THE RADIO EXPERIMENTER'S MAGAZINE

October
32

SHORT WAVE CRAFT

Edited by
HUGO GERNSBACK

NOW 25¢

Build This "BEARCAT-3"

5-Meter Super-Regenerative Receiver

See Page 336

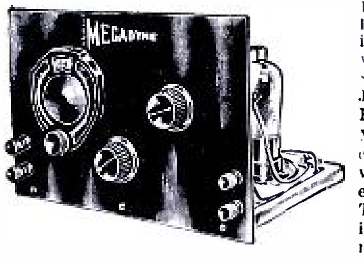
OCTOBER SPECIALS !!

EVERY month we list on this page certain *STAR* ★ items, which are NOT LISTED IN OUR CATALOG. These are all specials of which the quantities on hand are not sufficient to catalog them. *Once sold out, no more can be had.* First come, first served. ORDER NOW, TODAY.

STOP SHOPPING. The lowest prices are right on this page. *No one undersells us.* We meet any price on ANY NEW Merchandise. Order direct from this page and save money. 100% satisfaction on every transaction. Take advantage of these special offers. ORDER NOW, TODAY.

"MEGADYNE" ONE-TUBE PENTODE LOUDSPEAKER RECEIVER KIT

In the front part of our catalog—get your FREE copy now—there is presented a thoroughly illustrated discussion on the construction and operation of the MEGADYNE Receiver by Hugo Gernsback, editor. This ingenious circuit was originally described in the July issue of the RADIO CRAFT Magazine, FREE copy of which will be given with each purchase. This receiver is indeed one of the most outstanding developments in the radio industry. It is the first **real** one-tube receiver which will actually operate a loudspeaker. Thousands of experimenters and radio fans will want to build this remarkable receiver. For their convenience, we have compiled a complete list of parts required for its construction. These parts are of the highest quality and are exactly as specified by the author. The following parts comprise the complete kit.



1 B.M.S. Fixed Crystal Detector; 1 6-ohm Filament Rheostat; 1 3-circuit tuner for use with a .0005 mf. tuning condenser; 1 Na-ald type 481 UY 5-prong socket; 1 Hammarlund type ML-23 Variable Condenser; 2 sets of Cinch double binding posts; 1 Polymet .00025 mf. fixed condenser; 1 X-L Variodenser; 1 Polymet .00025 mf. fixed condenser, or 1 Polymet .0005 mf. fixed condenser. (NOTE: Only one of the latter two condensers is actually employed in the circuit); 5 Fahnestock binding posts; 1 25-ft. roll of hook-up wire; 2 black Bakelite 1½" knobs; 1 Kurz-Kasch vernier dial with 0 to 100 scale reading clockwise; 1 type 38 pentode tube. "Triad" or "Speed"; 1 Bakelite Panel **already drilled with all holes,** size 7 x 10 x 3/16 inch; 1 hardware assortment. The wooden base is not included.

No. 2545—Megadyne Receiver Kit. Your Price.... $10.25

★ "RELIABLE" WORLD WIDE SHORT WAVE RECEIVER

EMPLOYS NEW 2-VOLT PENTODE TUBES. RANGE 14 TO 200 METERS.

An extremely efficient short wave receiver that tunes indiscriminately to all short wave stations between 14 and 200 meters. The most ardent DX fan will be astonished at the signals intercepted by this compact, sensitive set. **It is by far the simplest and most fool proof short-wave receiver ever manufactured.** Takes but a minute to install and get going. Requires one 230 detector, one 233 pentode power tube, two No. 6 Dry Cells and two 45-volt B batteries to place it in operation. The 2-volt tubes were chosen because of their extremely low current consumption and hence, **low operating cost.** This little instrument has the same sensitivity and selectivity as many larger and more expensive short wave receivers. With 135 volts on the plate of the output tube (i.e., three 45-volt B batteries) **loudspeaker operation at comfortable room volume may be obtained. Any degree of volume may be obtained by adding a power amplifier.** The receiver is fully assembled and wired, ready to use. It is put up in a metal cabinet, finished in gray crackle. The front of the cabinet is equipped with three controls—station selector, regeneration control and filament control. A beautiful, full-swing, full-vision, illuminated dial completes its professional appearance. The set is sold complete with four high-grade plug-in coils and 5-ft. color-coded battery cable. Measures 11 in. long, x 6½ in. wide x 7 in. deep.

NOW

No. 5001. "Reliable" World Wide Short Wave Receiver. YOUR PRICE $9.95

No. 5002. Receiver Complete with Tubes and Batteries. YOUR PRICE...... $14.50

★ POWERTONE DIRECT COUPLED AMPLIFIERS

All the latest features in amplifier design have been incorporated in this direct coupled **amplifier. Input** terminals for permitting phonograph attachment, and in addition, by attaching the proper microphone transformer, also dry cell batteries, a microphone may be used for public address work. Any type of receiver can be connected to the input terminals without fear of loss of energy. These amplifiers are for use with dynamic speakers.

Amplifiers supply field current of 2500 ohms to dynamic speakers. Resistors are furnished when A.C. speakers are used. Amplifiers operate on 110 volts, A. C., 60 cycles.

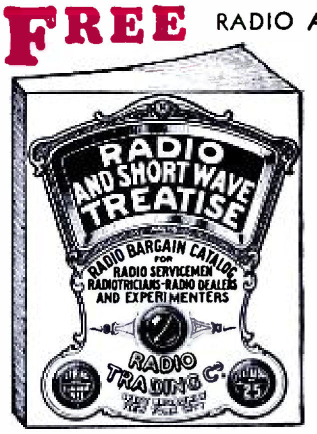
Model SP-5003 uses 1—224, 1—245 and 1—280. Output is rated at 3 watts.

No. SP-5003—Your Price........$10.95 (less tubes)
Exactly the same amplifier, but employs a power pentode in place of the 245 tube. Output 3.5 watts.

No. SP-5004—Your Price........$12.95 (less tubes)
Model SP-5005 uses 1—221, 1—250 and 1—281. Consumption is 85 watts; maximum undistorted output, 6 watts. Gain rated at 1000 cycles, 55db; gain at 10,000 cycles, 51.5. Input direct to 224 control grid; output direct from 250 plate.

No. SP-5005—Your Price........$15.25 (less tubes)

FREE RADIO AND SHORT WAVE TREATISE



100 New Hook-Ups, Etc. 1000 Illustrations.

The new and enlarged Summer edition of our Radio and Short Wave Treatise, No. 25, has just come off the press—**100 solid pages of useful information, radio items, diagrams and illustrations.** Positively the greatest book in print—**NOT JUST ANOTHER CATALOG.** Contains a large editorial section with valuable information not found anywhere else. Considerable space is devoted to a **TREATISE ON SHORT WAVES** for both beginners and regular "hams." Among the new technical information listed are the following: **Modernizing old radio sets—repairing speakers and head-sets—making superhets out of old sets—data on constructing two-volt battery and automobile receivers—circuit of the famous Gernsback Megadyne One-Tube Loudspeaker Set—short wave coil winding data—discussion on S.W. adapters, converters and receivers, etc., etc.**

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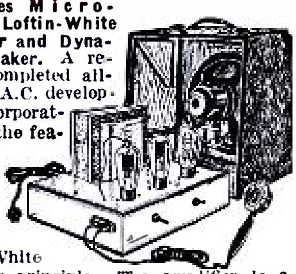

The design is adaptable to all purposes, i.e., microphone, radio and phonograph. Has an undistorted power output of approximately 3.5 watts; **SUFFICIENT TO OPERATE FROM 2 TO 3 ADDITIONAL DYNAMIC SPEAKERS.**

The portable address system is sold **COMPLETE WITH THE NEW R.C.A.-VICTOR HAND MICROPHONE.**

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No. SP-5011—Versatile Portable Address System Your Price, complete with microphone... $24.95

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D.C. 2500 Ohm—110 Volts, Less Stand,
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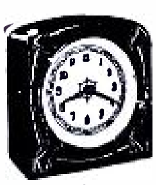
D.C. 2500 Ohm—110 Volts Field, Less Output Trans.,
No. SP-5010—Your Price $3.25

★ SYNCHROMATIC ELECTRIC CLOCK



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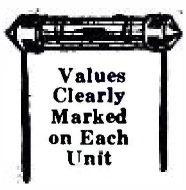

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IN THIS ISSUE: PROMINENT SHORT WAVE AUTHORS

Reinartz • West • Millen • Denton • Cisin • Palmer

SHORT WAVE CRAFT

HUGO GERNSBACK
Editor

H. WINFIELD SECOR
Managing Editor

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SHORT WAVE TRANSMITTERS:

MISCELLANEOUS:

FEATURES IN NEXT ISSUE

What Short Waves Mean to Me, by Dr. Robert A. Marks.
A 20-Meter Transmitter, by A. Binneweg, Jr.
New Vacuum Tube for Generating Ultra Short Waves.
A Super-Regenerator with "Pentode Sauce," by R. William Tanner.
A Beginner's 3-Tube S-W Receiver of Quality, by James Millen, M.E.
Doublet Antennas—Reduce Interference with the Aid of Transposition Lead-ins—Constructional Dimensions Given, by Everett L. Dillard.

● **THE next issue will be a special SHORT-WAVE BEGINNERS' number and will contain a host of articles which were written especially for the layman.**

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OUR COVER

The "Bearcat-3" 5-Meter Super-Regenerator Receiver is described in detail by the master set-designer, Clifford Denton, on page 336

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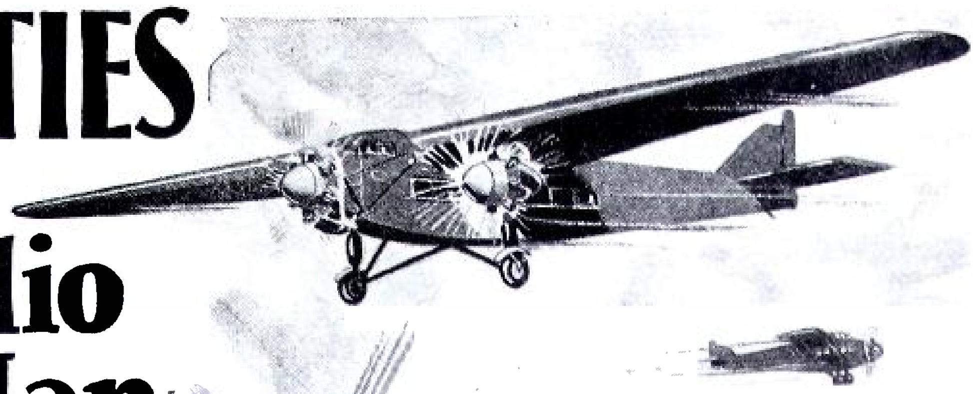

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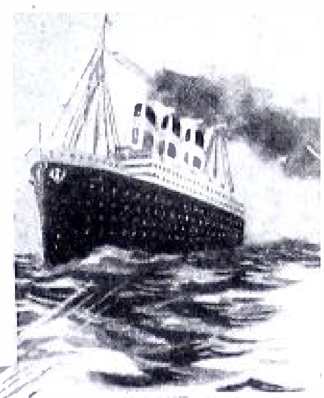

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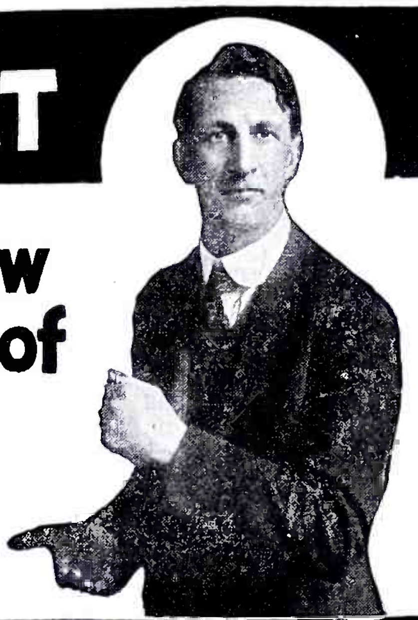

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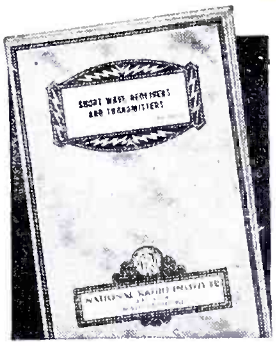

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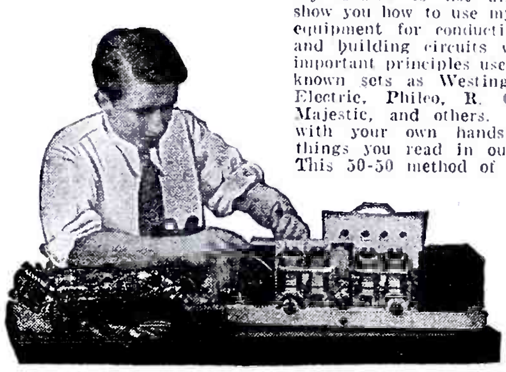

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"32FR"

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IT is always the well-trained man who wins out over the horde of thousands of superficially trained and incompetent men. You are reading this magazine because you are interested in radio. Sooner or later, the time will come when you will wish to cash in on your knowledge. Your chance may come over night, and then the big and vital question will be, "How well equipped am I to fill the job?" You are in radio because you like it. You also realize that, at the present time, there are many branches of the radio art which you do not know as thoroughly as you should. Knowledge, these days, can be gotten cheaper than ever before. It isn't necessary for you to go to college to become proficient in radio. Start today, to build a REAL radio library and become acquainted with all branches of this great and growing art. In this page are listed the world's best radio books. We have combed the market for the really important books in radio; so that, no matter what branch you are interested in, you can pick out the best books that are now printed. Start, today, to build a complete radio library. You do not have to get all the books at once, but make up your mind to get one book a month; so that, when your chance comes, you will be fully equipped to win out over the others not so well equipped.

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We publish no catalogue and ask you to be kind enough to order direct from this page. Prompt shipments will be made to you direct from the publishers. We merely act as a clearing house for a number of radio publishers and OUR PRICES ARE AS LOW OR LOWER THAN WILL BE FOUND ANYWHERE. Remit by money order or certified check. If you send cash, be sure to register it.

IMPORTANT.—This list is changed every month to include the latest books. Note also new low prices.

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HUGO GERNSBACK, EDITOR H. WINFIELD SECOR, MANAGING EDITOR

SHORT WAVE CRAFT

"Bent" Short Waves

An Editorial by HUGO GERNSBACK

● THE recent announcement that Senatore Guglielmo Marconi has succeeded in "bending" ultra short waves has set radio engineers the world over agog.

It has been reported, in short, that Marconi succeeded in sending ultra short waves of 57 centimeters (about ½ a meter or 22 inches wavelength) beyond the horizon and still noted reception. The transmission distance in this case was 167 miles.

This seems like an extraordinary feat when it is remembered that ultra short wave communication up to now has only been possible where the transmitting antenna and the receiving antenna *were within sight of each other*. In other words, the two aerials must be in the line of sight. The accepted reason for this was, of course, that ultra short waves, also called *quasi-optical* waves, follow the same line of propagation as light waves; thus, for instance, even if the air were absolutely clear, or there was no air between New York and Chicago, one could not see one city from the other, because light waves travel in straight lines and you cannot look beyond the horizon, generally speaking. There is, of course, such a thing as refraction of light rays in the air, but this does not go beyond a certain point.

No Relays in My Opinion

Some radio authorities rashly stated that Marconi effected his results by intervening "relays" such as, for instance, reflectors raised at suitable heights. To be sure, you can accomplish the same result by sending a light impulse beyond the horizon through the use of suitable mirror reflectors.

No one, however, is apt to do this, principally because of the cost, and second, because the method is not practical. If I know Marconi at all, I believe that he will not stoop to such artifices, and he will not be caught putting reflectors on the mountain-sides.

This method, as far as radio is concerned, also suffers from the disadvantage that the transmitted impulses would go only in certain directions. Thus, for instance, if you had such a system mounted on top of the Empire State Building in New York, you would require reflectors every few miles within a large circle drawn at the horizon, figuring the Empire State Building as the center. If you had no such reflectors all around, then the impulses could only be sent into that direction where there were reflectors. No impulses could be sent where reflectors were absent. The method, at best, would be a scientific plaything.

A Possible Solution

There is, however, another solution, and if Marconi is not using that method at the present time, I believe that sooner or later it will be used. I advance it here, not necessarily as a prediction, or as guesswork as to what Marconi is doing, but as a serious thought of what can be done in this direction.

Away back in 1904 I did a good deal of radio experimenting, and in one of the early experiments I used the then only known transmitter, i.e., a spark coil with a ball spark gap. To each end of the 2-inch zinc balls was attached an "antenna," the total length of which was about 8 inches. This gave a transmitting antenna of about 16 inches long, which is equivalent to a wavelength of 81 cm. (a little over ¾ meter). At the receiver I had a coherer, decoherer, relay, battery and bell, and exactly the same antenna. This wireless transmitter and receiver, which I was manufacturing at that time, incidentally was the first amateur radio outfit sold in this country. It was used mainly to transmit signals across a large room or hall, and every time you pressed the key at the transmitter, the bell would ring at the other end. The system worked exceedingly well and it was quite reliable.

Tesla's Ground Transmission Theory

However, I soon found that very much better reception over distances of several blocks, even with intervening buildings, could be obtained *only* if one of the transmitter spark balls was grounded, and if one of the receiver coherer posts was grounded at the other end.

The experiments were not continued further than this point, but it is interesting in these days when we again experiment with ultra short waves. I mention this case, only because of a talk which I had many years later with Nikola Tesla, the well-known inventor.

According to Tesla, our present theory of radio transmission is all wrong. He steadfastly has held to the view that radio transmission takes place mainly *through the earth*. Indeed, in 1892, he lit electric lamps at a distance of one-half mile, with no other connection than a *ground*. This, of course, was transmission of radio power at a distance. And the more I think of it, the more I believe that Tesla is right.

No Aerial Gives Excellent Results

Short-wave experimenters have found that in many instances short-wave reception is easily had without an aerial, using only the ground. I believe the time will come when in the transmission and reception of ultra short waves we shall use no aerials to speak of and that the entire transmission will be done *through the ground*. Even on the broadcast wavelengths, radio engineers have found that the so-called aerial-counterpoise, which is nothing but a *condenser effect* near the ground, works as well as a good antenna.

And then, of course, we have the brilliant experiments conducted in underground radio by the late Dr. James Harris Rogers.

I shall be glad to hear from those who have made experiments along these lines, as I am convinced that by this method ultra short waves can be sent not only beyond the horizon, but over great distances, and in time to come, all around the globe!

SHORT WAVE CRAFT IS PUBLISHED ON THE 15th OF EVERY MONTH

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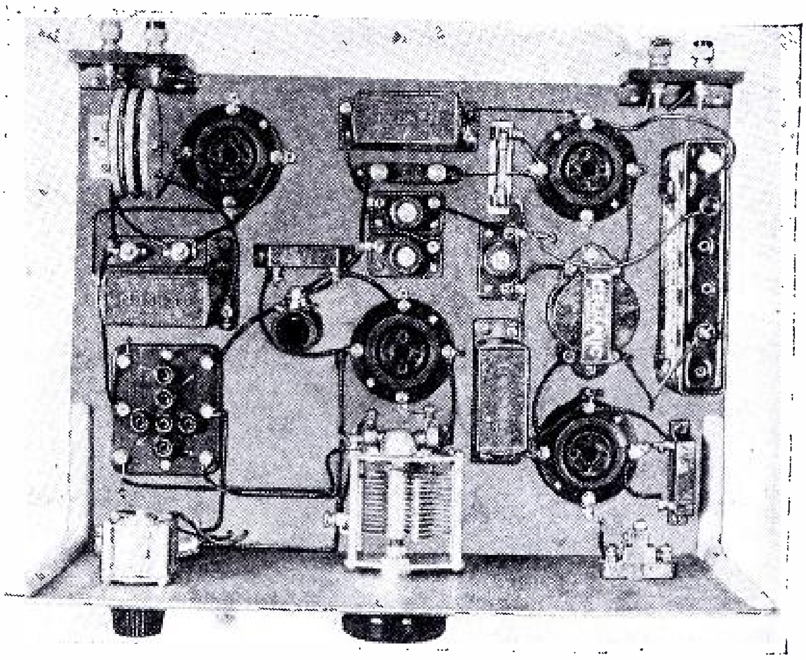


Top view of the "Super-Regenerator Four" here described by Mr. Dent.

The Super-Regenerator Four

By H. B. DENT

● WHENEVER a number of radio enthusiasts gather, it is reasonably certain that the subject of short-wave reception will come up for discussion, variations of the well-tried methods, as a rule, receiving greatest attention, with occasionally a discourse on some lesser-known arrangement. There is one system, however, namely super-regeneration, which is rarely mentioned, but possesses such obvious advantages that there is scope for further investigation, more especially since this system has not been thoroughly tried out on the short waves.

Will this become the recognized system in the future when ultra-short-wave transmissions are inaugurated? The present would be opportune to compile a few facts on the subject. Although ultra-short waves are not generally available for testing purposes at present, the general performance of the system can be gauged with reasonable accuracy by comparing the performance on wavelengths of about 20 meters, and on some higher wavelengths, say, in the region of 80 meters.

Recent experiments show that without a shadow of doubt there is a definite improvement at the lower end of the short-wave band, the particular advantages being simplicity of operation and absence of that annoying effect described as "threshold howling." The initial adjustments are not critical as those who have used this arrangement on broadcast wavelengths might seem to think. Indeed, the entire absence of any spurious effects, uncertainties and trickiness in the operation all lend weight to the suggestion that this system has much to commend it for the reception of the extremely high frequencies.

Now, what do we find on the debit side? First, the selectivity seems less good; this may not necessarily be a disadvantage, especially on the ultra-short waves. Secondly, background noises tend to increase, especially if the maximum amplification available is utilized. Possibly we must include also the inability to receive C.W. signals without the aid of a separate heterodyne, but this does not apply, of course, if our intentions are to develop a receiver for telephony reception only.

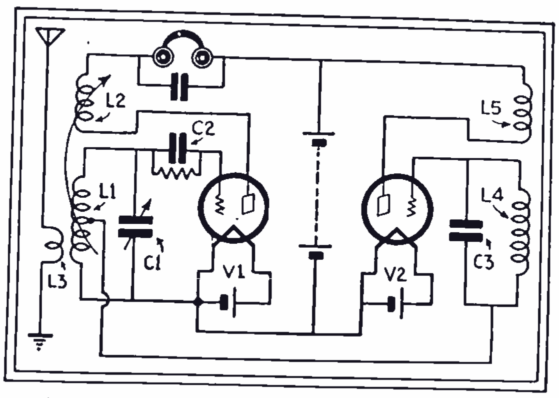


Fig. 1—Fundamental arrangement for super-regeneration. V1 is the detector-amplifier; V2, the "quenching oscillator."

Negative Resistance Explained

Now, before proceeding farther, it might be well to refresh our minds and consider a few fundamental facts relating to regenerative circuits in general, and super-regeneration in particular, since the two are closely interwoven. The effect of applying reaction to a circuit is to reduce its positive resistance, or, put in another form, it introduces a negative resistance tending to neutralize the existing resistance in the circuit. This negative resistance may be either less than, equal to, or greater than the positive resistance.

The one circuit that has perhaps greater possibilities than most any other circuit for short-wave receivers, is the Super-Regenerator. A number of new ideas are incorporated in the super-regenerative circuit here described by Mr. Dent, a well-known English radio expert. The super-regenerative circuit here presented is the result of the writer's experiments.

In the first case, when a signal is induced into the circuit the oscillations will build up to a certain definite amplitude determined by the effective positive resistance, and will be maintained so long as the signal continues. On cessation the oscillations die out.

When the negative resistance equals the positive resistance, the effect of injecting a signal E.M.F. is to cause oscillations to build up, which in time will attain an infinite amplitude, and these oscillations continue after the signal is interrupted, but without further increase in amplitude. The condition is

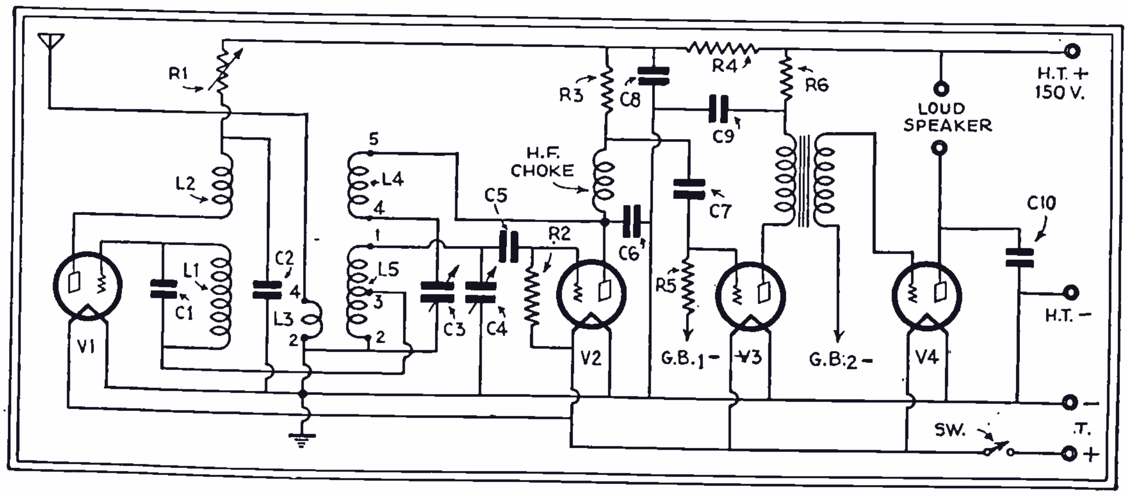


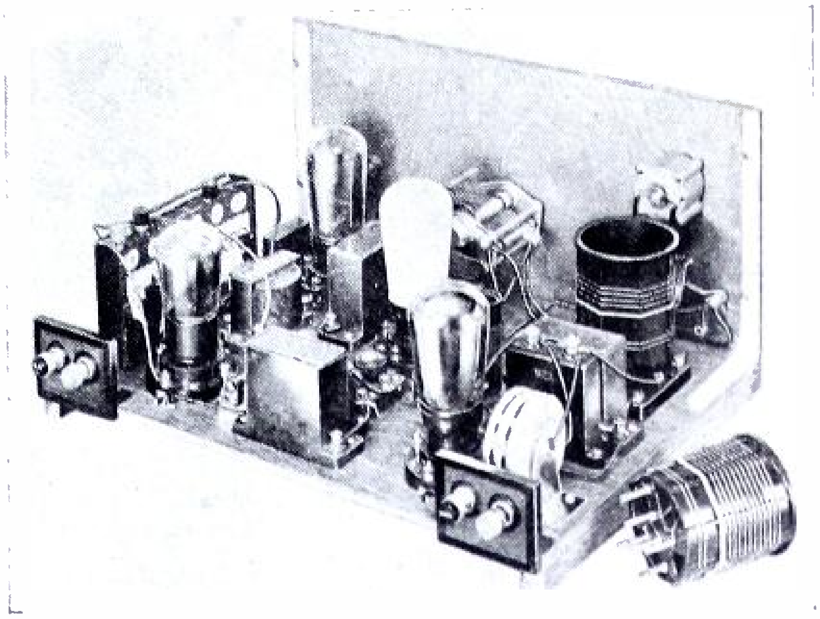
Fig. 2—Theoretical circuit diagram of the Super-Regenerative Four receiver for short waves. Values are as follows: C1, 0.05 mf.; C2, C8 and C9, 2 mf.; C3, 0.0003 mf.; C4, 0.00015 mf.; C5 and C6, 0.0001 mf.; C7, 0.01 mf.; C10, 0.001 mf.; R1, 0-2 megohm variable; R2, 5 megohms; R3, 30,000 ohms; R4, 20,000 ohms; R5, 2 megohms; R6, 10,000 ohms; V1, V2 and V3, average general purpose type tubes; V4, small power tube.

similar to one which we are familiar, namely, when the set is in a state of self-oscillation. The injected E.M.F. need not come from the ether, any minute electrical change in the circuit being sufficient to start this process of building up oscillations. In a practical case, however, self-oscillation appears before the effective positive resistance is completely neutralized, since there are other factors which come into the picture at this stage.

So far as the third condition is concerned, namely, when the effective resistance is negatived, it will suffice here to say that it is a theoretical condition only, being the logical conclusion having regard to the sequence of events concomitant with regeneration, but not attainable in practice.

Although space permits only a brief survey of this subject, it will have been realized that were it possible to devise a stable reactive detector circuit in which the effective resistance is lower than the critical value where self-oscillation appears, we should possess a receiver in its most simple form with phenomenal H.F. amplifying properties.

Super-regeneration attains this end and in a very simple manner, as it is now proposed to show. The arrangement is the outcome of some experiments carried out by E. H. Armstrong many years ago, and in its simplest terms consists of periodically varying the positive and negative resistance of the circuit, the balance being arranged so that the average resistance is positive; the circuit will not oscillate, therefore, of its own accord, but during the intervals when the resistance is negative, induced signals will build up to large amplitudes. Since the average resistance of the circuit is positive, these oscillations will die out immediately the impressed signal is interrupted, and indeed follow faithfully any change in its amplitude, but at a much higher level.



Rear view of the 4-tube super-regenerative receiver of unique design.

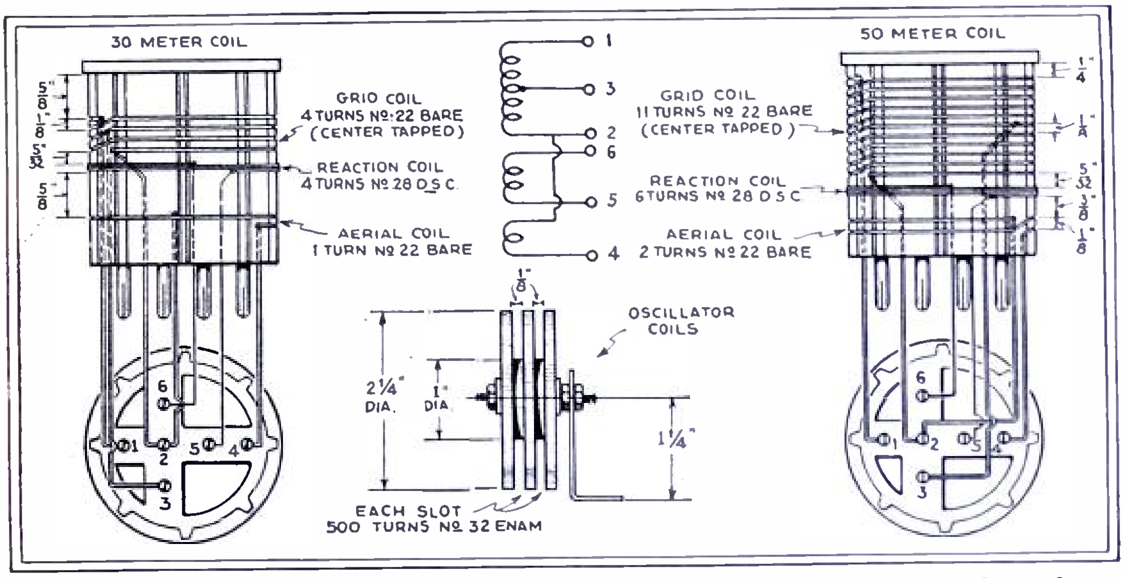


Fig. 3—Details of coils and winding data, also dimensions of wooden form for quenching oscillator coils.

