MODERN RADIO

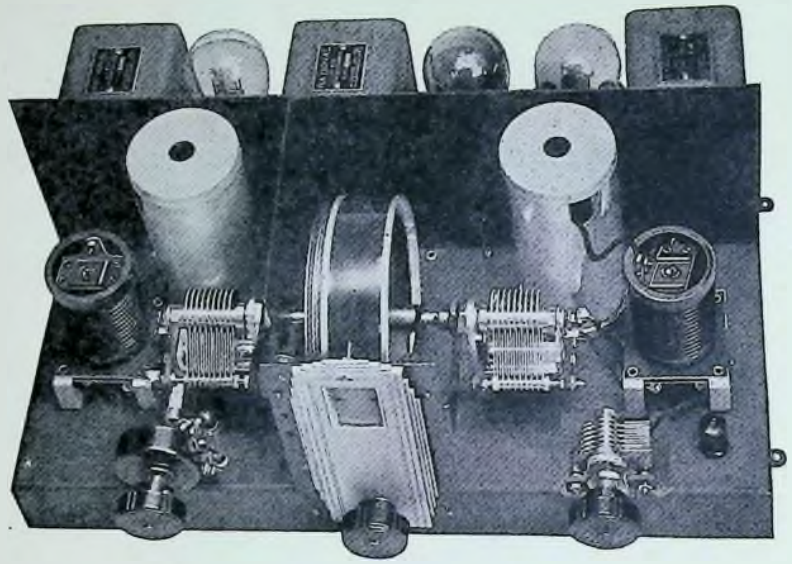
EDITED BY ROBERT S. KRUSE

contents

Number 1 July 20 cents

1931

Now Still Further



Now, NATIONAL CO. has made use of the remarkable UY 235 Variable Mu Screen Grid Tube, giving even better performance on the THRILL-BOX than ever before.

The short waves give a quality of daylight reception and a daylight distance that is amazing. Signals come in in mid-day from England so loud that they can be clearly heard all over a large house.

Lower Noise Level With THRILL-BOX

The circuit employed in the THRILL-BOX gives less background noise and a lower noise level than any other short wave circuit we have tested in our Research Laboratory. There is less crackling, less hum, less interference with reception of broadcasts or the signals themselves.

270° CONDENSERS GIVE WIDER SEPARATION OF STATIONS

The special 270° Tuning Condenser employed in the NATIONAL THRILL-BOX spreads out the stations and the genuine Velvet Vernier Drive makes separate station logging easy and accurate.

NATIONAL THRILL-BOX SW5

Made by the Makers of the Famous Velvet Vernier Dials

Improved!

The NATIONAL THRILL-BOX

Range 9-850 Meters

A special 245 push-pull model is now available for general short-wave broadcast reception.

For technical and amateur communication, the 227 push-pull model is recommended.

Special Band-Spreading Coils

If still further spreading of the 20, 40 and 80-Meter Amateur Bands is desired, NATIONAL CO. has standard Band-Spreading Coils which give a spread of 50 dial divisions on these signals.

Genuine Single Control

The THRILL-BOX has TRUE SINGLE-KNOB TUNING. The tuning is done literally and actually with one knob only, not two or more knobs on one shaft. The stations always come in at exactly the same place on the dial.

Circuit Design for Maximum THRILL-BOX Performance

There are no band-changing switches on the THRILL-BOX or other additions to the R.F. circuit which are likely to reduce its efficiency and performance. Coil forms of R.F. transformers are made of R-39, the new low-loss coil material, developed by Radio Frequency Laboratories, available only in the THRILL-BOX. This is just another reason for the supremacy of the THRILL-BOX—every part, every component has been designed for the highest efficiency.

Humless Power Unit

The power unit of the NATIONAL THRILL-BOX is specially designed for humless operation on the short waves. There is an electrostatic shield in the power transformer which isolates the secondary windings from disturbance and there is an over-size hum filter. Even the Rectifier Tube has an R.F. Filter which eliminates tunable hum. R. C. A. License.

A New Special Broadcast Receiving Model Also Offered

We now announce a special broadcast receiving model of the THRILL-BOX, equipped with 245 tubes in Push-Pull for audio output. This gives very fine quality with large volume. For technical and amateur communication we recommend the Push-Pull 227 model. Write us for particulars and prices, using coupon below.

Universal Use All Over World Proves THRILL-BOX Quality

The THRILL-BOX is built with NATIONAL Precision-Made Radio Products. NATIONAL Precision-Made Radio Products are used by: General Electric Co.; Westinghouse Electric & Mfg. Co.; R. C. A.; Tropical Radio (United Fruit Co.); Federal Tel. & Tel. Co.; American Tel. & Tel. Co.; Canadian Marconi; U. S. Naval Research Laboratories; U. S. Navy; Signal Corps, U. S. Army; Jenkins Television Corp.; Press Wireless, Inc.; De Forest Radio Co.; Wired Wireless, Inc.; U. S. Dept. of Commerce (Lighthouse Service); Pan-American Airways; Curtiss-Wright; Boeing Airplane Co.; Western Air Express; Roosevelt Field, Inc.; Southern Air Transport, and by thousands of leading Amateurs, Experimenters, Colleges, Universities, Schools and Research Laboratories the world over.

NATIONAL CO., Inc.
61 Sherman St., Malden, Mass.

Gentlemen:

(Check which)

( ) Please send me complete information and prices on your new Improved THRILL-BOX, with 227 Push-Pull Output.

( ) Please send me complete information about new Special Broadcast Receiving Model of THRILL-BOX, with 245 Push-Pull Output.

( ) I enclose 50c (stamps or coin) for your 64-page Handbook of Short-Wave Radio, describing in full the latest and best short-wave receiving circuits, adapters, meters, etc.

Name .....

Address .....

Television Possibilities

"Modern Radio" believes thoroughly in television as a most enchanting game for the radio amateur, both because it is a change from the same old things he has been doing for ten years, and also because it is in just such a stage of development as must appeal to the amateur. Some one of the next years will see it a commercial and household device and it is too bad that this change is being delayed by exaggerated news stories which cause everyone to lose confidence in a very real development.

There is no excuse for hailing each new transmitter as "solving the problems of television". The actual problems are rather basic and not to be answered by a mere change in the machinery. Thus the newspapers have just recently carried a series of items to the effect that the problem of television has once again been solved by replacing the ancient and familiar Nipkow scanning disc with an electron tube—an idea which is at least 23 years old! Please do not take such excited reports too seriously for they do not touch on the real problems at all.

The basic difficulties are those of transmitting a huge number of impulses per second in an undistorted manner. The manner of scanning a picture at the rate of 16 to 20 times per second has been so much discussed that it is needless to repeat the explanation of the causes of the appearance of high frequencies, that is to say a large number of pulses per second. The intention here is merely to show the seriousness of the effect on the problem of transmission—altogether aside from the particular set of cams, gears, levers, lenses, tubes and batteries which the designer is using at the transmitter and receiver.

Assuming that both transmitter and receiver were altogether perfect we must still consider how the pictures are to go from one to the other—and that's where the rub comes in! Suppose we consider the accompanying photographs, reproduced by courtesy of Mr. Paul B. Findley, Managing Editor of Bell Laboratories Record. The pictures were, except for Fig. 1, sent over a high grade laboratory circuit. Fig. 1 is the original photo. If a really high-grade picture is to be transmitted, and only 16 pictures per second are to be sent, we find it necessary to use a transmitter and receiver which can work at 8,000,000 impulses, or 4,000,000 cycles per second! Can it be done by wire? Certainly not over any present public-service lines and probably not at all—until we have learned to build much better lines. Can it be done by radio? Possibly—but it will take 400 ordinary broadcasting channels of 10 kc each, or in other words everything from 66 meters to 545 meters. How does one make a transmitter to radiate such a band of frequencies? How does one make a receiver to take it all in? How does one persuade a number of governments to push a few thousand stations off the air to make room for the one picture? The thing is clearly ridiculous and we must decide that—

A—To transmit a picture as good as Fig. 1 by radio is not practical unless—

B—We can think of a wholly new basic idea which does NOT require scanning at all in the present sense—that is in the sense of looking at all the little bits of the picture, one after the other.

Very well—what CAN be done. As to that, look at the other pictures, recalling that they show the BEST PRACTICAL POSSIBILITY and that in practice the picture will never be that good, for neither the transmitter nor the receiver are perfection and between them lies the unknown performance of the ether. The ether is not a very reliable errand-boy. Our position is that of having very, very carefully worked out the exact orchestration of a sonata and then having to entrust it to the memory of a careless small boy who may get it straight, but probably will not. The shorter the wave length, the younger and more careless the boy becomes and the worse he mixes

Fig. 1.—Something for the future to aim at. To transmit such pictures at the minimum required rate of 16 per second will take about 8,000,000 pulses or 4,000,000 cycles per second. This is about 400 broadcasting channels or everything from 545 meters down to 66 meters! The pictures have 250,000 "elements" each. The amplifiers must handle all frequencies from 16 cycles to 4,000,000!

Fig. 2—An "88 hole" picture with about 6,250 elements. If sent at the rate of 16 per second this requires 10 broadcasting channels, if sent at the rate of 20 per second it requires 12½ channels. The amplifiers must handle frequencies from 16 to 100,000 cycles in the first case and from 20 to 125,000 cycles in the second.

Fig. 3—If only two ordinary broadcasting channels are to be used one can send 16 such pictures per second, each having 1,250 "elements". This corresponds approximately to the "48 hole pictures", lately considered standard.

Fig. 4.—To get television into a single broadcast channel one would need to tolerate such things as this, even when sending but 16 pictures per second.

the music. If he is a 660 kc boy he will bring us the music from WEAF and WTIC in very good order, but if he is one of these little 6,000 kc boys or one of the other little boys he will make an awful mess of the music from G6SW, W2XE, or almost any other high-frequency broadcasting station. Is it likely that he will do better when it comes to carrying pictures? Of course not if he has to go very far with them. I personally have seen a number of pictures that illustrated perfectly Boyd Phelps' description of "Looking like a dirty thumb print". This is an argument for local stations.

It looks then as if we must for the moment expect from radio television something not quite so good as Fig. 3 when everything is just right. Fading and apparatus deficiencies will make it worse, static will cause it to look like a Nebraska rural mailbox that someone has used for a shotgun target, electrical noise will cause it to be overlaid with hailstorm effects like an old-fashioned movie—none of which will for a single moment discourage a real radio amateur, for what's the fun if the thing is easy? It is easy to make decent music from the European shortwave broadcast signals? Is it easy to understand an amateur radiophone through the horrible interference in the little 'phone strip at the top of the 80 meter band? Well—this is no worse—and it's newer.

