusiasts and realize sound quality.

Write for complete Technical Data.

The **BRUSH** DEVELOPMENT COMPANY
PIEZO ELECTRIC
1879 E 40th St. CLEVELAND, O.
MICROPHONES • MIKE STANDS • TWEETERS • HEAD PHONES • LOUD SPEAKERS



NEW! Sensational
AUDITION EQUIPMENT

The 3-A is a 32 Watt amplifier which with its 18 inch Super Giant Speaker has an acoustic sound output equal to a 214 Watt System. It will drive one to four Super Giant Speakers to completely cover the largest indoor enclosure, and will comfortably and easily cover 50,000 to 100,000 people. An unequalled booster amplifier to raise the power of existing P A equipment, the 3 A provides flexibility never before available.

Send in the coupon today for complete details on this sensational *new* audition equipment.

McMURDO SILVER MASTERPIECE AMPLIFIERS

FULL DETAILS FREE **MAIL THIS COUPON**

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2900 So. Michigan Blvd.
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Please rush me full details on new 3 A Masterpiece Audition Equipment.

Name ....

Address ....

MANUFACTURERS—continued

OPERADIO P-A SYSTEM

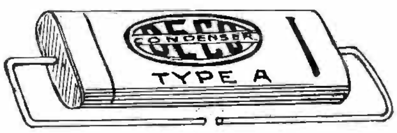
The model 115 portable p-a system is a 12-watt Class A system. It is suitable for orchestra and voice reinforcement, for soloists and public speakers; it permits mixing one or two low-level inputs such as a crystal and phonograph input; has two variable tone controls, one for high frequencies and one for low frequencies. The 115 furnishes complete power supply for the model 681 preamplifier which makes the 115 usable with high-impedance crystal microphones or for frequency attenuation.

The 115 comes complete with a 10-inch speaker with rubber cable and a polarized plug. Provision is made for the use of an additional speaker. A dual diaphragm crystal microphone is also supplied with the system.

Additional information may be obtained from the Operadio Manufacturing Co., St. Charles, Ill.

DUCO PAPER CONDENSER

A new type of paper condenser, impregnated with a compound which insures against the absorption of moisture, is made by the Dumont Electric Co., Inc., 514 Broadway, New York City, in accordance with RMA specifications. Its shape reduces r-f pickup, a cause of noise in sensitive circuits. The condenser is protected



from moisture by a layer of aluminum varnish and its shape enables its use in small spaces.

G-E "CHARGING SHOP"

A new G-E Tungar "Charging Shop," which will charge as many as twelve 6-volt batteries or six 12-volt batteries at 6 amperes and is intended primarily for use in service stations and garages, has been announced by the General Electric Company's Appliance and Merchandise Dept., Bridgeport, Conn. It is of heavy steel, one-unit chassis construction, with all parts panel-assembled.

The 12-battery charging shop is housed in a steel cabinet finished in red with an ivory panel. Compartments on each side provide space for battery tools and jumpers, carrying straps, etc. Shelves of the cabinet hold 12 batteries, which are accessible for testing without removing. The unit is equipped with four-acid-proof molded rubber trays, battery clips and jumpers for 12 batteries, and an all-rubber cord and plug for connection to 110-volt, 60-cycle a-c circuits. The complete unit is protected by an acid-resistant finish.

BIRCO "SWITCH-O-MATIC" ANTENNA

To guard against the possibility of incorrect or poor connections the Birco "switch-o-matic" antenna, introduced by the Birnbach Radio Co., Inc., is completely connected and soldered at the factory. No switching is required on either the short-wave or broadcast band.

Complete information on this new type of antenna may be obtained from the manufacturer, Birnbach Radio Co., Inc., 145 Hudson St., New York City.

ASTATIC PICKUP

After much research the Astatic Micro-

phone Laboratory, Inc., Youngstown, Ohio, has released a crystal pickup known as the Tru-Tan model B constructed with an off-set head which holds the needle, throughout the entire playing of a 12-inch record, practically true to the tangent of the circle at all points (maximum error never exceeds 1.5 degrees from the true tangency).

In addition to its performance features the model B pickup has a full double row ball-bearing base swivel with hardened steel pivot trunnion.

Another feature is the provision for needle loading—which consists of a reversible head permitting the needle to be dropped in from the top.

TURNER MICROPHONE

The Turner Co., Cedar Rapids, Iowa, has announced the model VT-73 microphone. An adjustable swivel head permits the microphone to be used either on the desk or as a hand microphone. An output level of —55 db is available from the VT-73.

It is designed chiefly for voice transmission.