There are various ways of obtaining this effect in practice, but one only will be discussed here, and the form this takes is shown in Fig. 1. Briefly, its action is as follows: Variation in the resistance of the receiving circuit L1, C1 is achieved by varying periodically the potential on the grid of the valve V1 by means of a low frequency oscillating circuit L4, C3. When the oscillating potential of the grid of V2 is positive, a conduction current flows from the tuned circuit, thus increasing its effective resistance. During the other half cycle, when the grid of V2 is negative, no conduction current flows; the circuit of L1, C1 thus having a very low resistance, which is determined by the regenerative effect produced by the feed back, or reaction coil L2. It is during this period that signal currents flowing in the aerial circuit, coupled by the coil L3, build up, are rectified by the action of the grid detector V, and become audible in the headphones.

Intermittent Cessation of Signals

The ear, being unable to respond to rapid changes, does not notice the intermittent cessation of signals at each half cycle of the oscillator V2, and in this respect resembles the human eye, the retentive effect of an image on the retina precluding any determination of change in the form if the variations are sufficiently rapid. This defect, if it can be regarded as such, makes moving pictures possible, so likewise does the accommodation of the ear render super-regeneration possible. It has been suggested in some quarters that for the reception of broadcast matter and telephony signals the quenching oscillations generated by V2 should be above audibility, since obviously these will modulate the carrier wave and be superimposed on the signal. Recent experiments carried out by the present writer have shown, however, that the performance in general is better with a low quenching frequency, but practical considerations preclude the use of those much below 6,000 cycles per second, otherwise it cannot be filtered out after rectification without noticeable deterioration of the quality of reproduction.

Armed with these few fundamental facts it only remains now to consider how best we can apply the principle of super-regeneration to a practical case, for there are certain features inherent in the system that tend to impose a limit to the amplification desirable at the detector stage. If the maximum possibile amplification is extracted, background noise is inclined to be rather troublesome. This is due to the exceptional sensitivity of the detector-amplifier, which not only responds to minute electrical pulsations having a tunable component, but greatly amplifies the inherent valve noises brought about by very small changes in the operating state of the valve. For example, fluctuations in the electron emission from the filament normally passing unnoticed become audible in this system, but even with the valve operating well below its maximum the amplification available is quite sufficient for all practical purposes. Under these conditions the background is then comparable with that present in any other arrangement affording an equivalent over-all amplification.

Quenching Oscillations

Therefore, in the receiver with which the experimental work was undertaken there were two L.F. amplifiers after the detector, which, with the separate quenching valve, gives four valves in all. Since general-purpose tubes are now obtainable at a reasonable price, there is no point in unduly complicating the issue by endeavoring to make one tube serve two purposes, such as combining the functions of quenching oscillator and detector.

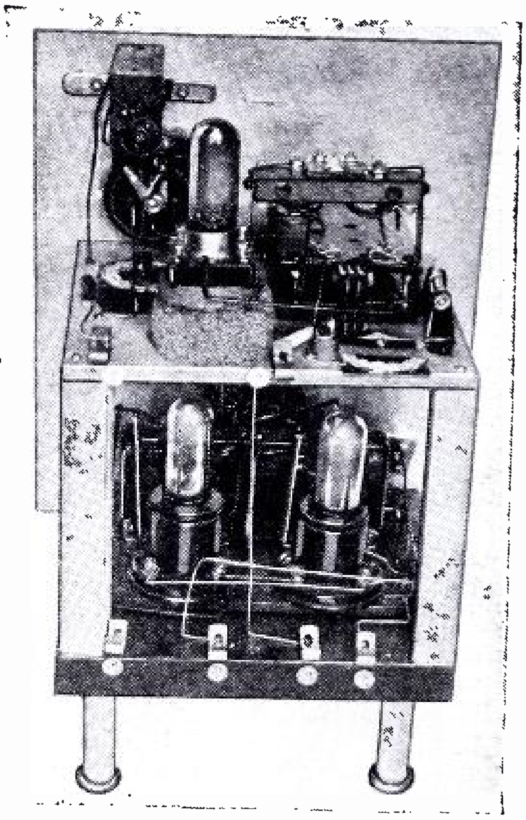
The theoretical circuit is shown in Fig. 2, from which it will be seen that, with the exception of the quenching oscillator V1, the circuit follows quite orthodox lines. Coils L1, L2, and condenser C1 constitute the quenching circuit, the frequency of which is just within the audible range, and if the superimposed oscillators are found to be troublesome they can be suppressed by fitting a filter between the plate of V3 and the primary of the A.F. transformer.

Details of the small wooden former supporting coils L1 and L2, together with the winding data, are given in Fig. 3. Oscillations generated by V1 are controlled by a variable resistance

(*Continued on page* 374)

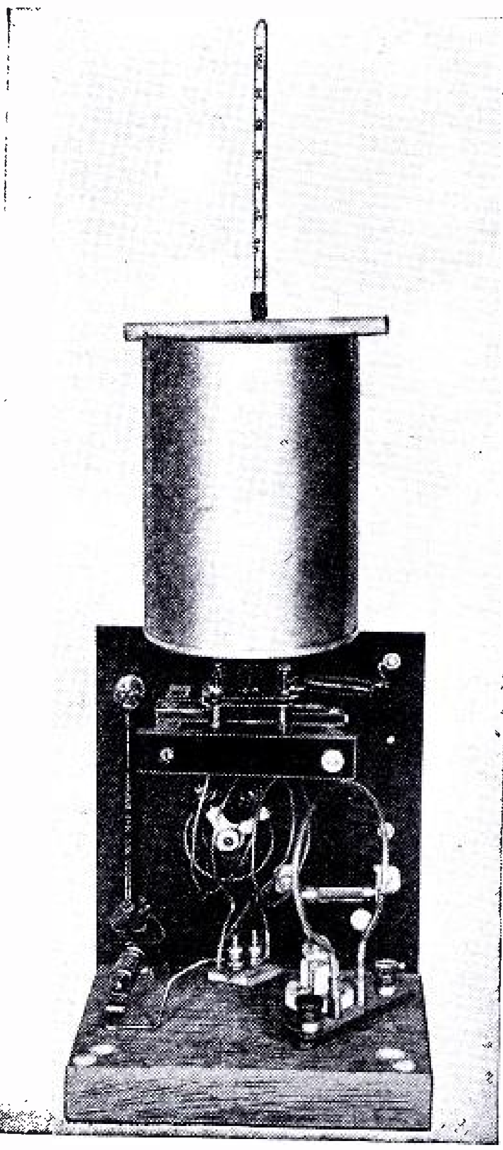
Mysteries of the 5-Meter Band

By C. H. WEST
W2AIU — Adm. Asst. U. S. Public Health Service



Rear view of 5-meter receiver as built by Mr. West, with shock-absorbing sockets for the tubes.

Two hundred and fifty miles with 5-meter signals covered by the author! Many astonishing and little known facts concerning 5-meter "sigs"!



Rear view of Mr. West's 5-meter transmitter with the vacuum tube water-cooled; note the thermometer.

A Few Facts Connected With The Art

● THE writer has conducted experiments since 1924 on various phases of ultra-short-wave transmission and reception; and during the present year has devoted most of his time in research pertaining to the production of fever in the human body by the use of these ultra-high frequencies.

Of late, however, the general trend of research seems to lean to transmission and reception within the 5-meter band, or from 56 to 60 megacycles.

Examination of various apparata used in this work discloses certain features that the writer thrashed out years ago. We find beautifully constructed receivers with tuning ranges all the way from 3 to 7 meters; and some with a scale of 1.5 meters.

Let us take up the broadcast wavelengths, in which our object is to own and operate a receiver with 10 kc. selectivity. Suppose we locate our receiver within one-half a mile of a powerful broadcast transmitter. Where would our 10 kc. selectivity be? We drop to the 80-meter amateur band, where the wavelength decreases and the kilocycles increase. To take care of the increased sharpness of tuning, we chop a few plates from our variable tuning condenser. On the still lower bands we reduce still further the capacity of the tuning condenser. Then we arrive at the band from 56 to 60 mc. It means little in our life. It is only a very short wave; therefore, it ought to be easy to tune. We fail to observe the fact that this band is 4,000 kc. wide.

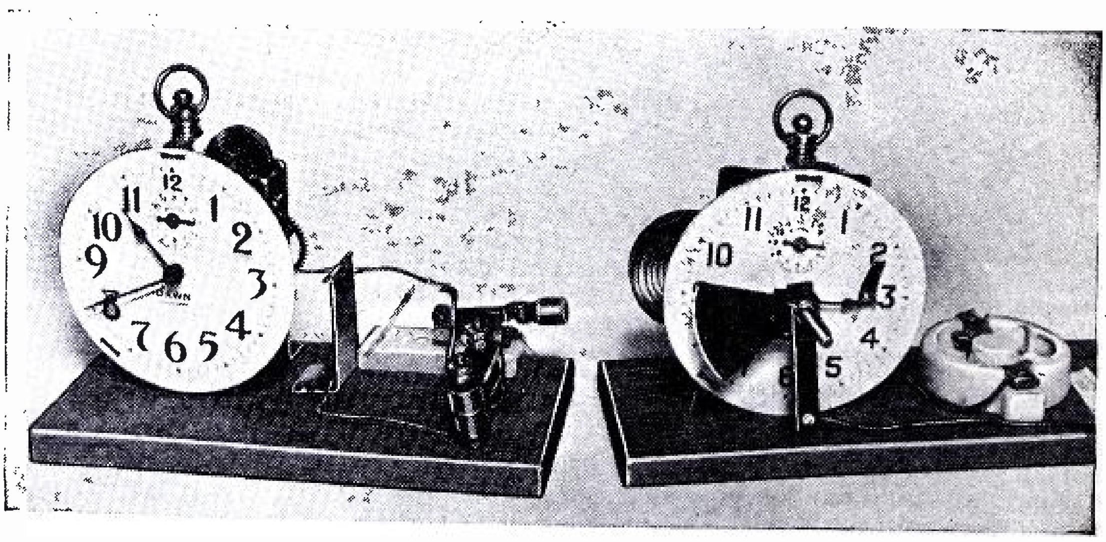
We construct our receiver to cover the band and glory in the fact that we are able to receive the signal at from 5 to 20 miles; and probably with high power on the transmitter. Beyond that point we are unable to receive the signal; and yet at a distance of one-quarter of a mile we hear it over the entire tuning scale. What has applied to all the other bands we fail to make use of within the ultra-short-wave spectrum.

The Transmitter

There are many forms of 5-meter transmitters in use; most of them have the habit of "whooping" and "whining" over the entire range. They are unsteady, not at a few miles away, but at long distances simply jump out of the tuning scale, especially with a suicidal tuning scale from 5 to 7 meters, or anything over *one-fifth of a meter*.

As will be noted in the photographs, the transmitter constructed by the writer uses the conventional ultra-audion circuit, with a new addition. *The tube is encased in a metal can filled with water!* A thermometer is suspended within the open top. A storm of protest will probably be directed at the writer for cutting down his output, radiation, and increasing the external, internal and detrimental capacity of the outfit.

During the year 1929 it was noted that as tube temperature increased, likewise did the frequency, which was easily followed up by a micro-variable condenser on the receiver, which had a tuning scale of 20 mmf. The signal, as the tube heated, passed very gently outside of the receiver range. This was done at a seven-mile range on low power. At length the tube was encosed in a can full of water and allowed to reach its maximum temperature, before any reception was attempted. The water reached 43 degrees Centigrade, and stayed within the neighborhood. Satisfactory reception was then accomplished, but even then the frequency changed from time to time, but was followed up very easily by the use of this very fine micrometer adjustment variable tuning condenser.



Clocks can be used to very good advantage in transmitting signals during 5-meter and other short-wave tests, as testified to by the photos of Mr. West's automatic "keys" herewith.

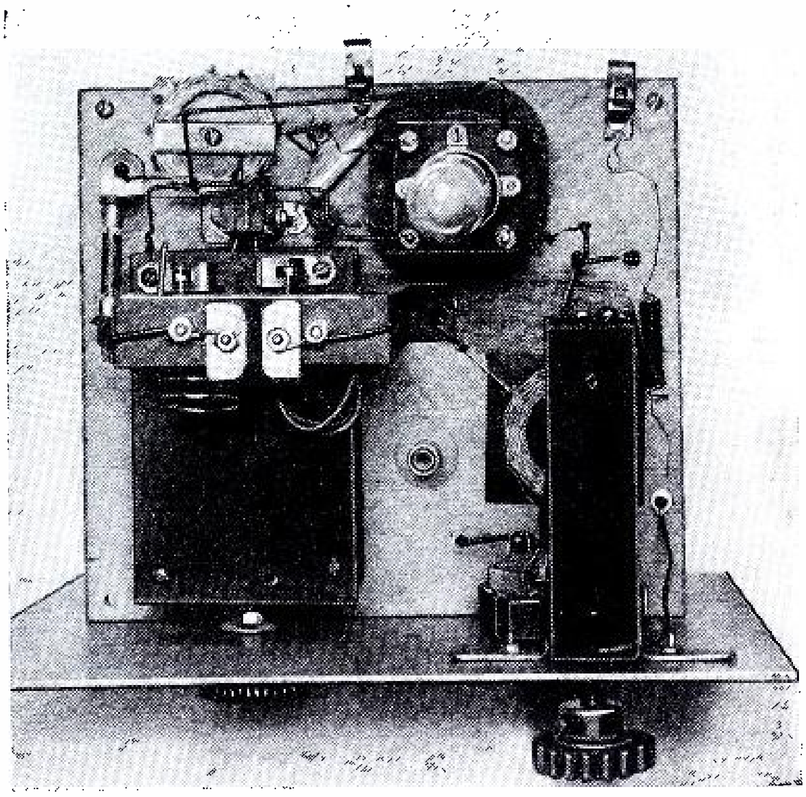
The idea of water temperature control may be applied to any transmitting circuits with an equal effect. In case of push-pull application, two cans, of course, would be required. For those wishing to use the author's circuit, Fig. 1 is self-explanatory.

The Receiver

With the advent of many new types of tubes on the market, the general trend seems to be in using them. Due to additional elements requiring more complicated wiring and additional "gadgets," it seems the desired degree of reception is "lost in the shuffle," but volume is increased to loud-speaker operation at a few miles away. This, likewise, disappears in the maze of 5-meter mysteries and no better results are obtained than in early days when the signal died a natural death amid steel buildings and other obstructions.

Many experimenters have coupled oscillators to the receiver, added push-pull amplification, or anything that would increase the signal strength, and were able in the long run to operate loud-speakers with terrific strength over one mile ranges. As the distance increased from the transmitting source, likewise did the signal strength. Tuning became sharper and sharper—and at length it became so *sharp* it wasn't there at all!

Something was evidently wrong with the system. More amplification in the receiver and larger "bottles" in the transmitter—this has always been the opinion of 5-meter experimenters. It is wrong. You can easily prove it is wrong. Suppose on your "pet receiver" you remove the beautiful ganged-condenser with bridge girder end-plates, and substitute two copper one-cent coins in place of it. One is the stator, while the other, mounted on a fine thread machine screw, is the rotor. Adjust the transmitter as near as possible by the frequency meter to fall within the tuning scale of the receiver, whose rotor plate opens one inch and approaches the stator within ⅛ inch.



Top view of Mr. West's 5-meter receiver with wedge type condenser at left.

Within a few blocks of the transmitting source the signal *is all over the scale*. As the distance is increased, the signal will, in ninety-nine cases out of a hundred, be towards one extremity of the micro-condenser. At a still further distance it will go out of the "picture" altogether. Five meters ends there with most people.

Now reduce (or increase—as the case may be) the frequency of the transmitter. The slightest movement on the tuning condenser of the oscillator will be sufficient, and one will be surprised to find the signal creeping back within the tuning scale—but still very much at one extremity. As the distance is increased between the receiver and transmitter, likewise will the signal move towards one end.

After a little research, one will find over a 20-mile range that it takes approximately 10 rotations of the machine screw vernier to tune the signal completely out.

Signals at 250 Miles!

With a similar type of apparatus in 1929 the writer received the signal from a low power-transmitter at a 250 *mile* range! Two rotations of the screw tuned the signal out, and the movement of the rotor plate was approximately 1/16-inch, but spaced ¾-*inch* away from the stator plate. This is a remarkably small capacity. Try and measure it in micro-microfarads! Quite a job, and as bad as an attempt to measure in kilocycles the tuning range of this micro-midget variable condenser.

From the foregoing, our object in receivers should be to construct them with plenty of inductance, but very little *tuning capacity*. Make them as broad tuning as possible. If possible make a handful of little "rings" or inductances each tuning from 4.8 to 4.10; 4.10 to 4.12 meters, etc., but one will hardly know which is which by the looks of them. They means a lot, and in fact more than any of us realize. There is just 4,000 kilocycles in those handful of rings and to the eye they all look about the same size in diameter.

The photograph of the receiver shown is of the autodyne type, using the ultra-audion circuit. The two penny pieces, previous mentioned, have not been made use of, as the rotor is too "scratchy."

In place thereof, we have two stationary plates, in which a stationary wedge of insulated material moves horizontally between the two stator plates of spring brass. The wedge is fitted with a machine screw of fine pitch and the movement is very gradual, as is also the separation between the two condenser plates.

It may be of interest to note that during recent experiments, the control could be rotated 100 times, representing a minimum to maximum running of the condenser, without tuning out the transmitter signal at one mile.

The range was increased to seven miles with a rotation scale of about six turns, which required from time to time further movements of the control to follow up the signal as it climbed to a higher frequency, due to internal heating of the tube. The *water-cooled* tube with fixed temperature solved the problem to a greater degree, as the maximum temperature of the tube had been reached.

The receiver was moved to a point in New Jersey and three miles above Edgewater at a distance of approximately 15 miles. It was hard work locating the signal again, as it had narrowed down to less than two rotations of the control and was exceedingly sharp. The wedge was removed and planed down to a point where it took 200 rotations to open the condenser plates from maximum to minimum.

After patient hours of very slow turning, the signal was again picked up and found to have a tuning scale of 10 rotations.

From the foregoing it is very evident that if any great distance is to be expected, the maximum to minimum rotations should be at least 400. Once it is located any frequency changes in the transmitter can be followed up by ¼

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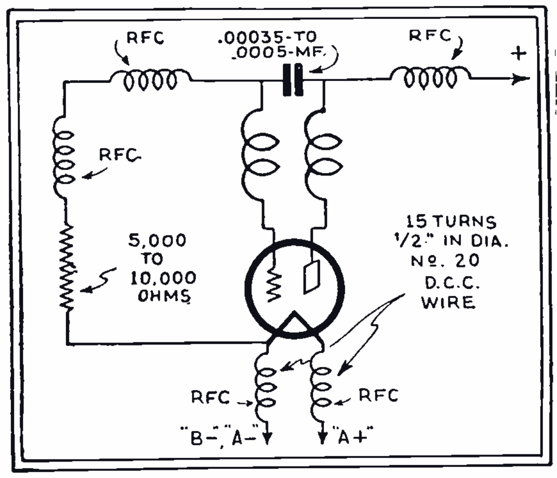
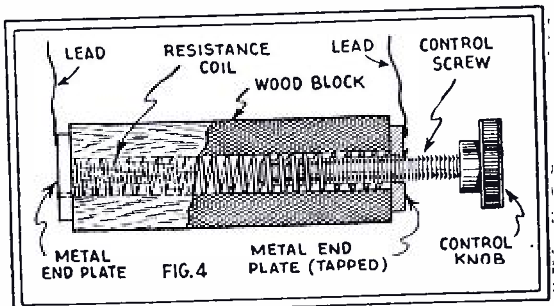


Fig. 1—Hook-up of 5-meter transmitter.



Finely adjustable resistance coil used by the author in his 5-meter experiments.

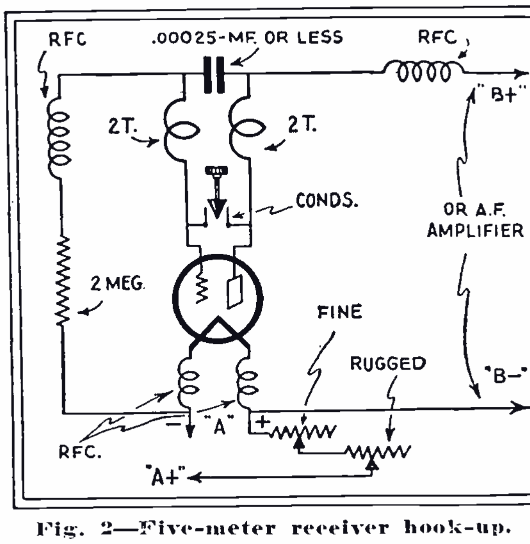
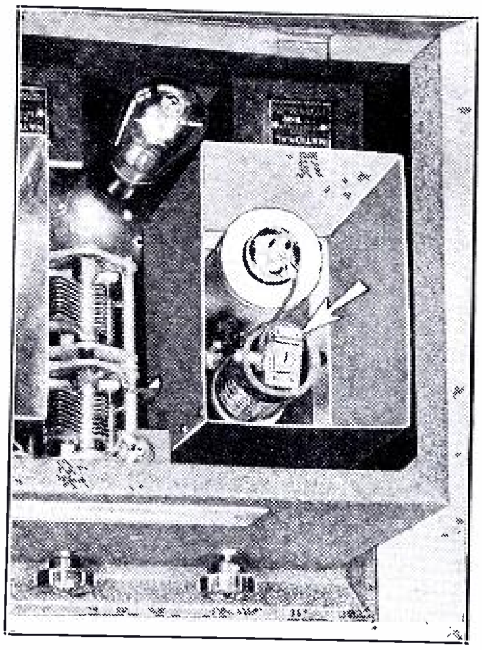
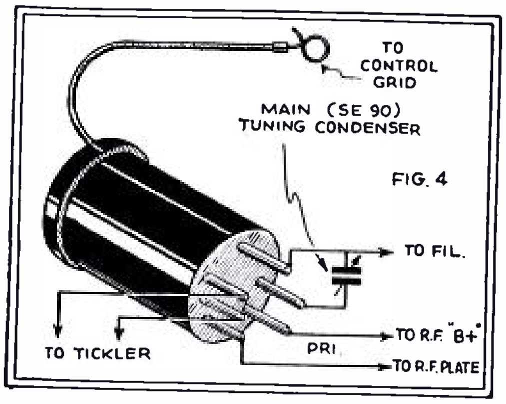


Fig. 2—Five-meter receiver hook-up.





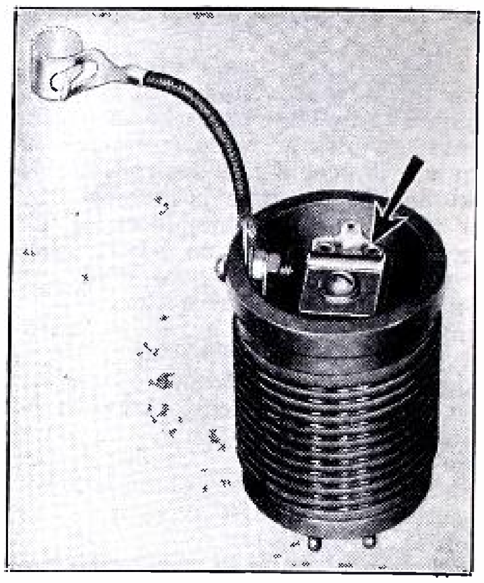


Fig. 4 (above)—Coil connections in a commercial band-spread unit, designed for use in the National SW-58 short-wave receiver. Fig. 5 (right)—A commercial form of band-spread plug-in unit, which may be instantly replaced by standard coils for band extension. Fig. 6 (left)—The National SW-58 with band-spread coils.

BAND SPREADING

By JAMES MILLEN, M.E.*

The "broadcast" fan who has just become acquainted with the wonders of short-wave reception will be particularly interested in this article by Mr. Millen, a leading short-wave expert, who here describes the theory and practice of how to spread the signals over the dial and thus render short-wave tuning easier.

● CONDITIONS concomitant with short-wave reception are such as to necessitate an unusual degree of finesse and technique on the part of the operator, when tuning systems, closely comparable to those used in broadcast receivers, are employed. This delicacy of control is immediately appreciated when it is considered, for instance, that the average short-wave receiver design for 20-meter reception covers a band of about 8 megacycles in one complete sweep of the dial, which is more than eight times the frequency range encompassed by broadcast transmission between 200 and 550 meters! On a broadcast receiver designed for simplified tuning and logging, the 400 kc. band between 300 and 500 meters occupies about three-quarters of the dial. In contrast, the same number of kilocycles, representing the amateur 20-meter allocation, occupies only one-thirtieth of the entire dial range! Such concentration inevitably results in hair breadth tuning and micrometer logging which is unsatisfactory and inaccurate.

To start with, it must be understood that the problem has nothing to do with the *electrical* separation of stations—the actual selectivity. Whatever means are adopted to facilitate the mechanical location of the station will not reduce interference from adjacent channels, except to the extent that simplified tuning may facilitate sideband choice with a slightly superior rejection characteristic. If we so design the tuning ensemble that 400 kc. is spread over 100 dial divisions, instead of 9, the selectivity characteristics of a signal receiving interference from two stations 5 kc. on each side of the desired frequency will not be improved in the least. The 5-kilocycle beat notes will be as intrusive as ever—but it will be much easier to center and log the desired signal. And if the interference is caused only by a solitary station, simplified tuning will make possible the rapid reduction of this interference by selecting sidebands (in the case of a modulated signal) or by employing a local beat frequency (in C.W. reception) on the side away from the interference.

* The National Company, Malden, Mass.

A High Ratio Dial

The most obvious solution to the problem is the simple mechanical expedient of employing a high ratio dial—such as the 250-to-1 device used in the crystal controlled Stenode. This, of course, does not effect band-spreading, as far as the dial reading is concerned, but it does eliminate the necessity for over-exacting delicacy in control. The objections to the high ratio dial are that it does not solve the logging problem and, unless the mechanism is cleverly designed and carefully made, the back lash is likely to be annoyingly excessive.

Special Condenser Plates

Attacking the subject from an electrical point of view, the possibility of specially curved condenser plates is an immediate consideration. It is not at all difficult to design a condenser plate so

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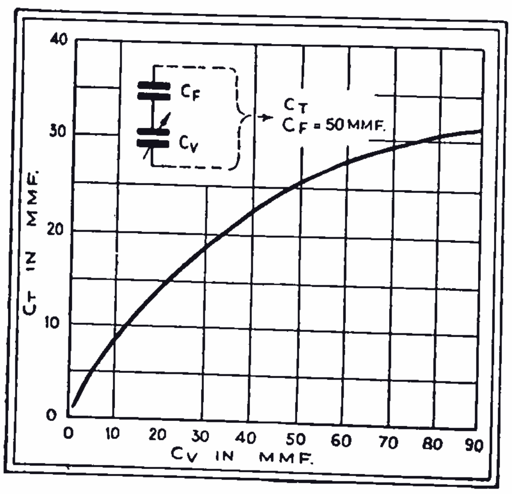


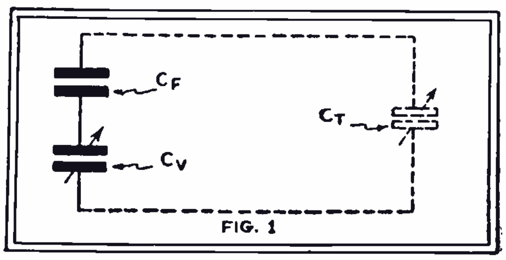
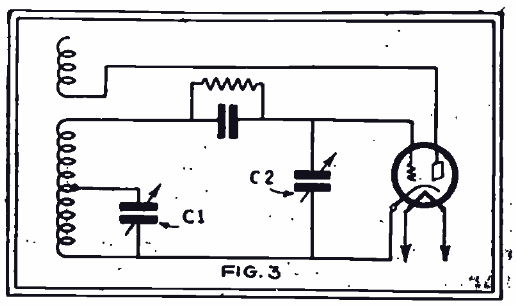
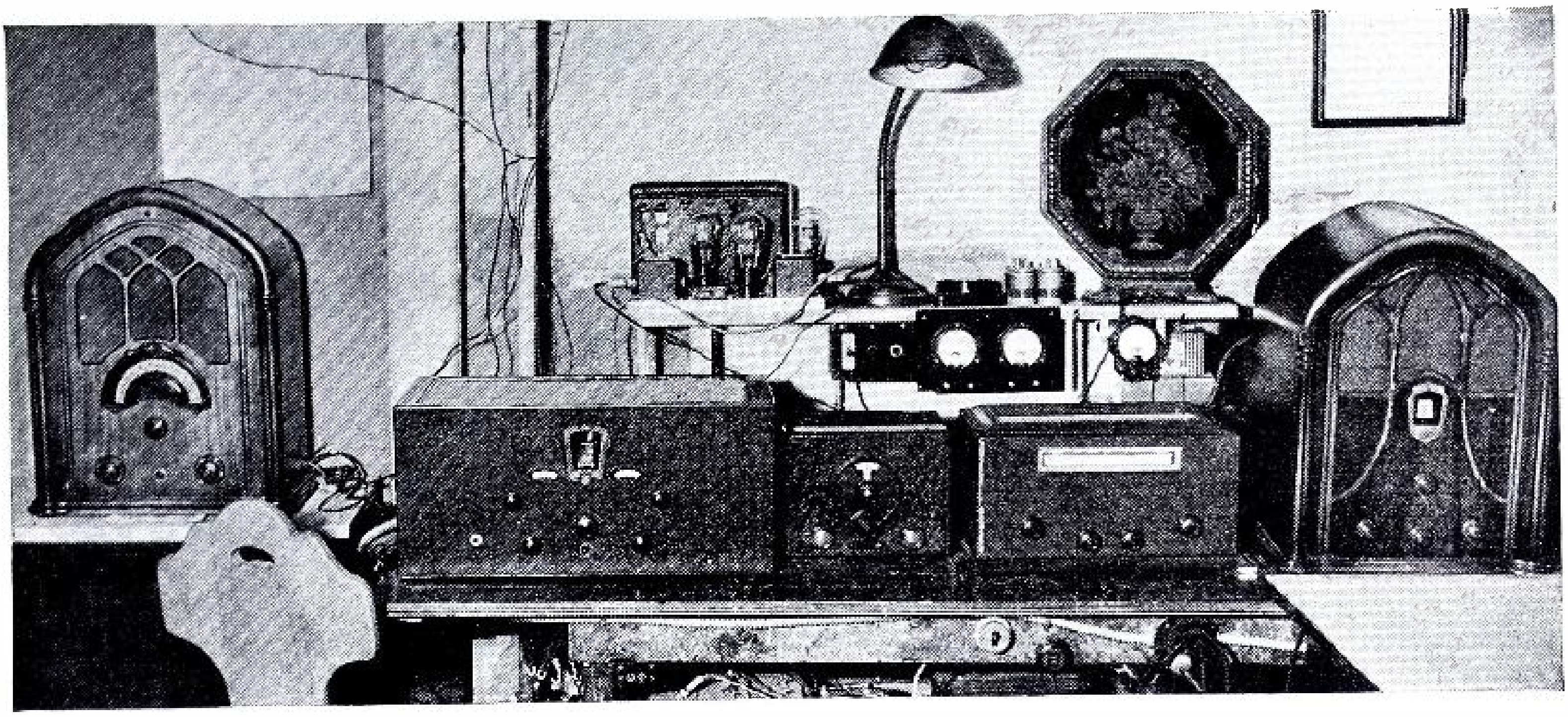


Fig. 1—A simple series condenser arrangement for reducing the variation in tuning capacity, Ct, with changes in the variable or control capacity, Cv. Fig. 2—Indicating how the rate change in tuning capacity, Ct, varies as the relationship of variable to fixed capacities is changed. Fig. 3—A circuit arrangement which approximates Figure 1, and which permits the inclusion of band spread components in the coil unit.