Besides, a moving picture always looks a good deal better than the single pictures that make it up. By way of illustrating that, just stop a movie projector sometime and see how inferior the "still" picture seems, how full of defects and haze. "There is hope".

Stuart Ballantine Receives I. R. E. Award

At the June convention of the Institute of Radio Engineers the Morris Liebermann Award for 1930 was given to Stuart Ballantine, of the Boonton Research Corporation for "outstanding theoretical and experimental investigation of numerous radio and acoustic devices."

The work of Stuart Ballantine has been of major importance in bringing about many of the important developments in radio broadcasting, notably automatic volume control, high-voltage detection, linear detection, single-control tuning and the variable-mu tetrode. He has for many years been a prolific contributor to the literature of radio but has not confined his attention to that art alone, having made extensive excursions into acoustics, chemistry and other branches of natural science. In the more modest field of amateur transmission he contributed the book "Radio Telephony for Amateurs", and to commercial transmission the cross-neutralized push-pull radio-frequency amplifier which is so essential to the modern high-power station.

Editor ROBERT S. KRUSE
Associate Editor L. W. HATRY

Published Monthly by
MODERN RADIO CO.
127 Ann Street
Hartford, Connecticut

Business and Advertising Manager N. T. YOUNG
Tel. 5-2733

Entered as second class matter at the post office at Hartford, Conn. (permit pending), June 20, 1931, under the act of March 3, 1879. Yearly subscription $2.00 in U. S. and Canada, $3.00 in foreign countries. Single Copies, 20c.

Contributions not returned unless accompanied by stamped, self-addressed envelope.

Anti-Noise Receiving Aerials

By L. W. Hatry

The working theory of any anti-noise effort must be based on experience. If any of the following statements seem unorthodox it should be remembered that they represent experience rather than theory.

The use of a long antenna, although not the only means discussed, has been given prominence because of its extreme simplicity. There appears to be a very general conviction that long aerials aggravate noise while short ones reduce it. This is contrary to the facts, a point which may as well be settled before going any further.

The Short-aerial Fallacy

The short-aerial rule was born in the days of the regenerative broadcast receiver—and should have been buried with those same "bloopers". It was perfectly true that with the obsolete 1, 2 and 3 tube receivers a short aerial DID reduce both noise and interference.

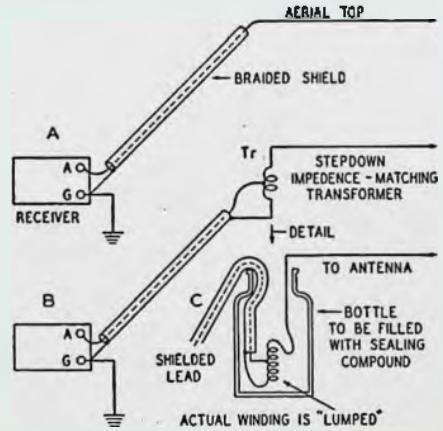


Figure 1

The reduction in interference was due to a general lowering of the noise and signal input level which permitted effective use of the regeneration control and thus increased the selectivity. The reduction in noise was a product of this same lowering of input levels, which prevented the regenerative tube from being jarred into blocking or irregular oscillation. Neither of these reasons applies to present receivers.

The Cause and the Cure

Man-made electrical noise is almost always strongest near lighting, power or trolley wires and dies off very rapidly as one goes away from the wires. It is this fact which permits the use of long aerials to reduce noise. One needs only to extend the antenna into a comparatively quiet region where it is possible to collect ample signal without so much noise. If it develops that the leadin wire and ground wire by themselves collect too much noise they must receive the simple treatment described later.

Frequently the long aerial is a sufficient solution. When a 50 or 100 foot aerial is noisy, stretch the top out for 200 or 300 feet—not necessarily as one span but avoiding wirelines and houses which are full of wires that is not in conduit. It has been my experience that in some very severe cases a 300 foot aerial gave such an improvement that the customer was perfectly certain that "There warn't no more noise".

Of course long aerials can change other things besides the noise level. In one case an 80 foot aerial was replaced by a 250 footer for noise abatement. The interference from the local station at once decreased greatly. In this case the local station was operating at a rather high frequency to which the antenna circuit of the receiver had been semi-resonant when connected to the short antenna. That particular part of the result could of course have been obtained with a simple loading coil, but loading coils suppress no noise. In other cases, particularly with receivers built around the 224 tubes, very long aerials may tend to increase cross-talk. The cure is usually a wave-trap tuned to the local station. Today's receivers do not have this fault. The cross-talk tendencies of the early screen-grid sets (both T. R. F. and Superheterodyne) have been overcome by the Snow-Ballantine variable-mu (or multi-mu or super-control) screen grid tubes such as the types 551 and 235. Selectivity has been made

ample in all the better designs, a long aerial can be used without extra interference and the noise-vs.-signal question can now be considered without complications. (Should your set be one of the types using 224 tubes in all the screen-grid sockets add a good wavetrap and then follow the rest of the argument with us.)

Antenna Locations

In the usual residential location, that is, one that consists of a lot facing a street with the light-line passing down the street, the anti-noise work is at its minimum. The center of the "block" or square will very likely be the quietest area in that it is farthest removed from the light-lines parallel to its four sides. If the lighting wires are so placed as to halve the square by running down what is technically known as an alley, a passageway or small street between the rear ends of lots facing parallel streets, the problem is unchanged basically.

In brief if the long aerial is to be of any use it must be properly placed. Run it down the street parallel to the light-wires and make it a liability; run it back across lots keeping on all sides the maximum distance from the A. C. lines and it will do its best.

The Worthless Waterpipe

In a location so extremely noisy that a long aerial does not permit one to drown out the noise completely the next reasonable precaution is to use one of the other special leading-in systems mentioned later. This will be comparatively unprofitable if the receiver is grounded to a waterpipe or radiator for such piping covers a large area inside the house (noisy region), is not necessarily of low resistance and probably of high reactance, causing a high noise-voltage. Also other devices, such as the telephone, may be grounded on the piping and be causing it to carry noises not otherwise heard in the receiver. Add a highly reactive, ground circuit to the capacity feeds from the lighting wires into an A. C. receiver and the result is a high-pickup loop effective chiefly on noise—in fact already containing most of the noise sources. A good independent ground tends to end this, particularly in receivers carrying built-in bypasses. Thus the good ground makes it possible to gain some good from the special leadins about to be described. Sometimes it is the sole change necessary.

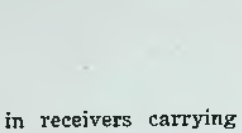
Trick Leadins

Special leadins for anti-noise aerials are all arranged to prevent them from picking up either signals or noise, so that the top of the aerial is essentially the sole source of pickup. If this top is properly placed outside the noise area improvement is automatic.

All these special leadins cause some loss of signal strength. This loss may be rendered harmless by the simple scheme of starting out with a lot of signal—which is to say a large antenna, or if that is impractical it may be minimized by some of the devices described later. I suggested the long aerial first because it is so simple, and usually cheapest.

Shielded Leadins

The simplest of the special leadins is that shown in Fig. 1A. It is a length of rubber-covered wire over which is a metallic braid that is grounded at the receiver. Such wire may be bought



ready-made, but one should avoid the sort that has only cotton or silk insulation as it is soon spoiled by the weather.

The losses in such a system are rather high because the leadin is in effect a rubber-insulated condenser shunted across the receiver terminals, and soft rubber is pretty poor stuff at radio frequencies. One may, as has been suggested, anticipate this loss by providing a large antenna with plenty of signal so that one can stand the loss. If that is not possible one may use another remedy suggested, I believe, by W. F. Cotter. This arrangement will be understood when its theory is suggested.

The losses in a low-grade condenser go down very rapidly as the voltage on it is lowered. Thus if we could reduce the R. F. voltage on our rubber-insulated leadin we would save precious signal-

power. This may be done by using a small very simple home-made stepdown R. F. transformer as suggested at Tr. in Fig. 1B (dimensions later). The signal is then sent along the shielded line at lower voltage and higher current. When it reaches the receiver it must be stepped up once more though this does not necessarily call for any additional machinery, as will be shown.

A Detour on Transmission Lines

It may be simpler to think of the whole thing in this way—The antenna is a high-impedance system; the line is of low impedance. One must accordingly match the impedances by means of a stepdown "impedance-matching" trans-

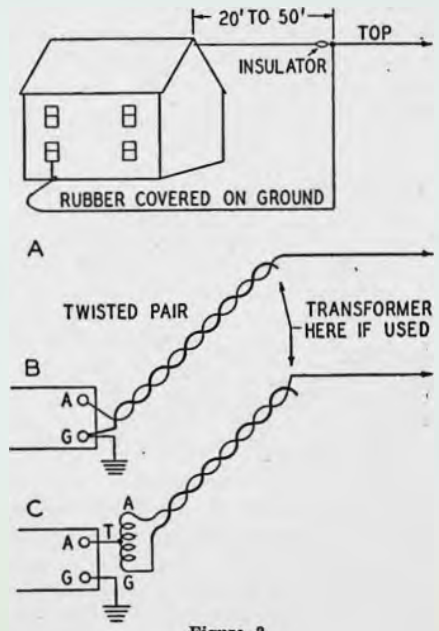


Figure 2

former between them to avoid reflection losses. At the other (receiver) end of the line one must step up again because the first tube in the receiver is a voltage-operated device. If the original antenna transformer in the set does not do this job one must make the changes or additions just suggested.

Getting Down to Practice

In practice the transformer is a magnificent help, if one has time to spend on getting it right for the particular antenna, so that the entire broadcast (or other desired) band is received well. If too many turns are used (or if the antenna is too long for that transformer) the long waves will come through well but the other end will be missing.

Because of the cut-and-try effort required to approximate proper conditions for various lengths of antennas and leadins the use of the transformer proves expensive in commercial installation and service work. That is why for such work it is more practical to anticipate the losses by means of a very long antenna. The impedance matching transformer should, however, be used unhesitatingly when no other solution is possible, and the time expended in finding a correct size is justified. Its use is most logical when the location permits only a short aerial top, and therefore necessitates making that top as effective as possible, in spite of the need for a shielded leadin. Specifically, if the top is shorter than 70 feet it is usually desirable to use the transformer with a shielded or other special leadin.