The VT-73 is complete with stand, cable and shielded plug.

HIGHLIGHTS—continued

HYTRON GIVES BONUS

In keeping with the times the Hytron Corp., Salem, Mass., has granted a bonus in the form of an additional week's salary to all of its employees. At the same time it was announced that the New York office of the company, under the management of David Cohen, has been moved to 315 Fourth Ave.

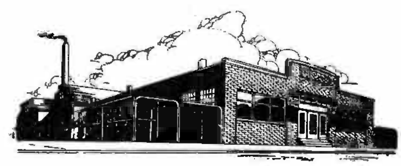
SPRAYBERRY FOUR-COLOR DIAGRAMS

To facilitate study of the action of a tuned-radio-frequency receiver, the Sprayberry Academy of Radio, 2548 University Place, N.W., Washington, D. C., has announced a lesson in which a circuit diagram in four full colors plays a prominent part. This and other lessons with color diagrams now in the course of preparation will be supplied with Sprayberry training at no additional cost to students.

By illustrating various circuit components in color, study is greatly simplified. It becomes easy for the student to trace a signal through the circuit or to understand the action of various units. Refinements, frequently found in modern radio, have purposely been omitted to further simplify the subject. These refinements, however, are dealt with individually in later lessons so that the student has a thorough grounding in fundamentals before tackling them.

WARD PRODUCTS MOVE

The Ward Products Corp., manufacturers of automobile aerials and sound systems, have recently moved into their own new building on East 45th St., Cleveland, Ohio. They have doubled their manufacturing space and enlarged their sales of-



fices. In addition to their Cleveland plant, the Ward Products Corp. have a branch in Canada and an export office in New York City.

TOBE "FILTERETTE" CATALOG

Specific recommendations for quelling man-made static are given in the current issue of the Tobe Deutschmann Corp. "Filterette" catalog in which are presented the results of ten years' laboratory and field research by this organization in the radio interference eliminating field.

Forty-two stock models from which may be chosen a suitable unit for any application are fully described and their installation illustrated in this handbook for the Service Man.

The catalog also tells how Service Men may have placed at their disposal the services of an engineering staff devoted exclusively to the study of radio interference problems.

TRIUMPH APPOINTMENT

J. P. Kennedy, formerly an account executive for The Fensholt Co., was named sales and advertising manager of the Triumph Manufacturing Co., Chicago. In his new position, Mr. Kennedy expects to develop the direct-to-dealer sales policy of the Triumph Manufacturing Co. and to seek new markets for radio and electrical instruments.

AUTO-RADIO—continued

Adjusting Antenna Compensator

(a) Set the signal generator to 600 kc.

(b) Tune in the 600-kc signal with the station selector for maximum output.

(c) Adjust the antenna compensating condenser for maximum output.

(d) Repeat operations (b) and (c) alternately until no further improvement can be obtained.

(e) Set the signal generator at 1400 kc again."

(f) Tune in the 1400-kc signal with the station selector for maximum output.

(g) Readjust the trimmer on the antenna section of the tuning condenser for maximum output.

It will be necessary to adjust the antenna compensating condenser to the car antenna after the receiver has been installed in the car.

(a) After the installation is complete, tune in a weak station between 55 and 65 on the dial.

(b) Adjust the antenna compensating condenser for maximum volume in the speaker.

PUBLIC ADDRESS—continued

denser-resistor combination ahead of the 6N6 output tubes.

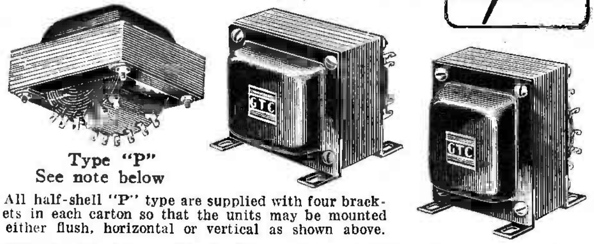
The high-frequency channel has a frequency range of from 2500 cycles to 12,000 cycles. It was found possible during tests to obtain frequencies as high as 25,000 cycles but that present-day broadcast facilities do not lend themselves to the reception and reproduction of these higher audio frequencies, and therefore, 12,000 cycles was set as the upper limit of audio frequencies. Power output of this channel is about 12 watts.