Here she is, boys! Mr. Hertzberg's set-up of four short-wave receivers, all coupled to one antenna, each set receiving a different European station simultaneously.

4 European Stations AT ONCE!

By ROBERT HERTZBERG, W2DJJ.

Many of us have picked up four European stations at successive periods, but here is an exception indeed—Mr. Hertzberg tells how he listened to four European capitals SIMULTANEOUSLY!

● MANY short-wave fans consider themselves lucky if they can definitely identify one or two foreign broadcasting stations during the course of an evening's listening. It's easy enough to pick up all kinds of music and talking that sounds foreign, but getting call letters and understandable announcements is another matter, as many listeners will testify. Therefore, the writer thinks he accomplished something by bringing in programs from four European capitals simultaneously on four different receivers working off a common aerial, and getting clear, unmistakable announcements that were verified and witnessed by a German professor of languages who even recognized the voice of the Berlin announcer!

Rome!

This spectacular feat, which thrilled even an old-time, hard-boiled dial-twister like "yours truly," happened more or less accidentally during a series of tests being made on a number of short-wave receivers. The professor, who occupies the other half of a two-family house, was disentangling his young daughter's bicycle from a roll of loose aerial wire in the cellar, and was probably more annoyed than anything else at the assorted squeals and whistles from the imposing line-up of receivers shown in the accompanying illustration. However, he pricked up his ears when the Lafayette All-Wave set (on the extreme right) issued the clear, loud voice of the famous woman announcer at the Rome station. We just caught the tail-end of an operatic selection, which was followed by the announcement, "*Radio Roma Napoli*," and a long discourse in Italian. The time was about 4:30 in the afternoon; the wavelength 25.4 meters.

Berlin!

Turning down the volume a bit, because the signals actually made conversation difficult, we switched on a new National SW-58 (second from the right). There was a mess of music around 31 meters, but as there are several powerful Americans on this channel we didn't pay much attention. Just as we were about to turn the set off, the music cleared wonderfully, stopped, and was succeeded by a deep German voice, which announced "*Berlin Deutschland Sender*" and then continued for a few minutes while the professor jumped up and down excitedly and exclaimed, "I know that man! I know that man!"

Our stumbling into this announcement was extremely fortunate, for we heard nothing but music for another hour.

London and Paris

Inspired by this reception, we swung a Hammarlund Comet "Pro" into action (second from the left), fished around 25 meters again, and picked out some dance music which happened to swell up to great volume just at that moment. The announcer sounded very British, but mentioned no call letters. As we have long since learned not to be fooled by accents or tongues, we left this program tuned in and went at the Pilot Dragon at the extreme left. The German, the Italian and the suspected Englishman all "clicked in," but just beyond the Englishman was some mushy speech that sounded like French or Spanish. After about five minutes this resolved itself into voluble and clearly understandable French, with several "*Ici Paris*" announcements. A long-winded political talk finally gave way to some unexpected American—not English—and for a moment we thought we had tuned in the wrong end of one of those trans-Atlantic rebroadcasts. However, the speech turned out to be a review of European political events given by the Veterans of Foreign Wars in Paris, for the benefit of American listeners. What a relief!

While the American was talking, the Englishman announced the last number of his program, and then identified the station as G5SW. A glance at the clock showed that the time was close to 7 p.m., and sure enough the midnight chimes of Big Ben rang through in a few minutes.

The professor was now thoroughly bewildered and not a little incredulous.

Madrid

"How about the rest of Western Europe?" he asked, jokingly. "Why not bring in Spain and call it an evening?"

Unfortunately EAQ was not on the air so early, but he interrupted his supper an hour later to come down and hear the programs from Madrid boom in with fine strength and quality. By that time

(*Continued on page* 377)

The author with his transmitter constructed from an old neutrodyne receiver.

MAKING A Short-Wave TRANSMITTER from a Neutrodyne

By LOUIS F. LEUCK

The once famous neutrodyne receivers are being sold at bargain prices today—anywhere from $1.00 and up. Mr. Leuck gives us an interesting description of how he built his short-wave transmitter from an old neutrodyne.

THIS is the story of how an antiquated 5-tube, 3-dial neutrodyne type of broadcast receiver was changed to a low-power amateur phone and code transmitter of the master oscillator - power amplifier type, employing two stages of speech amplification and 100 per cent modulation. From an obsolete, discarded receiver to one of the most modern types of transmitters surely is "reversed radio" in my opinion. The type of receiver that was used may be found in many an attic or purchased very reasonably. Sufficient information is given below to enable the reader to do a similar job of remodeling if he desires.

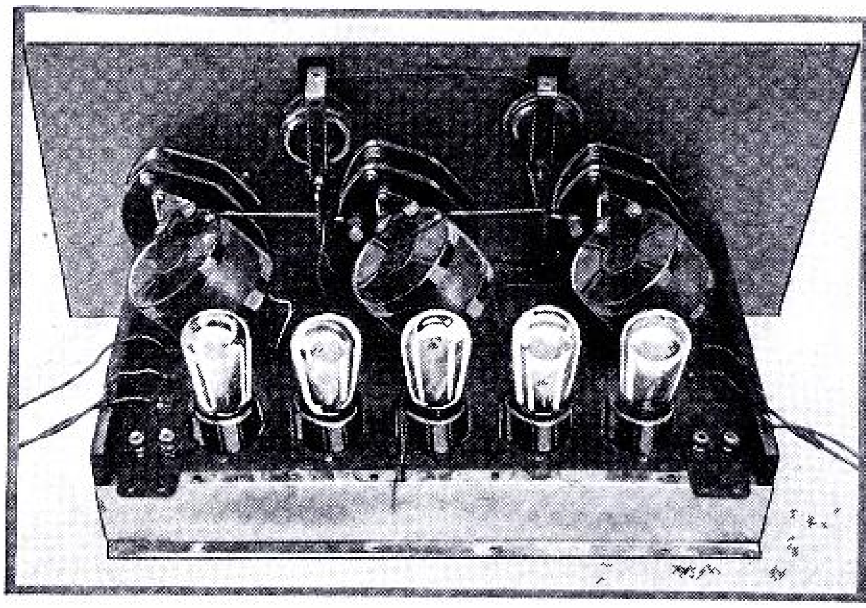
Reversing Receiver Into Transmitter

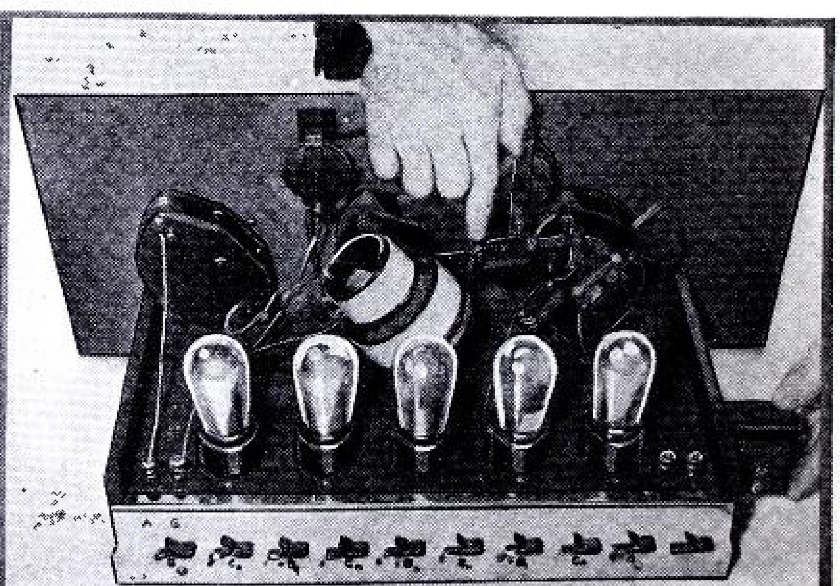
In making the change the wiring was altered, but practically all the parts of the receiver were used except the detector coil and coil form. The two radio frequency stages became the *master oscillator* and *power amplifier*. The audio frequency system remained an audio system, the detector becoming the *first amplifier* and the original output tube being elevated to the position of *modulator*. The *antenna series tuning condenser* was originally the detector stage tuning condenser. The *master oscillator tube, coil and tuning condenser* was originally the first R.F. stage.

In making the conversion an attempt was first made to trace all wiring carefully and so do the job with the fewest possible changes of wiring. This worked out quite nicely as far as the filament wiring was concerned, and also fairly well for the balance of the changes in the audio frequency system. In fact, it is really important that the connections to the audio frequency transformers remain poled as they were in the original set. If this is not observed there will be a tendency to "howl" at some audio frequency. If any such tendency exists in the completed transmitter it can usually be cured by placing a resistor of about 100,000 ohms across the secondaries of each of the transformers. If the tendency still persists, lower resistances should be used.

A telephone induction coil serves as a *modulation transformer*. This was used partly because it happened to be available and partly because there would actually have been too much gain if a regular modulation transformer had been used. If a regulation modulation transformer is used it is permissible to omit one of the stages of speech amplification, though the operator may have to raise his voice a bit above normal. An automobile ignition coil may be pressed into service as a modulation transformer if no other is at hand, without introducing appreciable distortion.

All three of the tuning coil forms were removed and the detector coil form discarded. One of the others was then rewound with 30 turns, center-tapped, of the *original* wire. This became the plate and tickler coils of the *master oscillator* (L1 and L2 in Fig. 1). Twenty-seven turns of No. 18 D.C.C. wire were wound on another form, which serves as the plate coil of the power amplifier. Eleven turns of the original wire were wound on as the tickler. These are designated as L3 and L4 in the figure. The grid coils of this particular receiver each had 53 turns originally. If a receiver having different size coil forms and a different number of turns is to be remodeled, the correct number of turns can be arrived at by taking the same *ratio* of turns for the various coils as was done in the set described here. In order that the set





Two interesting photos of Mr. Leuck's short-wave phone and code transmitter constructed from a once-famous neutrodyne receiver, which he hauled down out of the attic.

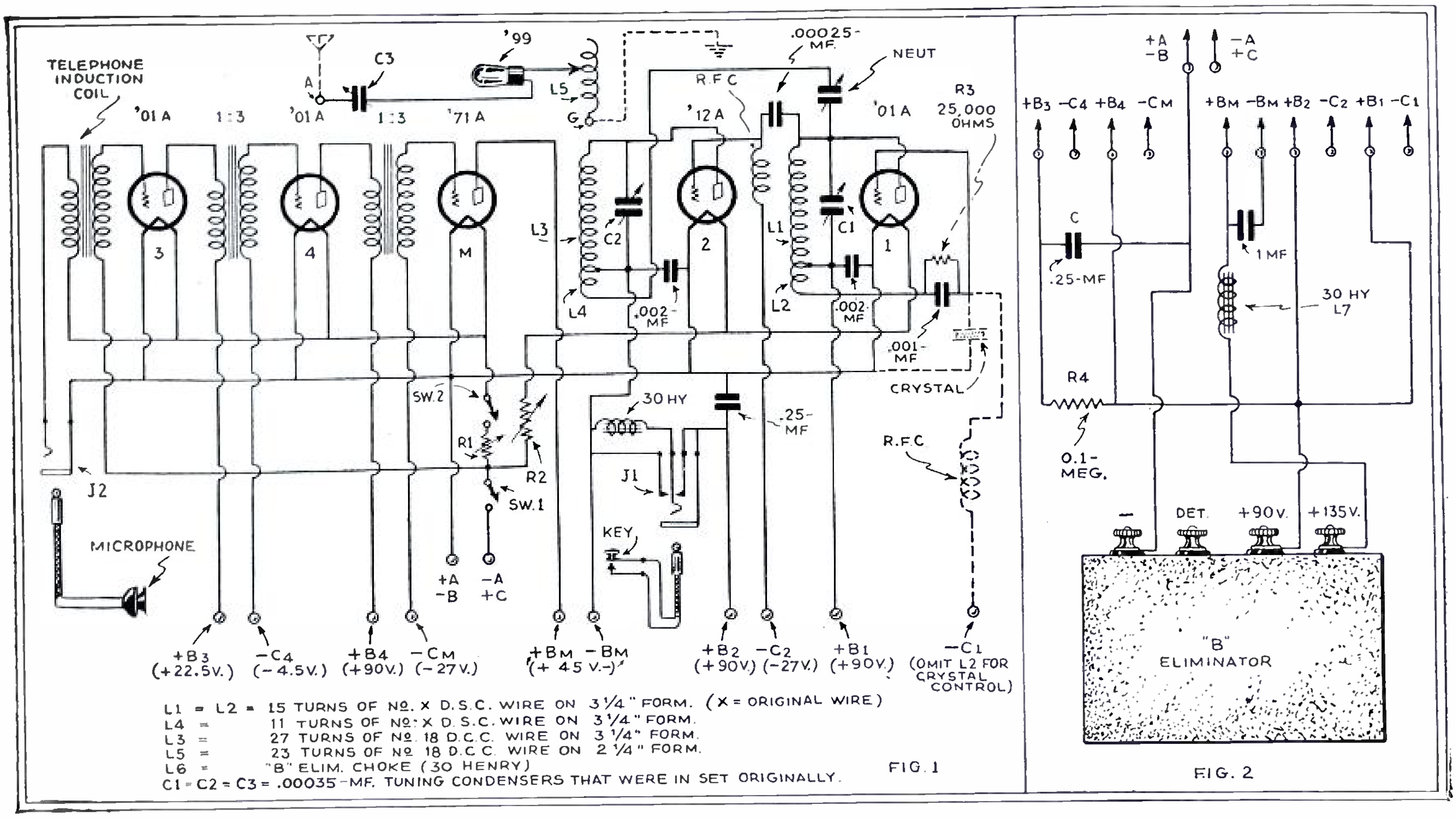


FIG. 1 FIG. 2

Circuit above shows how Mr. Leuck hooked up the microphone and key connections to his revamped neutrodyne receiver, which then served him as a short-wave phone and code transmitter. Fig. 2, at right, shows connections of "B" eliminator.

may be properly neutralized, L3 and L4 must be wound in the same direction. Another way of saying it is that L3 and L4 are essentially a tapped winding. The connections of the master oscillator and power amplifier plate coils to their respective plates should be made in the same way. For example, the plates should be connected to the top ends of the coils in both cases. If this is done and both coils have been wound in the same direction there will be no trouble experienced in neutralizing. One of the original neutralizing condensers is satisfactory if it doesn't happen to be too small, as it was in this set.

Note that in a receiver the grid coil is tuned, while in a transmitter the plate coil is tuned. This makes it necessary to switch plate and grid connections on both of the R.F. tubes. That is one of the reasons why it is best to just cut all wiring except filament leads away from these two tubes and their associated coils and rewire according to Fig. 1. This receiver happened to have two rheostats, two jacks and two switches and so use was made of all of them. All that is really necessary in this line is one filament switch (SW1) and a single fixed resistor which will handle five tubes. With the arrangement shown the Heising modulation system choke is short-circuited when the key is pushed in the jack for code work. A switch could be arranged to do this if keying impacts proved to be too noticeable with the choke in the circuit.

Tubes and Voltages

Three of the tubes are '01A's, the power amplifier is a '12A and the modulator is a '71A. With 135 volts on the plate of the modulator tube, 22½ on the first audio tube and 90 on the remainder, the whole outfit operates with rather high efficiency. A consideration of the rated output of the '71A and its plate resistance at 135 volts, and also that of the '12A at its operating voltage of 90, shows that conditions are just about right for 100 per cent modulation without overloading or overworking the '71A. The load resistance relations between the two tubes are just about ideal for the '71A to do its most effective work as a modulator. An additional 45-volt battery serves as a voltage booster for the modulator tube. Its positive is connected directly to the plate of the '71A and its negative is connected to the 90-volt plate lead to the '12A on the plate side of the Heising modulation choke. (A "B" eliminator filter choke is used as a Heising choke.) A "B" eliminator may be used as a source of plate supply if desired. This requires an additional 30-henry choke and a couple of 0.25 to 1 mf. condensers. The connections are shown in Fig. 2.

This transmitter was intended for low-power work and for use in places where it is necessary to use battery power. It is easy on both the plate and filament batteries.

Tuning and Neutralizing

The setting of the master oscillator tuning condenser determines the wavelength. With the coils as given, the set will tune down to the "80-meter band" also, but will not be operating with "high C" which is desirable for stability of frequency. The first step in the tuning process should be to set the oscillator frequency within an amateur band. With the master oscillator tuning condenser set at 50 the wavelength is around 160 meters. This may be checked approximately by listening to other transmitting amateurs and comparing frequencies if no frequency meter is available.

The next step is *neutralization* and since this is something of a mystery until one has once successfully accomplished the feat, some pointers will be given. The reason for the elaborate row of Fahnestock clips along the rear of the transmitter now becomes apparent. Since the transmitter's power is low, it was found advisable to use the D.C. plate meter method of neutralization. In neutralizing the power amplifier with this method, its power should first be cut off by removing the 90-volt lead at the clip. A 25 ma. meter should then be connected temporarily in series with the 90-volt lead to the master oscillator. When oscillating properly without load, its plate current will be 6 to 8 ma. Next the plate circuit tuning condenser dial of the power amplifier should be rotated back and forth. When resonance with the master oscillator is passed, the needle of the milliammeter will "kick." The neutralizing condenser should be adjusted until the "kick" is absent, or nearly so. Twirling of the dial back and forth should alternate with adjustments of the neutralizing condenser until the desired "no kick" position is found. The power amplifier is then neutralized. The milliammeter should then be changed to the plate lead of the power amplifier and its plate power applied. Its plate circuit must be tuned to the same frequency as that of the master oscillator. There will be a sharp downward dip of the milliammeter needle at this point.

The Antenna

Now we have arrived at the point where the radiating system should be connected. A wavelength of 160 meters requires an antenna approximately 120 feet in length. The ground should be as short and direct as convenient. If it

(*Continued on page* 372)

The "Bearcat-3" 5-Meter

A GOOD 5-meter receiver is in big demand just now, with hundreds of amateurs getting into operation with their 5-meter transmitters. Not only must the 5-meter receiver be selective, but it must also possess powerful amplification properties. The "Bearcat-3" possesses these qualities. Data are also given on the construction of the new antenna resonance coils which greatly increase the signal strength.

• CROWDED channels and the desire to explore the little known ultra high frequency regions has led to many interesting developments in the 5-meter band. Increased activity on the part of amateurs and other investigators has resulted in a great rush to start things in this band. Many interesting uses have been found for two-way intercommunication over short distances. For instance, two amateurs living in the same town or city will find that reliable transmission and reception can be carried on with a minimum of interference and this tends to relieve the congestion which exists on the lower frequency channels.

An example of how two-way conversations can be carried on is indicated in Fig. 1.

Stations A and B are located in the same city, say, New York, and stations C and D are located in some other town about 150 miles from A and B. Let station A transmit on the 80-meter band to station C. Station C listens to A and at the same time feeds the output of his 80-meter receiver into his 5-meter transmitter. Station D picks up the signal from C on 5 meters and transmits to station B on the 80-meter band. Thus, station A can talk to stations B, C and D at the same time. Note should be made of the fact that station A can converse with station B through stations C and D or direct on the 80-meter band.

A little thought will show that all parties can hear the remarks of any one station and can break in on the conversation without changing the adjustments of their receivers or shutting off their transmitters. This is indeed a very nice scheme and the beauty of it is that several fellows use it and commend it most highly.

NEXT ISSUE!

Special "BEGINNERS" NUMBER

Receivers, Converters and Other SHORT-WAVE Apparatus YOU Can Build EASILY!

Circuit Design

Three tubes are used in this design and the 6-volt automotive type has been selected as being the best for the purpose.

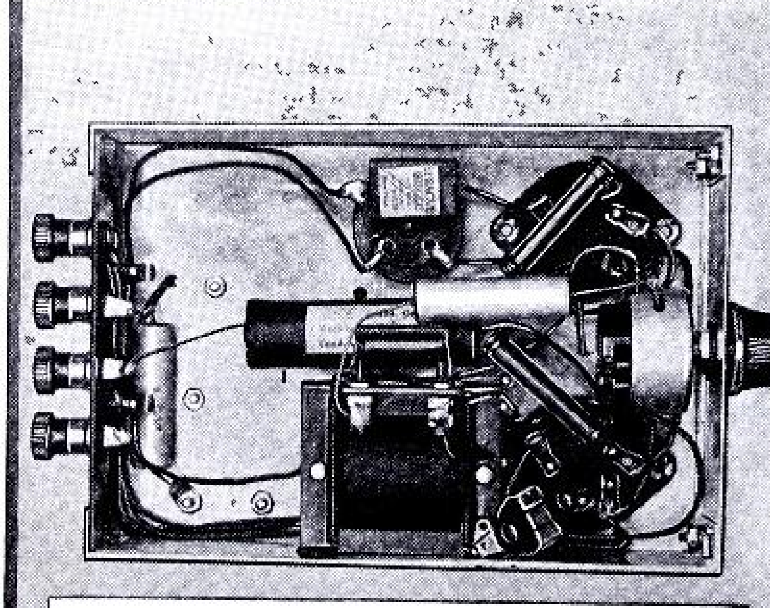
The detector tube, which is mounted directly in back of the tuning condenser, is one of the 37 type tubes. Note that the plate potential applied to this tube must pass through the resistance 13 and serves the dual purpose of controlling the regenerative action of the detector and limiting the amount of energy fed into the detector from the local oscillator. The frequency of the signal fed to the detector is determined by the size of the coil 18 and the condenser 16.

The local oscillator, which supplies the quenching frequency, derives its power from the tap marked B-plus 67.5 and the proper operation of the set will depend on the obtaining of the proper value of this plate voltage. Voltages from 22.5 to 90 should be tried, as different tubes may have different characteristics as far as power output is concerned. Select the voltage giving the smoothest control of resistor 13. With the circuit as is, there is a compromise between the exact operation point for maximum sensitivity of detector action and proper voltage from the local oscillator.

The output of the detector is fed through the transformer to the grid of the pentode output tube. This raises the power sensitivity of the set as a whole and if a suitable coupling device is used to couple the output of the 38 to the reproducer, satisfactory quality will result.

Construction is a simple matter, as the parts are not numerous and there is plenty of room even though the chassis is very small. Drill and fold the chassis as per drawings. Many fans may want to purchase a finished chassis, which can be done.

Mount the tuning condenser in the center as shown in the photographs. It



Above—A view under the chassis of the 5-meter receiver. Most of the resistors, by-pass condensers, etc., are mounted under the chassis as shown, which makes for the neatest appearance.

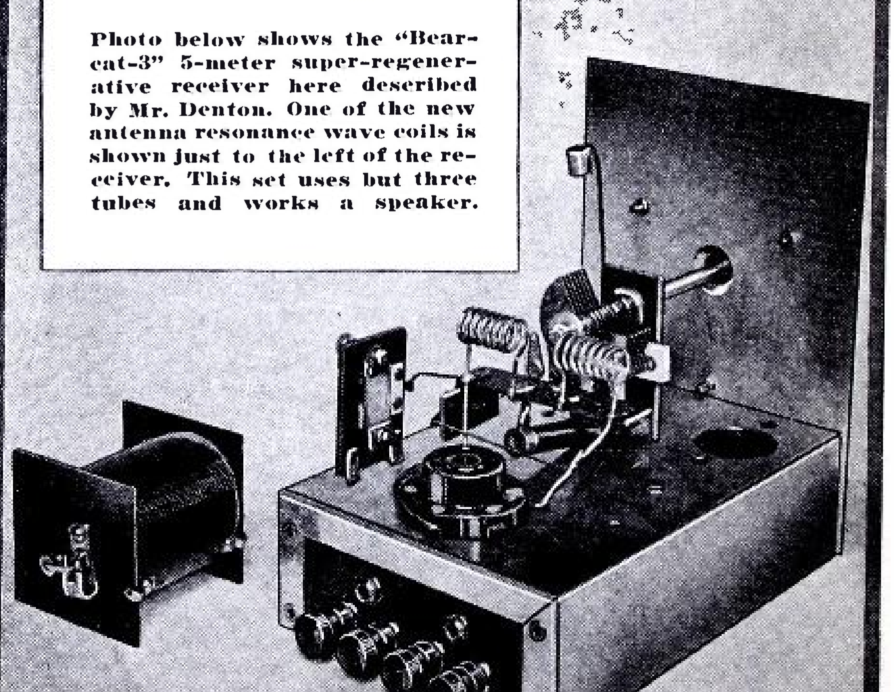
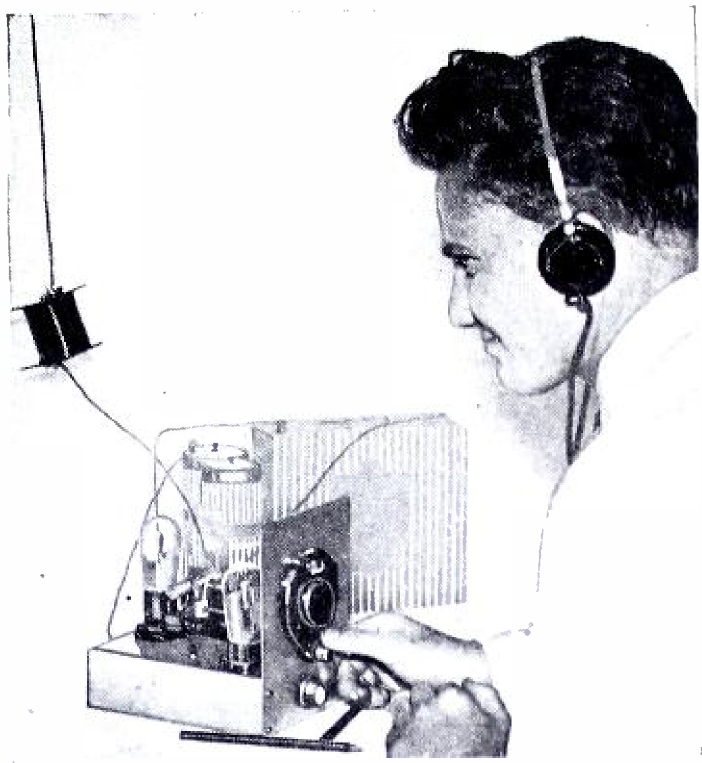


Photo below shows the "Bearcat-3" 5-meter super-regenerative receiver here described by Mr. Denton. One of the new antenna resonance wave coils is shown just to the left of the receiver. This set uses but three tubes and works a speaker.

Super-regenerative · Receiver

By CLIFFORD E. DENTON



Max Pearlman listening to the mysteries of the 5-meter "ham" band as the waves roll in on the "Bearcat-3."

would be wise at this time to check up the drilling of the front panel, noting if the shaft of the tuning condenser lines up with the bushing of the tuning dial. The sockets can be secured in place, as well as the audio frequency transformer.

Most of the remaining parts, such as the resistors, can be held in place by the wiring. It would be wise to bolt the by-pass condensers to the under part of the chassis so as not to place too great a strain on the wiring.

The tuning dial, which is mounted on the front panel, can be locked to the condenser shaft and then the set can be wired.

Wiring

Little need be said as to the wiring. Do not use long leads in the detector circuit. There is a definite reason for using the type of socket for the detector —to insure short leads. Grid and plate leads must be as short and as clear from surrounding metal objects as possible. It is not necessary to use the same care with the balance of the set because the frequencies involved are much lower.

Coil Data

The specifications for coils 4 and 5 are given below:

	No. of turns	*Wire size*	*Spacing*
Coil 4	7	14	1/16-inch
Coil 5	7	14	1/16-inch

Coil 17.—Coil 17 consists of 650 turns No. 36 double silk covered wire, wound on a small bobbin ½-inch in diameter and closely coupled to the coil 18.

Coil 18.—The grid coil is number 18 and consists of 1,000 turns of the same size wire used on 17. This is wound in the same direction on the same bobbin and due to its small size can be bolted into place under the chassis.

Radio Frequency Choke No. 9.—This is a small choke and care should be used in building it. As the frequency range to which the receiver responds is very high, it is necessary that the distributed capacity of the winding be kept at a minimum. A satisfactory choke can be made by "jumble - winding" 30 turns of No. 36 double silk covered wire on a bobbin ½-inch in diameter.

A detail drawing is shown in Fig. 3 and should be studied carefully. Note that the coils are wound in the same direction and when they are mounted be sure that there is no change in the winding direction between X and Y.

These precautions should be exercised in the construction of the set. It seems that most builders have trouble making detectors oscillate. If the constructor builds his own coils as shown, then the only thing that will prevent the proper operation of the set will be defective tubes or "B" batteries reversed.

Keep all leads between coils and detector socket as short as possible.

Operation

The set is tuned to an incoming signal and the resistance controlling the plate voltage on the detector is varied for the best results.

The adjustment of the antenna series condenser is important and should be done with care. The band spread condenser (3) should then be adjusted so that the band required is spread over the tuning dial.

Vary the size of the oscillator tuning condenser (16) until the proper quenching frequency is obtained. This is important, as the sensitivity of the receiver will depend to a great extent on the frequency of the local oscillator. Use the frequency which gives the best results.