In designing the transformer keep in mind that one-half the winding will give one-quarter the total impedance, and so on. Practice has shown that with leadins up to 50 feet long the tap should be made at three-quarters to about one-half way from the grounded side. For broadcast reception the coil L is so wound that, with antenna and receiver connected it will have a resonance point (broad) at about 700 Kc. Long wave (low frequency) stations are aided by this resonance while the high frequency stations are helped out by the increased sensitivity of most receivers at 1500 Kc. However, this can be no rule. The purchaser of the aerial might be interested chiefly in one station or a group of them about one frequency. Make the transformer in any case so that its resonant point aids the requirements of the user.

As a good start here are the dimensions of a transformer for use with 35 feet of shielded leadin and 100 feet of top:

Total—150 turns No. 30 D. S. C., lumped on 1 inch diameter.

Tap—90 turns from grounded end.

These dimensions apply only to a particular aerial. Different shielded wire

with less capacity per foot or different conditions surrounding the aerial top will affect the resonant point and the placing of the tap. The chap interested in satisfying all needs in the matter had best make up several sizes and on every size provide himself with at least two taps, the most useful taps being at one-half and three-quarters of the number of turns from the grounded end.

For higher frequencies the number of turns is reduced, keeping the proportions the same as long as the antenna remains the same. Thus for a transformer to work in the 80 meter amateur band the number of turns would be about half that stated, and the diameter about ¾ inch outside.

Simulating the Shielded Leadin

In many cases it is possible to imitate the shielded leadin without using a shielded wire. In no case are these trick leadins to be regarded as effective as the shielded type although they serve excellently when interferences are not too vigorous. Their chief value is to be got in locations not permitting an adequate top for a shielded leadin without a matchup transformer, or in locations where facilities are hopeless for the installation of the matchup transformer and the cut and try procedure necessary to get it to correct dimensions.

One imitation is extremely simple. In Fig. 2A simply drop the leadin before the aerial top has reached the house and bring it to earth. There lay it on the ground and have it follow the ground to the point of approximate entry into the house. Of course this sort of leadin can be improved with a matchup transformer connected in place where the leadin begins to travel on its stomach.

A second imitation is the twisted leadin Fig. 2B: if one side of the twisted leadin is connected to the aerial top and the aerial post on the receiver and the other side is connected to ground and hanging free at the aerial top the leadin is strictly a semi-shielded one. If, however, this leadin instead is connected as in Fig. 2C it becomes slightly different; for the dead wire (not connected to the top) is running at exactly opposite potential (180 degrees out of phase) to the live wire and consequently the two wires cancel each other as pick-ups, the top alone getting signal (and noise). A variation of the twisted leadin idea is shown in Fig. 3. This aerial counter-poise system has the same requirements as any other. Logically the top two wires, should be matched to the leadin by a transformer TR3. Antenna-counterpoise systems, being usually house-top or sideyard affairs are more uniform as to size. Most broadcast receiving needs will be met if TR3 has 150-160 turns of No. 34 D.S.C. lumped on a three-quarter inch insulating rod or spool and tapped 8 or 10 turns each side of center. And likewise, because the parallel nature of the two wires, neither of which are to be connected to ground, a second transformer must feed into the receiver for the receiver is inevitably grounded either

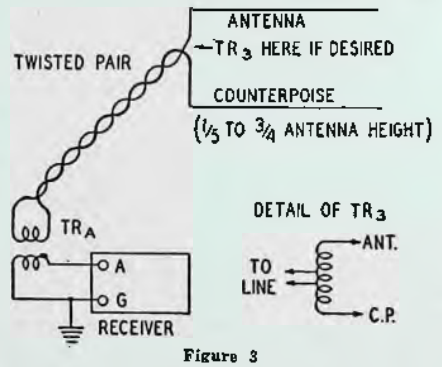


Figure 3

through the A. C. line or (as is preferable) to a good independent ground. The second transformer TRA is simple enough; it works into a low impedance (the antenna winding of the receiver) and consequently need only be 1-1 ratio to match up with the low impedance leadin; two windings about 30 turns each and **lumped over each other** on 1 inch tubing will serve.

These antenna-counterpoise schemes must **not** enclose the source of noise; do not put the antenna above a house and the counterpoise alongside. Put **both** or **neither** on the roof.

The Worst Locations

Business, apartment house, and similar locations crowded with unknown quantities of noise-making equipment from the telephone to the loose fuse are

subject to the same general practices as better and less generally noisy ones. Here, however, frequently the only manner in which reduction of noise is possible is height of the top. The top cannot be extended beyond the noise so it must be raised above it. A high aerial with a good shielded leadin is the answer and since here the leadin must be long a matching transformer is imperative.

Obviously by lengthening the top we are in a sense faking the action of the matchup transformer; in other words we are attempting by mere length to achieve an impedance similar to a shielded leadin. That is why in previous cases I have so insistently suggested the long top as the means of overcoming the apparent signal loss in the leadin.

The Receiver End of the Line

It was suggested that there should be a stepup transformer at the lower, or receiving-set end of the line. This is not essential but adds to the results. One may use a transformer exactly like that at the antenna end (reversed) or one may add to the receiver a new antenna coil with a very few turns (about one-tenth to one-quarter the usual number). If the receiver originally used a tap on a tuned winding one need only tap further down toward the ground end of the coil. Before making any changes in the receiver, or providing any transformer at this point, see how matters work out if the leadin is connected to the "long antenna" terminals of the set. In some cases this gives a good enough

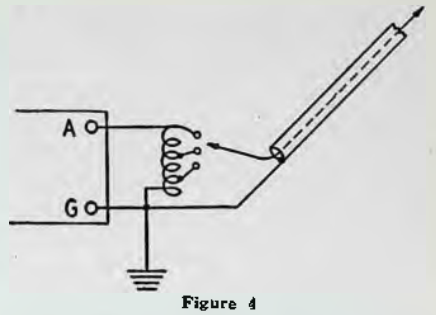


Figure 4

match. In general, as long as the shielded leadin does not get much above 75 feet long, the receiver matches it fairly well. But when the shielded leadin gets into lengths of unusual magnitude it will drop to an impedance appreciably lower than that of the input of the receiver and will likewise have to be matched, in this case the matching of course is in the opposite direction to that of the matchup of top to leadin, that is stepup instead of stepdown. A thirty turn winding with taps at 15, 20, 25 turns will usually fit nearly any condition; the winding being lumped on one inch diameter tubing. Again one has a case however of being able to alter the sensitivity at different portions of the waveband by getting the inductance in Fig. 4 resonant at some point in it. One has to experiment to satisfy the needs of a particular case.

A properly installed pair of 40 to 80 foot iron pipe poles and a shielded leadin aerial to fit will often make possible store demonstrations selling receivers which otherwise would have to be carried to the customer's home to prove that the radio is adequate.

Did you ever hear of a screen-grid B eliminator? We know an apiarist that wears one over his head whenever he is working around his beehives.

* * *

Electrad has a new volume-control folder on a good-grade of cardboard. It describes five volume controls and specifies 348 different receivers which these volume controls will fit for repairs, service and replacement. They send these cards on request; it is useful whether one has their controls on hand or not.

International Resistance, makers of I. R. C. resistors, are providing customers with celuloid "slide rules" of the disc variety for determining the size of a resistor by its color-coding. The color coding of resistors is now being done according to R. M. A. standards, the specifications of which were recently settled. The I. R. C. resistor "slide-rule" can be got from I. R. C. directly or any one of their distributors by anyone purchasing five of their small one-half or one watt pig-tail resistors. Any serviceman will find the chart useful daily.

The Successful Metal-chassis Receiver

By Robert S. Kruse

The mere presence of much sheet metal is not an assurance that one may be careless in the design or construction of a receiver. On the contrary, departures from standard design require more care than was necessary in the days of wooden baseboards and 201A tubes. This is only partly due to the higher amplification now used; it is quite as much due to the ability of voltages to wander about and to cross trails with circuits for which they are not intended.

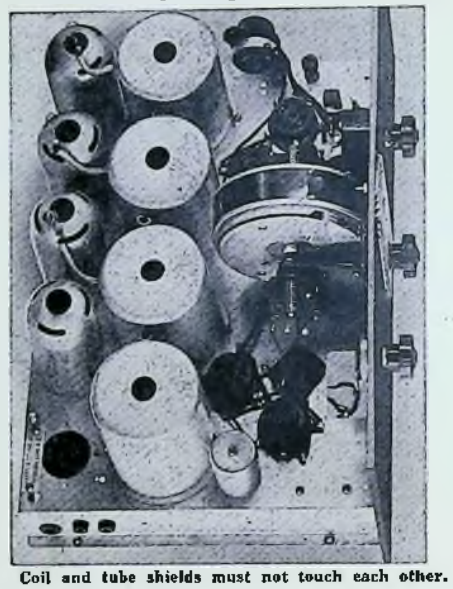
All ordinary electrical circuits are closed circuits. A current does not stop when dumped into a metal chassis but continues back to the point from which it came, contriving (like a boy let out of school) to get into deviltries on the way home. To anticipate, and head off, these pranks the designer seeks out safe routings. He does not do this blindly, but in accordance with plain principles. If the reader's patience survives the following elementary circuit description I may be able to show what some of these principles are.

A Bad Example

Let us talk about the circuit shown in Figure 1, which is a perfectly ordinary stage of screen-grid r-f amplifier followed by a triode detector. This circuit looks off-hand as if everything had been "fully bypassed and shielded". Nevertheless, it is quite impossible to tell from the diagram whether the stage will be workable, though we can say with a good deal of assurance that the diagram shows enough bad mistakes in design so that we can hardly expect satisfactory fidelity, amplification, selectivity and stability simultaneously. Unless the circuit is improved one or several of these faculties will be deficient.

It is very evident that the designer of this circuit has made the common error of assuming that all parts of the chassis are at the same r-f voltage, probably that of the ground. To be more exact, he assumed that the points L, M, N, O, P, Q, R, S, T and U are all of the same r-f voltage. The tuned circuits have been completed by connecting the lower ends of the coils and tuning condensers to the chassis, because this seems to be just as good as connecting them together with a bit of wire—and simpler to boot. In the same way it seemed safe to connect the emitter E1 of the screen-grid tube to its tuned circuit by simply grounding the condenser C1 at some convenient point on the chassis.

Unfortunately the points L, M, N, O,



Coil and tube shields must not touch each other.