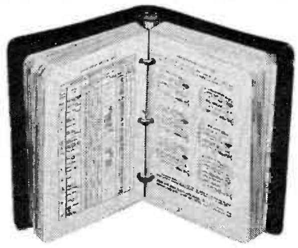
Speakers

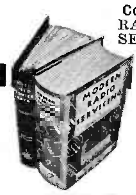
One 18-inch auditorium type of speaker is used for the low-frequency output, two 12-inch speakers are used for the mid-frequency output, three high-frequency diaphragm type speakers or tweeters are used for the output of the high-frequency channel. In the cabinet the 18-inch speaker is mounted as low as possible and in the center of the cabinet with the two 12-inch speakers on each side set at an angle of approximately 30 degrees with the front plane of the cabinet. One tweeter is mounted directly above the large speaker with two on each side at the same angle with the front as the 12-in speakers.

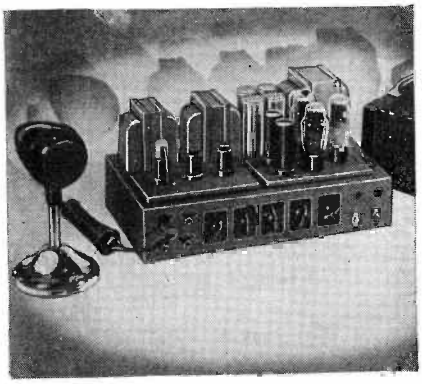
A. P. Richards, Crosley Radio Corp.

INDEX TO ADVERTISERS









NEW

Non-Reactive Dynamic Beam-Power Amplifier and Streamlined Bullet Electro-Dynamic Microphone.

Available at an almost unbelievable Low Price!

Provides unrestricted frequency response, two-phase bridge rectification, variable polar characteristics, etc., etc. Write for Circular No. 3714 for complete details and prices of this amazing development by A. C. Shaney.

AMPLIFIER CO. of AMERICA
39 West 20th Street New York, N. Y.

Switch-O-matic All Wave Antenna

Here is an all-wave antenna kit that really will improve your reception because it has been factory connected and soldered to eliminate incorrect and poor connections.

FEATURES include: Easy to install. Antenna Transformer matches Impedance to transmission. No signal loss in transmission to receiver coupler. No switching for s.w. or broadcast.

No. 375—All Wave Antenna. $4.25 ea. list

No. 376—All Wave Antenna for sets with built-in aerial selector. $3.50 ea. list

See your jobber. If he cannot supply you, write direct to Dept. S-1.

BIRNBACH RADIO CO. INC.
145 HUDSON ST. BIRCO NEW YORK, N. Y.

Curtis Electrolytic CONDENSERS

Patent No. 1,950,352

Our exact duplicates enable you to make satisfactory repairs on all makes of radios.

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3088 WEST 106TH ST. CLEVELAND, OHIO

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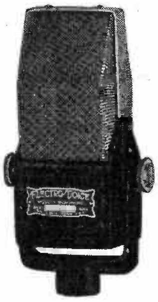
ELECTRO-VOICE

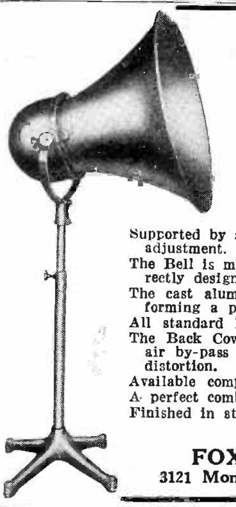


Public Address men, everywhere, are standardizing on ELECTRO-VOICE microphones. Constant improvement resulting from unceasing research keeps this line ahead of the field. When you buy an ELECTRO-VOICE product, you buy the latest in engineering design.

Six Velocity models priced from $19.50 to $75.00 list. Carried in stock by leading distributors.

ELECTRO-VOICE MFG. CO., INC.
332 E. Colfax Ave., South Bend, Ind.

Export Office: 100 Varick St., New York, N. Y.

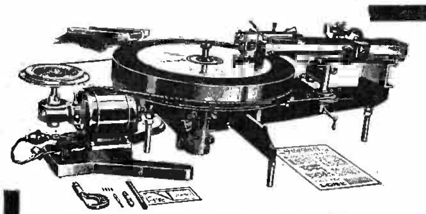


OUTSTANDING!
The New Fox B-5 Universal Baffle Type Horn

Quality construction.
Completely universal in directional characteristics.
Supported by a sturdy adjustable cradle complete with lock screw adjustment.
The Bell is made of FOX special alloy horn material and is correctly designed for utmost output.
The cast aluminum throat collar reinforces the entire assembly, forming a perfect foundation for speaker mounting and cradle.
All standard 12-inch speakers can be used.
The Back Cover is of heavy horn material and has the proper air by-pass so that the speaker can breathe, thus eliminating distortion.
Available complete with adjustable stand.
A perfect combination for indoor or outdoor work.
Finished in standard aluminum gloss or Fox special wrinkle.