When the receiver is working right, there will be a loud rushing sound in the phones or loud speaker, and as the signal is tuned in, this rushing noise will disappear. When the incoming signal is weak, some of the rushing sound will remain in the back-ground.

Many builders of 5-meter receivers have not obtained the maximum results and then turned around and condemned the whole idea. It is more than likely that their antenna systems had something to do with it.

Mr. Dana Griffin of N. Y. City has built a

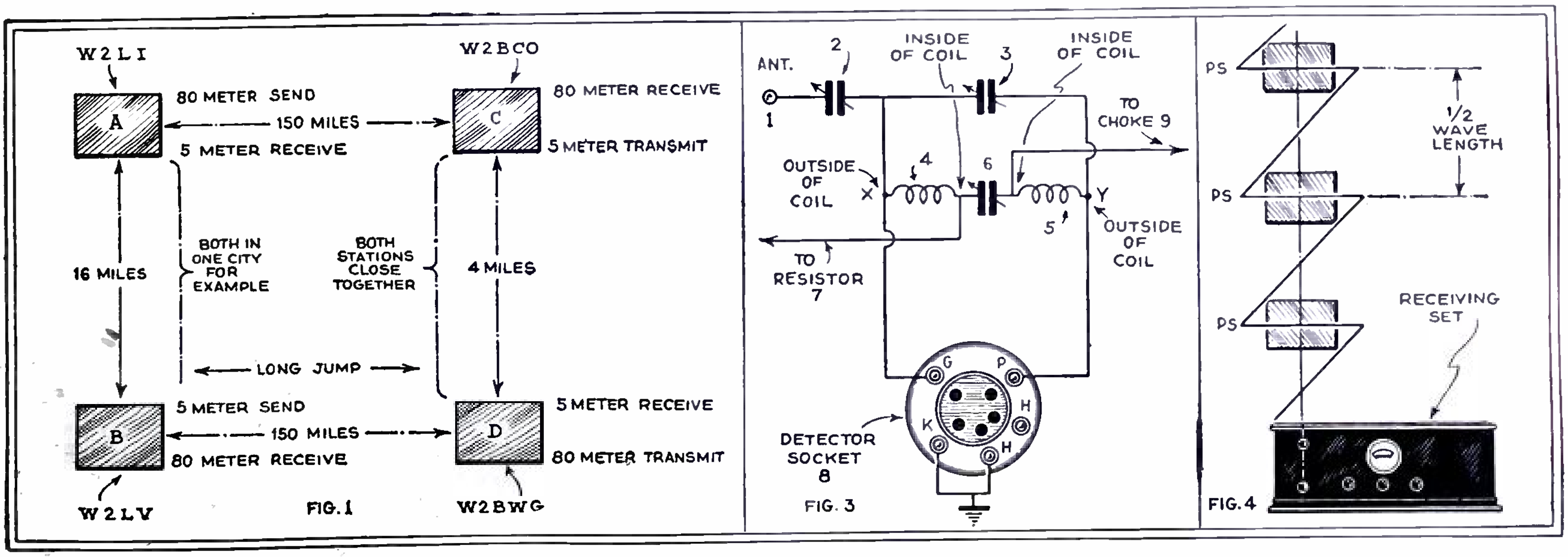


Fig. 1, at left, shows how 5-meter transmitters and receivers may be used in amateur stations to supplement 80-meter communication; Fig. 3 shows special part of the circuit in the super-regenerative receiver which requires accurate connections; Fig. 4, at right, shows positions for resonance wave coils along the receiving antenna.

device which permits the use of high vertical antennas for maximum pick-up and to develop the maximum signal voltage at the input of the receiver.

These units are called "phase shifters" and consist of a small coil and condenser capable of being tuned to the frequencies being received on the set. In general these circuits should be tuned to the center of the band on which the set is operating.

Figure 4 shows the voltage shift in the units after they have been tuned to the proper frequency in the band. It is a good idea to tune the "phase shifters" to the exact wavelength of the station being received.

The antenna can be as long as conditions permit. Run it straight up in the air, keep it free and clear from all obstructions. Place one of the phase shifters every 100 inches, starting 100 inches from the receiver antenna and ground posts. Use as many of these units as required and tune each one to the same frequency. This can best be done by building a small oscillator, calibrating it against some known 5-meter signal and then using this to adjust the phase shifters to the proper frequency.

Circuits for such an oscillator have been described in many of the past issues of SHORT WAVE CRAFT, so no further information should be necessary on this point. Many short-wave "bugs" have oscillators which will generate harmonics in the 5-meter band.

Some slight recalibration of the tuning condensers used in the phase shifters may prove necessary after they have been connected into the circuit of the antenna, the final adjustment being that of tuning for the maximum signal volume from some 5-meter transmitter.

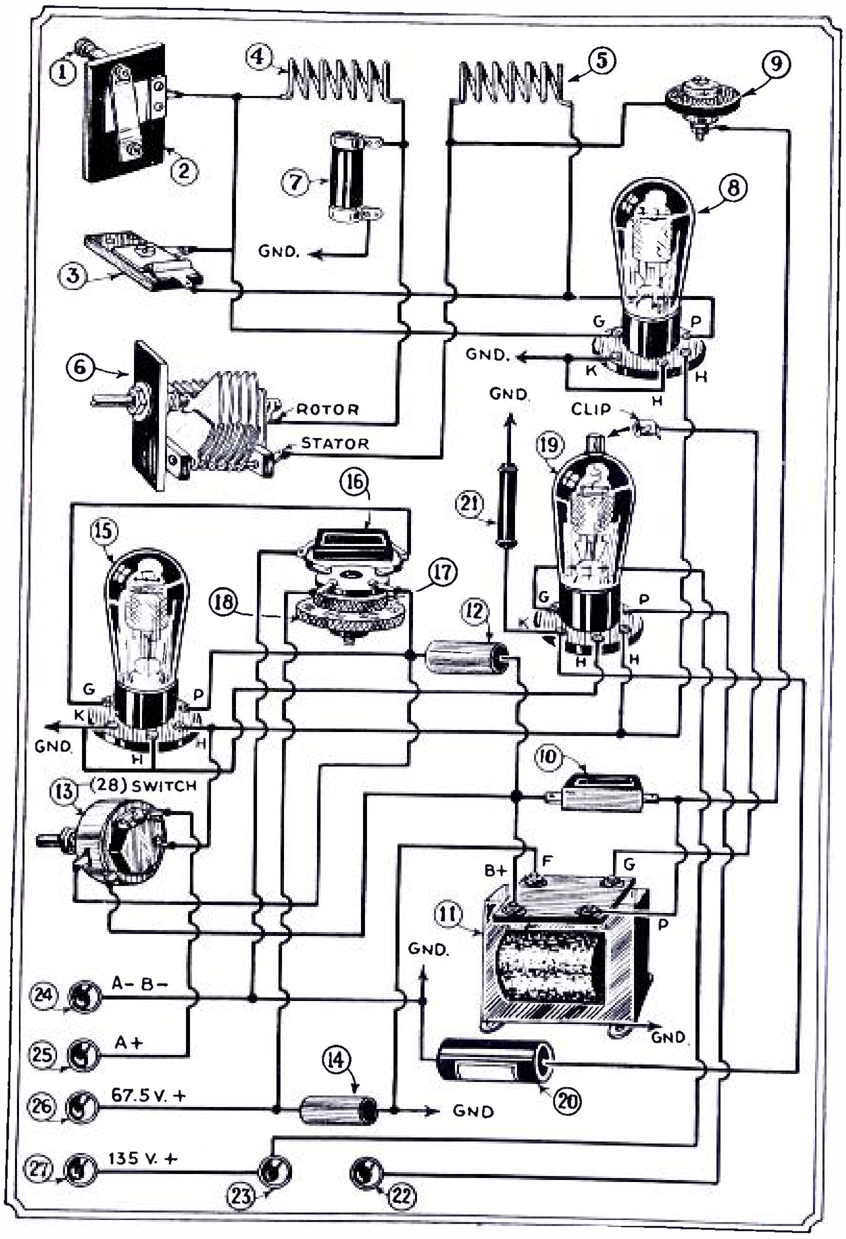
Parts List

- 1 Antenna binding post (1).
- 2 Hammarlund equalizing condensers, .000035-mf. (2, 3).
- 1 Hammarlund midget condenser (6).
- 1 International Resistance Co., 1-watt, 2-meg. resistor (7).
- 1 Panel mount socket, 5-prong (8).
- 1 Radio frequency choke (9). See text for specifications.
- 1 Aerovox mica condenser, .001-mf. (10).
- 1 Medium ratio audio transformer (11).
- 1 Flechtheim by-pass condenser, .1-mf. (12).
- 1 Electrad 50,000-ohm potentiometer (13) with filament switch (28).
- 1 Flechtheim by-pass condenser, .1-mf. (14).
- 2 Wafer sockets, 5-prong (15, 19).
- 1 Mica condenser, .001-mf (16). See text.
- 1 By-pass condenser, .1-mf. or larger (20).
- 1 1,500-ohm resistor, 2 watts (21).
- 2 Output terminals (22, 23).
- 4 Binding posts (24, 25, 26, 27).
- 1 metal chassis and front panel.
- 1 Tuning dial.
- 1 Screen-grid clip.

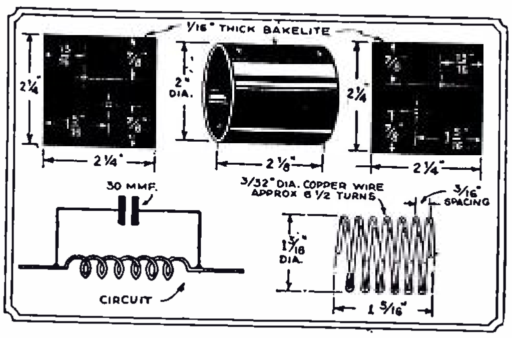
Wire, etc.

Note—Coils 4, 5, 17 and 18 winding data included in text.

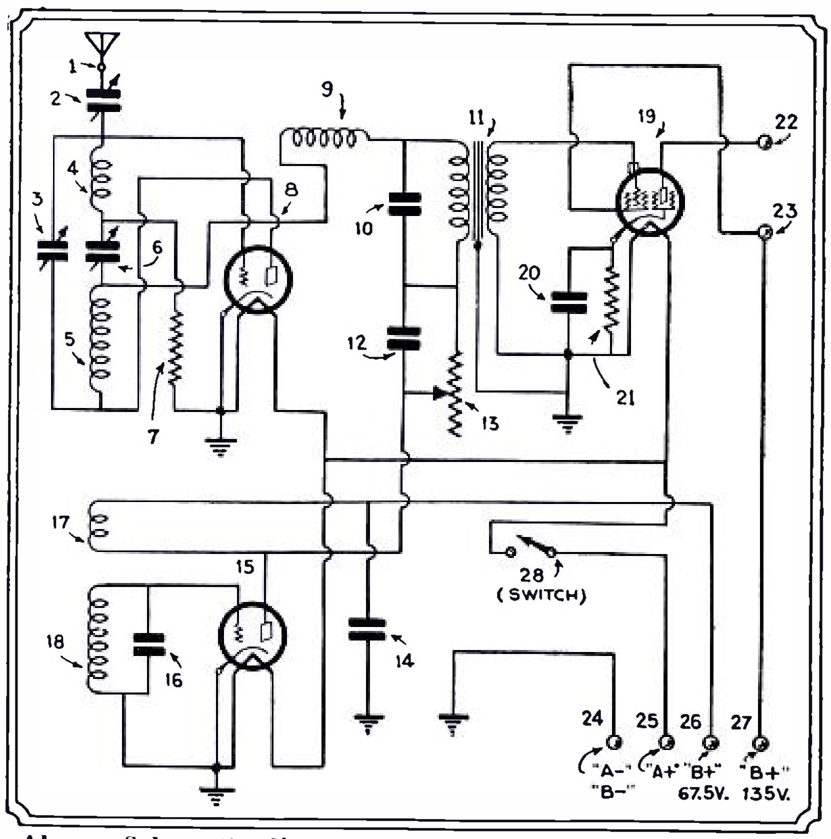
- 2 Eveready-Raytheon 37 tubes.
- 1 Eveready-Raytheon 38 tube.



Left — Picture wiring diagram showing how easy it is to build the 5-meter "Bearcat-3" receiver. This receiver possesses high amplifying powers and good selectivity and uses but three tubes, it being possible to receive strong signals on a speaker.



Right—Details of antenna resonance coil and condenser.



Above—Schematic diagram of 5-meter "Bearcat-3" receiver which the more seasoned experimenters prefer to follow.

IN NEXT ISSUE:

WHAT SHORT WAVES MEAN TO ME! In this absorbing article, Dr. Robert A. Marks, a New York doctor, tells us how, although blind, he builds short-wave receivers and transmitters and operates them, too. You will be amazed indeed.

A NEW TUBE FOR PRODUCING ULTRA SHORT WAVES! Did you know that to generate sustained waves a fraction of a meter in length a special tube is desirable?

A SUPER-REGENERATOR WITH PENTODES! R. William Tanner, the veteran "short-waver," shows you how to get the last microwatt out of this type of receiver.

BEGINNERS' "CONSTRUCTION" ARTICLES will feature the November Number. Don't miss it!!

This unusual circuit devised by Mr. Reinartz reduces the interference from non-tunable sources, such as static and line disturbances; it also permits two signals of different frequencies to be received simultaneously through the same amplifier system.

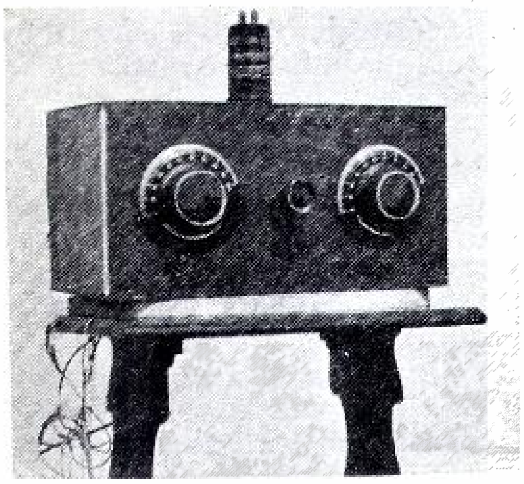


Photo of Mr. Reinartz's receiver, which employs a balanced circuit for reducing interference from various sources.

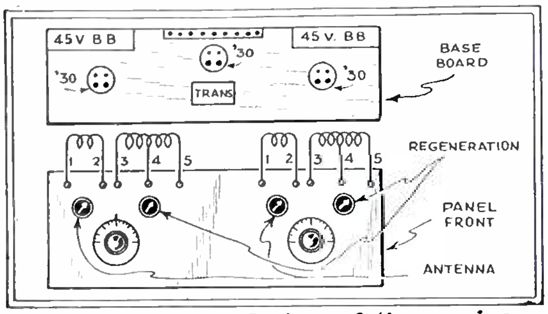


Fig. 2—Front-panel view of the receiver that "laughs at static" and other interference.

A Receiver That Laughs At STATIC

By JOHN L. REINARTZ

● TO circumvent the disturbance caused by static and other uncontrollable interference in the reception of radio has been the goal of many experimenters. A number of devices have been advocated that should help to reduce such unwanted interference. To date, however, no device is doing the job consistently or well.

For several years the writer has had in use a circuit that does reduce the interference from non-tunable interference such as static and line disturbances. It also has the advantage of allowing two signals of different frequencies to be received at the same time through the same amplifier system; that is, one can listen to a signal in two of the amateur bands at the same time and hear both, or if desired the same frequency can be tuned to in each half of the two parts of this receiver, and advantage can then be taken of its capability to balance out such interference as static and other non-tunable interferences.

The receiver had its inception during a study of methods to reduce non-tunable interference during reception of a signal, the idea being to so adjust the receiver that the non-tunable interference would be allowed to enter the two parts of the receiver and when again combined at the audio part of the system it would cancel out, while the signal which was desired would go through only one part of the tuning system and then through the audio and be heard in the regular way, minus the interference which may have been present. The result is so good that many of you will wish to build such a receiver, the description of which follows:

The circuit used (Fig. 1) will be recognized by the old-timers as the one which the writer has used for the last ten years and has found no good reason to displace, especially on amateur frequencies. The only difference is that there are two of them, so connected that the audio system starts in one and ends in the other of the two tuning systems. It is through this connection that unwanted signals are cancelled out, or that two signals of different frequencies can be tuned to at the same time and heard through the audio system. One precaution which must be taken is to keep the two systems

(*Continued on page* 375)

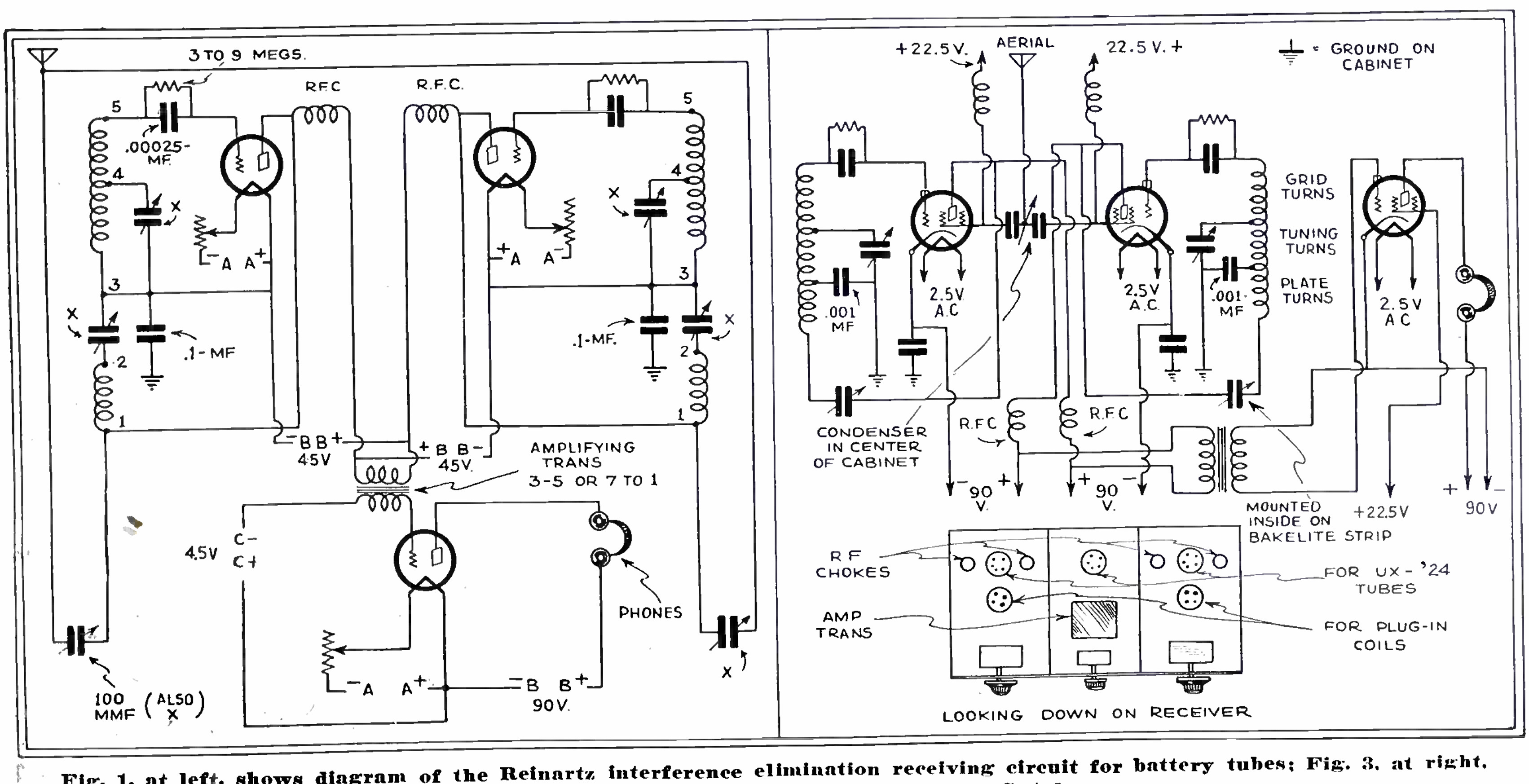
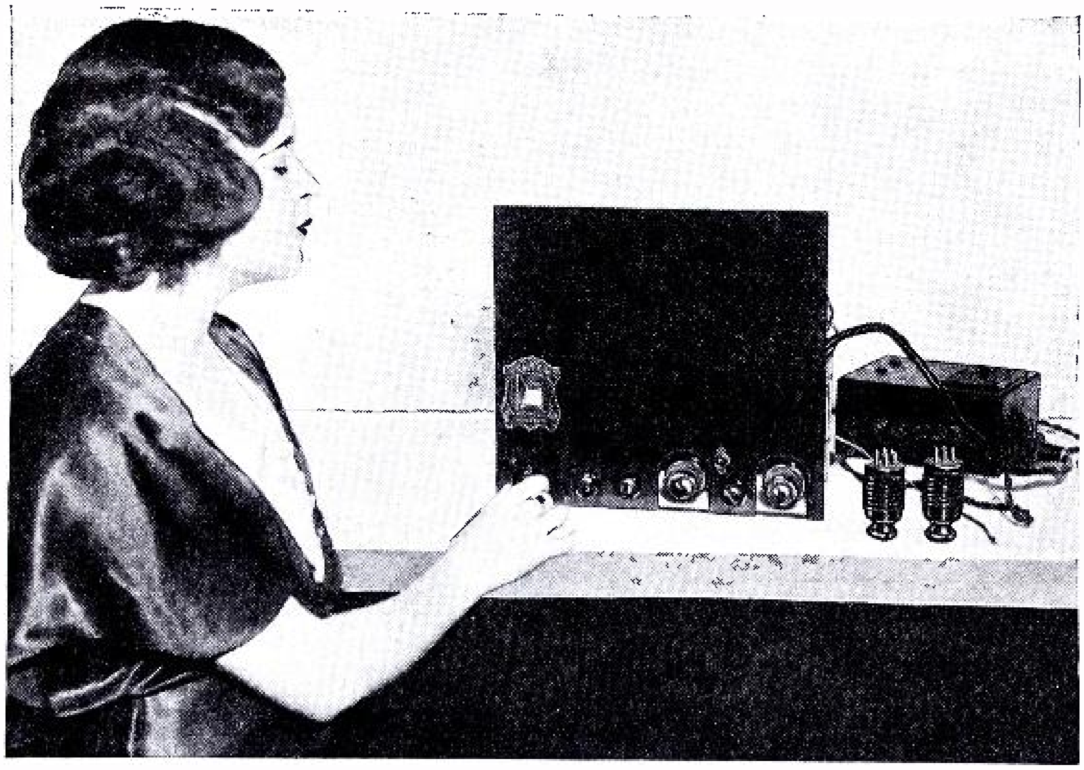


Fig. 1, at left, shows diagram of the Reinartz interference elimination receiving circuit for battery tubes; Fig. 3, at right, shows the same circuit adapted for use with A.C. tubes.



This young lady finds it easy to tune in distant stations on the "Ultra-Seven" All-Wave Superhet, with its single dial tuning.

A 9 to 550 meter range is covered by this exceptionally fine portable super-heterodyne receiver. It employs seven 6.3-volt automobile type tubes. This receiver has been tested by several radio engineers and they have testified that it actually brought in VK2ME, Australia, and other distant foreign stations. This receiver can be used on a 110-volt A.C. or D.C. circuit, and also on 6-volt storage battery if desired, as explained in the text. "B" batteries are recommended as the source of plate current. This receiver was designed and built by a famous radio engineer who makes the building and testing of fine receivers a hobby. Highly efficient plug-in coils are employed to cover all the wave bands from 9 to 550 meters. This set packs a real wallop and with only a short aerial it operates a loud speaker in fine shape.

"Ultra-Seven" Portable All-Wave Super-Het

9 TO 550 METERS

By

HARRY GEORGES, M.E.

● WHAT do radio engineers do in their spare time? The "Ultra-Seven" answers that question, for it was designed and built by one of the best radio engineers in the country as his own *personal* receiver. The writer borrowed this set and used it for several weeks and the accompanying list of stations gives definite evidence of its remarkable performance possibilities. In fact, the set made such an impressive showing that the writer decided to obtain complete constructional data on it especially for the readers of Short Wave Craft.

After much persuasion, the designer agreed to release the complete information on this circuit, stipulating, however, that his name should not be used in connection with the set or the article describing it. Such unusual modesty must be respected, although it is too bad that this engineer's name (known throughout the radio industry) cannot be disclosed, as this set is one which reflects great credit upon him and furnishes absolute proof of his radio experience, skill and knowledge.

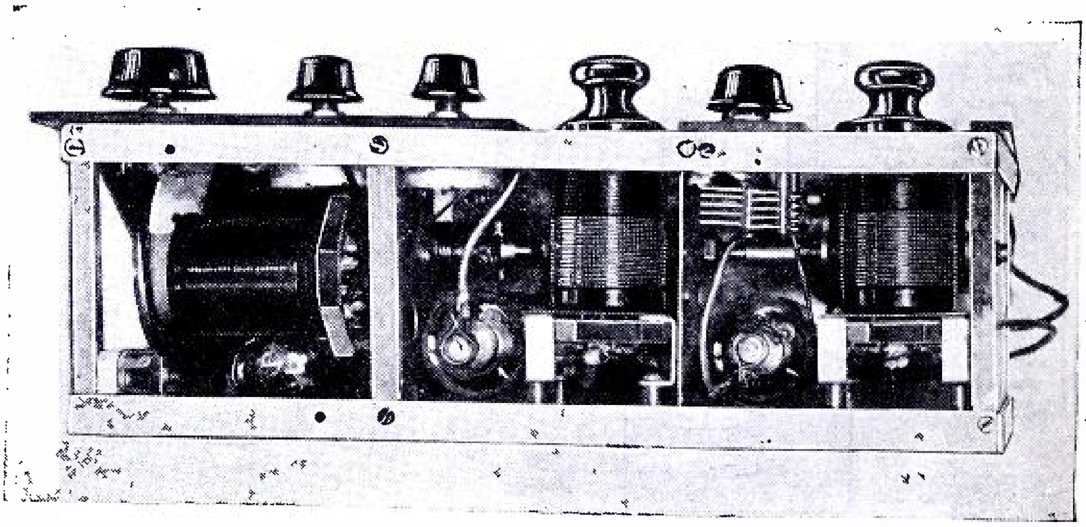
The "Ultra-Seven" has many outstanding features recommending it to radio enthusiasts. It uses heater-type 6.3-volt tubes. With the filaments connected in series, as shown in the schematic diagram, the filament supply may be a 110-volt A.C. or D.C. source, whichever happens to be available. By connecting the filaments in parallel, a standard storage "A" battery may be used to supply the filament current. When using 110-volt A.C., it is possible to use a "B" eliminator, or a direct-current "B" supply may be used on 110-volt D.C. However, three 45-volt "B" batteries are recommended as the "B" source under all conditions for best results.

"Ideal" Automobile Receiver

The constructional design is so compact that this receiver may be moved from place to place with the utmost ease. When the filaments are connected in parallel for storage battery operation, the "Ultra-Seven" is one of the finest automobile radio receivers it is now possible to produce. It has enormous distance range, extreme selectivity, plenty of volume and will operate well on the limited length of antenna available in automobile installations. The circuit is arranged for automatic volume control.

While primarily designed for short-wave reception, the "Ultra-Seven" may also be used on the broadcast band, merely by flipping a panel toggle switch, after plugging in the proper coil set at (2) and (9). Hence, this receiver will bring in stations, code signals, etc., over the entire range from 9 to 550 meters.

Reference to the accompanying log of stations brought in on the broadcast band



Bottom view of the "Ultra-Seven" Portable All-Wave Superhet showing plug-in coils in place.

will serve to illustrate the excellent selectivity of this receiver. Tests were made under fair average conditions in Brooklyn, N. Y. It will be noted that six stations were brought in between WOR and WJZ. WOR, Newark, N. J. (710 kc.), came in on 660 on the dial; WGN, Chicago (720 kc.), came in at 670; CKAC, Montreal, Canada (730 kc.), at a dial reading of 678; CMK, Cuba (730 kc.), at 680; XER, Mexico (735 kc.), at 685; WSB, Atlanta, Ga. (740 kc.), at 687; WJR, Detroit, Mich. (750 kc.), at 693; and WJZ, New York City (760 kc.), at 700 on the dial. Even the most distant stations came in with good loud speaker volume. Note that Montreal, Canada, and Havana, Cuba, came in only two dial divisions apart. Some selectivity!

As regards distance on short waves, this set has brought in VK2ME, Sydney, Australia; GBW, Rugby, England, and many other foreign stations. It readily picks up two-way trans-Atlantic 'phone messages, police calls from all over the United States, etc. Among foreign stations received but not logged because not absolutely verified were EAR125, Madrid, Spain; HBP, League of Nations, Geneva, Switzerland; YV2BC, Caracas, Venezuela; SRI, Poznan, Poland, etc.

Realizing that our more technically inclined readers have probably been anxiously awaiting the discussion of the circuit of the Portable "Ultra-Seven," we will now proceed to describe it.

Superheterodyne Circuit Used

A superheterodyne circuit is used, having a tuned R.F. stage ahead of the first detector; regeneration is also employed. Energy from the oscillator (19) is impressed on the screen grid of the first detector tube (13). Fixed condenser (16) keeps the "B" current off the oscillator grid. Condenser (77) provides an R.F. return, while padding condenser (78) provides the adjustment necessary to permit single dial control. The R.F. stage uses a 136-A screen grid tube. The same type of tube is used as a first detector; the oscillator is a 137-A tube.

The two *intermediate* amplifying stages employ 136-A tubes (28) and (39), and the three intermediate coupling transformers are of the grid-leak type. Resistor (38) in the control grid circuit of the second I.F. stage is used to control oscillations. Its value should be determined by experiment. The intermediate amplifier is one of the vital points in a superheterodyne, not only from the standpoint of *selectivity*, but also of *sensitivity*. Therefore, this portion of the circuit has been designed with special care. Double coil Automatic Winding Company 115 kc. I.F. transformers have been selected, using only one of the twin coils and only one of the twin Hammarlund tuning condensers. The transformer coils are universal wound and have an inductance of 6900 microhenries. The Hammarlund adjustable condensers with which they are tuned use a mica dielectric and have isolantite bases, resulting in high efficiency (low loss) and extreme *selectivity*. These have a capacity of 140-220 mmf. The I.F. stages are carefully isolated and shielded, thus preventing unwanted circuit interactions.

The second or I.F. detector (49) is a 137-A tube operated as a grid-leak detector. Voltage for regulation of the bias on the two I.F. amplifier tubes (28, 39) (i.e., for automatic volume control) is derived from the rectified carrier which produces a voltage drop across the detector load resistor. An efficient filter consisting of an R.F. choke (52), bypassed by fixed condensers (53) and (54), serves to eliminate the I.F. component from the plate circuit of the detector, thus preventing undesirable "feed-back."