P, Q, R, S, T and U are NOT at the same r-f voltage, for even a heavy metal chassis has some r-f impedence. Thus there must be small r-f voltages between the 10 points we are speaking of whenever a signal enters the receiver. If the chassis were being used for one r-f circuit only there might be no harm in this, but even in this simple one-stage circuit the chassis is being used to complete at least 7 r-f circuits, listed below to make the point clear:

1. The tuned circuit S1, L, M, C5.
2. The circuit from the tetrode input grid to the cathode.
3. The circuit from the tetrode screen to the cathode.
4. The circuit from the tetrode plate to the cathode.

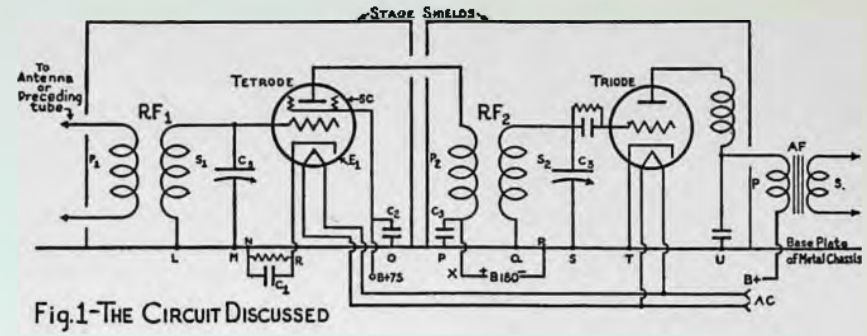


Fig.1-The Circuit Discussed

Connections to chassis at points L, M, N, O, P, Q, R, S, T, U, as shown, make direct, short wiring but can cause much trouble. Grounding to shield correctly will cause longer leads, better performance and, in most cases, will reduce tunable hum on short-waves. Yet this circuit, as shown, seems adequately by-passed, shielded and filtered.

5. The circuit from detector grid to cathode.
6. The circuit from the detector plate to cathode.
7. The tuned circuit S2, Q, S, C3.

Coupling between these circuits can produce the following effects:

1. Poor selectivity at one end of the tuning range.
2. Poor amplification at one end of the tuning range.
3. Poor fidelity at one or both ends of the audio range.
4. Instability.
5. "Hum on carrier" under some circumstances.
6. Vulnerability to local signals.
7. Tendency to change performance considerably as to most of the foregoing when line voltage changes.

The list is not complete but is surely adequate to show that the state of affairs is very unsatisfactory if the couplings through the chassis are sufficient so that any of the difficulties actually appear. Experience shows that they are quite thoroughly sufficient and that it is accordingly most necessary to avoid these "chassis couplings" as far as possible. The first and last of the r-f circuits just listed are tuned circuits and carry much larger r-f currents than do other parts of the system. The first precaution is accordingly to complete them as in Figure 2, each secondary having the lead run to its own tuning condenser with a view to making the leads short, direct, and well shielded from the leads in some other stage. It is most decidedly not satisfactory merely to ground the coil to any place on the frame of a multiple gang condenser. This is about the worst thing that could be done. If gang condensers are used there should be a separate low-resistance low-inductance jumper to each rotor. This may be a good wiping contact or a flexible "pigtail". At the same time something should be done to prevent the relatively large r-f current in the coil and its leads from inducing (by a transformer action) voltages in other circuits. A long step has been made when the coil itself is surrounded by a coil shield as in Figure 2. Satisfactory coil shields are of aluminum or better of copper, have a length and diameter perhaps twice that of the coil and no openings except the eyelets through which the wires emerge. The leads to both primary and secondary windings should obviously be shielded from other leads. It is helpful to place the coil cans close to the tuning condenser and to use "fences" or outright stage shields to prevent couplings between the leads running from coil to condenser and tubes. In sets using but one stage of r-f amplifier a little forethought permits the coil shields to be dispensed with by simply placing the coils far apart, and with a "fence" between them. Several short-wave tuners use this dodge, which is perfectly legitimate and satisfactory.

Bypass Cautions

More remains to be done to the input system of the tetrode. We have combined the points L. and M in Figure 2 but there is left the path between L-M and

the point N. This is obviously used by the r-f grid current, which is fortunately much smaller than the current in the tuned circuit. One's first thought is that the return to cathode should be made as in Figure 3. This is satisfactory enough for the r-f grid circuit alone but unfortunately the cathode is next to a 60-cycle filament from which it picks up a small 60-cycle voltage which tends to cause 60-cycle hum, even in r-f stages. The arrangement of Figure 2 generally permits the use of a sufficiently large condenser to minimize this hum voltage whereas the arrangement of Figure 3 either demands that this condenser be put above the base or else that the lead be brought up through the base, both of which are arrangements of dubious value. It is distinctly desirable to keep the lead between the cathode and C1 short and well shielded and to make C1 itself of low resistance and inductance. In the broadcast range a "non-inductive" condenser of .2 or .3 mufd.* is satisfactory if it has a metal container which may be grounded by attaching to the chassis near the cathode terminal of the socket. For high frequency receivers such a condenser is not satisfactory in all cases and it may be necessary to use a .01 mufd.* mica condenser in the connection of Figure 3 supplemented by extending the dotted lead to a .3 mufd. condenser which is expected to bypass a 60-cycle hum. This arrangement must be used with considerable caution because it is manifestly a series-tuned circuit and will cause strange things to occur if its resonance point lies inside the tuning range of the receiver. A general caution on the use of metal clad bypass condensers may be in order. In factory types the condenser is usually made to suit the job, the leads being brought out where most convenient. When working with stock condensers one is robbed of this convenience and exposed leads will result unless thought is given to placing and turning the condenser so that the exposed terminals are away from other wires though near the cathode or other point to be bypassed. Several condensers can sometimes be stacked with terminals pointing in different directions or a single one may have its terminals partly shielded by utilizing a corner or angle of the chassis. The idea is, of course, to shield the lead, not merely the condenser terminal. Incidentally, when it is necessary to ground one side of a bypass condenser to chassis, a convenient way is to solder one terminal down to one of the lugs of the container and

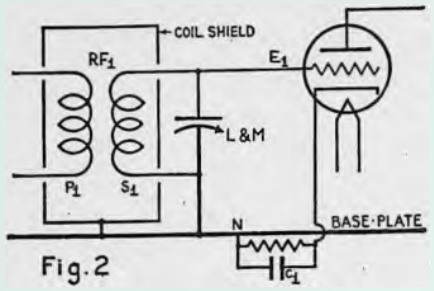


Fig. 2

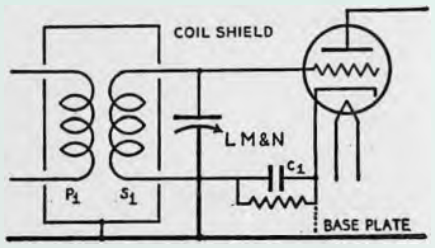


Fig. 3

Fig. 2.—This circuit shows how two chassis connections L and M can be combined. Theory calls for this change, and practice proves its need.

Fig. 3.—A variation of the circuit of Fig. 2. Proper choice of C1 as described in text is necessary.

then to make sure that one of the fastening screws goes through that part of the container into the chassis. This seemingly unimportant point sometimes makes a large difference in stability because the tin condenser cans have fairly high r-f resistance. Another old dodge that is sometimes useful is to employ the bypass condensers themselves as fences between adjacent tube sockets. For this purpose they are mounted under the base where the tube terminals are somewhat exposed. A most fruitful way of getting into a lot of difficulties is to crowd a group of bypasses into the same tin can or even the same stage shield.

* mufd., meaning microfarad since mu is the usual abbreviation for "micro" or "millionth". The abbreviation is more logical than "mfd", which does not really mean "microfarad" but "millifarad".

It is true that some broadcast receivers have "gotten away with" just that construction but only after much careful work. It is only fair to recall that several of them were so regenerative that their sensitivity was non-uniform and both their fidelity and selectivity rather poor.

In August, Part II of this story will cover the common difficulties due to incorrect bypass condensers, also the use of decoupling resistors, the proper allowance for condenser tolerance, and the avoidance of "hum on carrier".

Remarkable New A. C. Meters

The shortcomings of low-priced a. c. meters are too well known to require much comment. It must therefore be most gratifying to all of our readers to discover a line of a. c. meters which take no more power than a high-sensitivity d. c. meter, can work at any reasonable frequency, are moderate in price and—perhaps best of all—have scales practically as free from cramping as those

Fig. 1. A rectifier-type voltmeter showing the absence of the usual a. c. cramping at the left end of the scale.

of a good d. c. instrument. The last point is illustrated by the accompanying photograph of one of the new Weston rectifier-type voltmeters. The scales of the microammeters, and milliammeters are similar in this regard. The voltmeters can be had with either 1000 or 2000 ohms resistance per volt, thus drawing ½ or 1 milliampere at full scale, as compared to some 20 to 300 times as much for the usual a. c. voltmeter.

As made by Weston this meter is called Model 301. A similar G. E. meter is Type DO 14X.

As has been suggested, these meters are actually d. c. instruments, connected to a very small rectifier, which is placed inside the case, so that the device is self-contained and as compact as any other

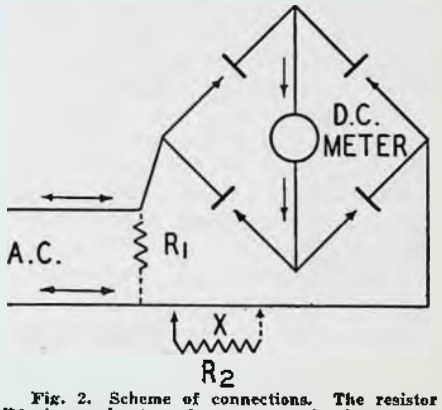


Fig. 2. Scheme of connections. The resistor R1 is a shunt and appears only in current meters. The resistance R2 is the "multiplier" and appears only in voltmeters.

of the familiar 3¼" Model 301 switchboard meters. The rectifier is of the copper-oxide type and is connected as shown in Fig. 2, which will be recognized as the usual "bridge" form of full-wave rectifier. The combination tends to operate on average, rather than r. m. s. values but it is so calibrated that readings are correct when the wave form is pure.

Errors

Such a battery of advantages cannot usually be gained without some disadvantages, and these must in fairness be listed.

The temperature error is less than 2% for low voltage ranges (under 20 volts) as long as the temperature does not go above 95 degrees Fahrenheit. In using voltage ranges above 20 the temperature

should not be above 85 degrees. Above these temperatures the error rises rather fast because of effects in the oxide rectifier.