Write for catalog sheets and prices.

FOX SOUND EQUIPMENT CORP.
3121 Monroe Street Toledo, Ohio



Record Piano Music at 33⅓ R.P.M. with UNIVERSAL Professional Recording Machine

New, improved design—Scientifically correct—Superlative performance—Solid, heavy, dependable—Precision machined for long and continued use—16-in. distortion proof turntable disc—Constant speed rim drive—110 volt A.C. 100% synchronous reversible motor—Individually calibrated timing bar provides for both 33⅓ and 78 R.P.M. at 90, 110, and 130 lines per in.—Solid steel bar slide—The climax of four years of research and experiment—Positively the last word in instantaneous recording equipment.

Write for latest folder giving detailed description.

UNIVERSAL MICROPHONE CO., Ltd.
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★ ALWAYS CARRY Ken-Rad Radio Tubes

Ken-Rad genuine *all-metal* radio tubes are dependable. They give outstanding performance. Write for information.

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First in Speed, First in Ease, First in Capacity, First in Economy, First in Durability. 17 exclusive improvements—more than 100 refinements. Phone for a demonstration of the New Royal. . . . Compare the Work!

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Your eyes and the MAGIC TUBE . . . see all, know all, quick as a wink! Capacity, power factor, leakage, resistance, read directly on the panel.

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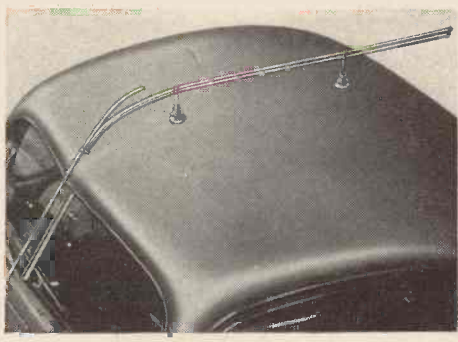
RCA Auto Antennas offer wealth of fine features for High Efficiency!

For 1937 RCA offers you the finest line of auto antennas, complete "from top to bottom"—both as to location and price. Scientifically designed antennas, ranging from $1.50 to $6.00 list. They're universal—designed for use with all makes of radios and autos. They're streamlined for the new 1937 cars. See the many features of RCA auto antennas.



RCA AUTO-TOPTENNA

Stock Number 9792—List price $5.00

CHECK THESE FEATURES:

✓ ELIMINATES WHEEL STATIC AND MOTOR NOISE.

✓ Fits all cars—all models.

✓ Provides simple installation. Drilling in steel top unnecessary.

✓ Streamline design enhances beauty of any automobile.

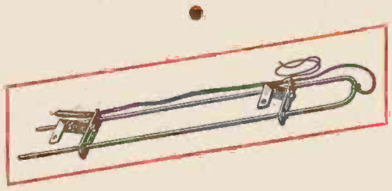
✓ Removable without mutilating car. A chromium button is furnished to restore cowl if antenna is removed.

✓ Triple-chromium plated, has molded bakelite insulators.

✓ Special cement furnished for suction cups.

✓ Operation not affected by climatic conditions.

✓ A special shielded fitting to cover inside terminal of this antenna is also included. Insures perfect shielding—prevents possibility of noise pickup in antenna terminal.



RCA DI-POLE AUTO ANTENNA

Stock Number 9605

List price $2.60

An under-car antenna that provides efficient station pickup and also eliminates ignition noise pickup. This antenna can be simply, quickly and easily installed.

For weak signals RCA Inlantenna gives high signal pickup. Stock No. 12322 — list price $5.00 . . . for quick installation RCA Roof Antenna. Stock No. 7622—list price $1.50.

RCA AUTO-WHIPTENNA

Stock Number 9793—List price $3.50

CHECK THESE FEATURES:

✓ ELIMINATES WHEEL STATIC AND MOTOR NOISE.

✓ Quickly installed—usually less than five minutes—no drilling required.

✓ Attaches to hinge pin of any car.

✓ Extremely efficient for maximum signal pickup.

✓ Extremely flexible—guaranteed unbreakable.

✓ Triple-chromium plated with molded all-weather rubber insulation; attractive appearance.

✓ Same model fits all cars.

✓ Easily installed . . . you merely remove hinge bolt on either side of car, attach antenna, and return the bolt. That's all there is to it—no drilling, no holes or cementing to top necessary.

RCA presents the Metropolitan Opera every Saturday afternoon. And "Magic Key of RCA" every Sunday 2 to 3 P. M., E.S.T. Both on NBC Blue Network.

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