The output tube (60) is a 138-A pentode. This is coupled to the second detector by an audio transformer. It will be noted that the detector plate voltage is supplied by means of a small 22½-volt "C" battery (56) fastened behind the panel at the upper right-hand portion. A small 3-volt flashlight battery fastened near the 22½-volt battery furnishes the proper detector grid bias.

Referring to the schematic diagram, the filament circuit is drawn in separately

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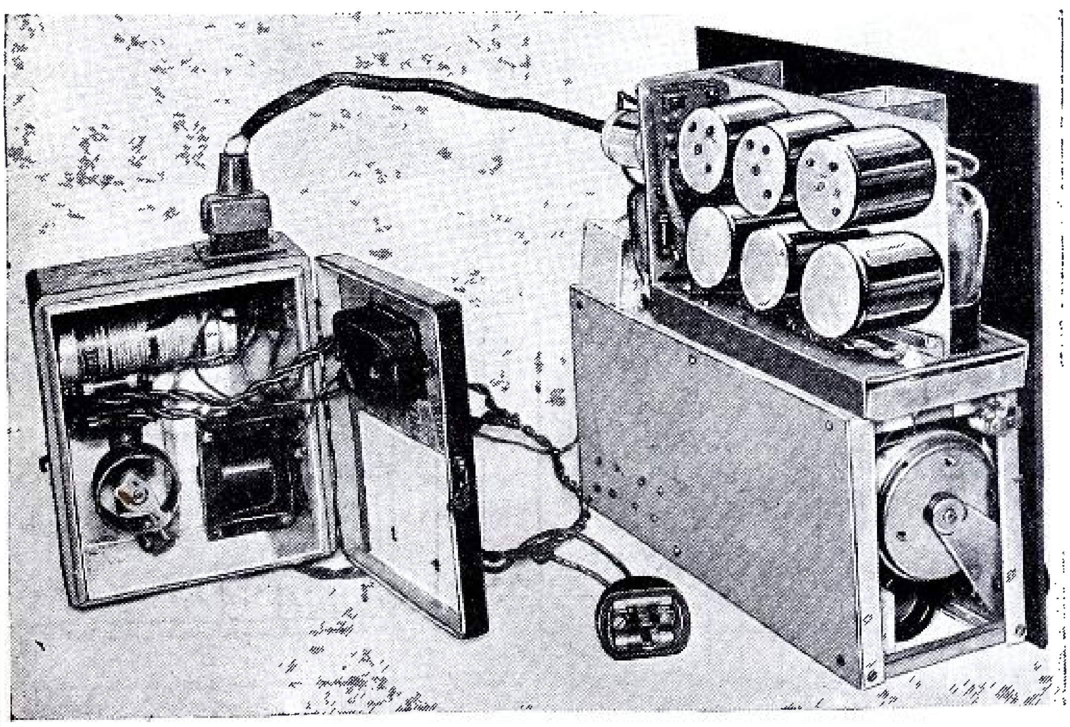


Rear view of the "Ultra-Seven" All-Wave Receiver, showing the intermediate frequency transformers.

Typical "Log" of the "Ultra-Seven"

The stations listed below with dial settings were actually tuned in and verified by several radio experts with whom the Editors are acquainted. This receiver was also tested by the Editors and was found to possess exceptional "selectivity" and "sensitivity." It operated a loud speaker when connected to short antenna only—no ground being necessary.

Coil Set Number 1

Dial Reading	Freq. kc.	Wavelength Meters	Call Letters	Location
610	9530	31.18	W2XAF	Schenectady, N. Y.
615	9570	31.33	W1XAZ	East Springfield, Mass.
620	9590	31.28	VK2ME	Sydney, Australia
640	9790	30.64	GBW	Rugby, England
735	11800	31.28	VE9GW	Bowmanville, Ontario, Canada

Coil Set Number 2

Dial Reading	Freq. kc.	Wavelength Meters	Call Letters	Location
600	6080	49.31	W9XAA	Chicago, Ill.
620	....	.....	W9XF	Chicago, Ill.
630	6120	48.99	W2XE	Jamaica, N. Y.
635	6140	48.83	W8XK	Saxonburg, Pa.
654	6425	46.70	W3XL	Bound Brook, N. J.
960	9530	31.48	W2XAF	Schenectady, N. Y.

Coil Set Number 3

Dial Reading	Freq. kc.	Wavelength Meters	Call Letters	Location
630	....	.....	W8XK	Saxonburg, Pa.
690	....	.....	WOX	St. George, Staten Island, N. Y.
718	2422	123.8	WMJ	Buffalo, N. Y. - Police
720	2442	122.8	WPDE	Louisville, Ky.-Police
720	2442	122.8	WPDL	Lansing, Mich.-Police
740	2450	122.4	WPEG	New York City - Police
750	2458	122.0	WPDG	Youngstown, O.-Police
775	2470	121.5	WPDP	Phila., Pa. - Police
775	2470	121.5	WPDZ	Ft.Wayne, Ind.-Police
790	....	.....	WBBC	Brooklyn, N. Y.
840	....	.....	WLTH	Brooklyn, N. Y.
920	....	.....	Mail Plane	Harrisburg, Pa.

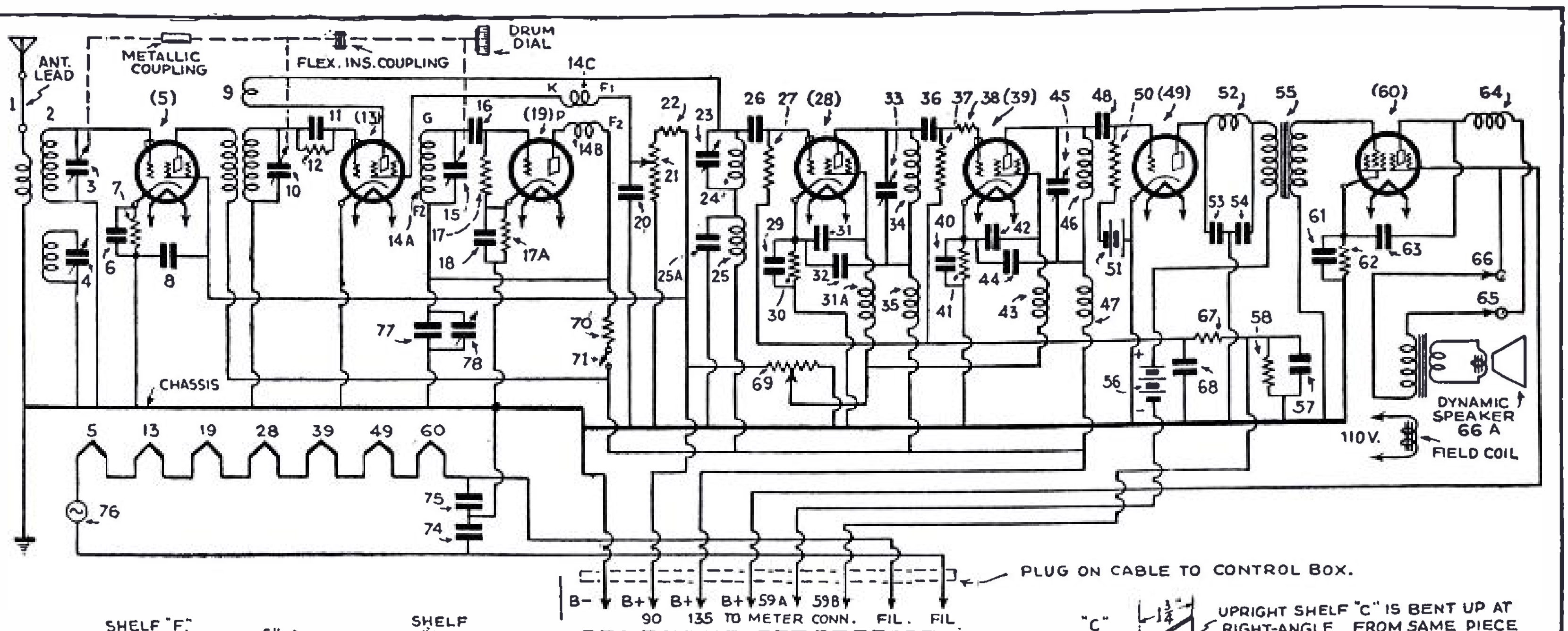
Coil Sets Nos. 4 & 5

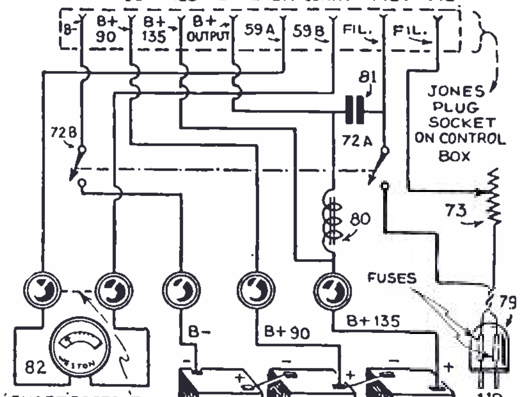
BROADCAST BAND

Dial Reading	Freq. kc.	Wavelength Meters	Call Letters	Location
610	660	454.3	WEAF	New York City
630	680	440.9	WPTF	Raleigh, N. C.
640	690	434.5	NAA	Arlington, Va.
640	690	434.5	CKGW	Toronto, Canada
660	710 [2]	422.3	WOR	Newark, N. J.
670	720 [2]	416.4	WGN	Chicago, Ill.
678 [1]	730 [2]	410.7	CKAC	Montreal, Canada
680 [1]	730 [2]	411.0	CMK	Havana, Cuba
685 [1]	735 [2]	408.2	XER	Mexico
687 [1]	740 [2]	405.2	WSB	Atlanta, Ga.
693	750 [2]	399.8	WJR	Detroit, Mich.
700	760 [2]	394.5	WJZ	New York City
720	780	384.4	WTAR	Norfolk, Va.
725	790	379.5	WGY	Schenectady, N. Y.
765	840	357	CMC	Havana, Cuba
805	890	337	CMX	Havana, Cuba
820	900	331.1	WJAX	Jacksonville, Fla.
1080	1132	265.3	WOV	New York City

1—Note that set is so selective that it separates stations between two dial divisions, corresponding to a difference of 5 kc.

2—Between Stations WOR (710 kc.) and WJZ (760 kc.), the "Ultra-Seven" brought in six stations, including Canada, Mexico, and various U. S. stations.





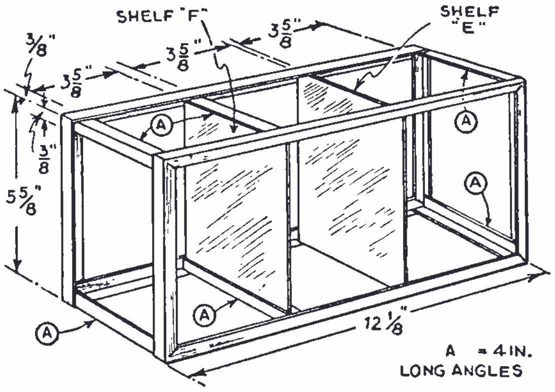


FIG. 1 CHASSIS FRAMEWORK

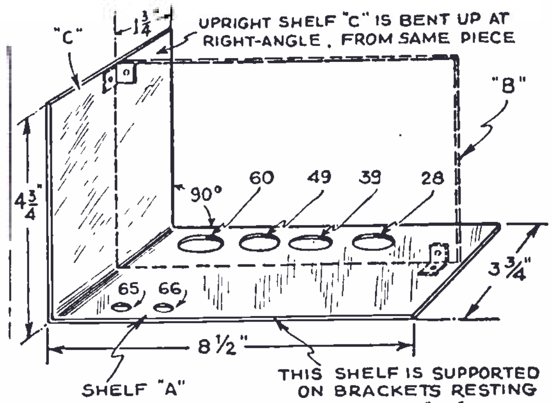


FIG. 2

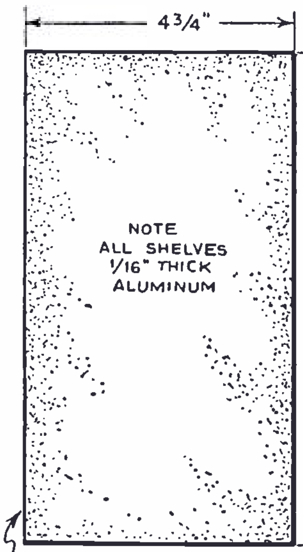


FIG. 1A
UPRIGHT SHELF "B" FASTENED TO FRAME-WORK. ALSO FASTENED TO "A" AND "C" BY RT. ANGLE BRACKETS.

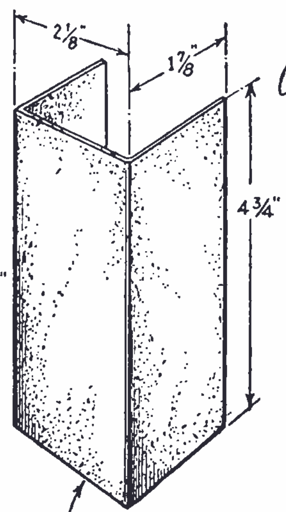


FIG. 3
ALUMINUM U-SHIELD SURROUNDING TUBE (39)

THIS SHELF SUPPORTED ON FOUR 1 INCH LONG PIECES OF BRASS TUBING FASTENED TO ANGLE FRAME WORK

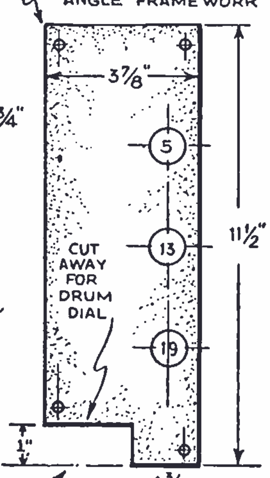
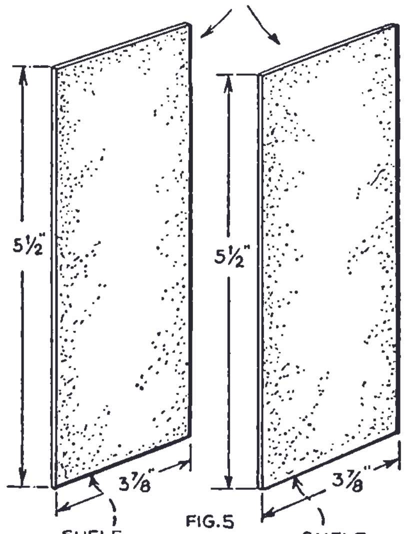


FIG. 4
UNDERSIDE VIEW OF SHELF "D"

UPRIGHT PARTITION SHELVES FASTENED TO ANGLE FRAME WORK



SHELF "E" FIG. 5 SHELF "F"

1/2" ALUMINUM ANGLE ENTIRELY AROUND SHELF USE ANGLE 35 1/2" LONG BEND AND CUT AT INSIDE CORNERS

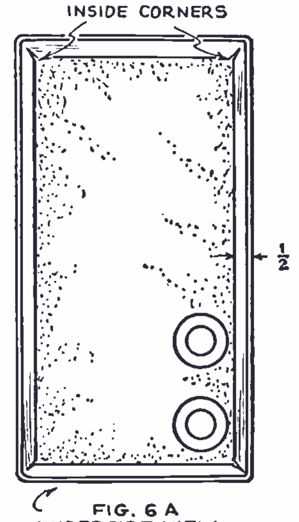


FIG. 6 A
UNDERSIDE VIEW OF SHELF "G"

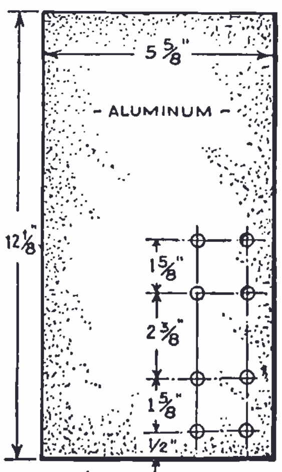


FIG. 6 B
REAR UPRIGHT SHELF "G"

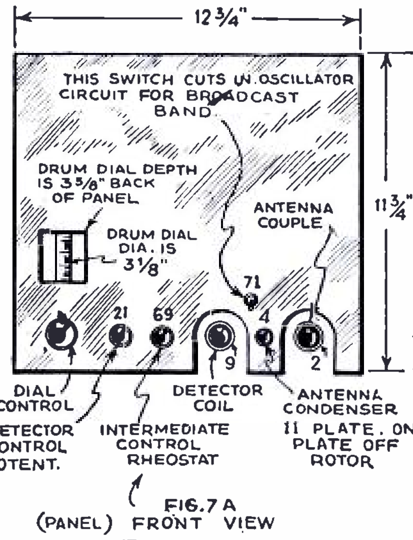


FIG. 7 A
(PANEL) FRONT VIEW

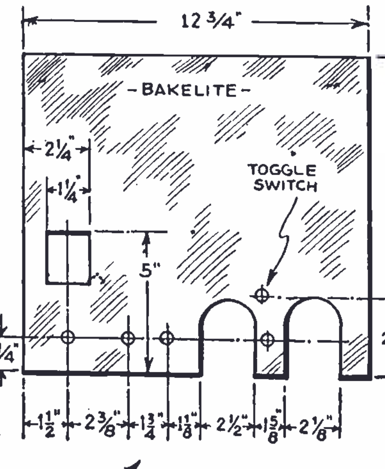


FIG. 7 B
FRONT VIEW OF PANEL SHOWING DRILLINGS & PUNCHES

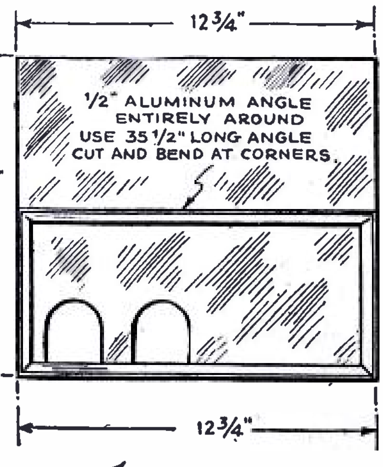
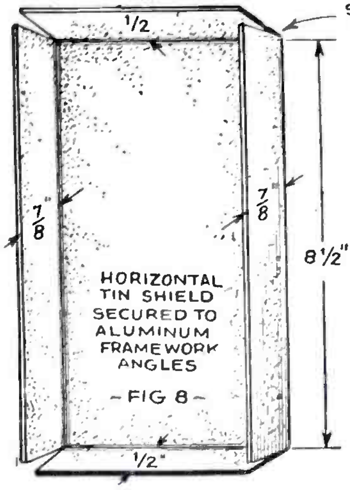


FIG. 7 C
BACK VIEW OF PANEL SHOWING FRAME

Details of Ultra-Seven ALL-WAVE Super-het.



– FIG 8 –

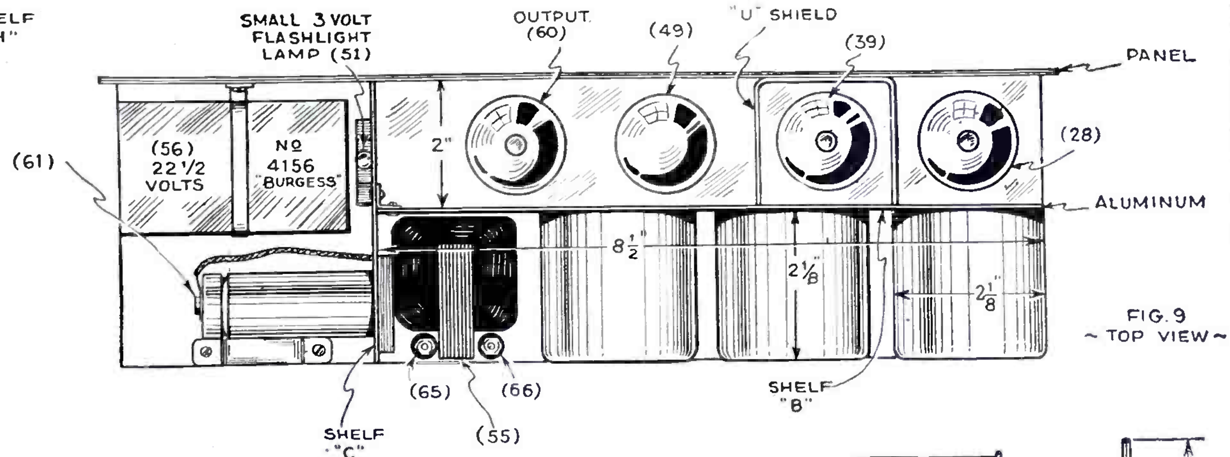


FIG. 9 ~ TOP VIEW ~

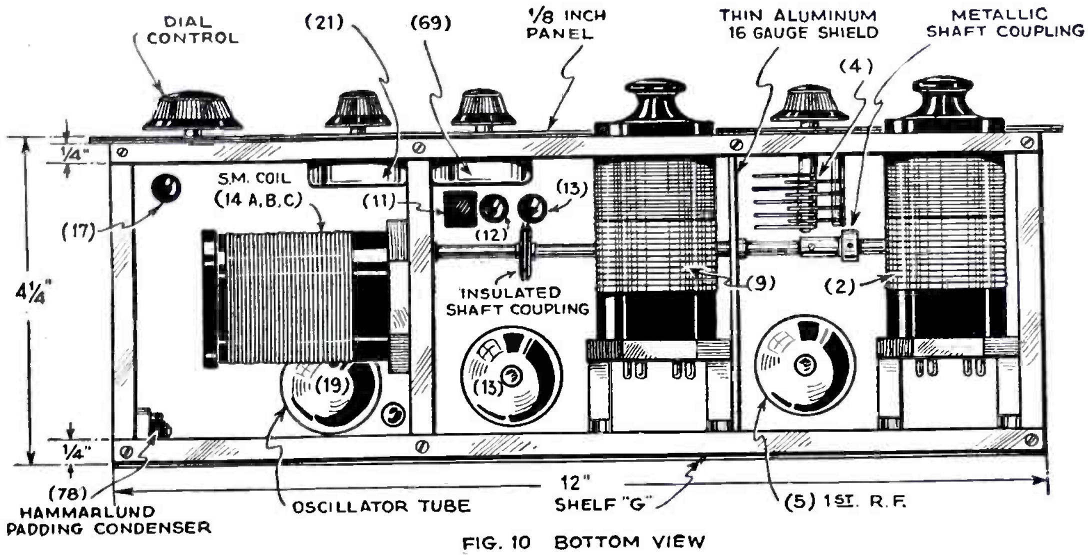


FIG. 10 BOTTOM VIEW

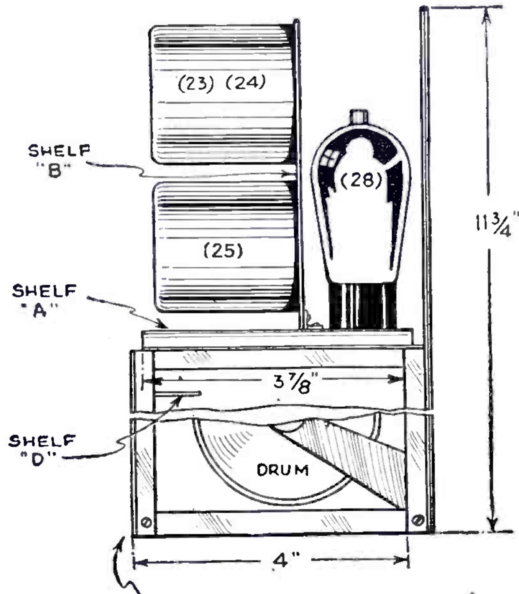


FIG. 11 END VIEW (LEFT END)

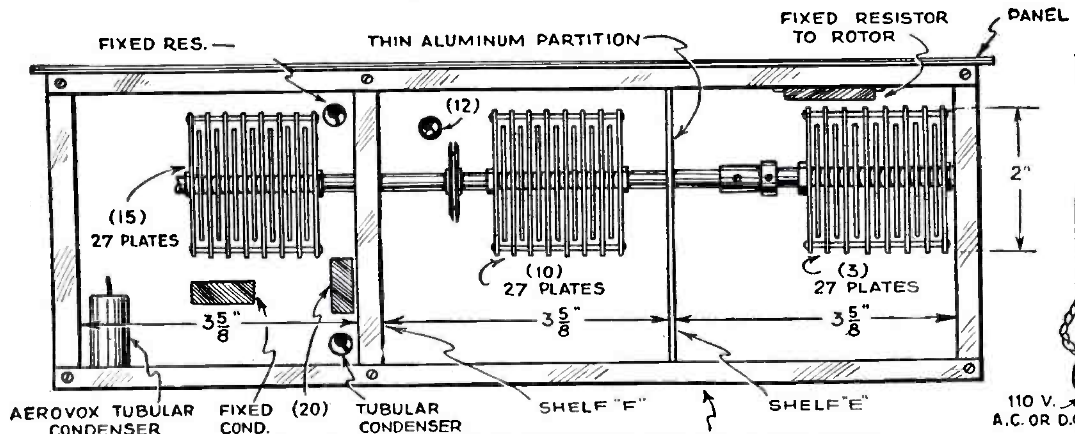


FIG 12 VIEW SHOWING CONDENSER GANGING (UNDERSIDE)

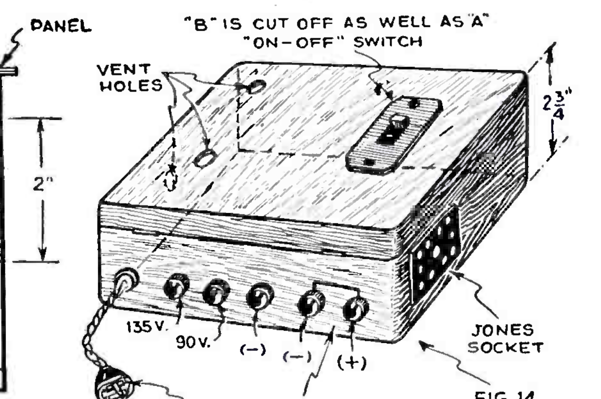


FIG. 14 CONTROL BOX

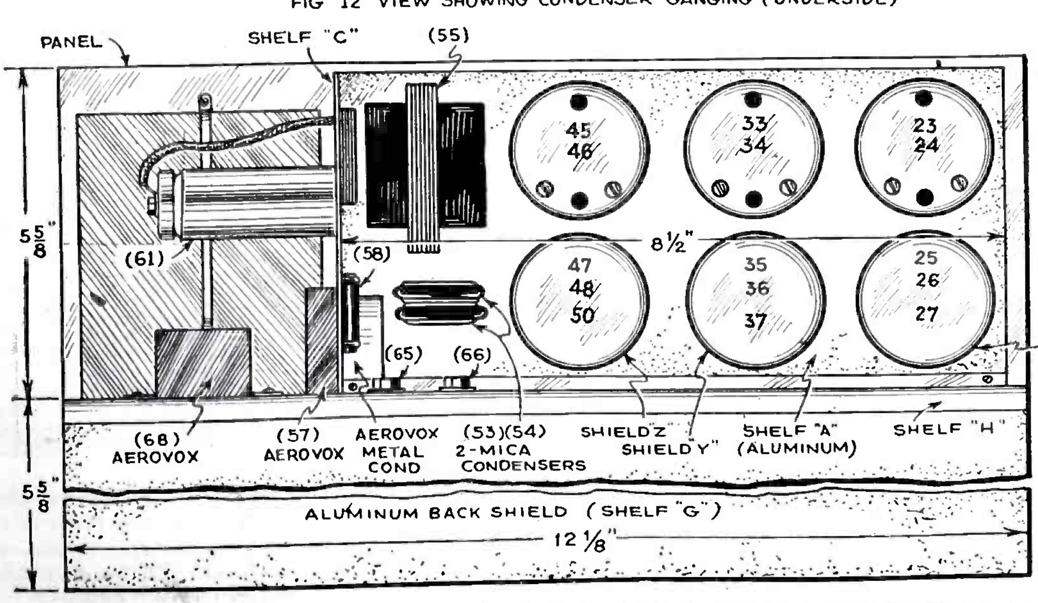


FIG. 13 REAR VIEW

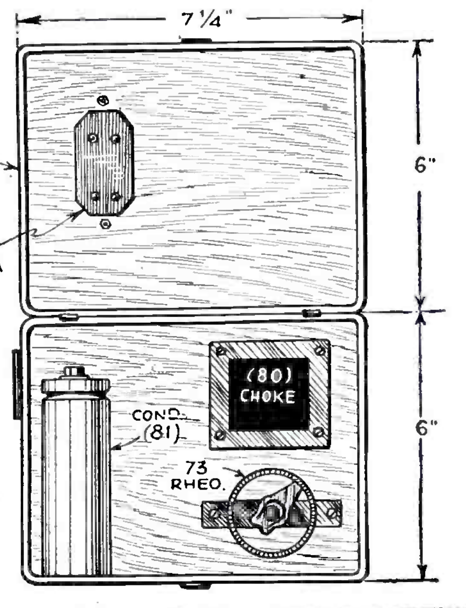
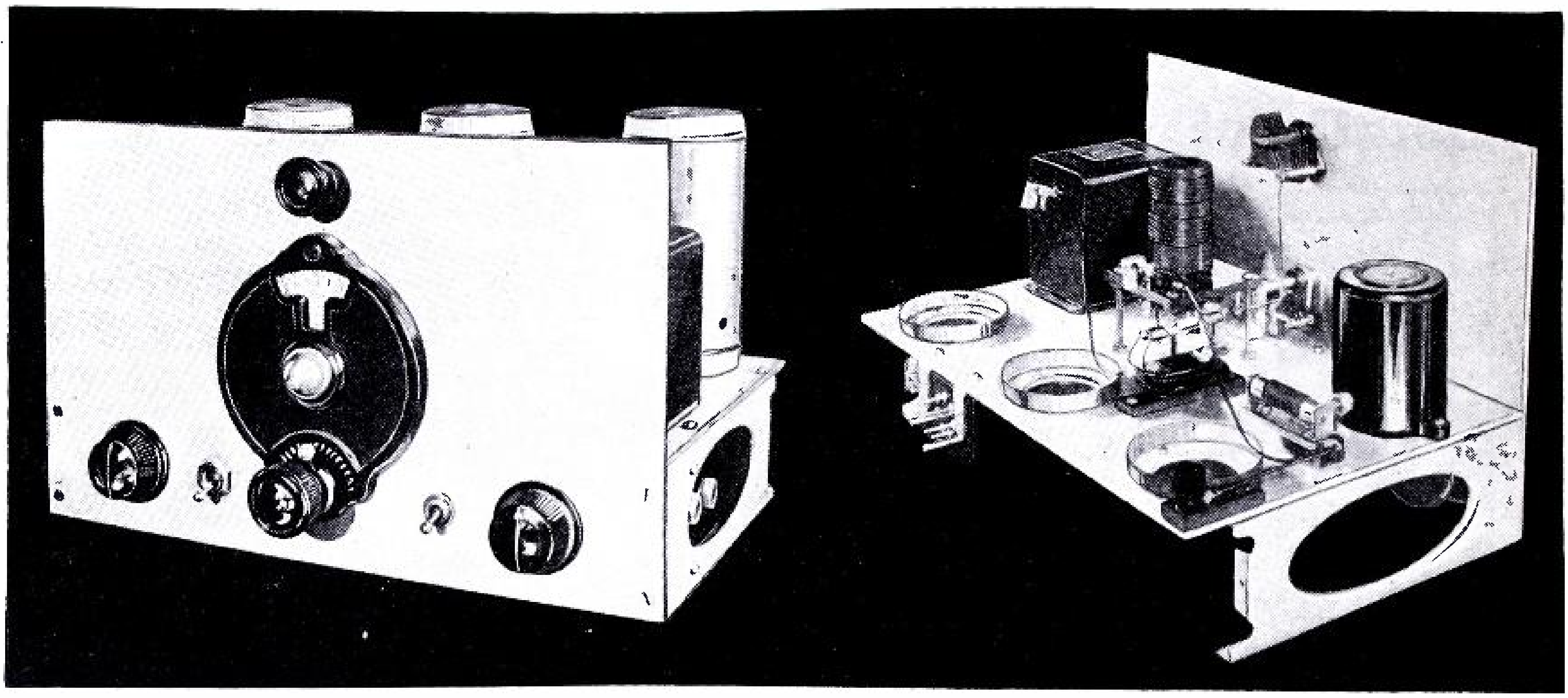


FIG. 14 CONTROL BOX (OPEN)



Front and rear views of exceptionally well designed 3-tube short-wave receiver which employs variable mu and pentode tubes.