When using microammeters or milliammeters one must—of course—take the usual care in making sure that the meter resistance is not too large as compared to the other resistances of the circuit, otherwise conditions are upset by the insertion of the meter. This is, however, an effect which takes place with all sorts of meters—even such meters as are inserted in the r. f. circuits of transmitters. The only difference is that rectifier-type meters may under such conditions, suffer a change in their own rectifier resistance and show a varying error as the current shifts. The effect is of no consequence in high-resistance circuits such as are usual in radio work.

Frequency Effects

The meters are useful through the entire audio range and on up into the "supersonic" range. The reading of the meter decreases about one-half of 1% for each 1,000 cycles. Thus at 10,000 cycles the reading would be 5% low and need to have that much added to it.

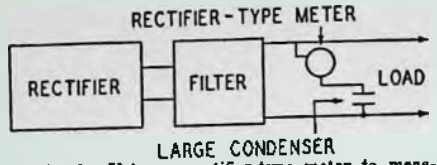


Fig. 3. Using a rectifier-type meter to measure the a. c. ripple of a filter system.

This effect, of course, causes further errors in reading when measuring a. c. with odd wave forms—anything but pure sinusoids—and in some cases such errors may be rather large though it must be noted that other meters are also affected very adversely by such bad waveforms.

The O-1 A. C. milliammeter has a resistance of about 1,000 ohms. A 9,000 ohm I. R. C. Precision or Super-Akra-ohm resistor will convert it into a 10 volt meter, correct on A. C. and equally correct on D. C. if the readings are divided by 1.1—or multiplied by .9

Further details on this line of meters can be had from the makers, who also supply a pamphlet, "Rectifier Type Instruments" in which the aforementioned effects are more fully explained. The address is, Weston Electrical Instrument Corporation, Newark, N. J.

Modulation Improvement

By Robert S. Kruse

In the last year there have come under the writer's observation a number of broadcasting stations, as well as amateur voice transmitters in which attempts at high-percentage modulation have resulted in a considerable assortment of unsatisfactory effects.

The purpose here is to suggest the cause of some of the shortcomings of the average moderate-power radiophone, including those shortcomings that are not suspected by the operator. The story will not be complete, but may be helpful. The story has been told "around" a transmitter using the '10 and the '50, but applies almost equally well to other power levels.

However, no other tube combination is so full of grief, hence it is an ideal example.

'50 Tube Troubles

It is possible that I have met the worst members of the tribe, but my opinion of the '50 tube as a modulator is not favorable. One of the most widely distributed makes has an inadequate plate and is un-uniform as well. Most of the makes seem inclined to produce more audio distortion than is nice, for various reasons that need not be detailed here but seem inherent in the design. Fortunately most of these difficulties can be overcome in a push-pull scheme, as suggested later. The tubes are decidedly NOT suited to parallel operation.

Now Then—!

Small-power radiophones of the better grade aiming at 100% modulation do not modulate the oscillator but instead modulate a "linear" R. F. amplifier.

The general principle is shown in Fig. 2.

The circuit of Fig. 3 is met frequently, and seems to be a good deal of a trouble-breeder, because the '50 tube

is being run on over-voltage and without any push-pull connection. Both things tend to bring out the worst of the tube, including a tendency toward sudden demise when a hard audio bump comes through. Even in the 50 watt class, the modulators are run at voltages above rating when using this circuit. The '10 is being run at about the right level, but a 500 volt supply is needed.

But a Way Out

Fig. 4 manages to get around nearly everything that has been mentioned. Here the '50 tubes are being run UNDER normal voltage, (which is much

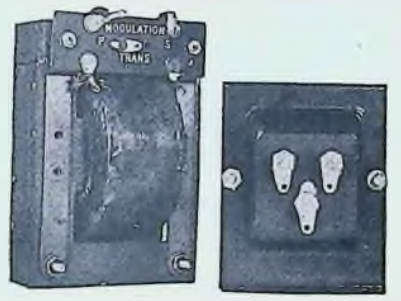


Fig. 1. A Pushpull step-up modulation transformer suitable for working from a pair of 250 audio tubes into the plate circuit of a 210 r. f. modulated amplifier. For comparison there is shown a step-down pushpull transformer for working from the same audio tubes into a 2000 ohm speaker.

easier on the tube and condenser budget), no coupling condenser or resistor (Fig. 3) is needed, the final filter condenser need be only large enough to serve as an A. F. bypass around the filter, and the curious distortions encountered when trying to use a single '50 are largely cancelled out by the push-pull arrangement—which is really the best part of the whole thing. The plate input to the '10 tube is adjusted by lowering the r. f. input. It must be remembered that this tube has so high a bias that if the r. f. input is removed the plate current stops altogether. This method is used in some high-quality transmitters.

Other Tubes

As was stated initially, the worst available tube combination is in discussion, which means we bring out nearly every difficulty at once. With other class C tubes one has less grief, but in nearly every case it will be found that the use of a push-pull output stage will still reduce troubles all around, mainly through:

Less feedback in audio system;

Less distortion in final audio stage (or modulator);

Lower plate voltage;

Permitting omission of R and Cc.

The push-pull output transformer itself does not cause distortions of importance if well designed—which in effect means—if enough good material

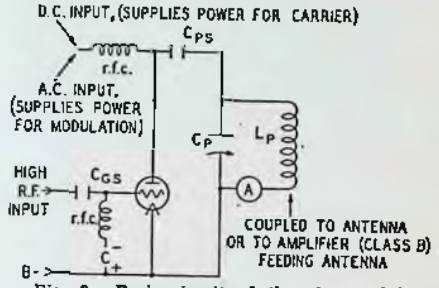


Fig. 2. Basic circuit of the plate-modulated "class C" amplifier. This may be followed by a "final" or "class B" amplifier.

is used. When working at higher powers it is sometimes advantageous to use the modulator (final audio) tubes in parallel instead of push-pull and to employ 3 of them. For instance, three 845 tubes might be used in parallel on an 800 volt supply to modulate a single 211, also running at 800 volts. The plate current of the 845 tubes would then be run through the primary of a "straight" transformer, whose secondary carried the plate current of the 211.

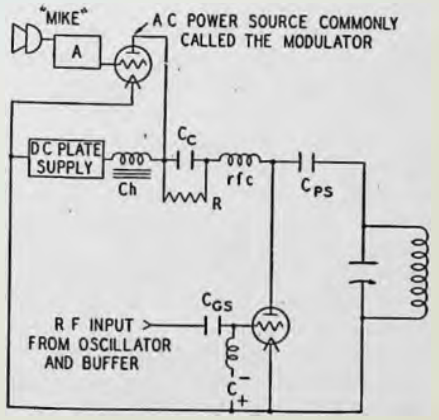


Fig. 3. The usual modulation circuit which appears to cause the trouble.

The direction of these currents can be chosen so that their magnetizing effect on the core is opposite and usually the required turn ratio is such that the resultant magnetizing effect is small. Some designs for such transformers have been worked out and we hope to show them in "Modern Radio". The arrangement was called to my attention by Mr. C. J. Franks of Radio Frequency Laboratories.

The Push-Pull Transformer

As seen from Fig. 1 the push-pull modulating transformer is larger than one designed to work from a pair of 250 tubes into a loudspeaker. This is mainly because the secondary of the transformer must carry the plate current of the r. f. tube and allowance must be made (in the core design) for the resultant magnetizing effect. How this is done will be discussed in following paper, as will the other details of the transformer design. Another cause for the bulk of the transformer is that it is a step-up device for the secondary must have enough turns to feed 10 watts into the rather high resistance of the 210 tube, instead of feeding a 10 ohm voice coil as does the small stepdown transformer also shown in Fig. 1. The transformer shown was "aimed at" the operating conditions of Fig. 4. Since the '10 is in this case to draw 20 watts at 425 volts it must evidently have a normal (non-modulated) plate current of 47 ma. Its plate resistance is then 425/.047 = 9050 ohms. Now it chances that a push-pull pair of '50 tubes will deliver its maximum **undistorted** output when working into a load of about 8000 ohms. Thus there should be a ratio of 9/8 between the secondary and primary, that is the secondary should have 9/8 as many turns as the primary. The actual number in each winding depends on the core design and material—of which more later as promised. Meanwhile—the pushpull input transformer feeding the '50 tubes (or whatever is used) is a perfectly normal one, therefore not discussed.

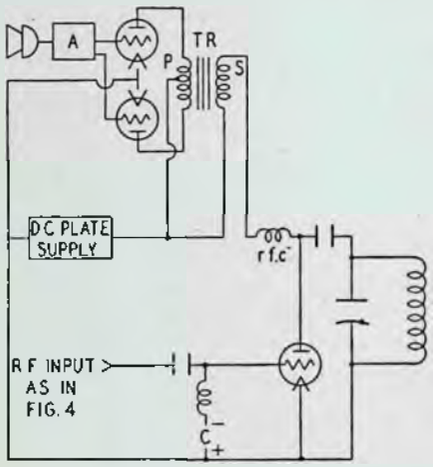


Fig. 4. A circuit which permits the same results as Fig 3 with lower plate voltages, less filter condenser, better audio quality and less tendency toward audio feedbacks.

The reader is undoubtedly aware of the inability of one type '50 tube (audio) to impose 100% modulation on a type '10 tube (radio) unless the latter is run at a pathetically low level—even when the '50 is overloaded. He may therefore be a bit puzzled when 425 volts is suggested for use on all three tubes in Fig. 4, and 100% modulation promised, without overloading the '50 tubes—which are below normal voltage.

This is quite sound and proper. Even imperfectly matched tubes (such as the '50's may easily be) can nicely be loaded to 2½ times the output which could be had from a single tube. If the pair is well matched the thing can be carried further. Usually the matching need be carried no further than to pick two tubes which will draw the same plate current when tested at the operating bias and plate voltage.

Short Circuits at W2BP

If it is proper to speak of a filament heating transformer, why isn't the other one a plate-heating transformer?

. ...

Speaking of heating; we burned out a grid today while using an exactly correct grid bias—reversed as to polarity. We then went out to bias a new tube.

. ...

Quite a few manufacturers have had forced landings lately. Distributor trouble.

An Adapter for Adapters

By L. W. Hatry, Associate Editor

It seems to this writer that, since the first, the average short-wave converter or adapter of the super-heterodyne type has had one large and glaring fault. The most of them use '24 tetrode detectors in either space-charge or screen-grid connections and invariably allow the plate circuit (R. F.) to feed directly into the antenna circuit of the receiver they are attached to. This is all right in practically no case. It is wrong mostly because of the excessively poor impedance match resulting. The '24 tube as an R. F. amplifier has an impedance of 400,000 ohms, as a detector it travels up from there to as high as 4 megs.