A Real 3-Tube Receiver

By I. O. MYERS

● IN THIS day of short-wave converters and all-wave sets there is still a place for the simple short-wave receiver. To the experimenter, amateur or lean-pursed individual, the type of receiver about to be described is dedicated. It may be used as a code receiver or will give excellent quality and selectivity on broadcast reception.

The set consists of only three tubes—a type '35 being used in both the radio-frequency amplifier and detector sockets and a type '47 pentode in the audio stage. The tuning of the set is very simple, due to the fact that only the detector is tuned. A switch in the detector circuit allows either the Aero Hi-Peak coupler or the National S-101 coupler to be used. The Hi-Peak is used to give high selectivity when receiving code, and may be omitted if the builder wishes.

The parts are all mounted on ⅛-inch aluminum, which is also used for the panel. Both pieces of aluminum are 7½ inches by 12 inches. The sub-panel is mounted on aluminum brackets. The by-pass condensers are located under the panel and are carefully placed so as to make the leads as short as possible.

Looking at the bottom view as shown in the photograph, the tube sockets are seen mounted at the rear of the panel. In the center and front are the two condensers C5. They are audio by-passes for the pentode bias resistor and the regeneration control. They are mounted one on top of the other to conserve space. This method of mounting is also used with the R.F. amplifier bias resistor by-pass and the screen grid by-pass condensers.

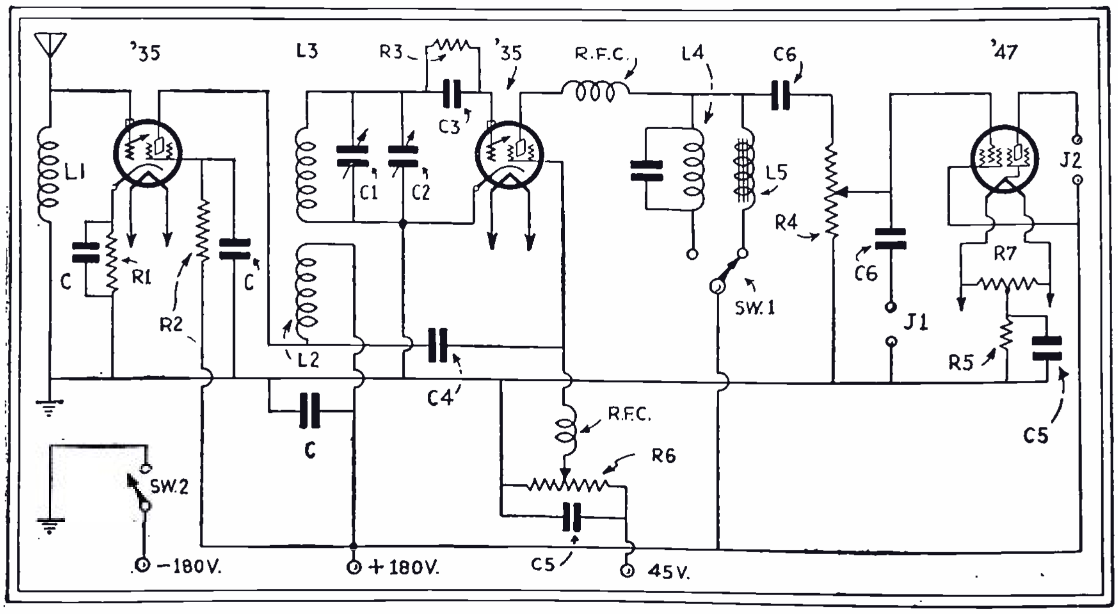
The screen grid voltage for the R.F. amplifier is obtained by connecting it through a 100,000-ohm resistor to the high voltage. The value of this resistor is not critical and if the constructor prefers he may omit it and connect to 90 volts instead. The pentode bias resistor has a value of 1,000 ohms and is soldered right across the by-pass condenser.

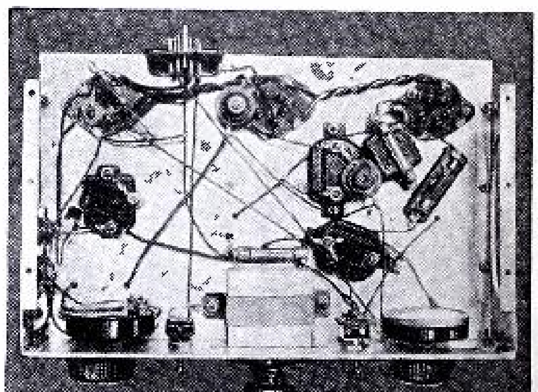
The radio-frequency chokes are necessary but not critical in value. They are mounted on long screws. The plug-in connector at the rear makes wrong connection impossible and improves the appearance of the set.

The output jacks are seen mounted on a small square of bakelite and bolted to the panel bracket. One jack allows the output of the pentode to be used where speaker operation is desired. The other jack is used when head phones are used. Extremely quiet operation is obtained when using this latter jack.

Looking at the front view, the tuning dial, control knobs and switches can be seen. The knob at the top controls the 50-micro-microfarad condenser C2. On the left and right are the regeneration and volume controls, respectively. One of the switches turns the plate supply off, while the other one is a single-pole double-throw switch which allows the peaked or flat audio to be used at will.

(Continued on page 379)





Above—Bottom view of Mr. Myers' ideal 3-tube short-wave receiver.

Left—Wiring diagram of the 3-tube receiver. J1, phone jack; J2, loud speaker jack; L4, "high peak" coupler.

How to Become a Radio Amateur

Adding Amplification to your Receiver

No. 4 of a Series

By JOHN L. REINARTZ

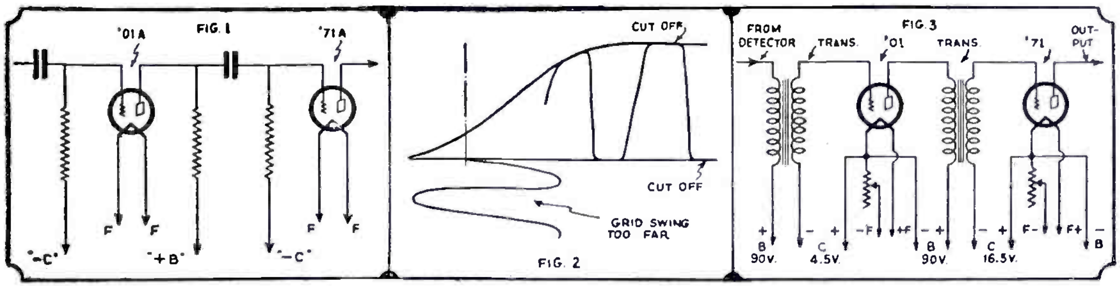


Fig. 1—Showing the elements of resistance coupling; curve at Fig. 2 shows one cause of distortion; Fig. 3, A.F. transformer coupling.

● AFTER we have had a one-tube receiver for a little while, we get tired of listening so closely and have a desire to add one or two stages of amplification. There are two general types of audio amplification, *resistance* and *transformer* coupling, and each has its merits. Before deciding which we will use, let us consider their general characteristics.

Causes of Distortion

In general, when it is desired to amplify a signal which is to retain *all* of its characteristics, *resistance* coupling is used; the arrangement is shown in Fig. 1. More tubes have to be used to obtain the same ratio of amplification that can be obtained with transformer coupling, the reason being that the amplification ratio is the tube amplification factor, while in *transformer* coupling we have in addition the ratio of the primary to the secondary winding turns. This is usually between 3-to-1 and 6-to-1 and is about equal to a stage of resistance coupling. However, as we increase the *turns ratio* our secondary voltages become rather high and if we have a good signal it is possible to go beyond the rated grid voltage swing of the tube to which the secondary of the transformer is connected, thus causing marked *distortion of the quality* by cutting off the lower plate current swing as it goes to zero and to the saturation point of the plate current on the upper plate current swing—see Fig. 2.

We sometimes run into trouble with *distortion*, due to a poor amplifying transformer design. Because we are dealing with a range of audio frequencies between 50 cycles and 15,000 cycles, these transformers have to be made especially well, particular attention being paid to the kind and thickness of the iron used in the core. In general, the thinner the iron laminations, the better the transformer will be, as its losses will be decreased thereby. As the power output requirements increase, the physical dimensions of the transformer should also increase to handle this greater load properly and without distortion, this being particularly necessary in the case of the *Class B* audio amplifier. For a one-kilowatt Class B amplifier the output transformer is as large as a five K. V. A. (K. V. A.—kilovolt-ampere or 1,000 watts at unity power factor) lighting transformer and weighs about 125 pounds. It can be seen from this that any old amplifying transformer will not do! Care must be exercised, and only reliable makes used. To be on the safe side, do not attempt greater ratios than 4½-to-1; two such stages will do for all ordinary use, using one type '01A tube and one type '71 tube in the second stage—see Fig. 3.

Proper Bias Important

In any form of amplification attention must be paid to the proper operation of the tubes used. Always apply rated filament voltages—this is one form of trouble that is very common. No tube can deliver its rated output when you refuse to supply it with the proper filament current. The second point to remember is to supply the proper grid bias voltage, either through a resistor or through the use of a "C" battery; of the two, the "C" battery system is preferred. The proper negative "C" voltage for the particular tube and plate voltage can be obtained from the carton the tube comes in, or from the wrapper around the tube. This information is also available in pamphlet form, obtainable from any leading tube manufacturer or radio dealer.

For the two tubes under discussion, we need 4½ volts and 16½ volts, respectively, for the type '01A and '71. When a plate voltage of 90 volts is used, this allows operation along the straight portion of their characteristic curves and will allow maximum output for that voltage, without distortion.

Because we should not allow the plate current of the '71 to flow through the loud speaker without some intermediate form of coupling, such as an output transformer or a choke coil and by-pass condenser, we will provide that or the other form of coupling if our loud speaker does not in itself contain an *input transformer*. It is necessary, if we wish to preserve our loud speaker. If it is of the magnetic type, there is danger of connecting it so that the magnetic field would be weakened and the permanent magnet ruined through demagnetization. Fig. 4 illustrates these two forms of output coupling.

Unless the transformers which you are able to obtain are totally enclosed in metal cases, it will be necessary to so mount them that there will be little or no chance for *interstage feed-back*. It is always well to mount adjacent transformers at right-angles to each other, spacing them well. A good design for a two-stage amplifier is shown in Fig. 5. To avoid later trouble, solder all the connections—loose connections are a source of noises that are often very difficult to locate.

Resistance Coupled Amplifier

If we have in mind the *resistance coupled amplifier*, our job is less formidable; in the place of the interstage transformers, we use resistances and condensers. Also, we use a tube that has a higher amplification factor, such as the

(*Continued on page* 367)

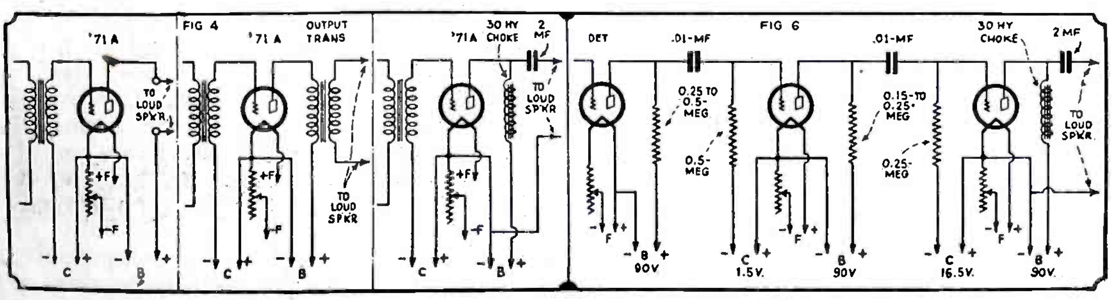


Fig. 4, at left, shows three different "output" circuits; Fig. 6, at right, shows three-stage resistance-coupled A.F. amplifier.

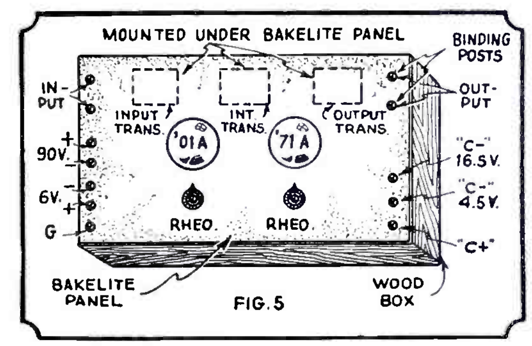


Fig. 5—Mr. Reinartz's suggested layout of a good two-stage A.F. amplifier.

SHORT WAVE LEAGUE

HONORARY MEMBERS

Dr. Lee de Forest
John L. Reinartz
D. E. Replogle
Hollis Baird
E. T. Somerset
Baron Manfred von Ardenne
Hugo Gernsback
Executive Secretary

Regulations Governing the Issuance of Amateur Operators' Licenses

Some facts about the issuance of Uncle Sam's licenses to "ham" operators that you may have overlooked.

● RECENT changes in the *amateur* licensing situation have confused so many readers that we are reprinting herewith the official regulations now in force. These are taken directly out of the Government *Radio Service Bulletin*. Read them carefully before you ask any questions about "ham tickets."

In the next issue we will print the regulations covering *commercial* licenses, as many readers have the idea in mind of "pounding brass" some day on ships.

Amateur Operator Licenses

The operation of an amateur station will be permitted only the holder of an amateur operator license.

Amateur extra first class.—To be eligible for examination for this class of license, an applicant must have had at least two years' service as a licensed amateur radiotelegraph operator and must not have been penalized for violation of any radio act, treaty, or regulation binding on the United States. The applicant must pass code tests in transmission and reception at a speed of not less than 16 words per minute in continental Morse code, code groups, and 20 words per minute in continental Morse code, plain language (5 characters to the word), and a theoretical examination relating to amateur apparatus, both telegraph and telephone, and international regulations and acts of Congress affecting amateur stations and operators.

This license is valid for the operation of any licensed amateur radio station.

The amateur extra first-class license examination will be sufficiently wide in scope to authorize the holder of this class of license the unlimited radiotelephone privileges set forth in paragraph 377 of the Federal Radio Commission's Rules and Regulations.

Amateur first class.—Applicants for this class of license must pass a code test in transmission and reception at a speed of not less than 10 words per minute in continental Morse code (5 characters to the word), and an examination similar to that given for amateur extra first-class liiense but not so comprehensive in scope.

This license is valid only for the operation of licensed amateur radio stations not utilizing special phone privileges as set forth in paragraph 377 of the Rules and Regulations of the Federal Radio Commission.

Holders of this class of license, after at least one year's experience as a licensed operator at an amateur station, may be accorded unlimited phone privileges as indicated in paragraph 377 of the Rules and regulations of the Federal Radio Commission after passing the supplemental examination and having their license so indorsed.

Temporary amateur operator class.—Application for this class of license will be accepted only from applicants residing more than 100 miles from examining point, which may be the district headquarters, a suboffice, or a city visited by an examining officer. The applicant must submit a sworn statement attesting to his ability to transmit and receive at a speed of not less than 10 words per minute in continental Morse code, and complete a questionnaire pertaining to the operation of an amateur radio installation.

Applications for examination for unlimited amateur phone privileges will not be accepted from holders of temporary amateur class operator license. Applicants for this examination must appear personally before an examining officer and pass a written examination.

Passing Mark for All Examinations

13. The percentage that must be obtained as a passing mark in each examination is 75 out of a possible 100. No credit will be given for experience in the examination for any class of license.

Execution of Oath of Secrecy

14. Licenses are not valid until the oath of secrecy has been executed and the signature of the issuing officer affixed thereto.

All examinations, including the code test, must be written in longhand by the applicant.

Amateur extra first-class and amateur first-class operator licenses may be renewed without examination, provided proof is submitted indicating frequent use of the continental Morse code during the license period. An affidavit indicating at least three amateurs with whom applicant has communicated by code within the last three months of the license term will constitute ample proof; lacking such proof, a code test will be required.

Temporary amateur class licenses are not renewable. Holders of this class of license will be expected to pass the regular amateur examination during the license term. Failing to appear for examination when given an opportunity, or failing to pass examination, the temporary amateur-class license will be cancelled, and holder will not be issued another license of this class upon subsequent application.

Holders of radiotelegraph licenses indorsed for operation of radiotelephone stations whose service has been wholly at radiotelephone stations will be required to pass the code test for the class of license held, and, failing this, will be issued a radiotelephone operators' license as a renewal of the class in which he previously qualified.

In cases where it is impossible for the applicant to appear for the code examination when making application for renewal, he will be issued a radiotelephone operator's license as above. However, in such cases the applicant may appear for code examination within three months after the date of the issuance of the radiotelephone license and be issued a license of the class formerly held, provided he passes the code examination. Failing to appear or failing to pass the code test during the three months' period the applicant forfeits this privilege.

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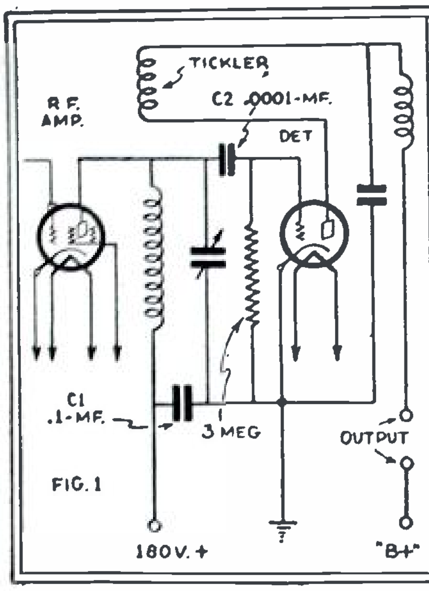
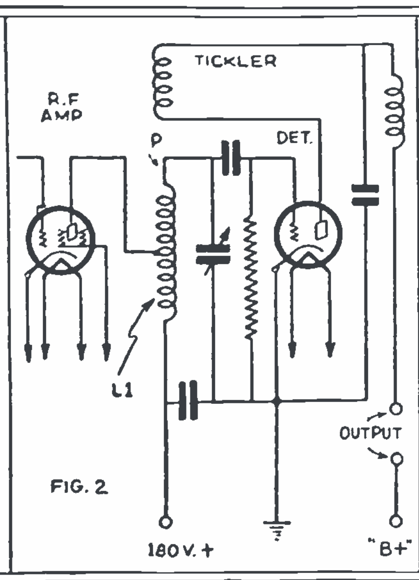
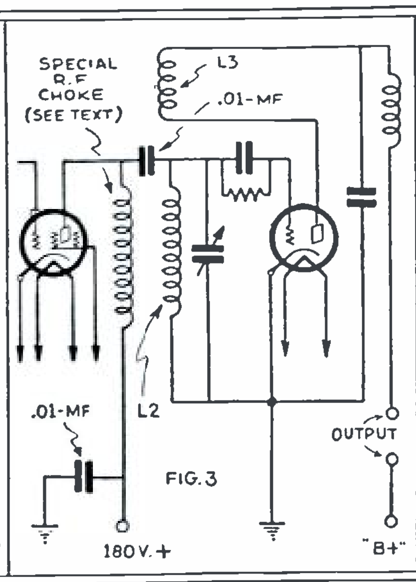


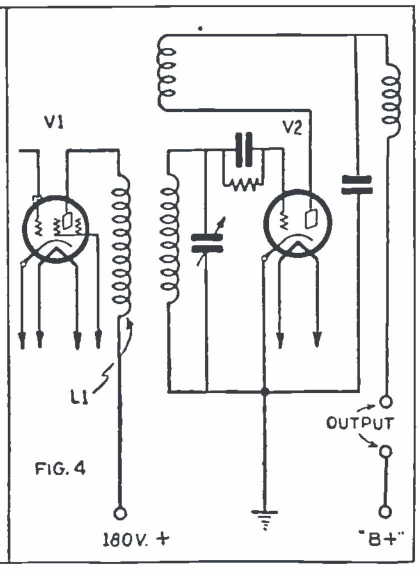
Tuned plate impedance coupling between R.F. and detector stages.



Here impedance coil, P, has tap and gives improved results.



R.F. plate circuit is here separated from detector by a choke.



Efficient coupling of R.F. and detector tubes with three-coil coupler.

Coupling R. F. Stage to Detector

By M. H. GERNSBACK

• ONE of the most popular types of short-wave receivers in use today consists of a tuned stage of R.F. amplification followed by regenerative detector and an audio amplifier.

In this article we shall discuss different methods of coupling an R.F. amplifier to a regenerative detector.

One of the simplest methods makes use of a tuned plate impedance. This method was very popular in the past, as it required only a 4-prong socket for the plug-in coils and in addition it simplified coil construction, as only two windings are used, tickler and plate impedance. A circuit of such a system is illustrated in Fig. 1. This method gives good results with certain reservations. Unless condensers C1 and C2 have good insulation, noisy reception will be experienced. Then, too, the tuning condenser has a potential difference of 98 to 250 volts existing between rotor and stator, depending on the voltage applied to the R.F. tube's plate.

In Fig. 2, a slight variation of this circuit is illustrated. The plate of the R.F. tube is connected to a tap on the plate impedance L1; this tap may be a center tap. Several taps should be made on the coil between center and the "P" end. This plate terminal of the R.F. tube should be tried on these various taps experimentally for best results. Here the plate impedance L1 is being used as an auto-transformer. It will give slightly greater sensitivity than the circuit in Fig. 1, but entails extra strain on the coil.

Another type of coupling which makes use of a separate plate impedance is illustrated in Fig. 3. It will be seen that the plate system of the R.F. tube is entirely separated from the grid circuit of the detector. The plate impedance should be an R.F. choke. This choke MUST have low distributed capacity. It should preferably be wound single layer; however, a sectional winding may be used, with at least three sections. Quoting from an article by R. William Tanner, writing in a past issue of SHORT WAVE CRAFT concerning the construction of such a choke, he says:

"A very efficient choke can be constructed by cutting six slots, separated ⅛-inch, in a ¾-inch wooden dowel; these should be about 3/16-inch deep. A total

(*Continued on page* 378)

Audio Amplifiers For S-W Receivers

• MANY set constructors give little attention to the design of the audio amplifier for a short-wave receiver, as they believe that it will have little effect on the final results. This is a mistaken idea, because a good audio system will make a great difference in any set's performance.

In general, more audio amplification is required for loud speaker operation of a short-wave receiver than is usual in a broadcast receiver. Signals are usually much weaker and in addition there is liable to be quite a bit of background

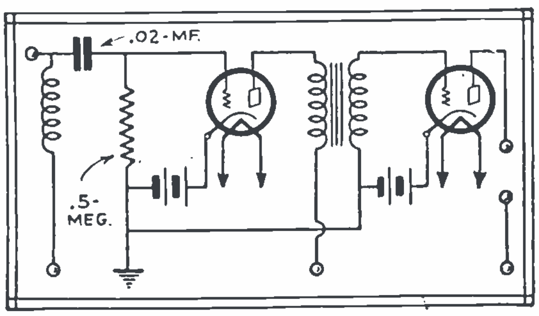


Fig. 1—One of the simplest audio amplifier systems.

noise. The ideal audio system should possess a substantially flat frequency response to insure good quality of reception and it also should be constructed in such a manner that its response can be altered. By this it is mean that there should be compensating devices included in the circuit by which the relative amplification of the different audio frequencies can be raised or lowered with respect to each other. In brief, the amplifier should have a carefully designed system of "tone control."

(*Continued on page* 378)

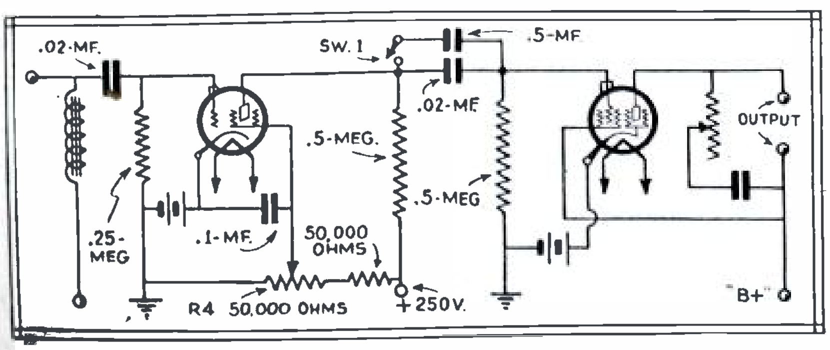


Fig. 2—Desirable A.F. amplifier employing SG tube in first stage and pentode in output stage.

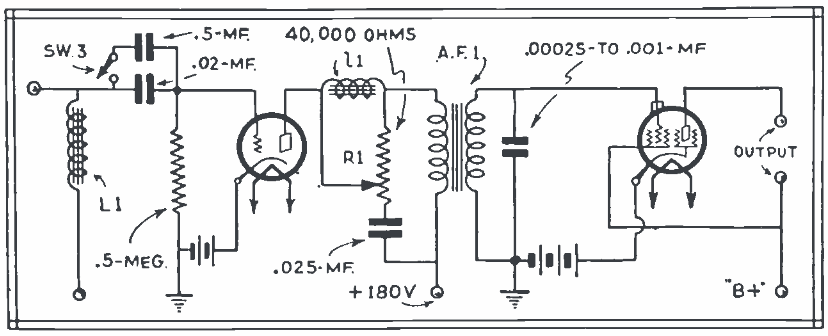


Fig. 3—Showing audio frequency amplifier with scheme for adjusting the frequency response.

Winners in the Third Set Builders' Contest

FIRST PRIZE—$50.00

Won by J. ROSSBACK, Elizabeth, N. J.

Combination Short-Wave D.C. Receiver and A.C. Adapter

● THIS instrument was designed to fulfill a twofold purpose, namely, as a complete dry battery operated receiver or as an A.C. adapter unit for broadcast sets. A description of each follows:

Short-Wave Dry Cell Receiver

The simple 3-circuit tuner hook-up is used, consisting of primary, secondary and tickler coils. All three windings are placed on one 5-prong coil form and spaced ¼-inch apart. Care must be taken to wind the coils in one direction and to solder the leads to the proper prongs as shown in the detailed *bottom view* of coil form. The wavelength range of the coil shown in the hook-up is from 100 to 200 meters. This covers the police stations nicely, also many amateurs. Other ranges may be had by winding coils as follows:

	Primary	*Sec.*	*Tickler*
80 meters	10	28	12
40 meters	9	12	9
20 meters	8	5	6

Regeneration is controlled by a 2,000-ohm variable resistor shunted across the tickler coil. Terminals for "A" and "B" batteries are provided at the rear of the cabinet. At the left end of the panel are one ground and two antenna posts. Post L is for a short antenna and S for a long one. It is best to use a midget variable condenser in series with both antennas to eliminate dead-spots. When using post S the antenna series condenser is adjusted for maximum sensitivity.

With a good pair of phones plugged into the jack on the main panel, the coil placed in the *left-hand* socket and a dry cell tube with an *adapter plug* placed in the *right-hand* socket, the set is now ready for operation. This adapter plug, however, must first be altered a bit. A small piece of wire (jumper) is soldered between the *cathode prong* and the *adjacent filament prong*. This is necessary in order to complete the grid return circuit to the A-plus side of the filament (since there is no "cathode" in a dry cell tube).

Any type of detector tube may be used in this set, such as a '30, '99, '00A, etc. Any voltage "A" battery (up to 12 volts) may be used, making it possible to plug the set into the cowl light socket of practically any automobile. To compensate for these different voltages a semi-variable resistance in the filament lead is incorporated in the set and is placed in back of the *right-hand* end panel. Its shaft is slotted with a hacksaw and a small hole drilled in the panel so that a screwdriver placed in the hole will enable one to vary the resistance in order to obtain the correct voltage for the particular tube in use. When once "set" it is left alone. A 6-volt socket voltmeter may be plugged into the tube socket to accurately determine the correct voltage before the tube is put in.

The dimensions of the set are 7 x 4¼ x 2½ inches deep. The entire cabinet is made of ⅛-inch bakelite. Copper foil shielding is used behind the main panel and run to the ground post to prevent hand capacity effect. A ¼-inch square brass rod is used instead of "angle iron" where the panels join, as it makes a neater and firmer job. Two brass machine screws at the bottom of the set permit the lower panel to be removed when desired.

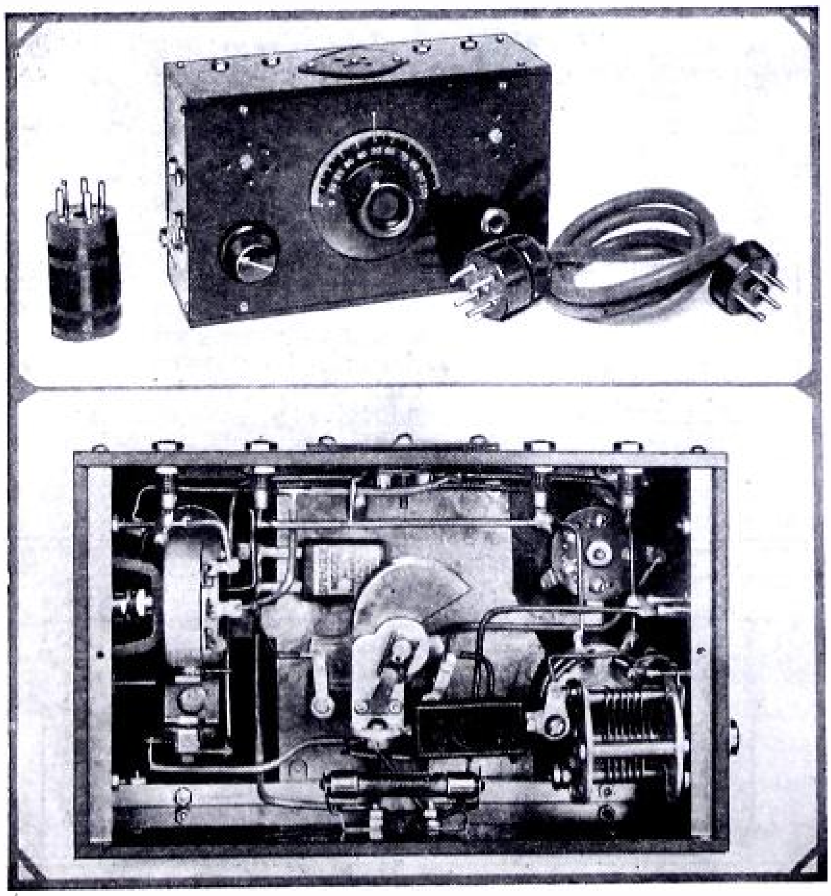
Short-Wave A.C. Adapter Unit

This adapter will work on any A.C. receiver having a '27 type detector tube. Simply remove the '27 from the broadcast set and place it in the *right-hand* socket. Then plug one end of the 4-wire connection cable (shown in diagram) into the socket at the rear of the unit and the other end into the empty detector socket of the broadcast set. Remove the antenna connection from the broadcast set and attach it to the antenna post of the adapter instead. *Do not remove* the ground connection from broadcast set. No ground connection is necessary on the adapter unit.

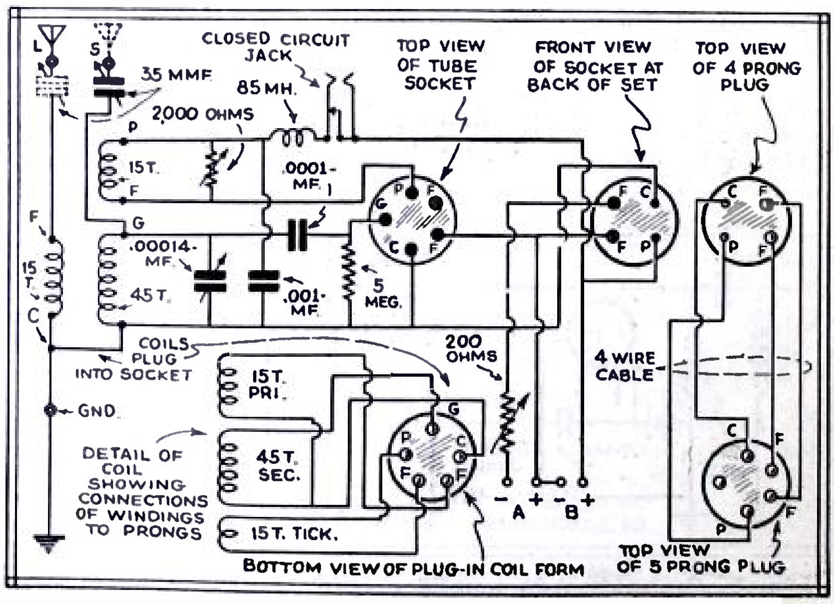
It will be seen that a *closed circuit* jack is provided in the plate lead so that the plate circuit is not broken, as the phones have been removed.

The 4-wire connection cable should not be much over 2 feet long for best results.

Using a bed-post as an "aerial" and a radiator as a "ground," the writer has listened to police stations by the score, day or night, besides the always interesting conversations between amateurs. With a suitable outdoor antenna the range of reception of this set can be said to be well over 3,000 miles, under favorable conditions.



Exterior and interior views of Mr. Rossback's short-wave receiver and converter.



Wiring diagram of Mr. Rossback's "first prize" winning set.

SECOND PRIZE—$25.00 Won by LARRY L. JOHNSON, Willcox, Ariz.

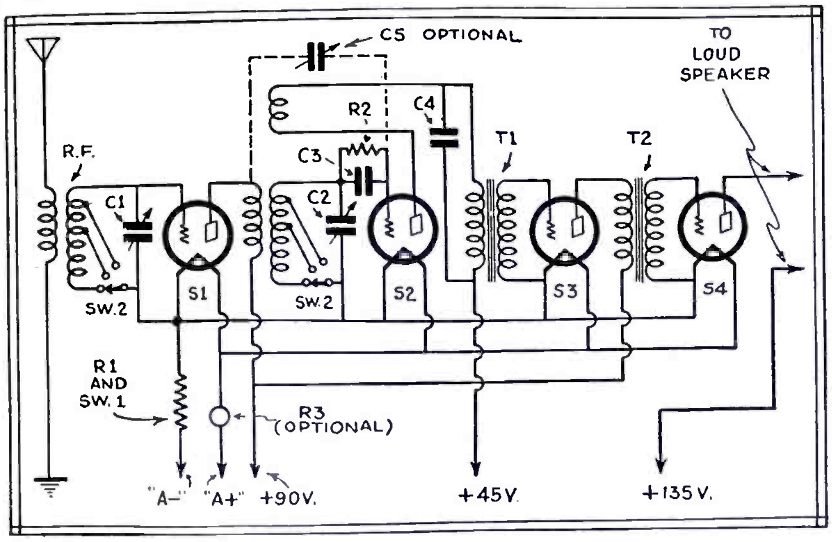
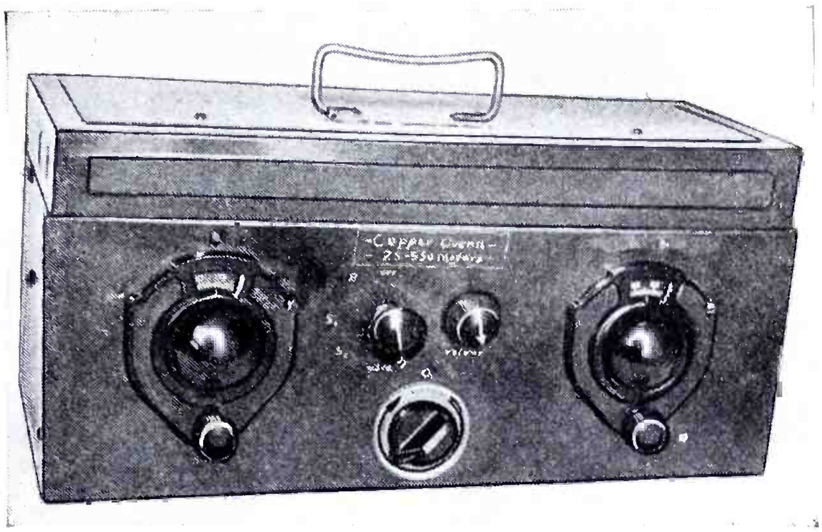


Diagram of "second prize" set, built by Larry Johnson.



The "Copper Queen" 4-tube S-W receiver built by Mr. Johnson.

The "Copper Queen" 20-550 Meter Portable All-Wave Set

● THE "Queen" has one stage of radio frequency amplification, detector, and two stages of audio amplification. When 2-volt tubes were used, ample loud speaker volume was obtained out here (in Arizona), 500 miles from a really powerful broadcast station. In the city '01's should work O.K. on the broadcast band at least. The set was logged with '01's.

I have "portability," as the "Queen" rests serenely in an old steel tool box, and it is padded with rubber to absorb the shocks of transportation. When it comes to "compactness," all I can say is that many a time I wished that I had a shoe horn to get all of the parts in O.K. The "Queen" is a four-tube set in a space 6 x 14 x 6½ inches, which is small, I believe. Under "workmanship" I was forced to try four cabinets before I chose the old tool box. In "novelty of circuit" I have an old idea with whiskers on it revamped (see diagram). The shorted secondary method of receiving short waves has been known a long time, but has been discarded in the modern stampede to separate coils for each wave band. I believe modern tubes could do much toward bringing it back, as the losses could be cut down considerably. "Ingenuity "qualification is covered in the cabinet used, type of circuit, and switch arrangements.

After trying bakelite and the original side of the tool box, copper was chosen as the best medium for this purpose, especially in regards to the short wavelengths, where shielding is essential. The rheostat acts as filament switch and oscillation control. The right-hand knob controls regeneration in the detector circuit through the rotating tickler coil. The left-hand knob is the wavelength selector switch and on this model has four taps; one is used for the "off" tap.

The dials, of course, are for the tuning condensers. Arrangement of the parts must be followed closely (as per drawing) to make everything fit. The tuning condensers, rheostat, all-wave switch and three-circuit tuner are all mounted on the panel. The first audio fre-

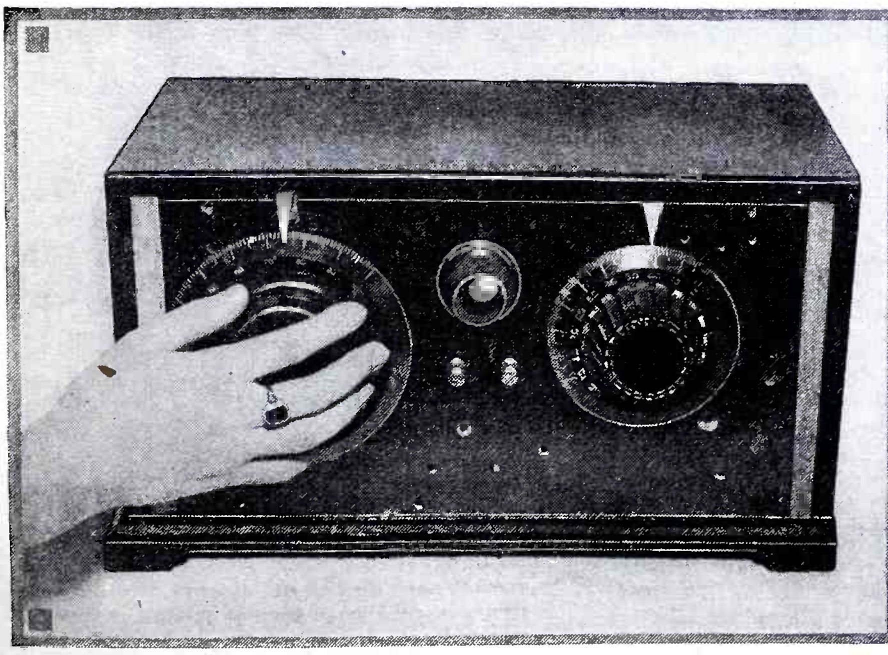
(Continued on page 367)

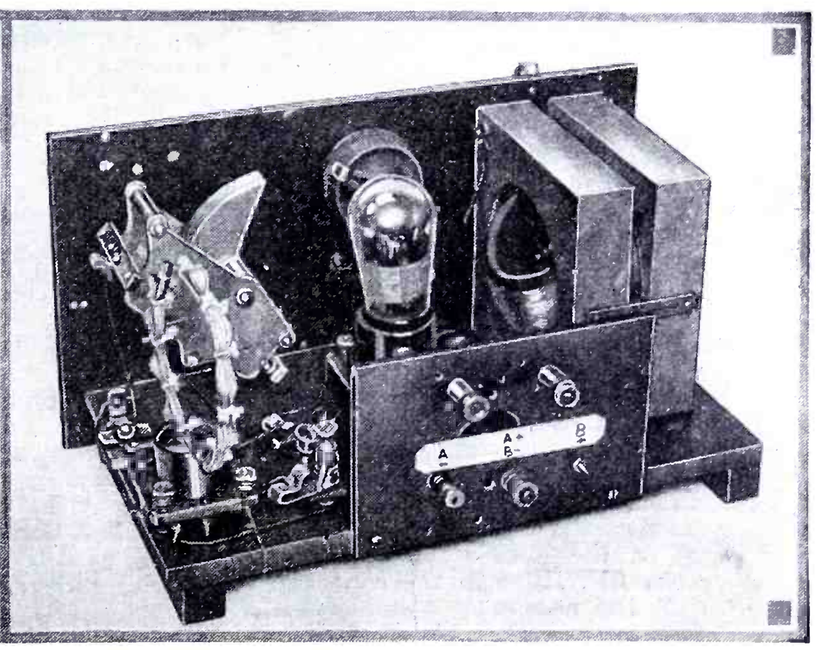
THIRD PRIZE—$12.50 Won by LESLIE HULET, New York City

● I AM entering a rather unusual short-wave set in your contest. I have always thought that old-style methods and obsolete apparatus could be used for ultra-modern reception. With this idea in mind, I dug out some old variometers and crystal detectors, and set to work.

Considerable experimentation resulted in practical reception over short-wave channels. Lack of time and money prevents a complete working out of the possibilities in this line, which appear to be very interesting, due to the stark simplicity. A variometer gives direct-close-coupling, and at the same time permits of extremely close and fine gradations of inductance. Crystal detection gives unusually clear reception, and also simplifies the circuit a great deal and eliminates the tube, rheostat and much wiring.

(Continued on page 373)





Front and chassis views of third prize winner—a novel S-W receiver comprising crystal detector and one-stage A.F. amplifier.

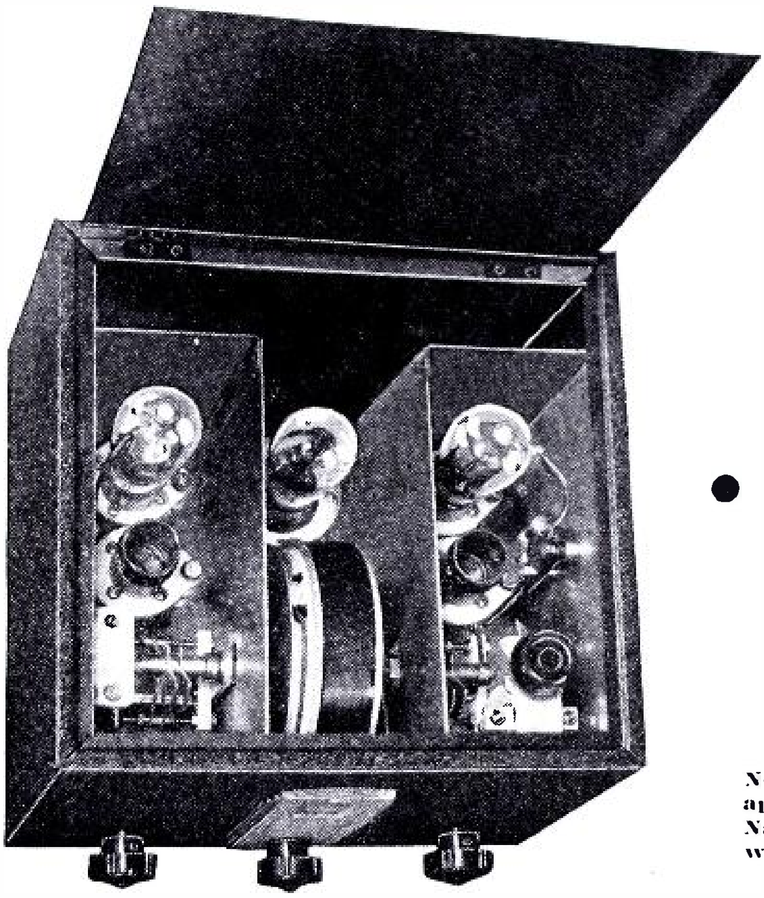


Fig. 4.

Note the business-like appearance of the new National ultra-short-wave converter. It uses three tubes.

The New National

Ultra Short

BY JAMES MILLEN*
Consulting Engineer

The 5-meter band is within your receiving range, if a short-wave converter of the type here illustrated and described is connected ahead of your ordinary broadcast band receiver. Mr. Millen and his associates have accomplished a fine piece of radio engineering work in the development and perfection of this ultra-short-wave converter, which actually changes your broadcast receiver into a short-wave superheterodyne for the reception of signals in the 5-meter band.

● THE almost complete lack of selectivity which is to be found in a super-regenerative receiver was quite an advantage in the early days of ultra-high frequency development when but few transmitters were on the air. With the present popularity of the amateur *five-meter band* this condition no longer exists and the need of a relatively selective *ultra-high frequency* receiver is great.

Another present-day disadvantage of the super-regenerative receiver is extremely high noise level and consequently lack of weak signal activity. All of these difficulties are overcome in the new electron-coupled type of ultra-high frequency superhet, such as the new National type HFR described in the last issue of SHORT WAVE CRAFT.

As the cost of a complete ultra-high frequency receiver of this type is in many instances prohibitive to the average amateur or experimenter, a special converter has been developed, which, when used with a good broadcast receiver, will form a combination having most of the advantages of the new type HFR complete receiver. This converter is illustrated in the accompanying photographs and diagrams. The special coils, sockets and tuning condensers are shown in detail in Fig. 2. The data for winding the coils are given in Fig. 3. The condenser capacity (12 mmf. each) is so selected as to spread the 50-60 megacycle amateur band over approximately 100 dial divisions, so as to give full band spread. In addition to comprising an electron coupled oscillator and ultra-high frequency detector, there is also built into the converter a combination I.F. and coupling stage, so that the converter may be used with most any type of broadcast receiver, regardless of the contents of the complete circuit and regardless of the R.F. amplification or gain, as the I.F. stage in the converter supplies all the necessary amplification. In constructing an ultra-high-frequency converter of this type it is absolutely essential that the insulation used in the condensers, sockets and coil forms be made of special low-loss material suited for ultra-high frequency work, such as National R-39 or National Isolantite. This is particularly true of the coil forms which are molded of the extremely low loss R-39.

Tubes

The design of this unit is such that it may be operated with either the 6-volt D.C. heater type tubes or 2½-volt A.C. tubes. In the first case, two '36's are employed for detector and oscillator and a '37 for the output coupling tube. For A.C. operation, the corresponding tubes are two '24's and one '27; '35 tubes may be substituted for the '24's if desired. A certain amount of care must be exercised in the selection of tubes or trouble will be experienced from *microphonics* or noise resulting from leakage between heater and cathode. This latter trouble appears as a loud grating or scratchy hum. As a general rule, tubes of recognized quality having standard characteristics will prove entirely satisfactory. No special matching is required, since ample provision for balancing tube capacities, etc., is incorporated in the various circuits.

Antenna

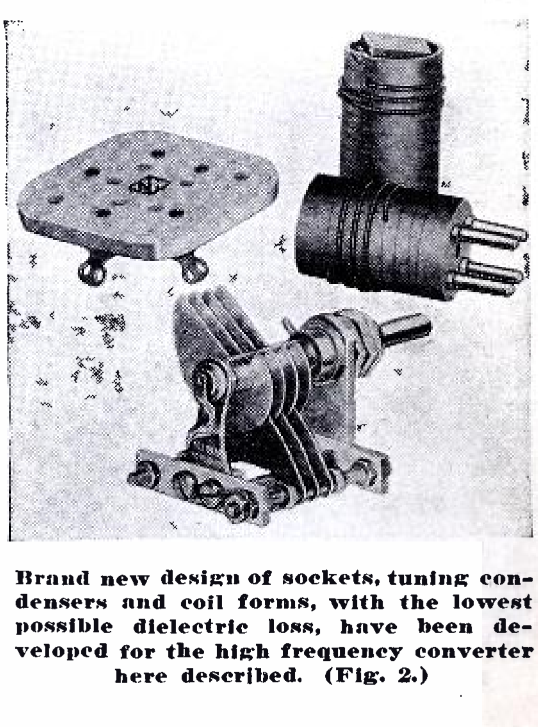
The antenna requirements are not in any way critical, although as a general rule a single wire as high as possible will give best results. The directional effects of various types of antenna are often very pronounced at high frequencies, so that the use of a vertical antenna located well away from any surrounding objects usually gives best results. The length may be between 5 and 50 feet over-all. A longer wire is not recommended, as it tends to increase the noise-to-signal ratio.

Power Supply

The filament or "A" supply may be either a 6-volt storage battery or 2½-volt transformer, depending upon the type of operation desired. In most installations, no connection between the storage battery and B-minus is required, although under certain conditions it may be advisable to ground one side. When a 2½-volt filament transformer is employed, the center of the winding should be grounded by means of a tap on the secondary or a center-tapped resistor having a total resistance of 10 or 20 ohms. The "B" supply may consist of either "B" batteries or a "B" eliminator, the batteries being preferable where fluctuating line voltages are encountered. The voltages are not critical and may be between 67 and 75 for the screen circuits and 135 to 180 for the plate circuits. Reference to the circuit diagram will show that the "B" batteries are subjected to a certain amount of current drain when the converter is not in use. The B-minus should, therefore, be disconnected during idle periods.

Intermediate Frequency Amplifier

The circuit of the type HFC converter is such that almost any broadcast receiver will be quite satisfactory for use as the I.F. and audio amplifier. For best results, the receiver should have a fair degree of sensitivity and should be stable. If the receiver has a tendency to oscillate, it will be somewhat emphasized



Brand new design of sockets, tuning condensers and coil forms, with the lowest possible dielectric loss, have been developed for the high frequency converter here described. (Fig. 2.)

*General Manager, the National Company.

Wave Converter

when the converter is connected, which may make it impossible to fully advance the volume control without causing over-all oscillation. Extreme sensitivity and selectivity are not required, since the converter employs a high gain I.F. stage and is in itself quite selective. As a matter of fact, the use of an extremely selective broadcast receiver is something of a disadvantage, especially when hunting for signals or when receiving signals having a large degree of frequency modulation. The broadcast receiver should be capable of tuning to a frequency of 1550 kc. (about 200 meters), the frequency at which the converter is designed to operate. If it so happens that a powerful station is operating on this frequency, the receiver should be detuned sufficiently to avoid the possibility of interference. Detuning as much as 30 or 40 kc. has no appreciable effect upon the ganging.

Installation

To install the converter, it is only necessary to connect suitable power supply equipment, *connect the* OUTPUT POST *to the* ANTENNA POST *of the* BROADCAST RECEIVER *and connect the* GROUND POST *of the converter to the* GROUND POST *of the receiver.* These two wires should be twisted loosely together or may be run closely parallel to each other. Ordinarily, shielding these leads is not required. The converter should not be placed more than six feet from the receiver and it is usually much more convenient from the operating standpoint to place the two units side by side.

The two coils accompanying the converter, while similar in appearance, have definitely different electrical characteristics. The coil having the red mark on the base should be placed in the detector coil socket (left-hand compartment), while the coil marked with black is for use in the oscillator circuit (right-hand compartment). The coils must be placed firmly down in their sockets or trouble will be experienced in obtaining correct ganging and maintaining calibration. It will be noticed that the connecting leads between the ends of the coils and the pins in the coil form are bent. These leads must not be straightened or altered in any way, since the coils are individually calibrated by carefully adjusting the leads in the laboratory. When the converter is properly aligned, the range from 56-60 megacycles will cover from approximately 125-55 on the dial. The calibration of individual sets may vary appreciably, however.

Operation, Alignment, Etc.

After the converter has been properly connected, the broadcast receiver should be tuned to approximately 1550 kc. (about 200 meters) and the volume control fully advanced. From left to right the converter controls are detector *trimmer condenser, tuning control* and detector *regeneration control*. The oscillator padding condenser will be found at the top of the oscillator (right-hand) compartment.

It is first necessary to set this padding condenser to properly align the oscillator and detector circuits. The detector trimmer condenser should be set at approximately half capacity and the tuning dial at about 100. No signal is necessary during this procedure, other than the usual background hiss from static, tubes, etc. Starting with the regeneration control (right-hand knob) fully advanced, rotate the padding condenser back and forth over the entire range, meanwhile slowly reducing the regeneration. At a certain setting of the regeneration, it will be found that as the padding condenser is rotated, the background noise will sharply increase at two points. At these points the oscillator is aligned with the detector, the lower capacity setting of the padding condenser being the correct adjustment, since the oscillator is designed to work on the high frequency side of the detector. In other words, while there are two points where the oscillator and detector may be aligned (when the oscillator is tuned either above or below the detector by the amount of the intermediate frequency), the correct

(*Continued on page 381*)

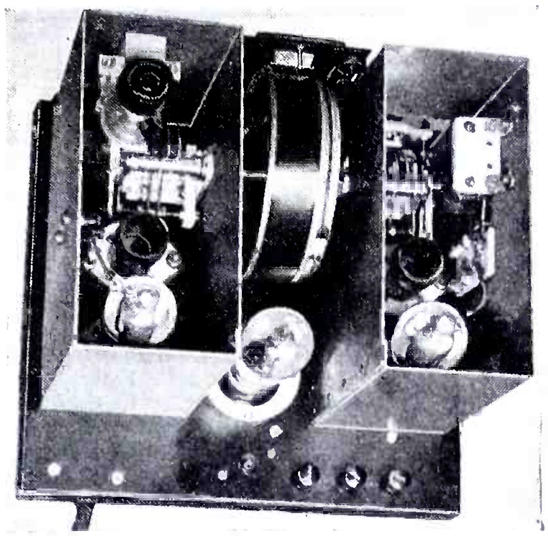


Fig. 5, above—Rear top view of U.S.W. converter with shield covers removed.

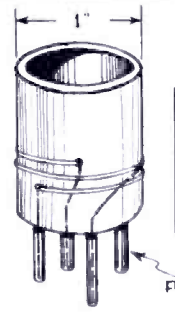


FIG. 3

56 - 60 MEGACYCLE DATA

COIL	WIRE	TURNS	TAPPED
MOD	No. 18	$2\frac{1}{6}$ T	$\frac{3}{8}$ T
OSC	No. 18	$2\frac{1}{12}$ T	$\frac{3}{8}$ T

Winding data for the coils used in the 5-meter band converter.

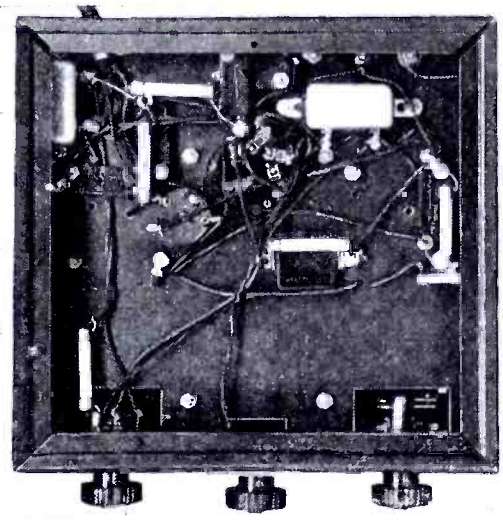
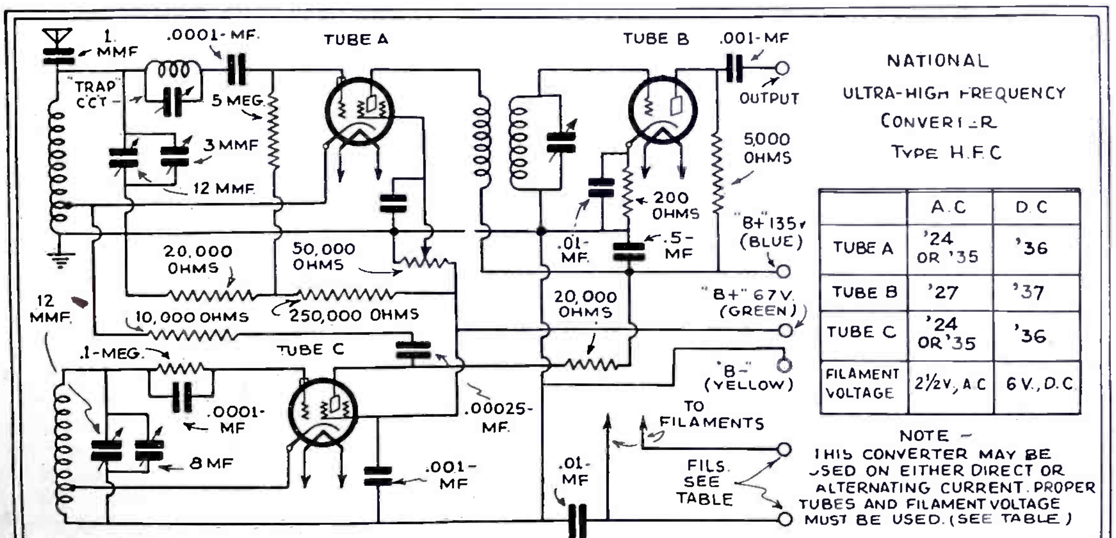
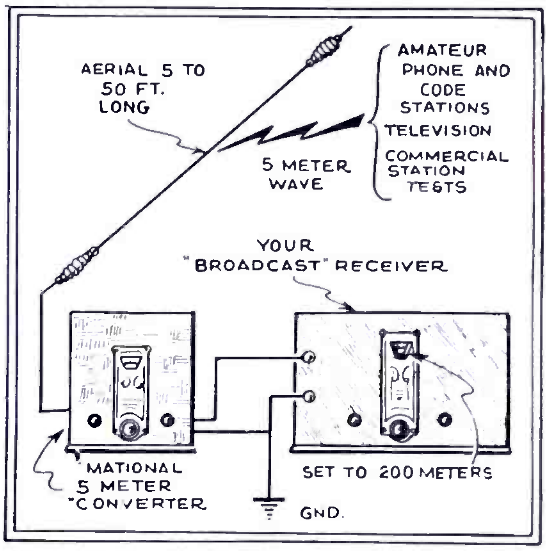


Fig. 6, above—Bottom view and relatively simple wiring of 5-meter converter.



	A.C	D.C
TUBE A	'24 OR '35	'36
TUBE B	'27	'37
TUBE C	'24 OR '35	'36
FILAMENT VOLTAGE	2½V, A.C	6 V., D.C

Diagram showing arrangement and connection of parts in the new National ultra-short-wave converter. (Fig. 1.)



By simply adding this U.S.W. converter ahead of your broadcast receiver, you can hear 5-meter signals.

LETTERS FROM S-W FANS

AN ENGLISH KICK

Editor, SHORT WAVE CRAFT:

Have just finished reading the current issue of SHORT WAVE CRAFT, to which I am a subscriber. SHORT WAVE CRAFT is a fine magazine for the keen ham, and I wouldn't be without it now. But in reply to a letter by Dean Powell (W3VJ) you said you were getting fed up with all this praise and would appreciate a first-class "brickbat." Well, here goes—I will hand you one. The circuits which you print are first-class, but why the heck don't you think a bit more of your readers outside of the U. S. and put the values of condensers in terms of .0005, .001, .0001 mf., etc.? You forget that in England we have no "mmf." terms for rating condensers; also our tubes are different and have different connections. Now "buck up" and let's see some English values, etc., published, and SHORT WAVE CRAFT will get a big boost over here.