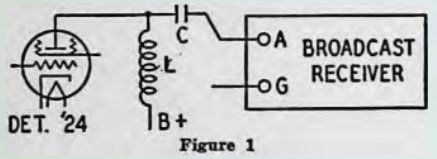


Figure 1

The measly 1,000 to 10,000 ohms of the antenna circuit of the average receiver is far from fitting this. As a consequence, (though the owner seldom suspects it), adapters fall below the possible performance and by no means give results proportional to the 8 to 13 tubes in use. A feeble attempt is sometimes made to cure the disease by using a space-charge 224. The only reason for using the space-charge connection for a tetrode as a detector is to lower its impedance; for the space-charge arrangement always gives a lower one than the screen-grid although both impedances are considerably out of proportion to the load impedance got from between a pair of aerial and ground posts on a receiver.

In general the only thing with enough impedance to begin to make a near match with the tetrode plate circuit is a tuned circuit as load. This of course could be got from a receiver by tapping into the first tuned circuit but so doing in a ganged outfit would throw the first circuit well out of gang; such adaptation if not permanent is highly inconvenient and impractical.

Fig. 1 shows the usual connections in a converter from detector to receiver. Fig. 2 shows an improvement in which the detector tube is given a tuned circuit and then a step-down feed arranged to

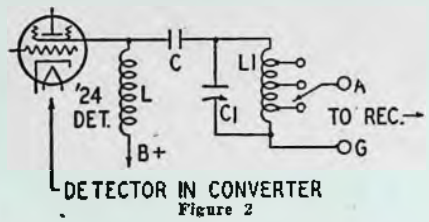


Figure 2

allow a match to the usual step-up antenna transformer in the receiver.

But the best arrangement, and one I have built into a number of adapters, is shown in Fig. 3. There the tuned-circuit is used to "match" the tetrode detector and is followed with a '27 tube. By changing the output tube to a '27 in this fashion we gain a couple of things; first the impedance of the '27 is only between a 50th and a 200th of the tetrode detector so that almost any receiver has a highly improved chance of matching up and second we gain the added selectivity

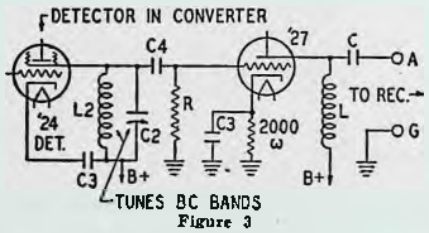


Figure 3

of the tuned circuit as well as some amplification from the '27, the overall gain being vastly desirable.

Of course the '27 on some receivers may show a tendency to oscillate although I have yet to meet a case of it. Should that happen we can add three or four turns at the bottom of the tuned circuit feeding the '27 and wire them through an insulating condenser of say 500 picofarads or larger in series with a 35 pfd. neutralizing condenser connected to the plate of the '27. This is the familiar Rice neutralizing scheme.

Although adding a tuned circuit seems to complicate the converter there is no

operating complication for the tuned circuit is a set-and-forget proposition. The receiver to which the converter is attached is simply set on a clear, or reasonably clear, frequency and the tuned circuit adjusted for maximum volume, its tuning being quite uncritical as is usually noticeable in a tuned circuit followed by a lot of amplication.

Where the usual converter may give G5SW with the volume control on the BC outfit set full, the "adapted" one with its '27 matcher will give the same volume with the receiver volume control moved back from two-thirds to three-quarters of the full turn.

MONEY SAVERS

The impatience of the user has taken many hours from the lives of '66 mercury-containing rectifiers—not to speak of the slow-heating '72 type. If the plate voltage is applied before the filament is thoroughly warm—fssst!—there went some of the oxide from the filament! With more haste one may even cause direct arc-backs which quickly ruin the rectifier tube altogether.

It isn't possible to estimate the time closely enough before throwing the plate supply switch, and one doesn't always trouble to count seconds. An automatic device formerly was too costly but two varieties at reasonable prices are now available. One is a relay-switch under thermostatic control, the thermostat being heated at the same time as the filament and not allowing the relay-switch to operate until full electron-emission is available. This is made by Ward Leonard Electric Co. of Mount Vernon, N. Y., and is shown in their advertisement in this issue. The time-lag is adjustable from 15 to 60 seconds and the device itself is meant for panel mounting.

The other device is intended for mounting in an ordinary steel switch-box such as is used in housewiring and in most transmitter control circuits. It may also be mounted through an opening in a transmitter panel or control-table top. This device, called the "Mark-time Switch" is shown in the photograph herewith and has a fixed time-lag between the throwing of the switch-handle and the closing of the second (plate) supply circuit. This lag is provided by a simple clockwork mechanism whose driving spring is wound by throwing the switch handle. When the clockwork has driven the release device to the proper point the second switch operates, and at

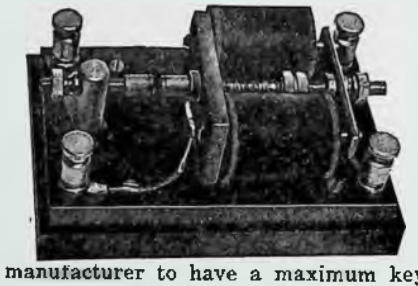
The Mark-time Switch

the same moment the word "ON" appears in a small opening in the switch-plate. Standard models of the Mark-time switch provide for relays of 15 and 30 seconds, also 3, 4 and 7 minutes. The prices range from $4.85 to $9.85. Variations of this principle are used in other types of switches.

The devices are made by M. H. Rhodes, Inc., 1010 American Industrial Building, Hartford, Conn.

A KEYING RELAY

The magnetic key shown herewith is designed for use in amateur transmitters of moderate power. It is stated by the



manufacturer to have a maximum keying speed of 35 to 40 words per minute when actuated at 6 volts and drawing a current of one-half ampere with the key closed. At this speed about 100 volt-amperes can be "busted" satisfactorily. The contacts are renewable at 50c per pair and the price of the device as a whole to amateurs is $5.00.

The manufacturer is Wireless Egert Engineering, Inc., 179 Greenwich Street, New York City.

"Short-Circuits" at W2BP

If a big bass note ever gets stuck crosswise of the loudspeaker of some of these midget receivers there will be a serious explosion.

. ...

A kilovolt is a thousandth of a megavolt, which makes it sound less shocking.

. ...

Recently a steam-turbine-driven generator was built which can deliver 160,000,000 watts. Why not connect all the low-quality broadcasting stations to that generator? The trifling 1,000 kilowatt load will not move the meter needle off the "0" mark—whereupon the operator will think the line is open and will shut down the generator.

Why hasn't the Federal Radio Commission thought of this?

. ...

Wanted: Vacuum cleaner with noisy commutator to be used in an apartment house for discouraging late-blooming radio receivers.

. ...

After seeing some 2½ kilowatt air-cooled Mullard tubes we have decided that the English have a fine sense of humor.

. ...

We are told that NBC once forgot to stop Floyd Gibbons. 20 minutes later he was 3 days ahead of the news.

. ...

In pawing through the list of U. S. Government publications we find "Federal Radio Commission" listed between "feathers" and "fertilizer".

. ...

After that we dare to revive the memory of the receiver which was named a "Chlorodyne"—and to wonder if the transformers inside were chloroformers. The set was made at about the same time as the Super-Iodyne which became a drug on the market.

. ...

Use your receiver twice a day; see your serviceman twice a year.

According to Ralph Schlagle of WOR the phone at the station rang just after an SOS shutdown and a Nice Old Lady asked what was wrong. On being told she said, "Well if there is anything I can do, just let me know."

. ...

If a woman shuts off a radio set, that is not news. On the other hand if a radio set———

. ...

Now that International Broadcasting is with us we need a linguaformer with an American secondary and a number of primaries of proper impedence to match various foreign languages. We would like to try putting static into the Chinese primary.

. ...

We can't afford to overload the plate until groceries are cheaper.

. ...

A small broadcasting station was transmitting a phonograph program spattered with invitations for requests. The telephone rang, and a tired voice from the receiver said: "I have a request; pull the big switch!"

. ...

A visitor at a high-power code transmitting station was asking questions. "Is it all-electric?" and "Do you use screen-grid tubes?" were answered in the affirmative, but the operator was almost cornered when asked if it had automatic volume control. Just in time he thought of the automatic key—which has just 100% effect on the volume!

. ...

Howard Mason seems to have set up something of a radio travel record by now. Seattle, Alaska, Wilkins Arctic Expedition, New England and way stations, Seattle again, Little America with Byrd via the East Coast and New Zealand, returning over the same route with a detour to San Francisco. If Seattle can get a man back from all those places it is time the Chamber of Commerce made a noise about it.

A "TUBE-SELLER"

Tube testing equipment that also provides display value is offered the radio dealer in two new Tube-Sellers, announced by the Jewell Electrical Instrument Company of 1642-U Walnut Street, Chicago, Illinois. The Pattern 535 Tube-Seller has a black panel 30 inches high by 28 inches wide, on which are mounted an 8½-inch meter for indicating tube test readings, a smaller meter to show when the line voltage adjustment is properly set, and several sockets for preheating tubes to reduce testing time. There is a separate socket for testing each type of tube, so that filament voltage readjustment is avoided. A short-circuit-test socket with indicating lights is provided.

The Pattern 535 Tube-Seller is suited for wall mounting. Dealers' price—$111.00. The glass sign is $12.00 extra.

AMATEUR RADIOPHONE CHANGES RECOMMENDED

In its annual session the Board of Direction of the American Radio Relay League made certain recommendations as to further restrictions upon amateur radiophone transmitters, and reduction of the channels assigned to them. These recommendations are for the consideration of the Federal Radio Commission. Omitting the unused "5 meter band" these recommendations may be summarized as follows: the channels marked (*) being restricted as explained below:

Table I—Channel Changes

Present Frequencies	Recommended	Increase	Decrease
1715- 2000 kc	1875- 2000 kc	..	160 kc
3500- 3550 kc	3900- 4000 kc*	50 kc*	...
14100-14300 kc*	14150-14250 kc*	..	100 kc*
		Net reduction	210 kc

Licensing changes have also been recommended whereby amateur radiophone operation will be permitted only on the 1875-2000 kc band for those holding a regular amateur operator's license, the "80 meter band" being closed to general amateurs. Considered in this way the changes have the following form:

Table II—Changes in Restrictions

	Present	Recommended
Open to all amateurs....	335 kc	125 kc
Open only to holders of extra-class operator's lic.	200 kc	200 kc

Thus the proposed 210 kc decrease would affect all but the special-license amateurs.

The Wire Gage Simplified

It was surprising to find that in a group of 5 radiomen, none knew the following rough but convenient rules about the American Standard, or Brown and Sharps, wire gage, commonly called A. W. G. or B. & S.

1—Number 10 A. W. G. copper wire "runs" 10 ohms per 1000 feet.

2—Number 10 has a diameter of 1/10 of an inch (.1019).

3—Number 10 has a cross section of 10,000 circular Mils (10,380).

4—The area doubles every 3 numbers, thus No. 7 has about 20,000 c. m. area, No. 10—10,000, No. 13—5,000. The resistance varies in the same manner, of course.

5—The diameter doubles every 6 numbers, thus No. 16 has a diameter of about 50 mils, No. 10 of 100 mils. and No. 4 of about 200 mils.

NOBEL PRIZE TO SIR C. V. RAMAN

The Nobel prize for physics for 1930 has been awarded to Sir Chandrasekhara Venkata Raman in recognition of the importance of the "Raman Effect" discovered by him. Briefly, the Raman effect may be described thus: When a one-color (i.e., single-frequency) light is sent into a transparent substance there come out a number of other frequencies in addition to the original one. If the original frequency (color) is changed, these extra frequencies change with it, keeping the same relation. Raman's discovery is that the arrangement of these lines is systematic and that, like radio sidebands, they tend to appear on both sides of the original frequency. He further found that while those on the high-frequency side of the original are invariably found to have mates on the low-frequency side, the reverse by no means follows. The effect appears to be a wholly universal one affecting all transparent substances, whether solids, liquids or gases. It is this very universality which gives the effect its great importance to the physicist, for it adds one more to his small supply of basic effects by which the universe may in some degree be understood. An excellent simple discussion of the Raman effect, and its relation to the two usual theories of light appears in the April issue No. 8, Vol. 9 of the "Bell Laboratories Record", from which most of the foregoing is taken. The radio man must almost automatically turn to speculation upon similarities between the Raman effect and some radio transmission effects.

A Vestpocket Volt-ohm-meter, and Polarity Indicator

The simple little pocket neon lamp of Fig. 1, called a "Testolite" is good for more than mere voltage indicating. When one end is put into a plug receptacle and the other held in the hand the little lamp will indicate when the ungrounded side of the line is being touched, for even at 60 cycles and only 110 volts the charging current to the user's body lights the lamp dimly. While the lights are not especially uniform, a little observation on any one of them will soon familiarize the user with the way it glows at different voltages, so that he can with a good deal of certainty distinguish between 100, 200, 300, 400 and 500 volt supplies, locate the various "B" voltages in a set and, if the set is of a familiar sort, have a pretty good

Figure 1

idea if the voltages are far wrong. On a. c. the two prongs in the bulb glow alike, on d. c. one only glows, and polarity is thereby indicated. Finally, with a known voltage available the extent and brightness of the glow gives a rough gage of the resistance connected in series for test. It all sounds very crude, but is very useful on a field job where one hasn't the shop along. Reminds one of the serviceman who said that he needed just three things to fix a radio receiver, his toolkit, an ashtray, and for the Lady of the House to leave.

A Useful Tool

Some anonymous person recently donated the ingenious tool of Fig. 2. It is made from an ordinary screwdriver bent, sharpened and re-hardened. Possibly it is a panel-cracker, possibly a graver—it is a pity that a real mechanic isn't here to name it. At any rate the use of the tool is this; when a sheet of aluminum is to be cut a steel straightedge (or an ordinary carpenter's square) is laid along the proper line and the

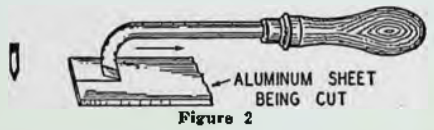


Figure 2

what-is-it drawn along the straightedge while being pressed firmly against the aluminum. The result is a well-defined groove, straight and deep. This cut is made on both sides of the sheet. The panel is easily cracked off by bending back and forth along the cuts. The edge is then dressed up with a file and a strip of abrasive paper tacked on a flat surface. Time saved over a hacksaw—95%.

THE STAFF OF "MODERN RADIO"

Collectively the staff of "Modern Radio" has:

Designed five successful receivers.
Designed and built 22 transmitting stations.
Contributed to every major American radio magazine.
The articles have been reprinted in all principal countries of the world.
Has operated 29 commercial, broadcast, amateur and experimental stations.
Had 12 years' experience in radio retailing and jobbing.
Had over 14 years' experience in radio service work.
Has participated in many sorts of radio experimental work.
Has had 42 years of experience in radio transmission.

EDITOR—Robert S. Kruse, E.E.—Formerly with Western Electric Co., International Tel. & Tel., Radio Section of the Bureau of Standards, Hammond Radio & Research Corp., Technical Editor QST for five years. Editor Sterling's Radio Manual and of several books now in preparation. Designer of a number of broadcasting and high-frequency transmitters, co-designer of National's S. W. 5 Thrill Box, Pilot's Wasp and Super-Wasp, also other commercial receivers. Has contributed to Radio News, Radio Design, Radio Broadcast, Popular Radio, Radio, Short-Wave Craft. His writings have been reprinted in all continents. At present Consulting Radio Engineer.

ASSOCIATE EDITOR—L. W. Hatry—Best-known during 1920-24 as owner and operator of 5XV at Port Arthur, Texas; also three other calls. Articles contributed to Radio, Radio News, QST, Radio Journal, Popular Radio, Radio Broadcast, Short-Wave Craft, Radio Craft, Wireless Age, Radio News Canada, many having been reprinted in the major countries of the world. Was department Editor and Information-service QST, Radio Editor the Hartford Times, recently active in short-wave super-heterodyne design. Participant in short-wave and amateur radio for eleven years. Has been first grade commercial shore-station operator, also operator of broadcasting station and station engineer.

BUSINESS AND ADVERTISING MANAGER—Nicholas T. Young—Experimenter and radio operator since 1912 (starting with a coherer and decoherer) until 1917, amateur station in Brooklyn, N. Y. Graduate of School for Enlisted Specialists, Radio Section, Fortress Monroe, Va. Radio Sergeant U. S. A., in charge Fort Winfield Scott radio station WUO at San Francisco, California; Instructor in radio to commissioned officers and enlisted men in France; Ship operator, stations KMS, KIP, KMA and KMX; Broadcast station operator WDAK; 9 years managing experience in retail and wholesale radio.

In Our Next Issue

KEEPING OUT OF THE RED
Not a "preachment" but the plain-fact story of the radio store that paid in a town "Overloaded with Radio".

THE SUCCESSFUL METAL-CHASSIS RECEIVER—Part 2
Cornering more troubles.

"100% MODULATION"—ON PAPER
What the diagram forgets to show.

THE PAINLESS MATHEMATICIAN
How a formula will improve your receiver—without a single calculation.

THE CURE FOR INTERLOCKING
In the short-wave receiver.
And of course—more
"SHORT CIRCUITS AT W2BP"

FREE!

You can get one of these Without Cost

FLECHTHEIM, through Modern Radio, is presenting subscribers with transmitting filter condensers. These are given without cost. The condensers to be awarded are two 2 Mfd. 2000v., two 2 Mfd. 1500v., two 2 Mfd. 1000v.

CARDWELL is giving a Midway transmitting variable condenser of 150 MMfd. capacity.

INSULINE is giving several sets of test-leads and neutralizing tools.

READRITE is presenting an ohmmeter, 10,000 ohms maximum.

MODERN RADIO on its own behalf is going to allow some fortunate chap his choice of five well-known short-wave receivers, a gift worth having. The choice will be of a National A. C. SW-5 kit with power pack, ready to wire less tubes; a Pilot A. C. Super-Wasp kit and power-pack less tubes; an I. C. A. Conqueror five tube outfit, with power pack but wired and ready to use less tubes; an HY-7, 6 tube A. C. or battery operated super-heterodyne wired and ready for use less tubes, batteries (or power pack).

I want to obtain without cost one of the Short-Wave receivers, or other equipment, mentioned in this announcement. Please send information, my subscription is herewith ($1.25 for 13 issues) enclosed. I assume no obligation by sending this coupon.

Signed .....

Address .....

City .....

Mail to
MODERN
RADIO
127 Ann St.
Hartford, Conn.

WRITE for it NOW

New Electrad Catalog

36 PAGES OF HELPFUL RADIO INFORMATION

THE new Electrad Catalog covers the complete line of Electrad Resistors, Voltage Controls and Loftin-White Amplifiers, including several important new products.

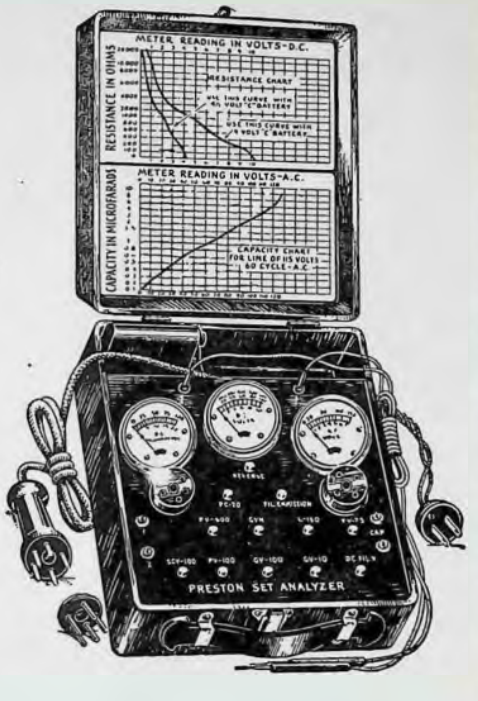
In addition, it contains a great deal of helpful information on resistance problems that confront amateurs, manufacturers and professional service men.

In order that we may be certain it reaches only those who can make good use of it, please request your copy on the coupon.

ELECTRAD, INC.,
175 Varick St., New York, N. Y.
Please send me copy of the complete, new Electrad Catalog.
Name .....
Address .....
.....
MR-6

175 Varick St., New York, N.Y.
ELECTRAD
INC.

The Preston Set Analyzer New and Complete



$25.00 List
$15.00 to Servicemen

Designed for quick and simple operation so that circuit tests or tube tests can be made instantly. No rotary switches are used, as each particular test has its own individual push button.

Three meters are used with scale readings of 0-10-100-600 DC, 0-10-150 AC, and 0-20-100 milliamperes.

Ideal for testing voltages of plate, grid, screen grid and cathode, as well as plate current, filament voltages and line voltage. Has continuity test for set circuits, choke and transformer windings, etc.
Resistance measurements and capacity measurements can be quickly taken. Calibrated chart is provided.

Panel is engraved bakelite. Case is sturdy and leatherette covered.
All in all, a modern up to the minute radio set tester and tube checker, one that any service man would be proud to own.

Beede Electrical Instrument Corp.

136 LIBERTY STREET, NEW YORK, N. Y.

Specials

For Service and Repairs—

908	110 v.-2.5 v. trans., for 2-227 tubes	$1.47
7541	For B elim., 280 tube, 110 v.-180 v.	2.94
4986	Rep. pwr. trans., 4-226, 2-227, 2-171 and 280, all sets of type. Allows 180 v. of B.	4.12
6512	Same as 4986 but for 135 v.	3.39
74	3-1 replacement A. F. T.	1.02
5164	6-1 replacement A. F. T.	1.31
R-100	Thor. 3-1 A. F. T.	1.31
R-101	Thor. push-pl. input A.F.T.	2.06
2143	Push-pull output to dynam. speaker	2.66
2144	Push-pull output to mag. spker.	2.66
7542	Double filter choke, 85ma., 30 hy	3.53
7543	Single filter choke 60 ma.	1.24
7544	Single filter choke 80 ma.	1.72
R-	Thor. sing. choke 75 ma.	1.18
4987	Power trans. 6-227 or 24, 2-245, 280, 250 v. excel. for replace. or pwr. pack	4.84
6952	Pwr. trans. for all midgs., 4-24-27, 1-245, 280, 250 v. real job	4.12
8C	Sprague electrolytic 8 Mfd.	1.06
1C	Dipped cartridge 1 Mfd. husky, 300 v.	.38
2C	Dipped cartridge 2 Mfd. husky, 300 v.	.72

FOR S-W RECEIVERS—

	Fil. Trans. 2-27 tubes	$1.47
S101b	National audio-coupler for screen-grid tubes	3.24
11	National R-39 low-loss forms, 4, 5 or 6 prongs	.89
11A	Pilot S-W plugin coil forms	.35
11B	1¼ diam. plugin, 4 or 5 prong, S-W coil-forms, colored bakelite	.29
11C	Set of Octo-coils, ea. coil @	.78
11D	Pilot super-wasp coils ea. @	.99

For General Use—

21	Brandes Phones	$1.45
22	Cannonball Phones	1.10
23	I. C. A. 50 watt socket	1.90
24	Neon bulbs	.55
36	Dust-proof plug-in crystal holders. Well-made, bakelite	2.50
27	Handsome key, nickle-plated lever, mahogany base, switch	1.35

RADIOPHONE EQUIPMENT—

45	Gavitt 2 button microphone	$19.50
91	Gavitt hand microphone	3.99
29	Gavitt 2 button trans.	5.88
32	Gavitt shielded mike cord, 6 feet, $1.50, 10 feet	2.00
38	Universal QRQ microphone	2.94
39	Universal Baby microphone	4.41
40	Universal Hand microphone	5.88
90	No. 12 enameled aerial, 100 feet	.88
46	Thordavon sing. but. trans.	2.94
47	Thor. two but. mike trans.	5.88
53	P. R. 588 tube	1.51
50	DeForest 510 tubes	5.35
5K	National A. C. SW kit	45.95
5P	3880 pack for it	19.59
5W	Factory wiring	5.75
5PK	A. C. SW-5 wired, with pack	69.90

TEST AND SERVICE EQUIPMENT—

209	Jewell tube-tester, list $30.	$22.06
409	Jewell 4 meter analyzer, list $124.50, your price	91.88
70	New Readrite test-kits	14.71
245	New Readrite tube-tester	11.76
M11	New (Beede) Mack tube-tester, self-biasing, all tubes	11.76
M12	New Beede set-tester, up to 500v. D.C., push-button operation	13.99
	Readrite ohmmeter	3.56
	Weston 10,000 ohm ohmmeter	4.55
	Jewell 15,000 ohm ohmmeter	4.47
	Weston 500,000 ohmmeter Mod. 301	10.12
	Jewell 100,000 ohmmeter, 2 in.	6.42

ALL NEW HIGH GRADE PARTS
NOTHING RECLAIMED
ORDER BY NUMBER

Hatry & Young
119 Ann St. Hartford, Conn.

THE BAZAAR

Bazaar advertisements should abide by the following rules:

1. 5c per word, payment to accompany the ad.
2. Ads for an issue must reach "Modern Radio" before the 30th of the second month previous; September ads must be our hands July 30th.
3. Used, reclaimed, surplus or bankrupt items must be so described under penalty of the postal laws, and the customer must be guaranteed full protection.
4. Please PRINT your name and address.
5. "Modern Radio" reserves the right to refuse any part of an advertisement not in accordance with its policies.
6. An advertisement may be all capitals, be spaced or otherwise designed to stand out from its fellows at extra cost; all capitals at 8c per word. Unfilled space calculated at $1.50 per inch.
7. No discount to agencies.

GENERAL RADIO 358 Wavemeter, $14.50. Has seen little use. John Rumbalow, 68 Deerfield Ave., Hartford.

CODE-TEACHER, Nacrometer, almost new, three double tapes (six lengths code), not buzzer type, audio oscillator with tube, bought with radio course, $19.50. Lawrence Schiller, 1231 Putnam Ave., Brooklyn, N. Y.

FOR SALE—ESCO Motor-Generator, 500v, 200 ma., two bearings. $35. G. W. Strickland, Corapolis, Pa.

SELL FOUR NEW, unused, DeForest 510 15 watt tubes, $5.40 each. One used one, $2.00. The one I used ran cool on 850v., 100 ma., 85 watt input. Have changed to 852's, crystal controlled. Harold Chamberlain, 81 Walden St., West Hartford, Conn.

FOR SALE—W. E. 250 watt sockets and good imitations, $3; 1000v, 300 ma, double commutator Esco generator coupled to ½ horsepower 110-220v, single phase Westinghouse motor, both units good condition, cost $175, make offer; Camera, improved Seneca view, 6½" x 8", bellows and racks extend 27", lens f.6.3 Zeiss convertible anastigmat, B. & L. shutter 1/100th to 3 sec. and time. Has levels, reversible back, many adjustments, bright nickel finish, 6 double cut-film holders, focusing cloth and carrying case. Ideal for model, portrait or scenic work. Complete, $40. Quartz blanks cut to size or high precision crystals any reasonable frequency, reasonable prices. Boyd Phelps, Box 247, Hicksville, L. I., New York.

BRAND NEW JEWELL 409 analyzer, never used, four meters, $75, cost $91.88. Must sell, need money. Revere Smith, Rose Farm Addition, Port Arthur, Texas.

I. C. A. CONQUEROR short-wave receiver. A. C. Complete with power-pack and all coils. Ready-to-use. Gets England, Italy, etc. here. Uses five tubes in set, one in power-pack. 245 output tube. Range 14.5 to 550 meters. Cost $68.50, want $35, is practically new. Have purchased super-heterodyne. Harold Johnson, 92 Brookline Ave., Bloomfield, Conn.

FREE!
Replacement Book on Volume Controls and Resistors. This book tells you what volume controls and resistors to use in 343 makes of sets. Send 4c in stamps to cover postage.
HATRY & YOUNG, Inc.
119 Ann St., Hartford, Conn.

MISTER HAM

You Want a Transmitting Condenser You Can Rely On

HERE IT IS!

Ask Exacting Engineers the World Over

Siemens and Halske have been making condensers since 1888. Their experience and integrity are built into these condensers.

Especially note our very generous ratings. These mean long life and insurance against breakdown.

Operating Voltage—1,000 Volts DC
Test Voltage—3,000 Volts DC

Mfds.	Size
1	2½—1¾—2¼
2	6 —1¾—2¼
4	4¾—2 —6

Operating Voltage—2,000 Volts DC
Test Voltage—6,000 Volts DC

Mfds.	Size
1	4¾—1 —6
2	4¾—2 —6
4	4¾—4 —6

Operating Voltage—1,500 Volts DC
Test Voltage—4,000 Volts DC

Mfds.	Size
1	6 —1¾—2¼
2	4¾—4 —6
4	4¾—4 —6

Operating Voltage—3,000 Volts DC
Test Voltage—10,000 Volts DC

Mfds.	Size
1	4¾—4 —6
2	4¾—8 —6
4	9½—8 —6

Insist on Siemens
At Your Dealers—Or Write to
MORRILL & MORRILL
Sole U. S. Distributors
30 CHURCH ST., NEW YORK CITY
Siemen's Transmitting Condensers
Used the World Over

I C A *Presents*
"THE ENVOY"

Aristocrat of Radio Receivers

A.C. and D.C. MODELS

The "ICA Envoy"—a set that's fit for a King! A powerful midget receiver featuring Radio's latest improvements—the Pentode Tube and the Variable Mu-Screen Grid Tubes, affording added tone fidelity and sharper tuning.

There is no cross-talk between stations at or near the same wave length—you will enjoy volume unknown till now and WITHOUT DISTORTION! The Envoy has a wave length range of 200 to 600 meters! Models also available ranging from 200 to 2000 meters. The "ICA Envoy" embodies every latest improvement that Radio has developed. "The famous ICA Tone Control"—A phonograph switch and jack for any phonograph pick up are standard equipment. "The Envoy" is built into a beautiful American Walnut Cabinet 18" high by 15" by 9" and its compactness and lightness (net weight only 28 lbs.) make it as handy as a portable set.

The "ICA Envoy" is not "just another midget." We staked our reputation on this job. We have devoted a great deal of time and money perfecting laboratory models so that you might have a really better Radio. By all means hear the "Envoy" before you buy ANY radio receiver. After hearing them all—judge for yourself. We feel confident of your choice.

The "ICA Envoy" is available in models for both AC and DC operation.

AC MODEL

100-125v and 220v—50-60 cycles
1 Pentode Tube Power Amplifier
1 224 Screen Grid Power Detector
2 Variable-Mu Screen Grid
1 280 Full Wave Rectifier
List Price 110-125v 50-60 cycles—
56.00 less tubes
220-240v 50-60 cycles—$57.50, less tubes
List Price of Tubes for AC "Envoy"—$9.70

DC MODEL

105-130v and 205-240v
3 new type 236 Screen Grid Tubes
2 two volt No. 233 Pentode Tubes
List Price 105-130v—$56.00, less tubes
205-240v—$57.50, less tubes
List Price of Tubes for DC
"Envoy"—$13.75

> > > > > **INSULINE** < < < < <

CORPORATION OF AMERICA

23-25 Park Place, New York City, U. S. A.