All the Best—Sincerely yours,

NORMAN L. H. PLATT,
Barton Court Avenue,
New Milton, Hants, England.

(Thanks for the brickbat, Norman, and coming all the way from England, it lands doubly well. As to the values of condensers, we frequently give their values in mf. but where the value is lower than .0002 it seems better practice to express it in mmf. American practice is becoming more and more standardized to express such values in even numbers instead of in small fractions. It is simply necessary to divide mmf. by 10^6 or 1,000,000 in order to obtain the equivalent value in mf. Multiplying mf. by 10^6 gives the value in mmf.—Editor.)

ON THE ONE-LUNGER

Editor, SHORT WAVE CRAFT:

Just writing to tell you of the wonderful results I received on the one-tube set described in the Aug.-Sept. (1931) issue of SHORT WAVE CRAFT magazine. I just want to mention that your magazine has given me the short-wave "bug"—it certainly deserves my mentioning it. Before I write about the stations I received on that hook-up, I want to say that I would be pleased to correspond with any other ham and if they desire this hook-up I will gladly send it to them.

I have received these stations: W9XF, W9XAA, WIXAZ, W3XAL, VE9CL, Canada, KEJ, Bolinas, California, testing with Hawaii; HKF-LSN-PRAG, all from South America; PLW, Bandoeng, Java. I received one station at 9:30 on Sunday which I am not sure of, because I did not get the full call letter. It was, I believe, VK2ME, the "star" station of Australia. According to the log book, this station broadcasts on Sunday mornings around 9:30 on 31.28 meters.

MILTON KERLIN,
507 Packard Ave.,
Cudahy, Wisconsin.

(Congratulations, Milton, and we are sure that you will receive plenty of requests from other short wave fans for the hook-up of the one-tube receiver which you have built and on which you have heard many distant stations, including Java. We are quite proud of the fact that SHORT WAVE CRAFT was the reason for your having been bitten by the short-wave "bug." Of course a lot of people who may read this will probably think that they would not have the patience to listen or tune a short-wave set so as to hear Bandoeng. But, Oh Boy! what a thrill when you really hear it on your own set, especially if you built it yourself. The other day one of the editors reported that his nephew had called him up very excitedly the night before and had told him that he could at last announce the reception of Siam on his home-made two-tube short-wave receiver—and loud at that. We believe it is one of the greatest thrills in this world! There are a great many other stations that will give you an equally great thrill when you hear them. Not only is there the thrill of hearing the announcement from a station five thousand miles away, but there is also the personal pride and satisfaction in the achievement of bridging this tremendous distance with a short-wave receiver which you have built with your own hands and at a cost which probably did not exceed a few dollars.—Editor.)

IT WORKS!

Editor, SHORT WAVE CRAFT:

I have just completed the 17 to 300 meter short-wave receiver described by Dale Tisdale in your April issue of SHORT WAVE CRAFT, and it sure works fine! I have only made two coils for the receiver and I have received short-wave broadcasters W3XAL, W2XAL, W8XK, W2XE, W9XL, W9XAA, VE9DR, VE9GW, W2XAF, W1XAZ, CMCI, HKD, GBS, GBK. Most of these stations came in on the loud speaker! I have also heard amateur phones and CW from all over the United States. I am hoping soon to become a "ham" myself, so I am interested more in CW than in broadcasters. I have read three issues of your magazine, and think it is a fine magazine for the "Ham" and "Experimenter."

Sincerely yours,

**HOWARD A. HELLWIG,
2212 E. North Ave.,
Baltimore, Md.**

(Well, Howard, the 17-300 meter S.W. receiver described by Brother Tisdale seems to be a real humdinger, doesn't it? We are always very glad to hear from our readers when they have had successful results with any of the receivers or transmitters described in SHORT WAVE CRAFT. We probably will receive a great many more letters like yours, which serve as the applause which cheers the actor on to ever greater heights. We trust to have you as one of our valued readers for many moons to come and we promise you a more interesting and better issue of SHORT WAVE CRAFT each month.—Editor.)

THE POLICE THRILLER

Editor, SHORT WAVE CRAFT:

I have been reading your magazine SHORT WAVE CRAFT about five months and have gotten a lot of pleasure out of it. I have built three sets that I have taken from your book. I have just built the *Police Thrill Box* and it works fine. I like to build them and rebuild them. I would like to build a five-meter transmitter, but I can't learn the code. It would be nice to have the transmitter for experimental use. It certainly felt swell when I finally completed my *Police Thrill Box* and connected it to my radio and found that it worked!

Here's hoping SHORT WAVE CRAFT will "go over the top."

Yours truly,

JAMES W. SHOAF,
365 Riley Street,
Buffalo, N. Y.

(Shoaf! Shoaf! James, you're a great boy. We are mighty pleased indeed to hear that you have built the Police Thrill Box described in the May issue of SHORT WAVE CRAFT and that it works fine. There are only "umpty ump" thousands of short-wave fans like yourself, we know, who would like to operate a five-meter phone transmitter, without having to laboriously learn the telegraph code first. Through the efforts of the SHORT WAVE LEAGUE officials we hope that something may be done about opening up the five-meter or some other low wave band, wherein enthusiastic radio amateurs like yourself can have the pleasure and experience of operating a phone transmitter without having to learn the code.—Editor.)

THAT "DOERLE" AGAIN

Editor, SHORT WAVE CRAFT:

I have just completed the two-tube receiver by Mr. Doerle in the January issue, and it surely is a great receiver! It works fine on all the wavebands. Nobody could wish for any better job than this one. I can get W8XK and W9XAA to work on the loud speaker at night, and the code stations come in with a wallop behind them. I would like to hear from some of the hams. If any of them have trouble with this receiver I would like to help them out. I will answer all letters on this receiver.

I have been doing some hard studying on code and I expect to take the examination in the near future, but I don't want to get on the air until I feel that I know the code thoroughly.

Now a word about SHORT WAVE CRAFT. I have eight copies now and I think it is the greatest little magazine on the market today. Wherever I go I always get my SHORT WAVE CRAFT magazine. Here is a booster for SHORT WAVE CRAFT.

Radioally yours,

SAMUEL E. SMITH,
Lock Box 241,
Grayling, Mich.

(Thanks, Samuel, for offering to help out the boys who have trouble in operating the "Doerle" receiver with which you have had so much success on all the different wavebands. We trust that by this time you have taken the examination for an amateur radio transmitting license and that you will soon be "pounding brass" in great shape. A word of admonishment—it will pay you much better in the long run to send slowly but accurately at first and gain speed as you gain confidence by the receipt of "good news" from other amateurs when you ask them how they like your "fist." One of the great temptations among amateur operators is to send as fast as they can, but you cannot get past the old adage—that practice, and only practice, makes perfect!—Editor.)

FROM WESTERN CANADA

Editor, SHORT WAVE CRAFT:

Would like to hear from every short-wave fan or owner of a short-wave set in Western Canada as soon as possible. Will answer every letter and want the help of every receiving fan.

Wish to congratulate SHORT WAVE CRAFT on the once-a-month publication; hope to see it out more often.

Let every one of us put this SHORT WAVE LEAGUE over big—and How!

I am waiting.

Yours truly,

WALTER R. NEWCOMB,
Enfield Crescent,
Norwood, Man., Canada.

(Glad to welcome you, "W. R. N.," and after publishing this letter in our columns, we feel confident that you will hear from oodles of short-wave fans, not only in Canada but in this and other countries as well. You ought to be able to cover some wonderful distances, both transmitting and receiving, especially in the winter, in your neck of the woods. We shall be glad to hear from you again.—Editor.)

$5.00 Prize

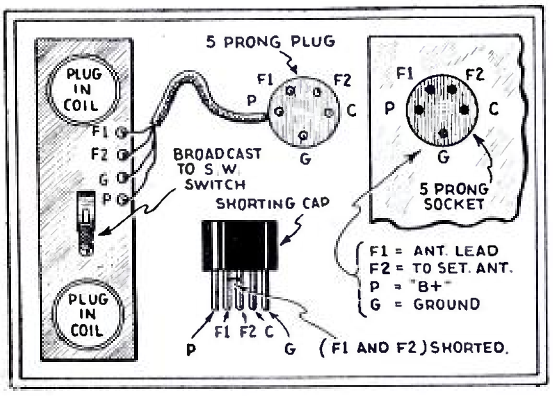
Converter Connector

● HERE is a plug and cord extension that I have used to connect a short wave converter to a regular radio.

First, a five-prong socket is mounted at the back or under the regular radio; to this the antenna lead, B + 180 volts lead from the power pack, a ground connection and a lead to the regular radio antenna binding post are connected. A four conductor cable having a five-prong plug attached, is plugged into the socket, at the other end of the four- to five-foot cord is connected to the short-wave converter terminal board. The code of connection I used are on the sketch.

A five-prong cap with the filaments shorted is plugged in the new socket on the regular radio when the short-wave converter is not in use.

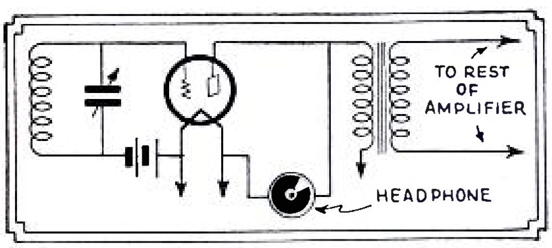
This is sent in to help others that are trying to sell short-wave converters that are easy to operate.—*K. A. Staats.*



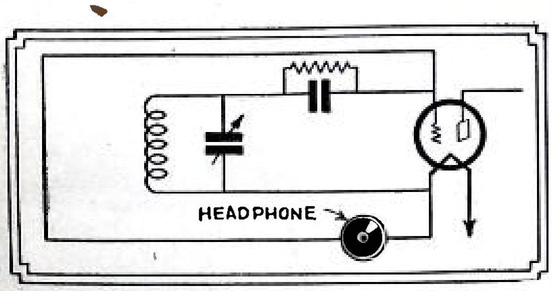
This extension cord and plug scheme for connecting a short-wave converter to a broadcast set will be found most useful.

Head Phone Tester

● AN ordinary headphone can be used in testing the audio-frequency portion of a receiver to see if it is working. To test receivers that employ the grid leak and condenser method of detection, connect one terminal of the headphone to the side of the grid leak that goes to the grid of the detector tube. Connect the other terminal to the chassis or ground. When the set is on and words are spoken into the headphone the voice will be reproduced in the loud speaker if the audio-frequency portion of the receiver is working.



How to use a headphone as a test "mike" in primary circuit of an A.F. transformer.



Here a headphone used as a "mike" is shown connected in grid-leak type detector circuit.

$5 FOR BEST SHORT WAVE KINK

The Editor will award a five dollar prize each month for the best short-wave kink submitted by our readers. All other kinks accepted and published will be paid for at regular space rates. Look over these "kinks" and they will give you some idea of what the editors are looking for. Send a typewritten or ink description, with sketch, of your favorite short-wave kink to the "Kink" Editor, SHORT WAVE CRAFT.

For receivers using grid bias detection, connect one terminal to the ground and the other one to a fixed high resistance (not shown). The remaining terminal of the resistor goes to the plate connection. When words are spoken into the headphone the current flowing through the primary of the first audio is varied. Thus the voice is reproduced if the audio-frequency system is correct.—*Alvin Gregory.*

Uses of Burned Out Tubes

● WHEN a tube is burned out it doesn't mean that it is worthless and should be thrown away. Coils can be wound on the bases and used in short-wave receivers. Radio-frequency chokes can be wound and placed inside the bases. The connections are soldered to the pins and plugged into tube sockets. Thus different values of choke coils can be substituted at will.

The bases also make an excellent battery cable plug. By fastening a socket to the battery connections of the receiver, a neat arrangement is secured. The base is connected to the batteries by a cable of twisted wires. This allows the batteries to be quickly disconnected.

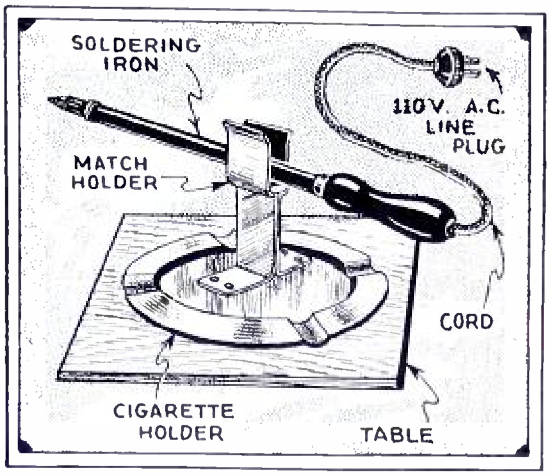
Burned out tubes may be put to use by the dealer who has several receivers on display. The sockets are filled with the dead tubes. This gives the receiver a complete appearance which attracts the buyer's eye. This also saves money, as tubes are often broken when handled.

Still another use of the burned-out tube is the use of the contact pins as headphone and speaker cord tips. The small pins are broken out of the base and the solder is cleaned out of the ends. The wires of the headphone or speaker cords are drawn through the pins. Solder is applied to the tips and allowed to cool. The wire is then filed off the ends in order to make them smooth.—*Alvin Gregory.*

Soldering Iron Support

● THIS combined cigarette and match holder, I have found, makes an excellent holder or support for any ordinary radio soldering iron, providing of course that its diameter is not so large as to prevent it from fitting in the slot at top of cigarette holder, or match container.

One day, while doing some radio work, I was looking for a support for my soldering iron, and happened to have this cigarette tray on hand, so I conceived the idea of using it for that purpose. Decided to send this to you and hope you may find use for the idea.—*S. H. Buchanan, radio operator, radio station, Ft. Crockett, Galveston, Texas.*



A smoker's ashtray makes a good support for a hot soldering iron.

Simple Antenna Condenser

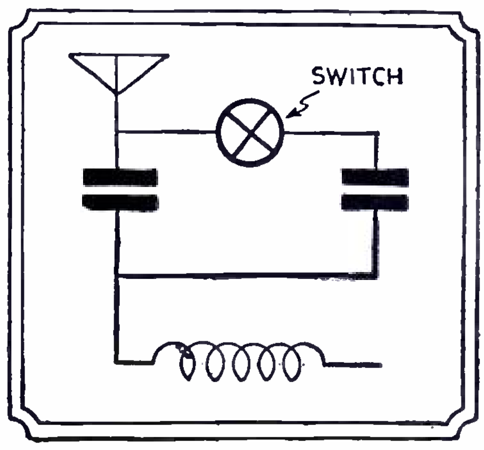
● AFTER becoming dissatisfied with a midget variable condenser I was using in the antenna circuit of my short-wave receiver, I constructed a fixed condenser of the usual type, that is metal brackets about one inch square and one-eighth inch apart. This served the purpose on the lower wave bands, but the necessity for a higher capacity on the 150-meter band was evident by a drop in the sensitivity on that band.

To obtain this higher capacity on the higher wave band, and at the same time making it convenient to switch to the lower capacity for the shorter waves, I used the following method:

Another condenser similar to the first was constructed and connected in parallel with the first condenser, with a switch to bring the second in or out of the circuit as desired. The switch, of course, may be mounted in any accessible place.

With both condensers in the circuit,

(*Continued on page* 378)



By means of the switch indicated it is an easy matter to switch the additional antenna capacity into or out of circuit.

The Short-Wave "Pentode

Everyone's asking for new short-wave receiver designs, incorporating the use of some of the new tubes. We are pleased indeed to present herewith another brand new receiver—the Short-Wave "Pentode Four," conceived by Mr. H. G. Cisin, prominent short-wave author and designer. This set uses 56, 57, 58 and PZ tubes; also, it operates a loud speaker and, besides being very economical to run and of low first cost, it provides excellent quality of reproduction. Range from 16 to 200 meters.

By H. G. CISIN, M.E.

● SHORT-WAVE fans will want to experiment with the recently developed 56, 57, and 58 tubes, and the "Short-Wave Pentode Four" receiver is offered to them for that particular purpose. Using a more or less conventional circuit, the correct application of the new tubes permits high efficiency and superior performance.

The circuit consists of a tuned R.F. stage, a regenerative detector and two audio stages. One audio stage is resistance coupled, while the other is transformer coupled. The R.F. stage employs a 58 tube. This is a new type of variable mu pentode and it is highly efficient, due to the fact that its long "cut-off" feature reduces both cross-modulation and modulation distortion. A "local-distance" switch is unnecessary where this type of tube is used. In a very interesting article in the July, 1932, issue of SHORT WAVE CRAFT, Louis Martin discussed the theoretical and practical features of the 56, 57, and 58 tubes, with special emphasis on their applications to short-wave work. Referring to the 58 tube, Mr. Martin mentions the fact that this tube is capable of amplifying weak or strong signals with equal efficiency. He states further that this tube is decidedly advantageous for short-wave receivers and that it may be used successfully for frequencies up to 60 megacycles (5 meters). Inter-electrode capacities and all other constants of the new tubes are given in the article and it is suggested that a copy of the issue be obtained, as it is very useful for reference purposes.

The 57 tube used in the detector stage has inherent advantages which make it ideal for the short-wave receiver. Among these are the shield arrangement in the dome, permitting great reduction in the output capacitance; the high transconductance and high plate resistance, and the sharp plate current grid bias "cut-off," resulting in extremely sensitive detection.

The Short-Wave Pentode Four employs grid-leak detection. While this method does not permit the attainment of maximum gain from the 57 tube, it does give very high sensitivity. Regeneration is controlled by means of the 50,000-ohm potentiometer at (17).

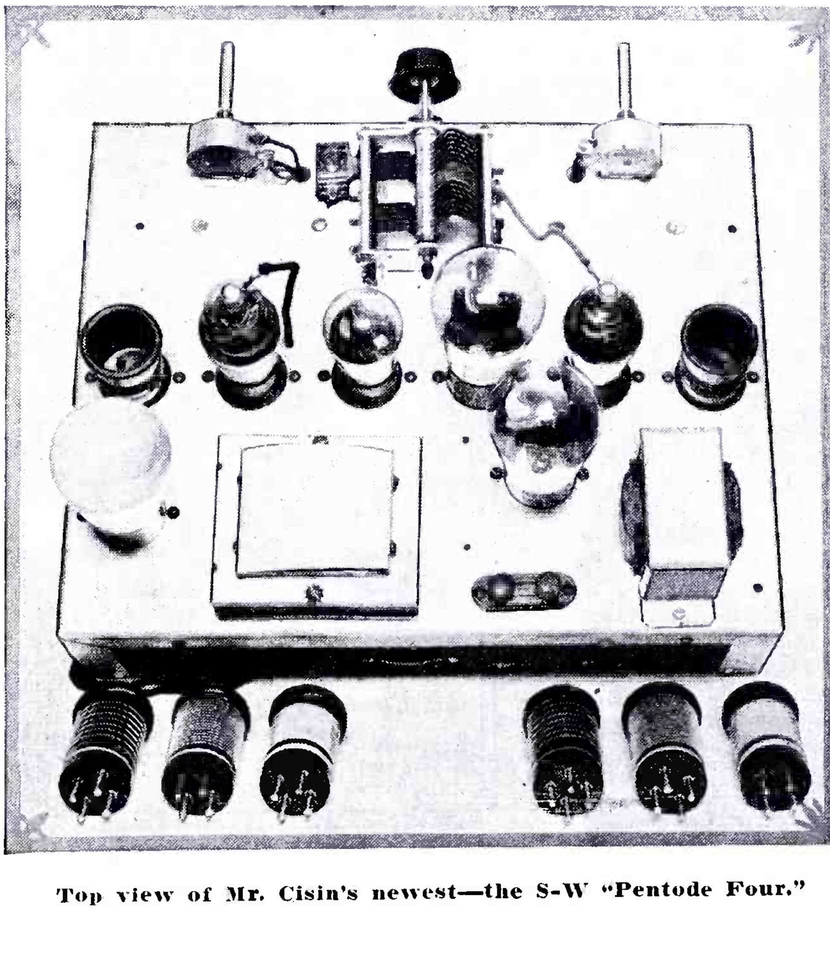
A volume or sensitivity control is placed in the cathode circuit of the 58 variable mu pentode, so that full advantage may be taken of the remote "cut-off" characteristic of that tube.

A tuned impedance (11), a grid condenser (12) and grid leak (13) serve to couple the R.F. stage to the detector. Hence, with the tuned R.F. stage, there are two tuned circuits. These are tuned by means of a dual Cardwell condenser, each section having a capacity of 150 mmf. The first section (3) is shunted by a small equalizer condenser (4), which permits accurate adjustment for single dial control.

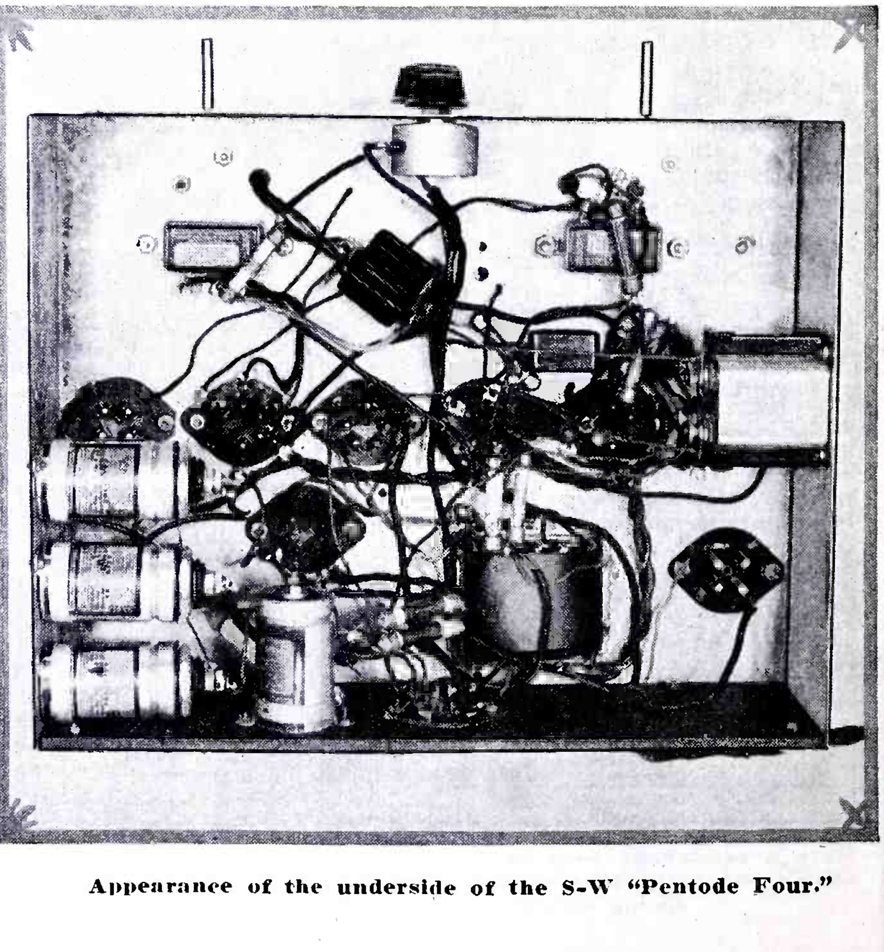
Both the antenna coupler (2) and the tuned impedance coil with tickler (11) are Alden plug-in short-wave coils. Both coils are identical, but in the case of coil (11), the secondary is connected to serve as the tuned impedance, while the primary is used as the tickler coil. Four coils are provided in each set, in order to cover the short-wave bands from 16 to 200 meters.

The R.F. choke (20), by-passed by condenser (19), serves to keep R.F. currents out of the audio portion of the circuit. The design of the resistance coupling between the detector and the first audio stage has been varied somewhat from conventional practice, since a potentiometer is used at (23) instead of a fixed resistor, in order that a means of tone control may be included at this point. The transformer coupling between the first audio stage and the output stage does away with any tendency toward "motorboating," which would undoubtedly manifest itself if another resistance coupled stage were used.

The first audio tube is a 56 type tube. This has an amplification factor of 13.8 compared to 9 for the '27 tube. While it has no particular advantage as a short-wave tube it is a very good general purpose tube. The pentode output tube has high power output, high mutual con-



Top view of Mr. Cisin's newest—the S-W "Pentode Four."

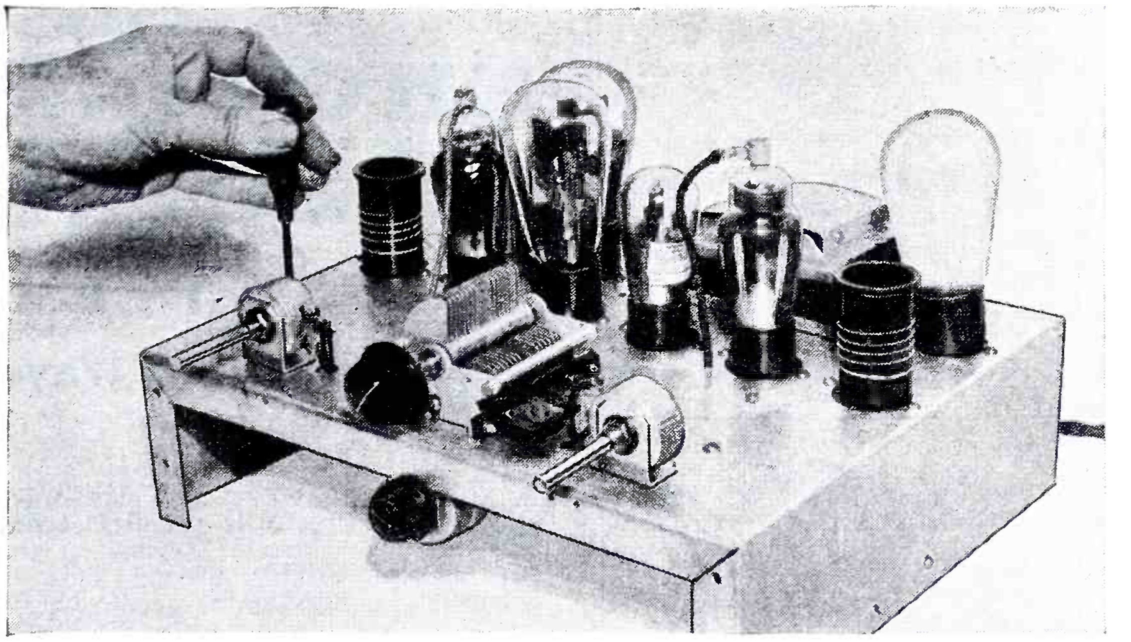


Appearance of the underside of the S-W "Pentode Four."

Four"

ductance and high power sensitivity. The power supply employs a full-wave rectifier and a standard filter system in which the 2,500-ohm field of the dynamic speaker serves as one of the audio chokes. Dry electrolytic filter condensers are used. A line voltage control amperite is shown in series with the primary of the power supply transformer. This is specified so that the set may be counted upon to give uniformly good performance, regardless of line voltage conditions.

The four connections from the chassis to the field and voice coil terminals of the dynamic speaker are made by means of a plug inserted in a four-prong wafer-type socket at the rear of the receiver.



Front view of the S-W "Pentode Four," without front panel. A good vernier dial should be used for tuning the variable condenser.

Constructional Details

A 12 to 14 gauge aluminum chassis is used. When bent to final shape its dimensions are 13½ x 10¾ x 2½ inches high. Socket holes and a hole for a flush mounting power supply transformer should be drilled out before chassis is bent. Afterwards, wafer sockets are mounted as indicated in the sketches and illustrations. The twin binding posts are mounted next and then the three potentiometers (8, 17, 23). Mounting holes are next drilled in the upright chassis walls for the electrolytic condensers, audio transformer, etc., and these parts are mounted. The dual variable condenser is mounted on top of the chassis, using spade-end bolts which fasten at the front and rear of the condenser, pass through holes in the chassis and are secured underneath by small hexagonal nuts.

Next, the parts beneath the chassis are mounted. The various fixed resistors and fixed condensers are soldered in place, as near as possible to the sockets of the tubes with which they are to function.

Wiring the Short-Wave Pentode Four

The wiring follows normal procedure, circuits being wired in the following order: filaments, grids, plates, cathodes, by-pass condensers and negative returns, antenna and ground connections, rectifier tube and filter connections and primary of power supply transformer.

The correct methods of making connections to the sockets for the new tubes are shown in diagram. The schematic diagram is marked to show that the control grid connections to the tubes (6) and (14) are made at the *caps*. In the case of both these tubes the suppressor grid is the one which is grounded to the cathode.

An examination of the Alden short-wave coils shows that the upper ends of both windings on each coil go to the two thin prongs, while the lower coil ends go to the thick filament prongs. Therefore, in wiring socket (2), connect both filament terminals to ground. If the socket is in such a position that the filament terminals are at the right (looking down on top of socket), then the upper thin prong should be connected to the antenna post, and the lower thin prong to the stator of (3) and to the screen grid clip going to the cap of tube (6).

In wiring socket (11), if socket is in such a position that the large filament terminals are at the right (looking down on top of socket), then the upper filament terminal should be connected to the plate terminal of tube (14) and the lower filament terminal should be connected to fixed condenser (10) and fixed resistors (18) and (21). The upper thin terminal is connected to the R.F. choke (20) and fixed condenser (19). The lower thin terminal is connected to grid condenser (12), stator of condenser (9) and plate of tube (6). If the finished receiver does not give regenerative whistles, this is a sign that the tickler coil is reversed or short-circuited. The leads to the caps of tubes (6) and (14) should be shielded. If shields are employed over these tubes, they should be of the new type, especially designed to fit 58 and 57 tubes. The Alden coils may also be shielded, using small aluminum cans.

List of Parts Required for the Short-Wave Pentode Four with 56, 57, 58 and PZ Tubes

2 sets of Alden short-wave plug-in coils, covering bands from 16 to 200 meters (2. 11).
1 Cardwell .000150 mf. (each section) two-gang "Midway" featherweight variable condenser, type 405-B Dual (3, 9).
1 Electrad potentiometer, type RI-240P, 10,000 ohms (8) with "on-off" switch (41).
1 Electrad potentiometer, type RI-205, 50,000 ohms (17).
1 Electrad potentiometer, type RI-203, 500,000 ohms (23).
1 Electrad Truvolt 200-ohm flexible resistor, type 2G200 (7).
1 Electrad Truvolt 400-ohm flexible resistor, type 2G400 (37).
1 Aerovox 25 mf., 25 volts, dry electrolytic condenser, type E-25-25 (38).

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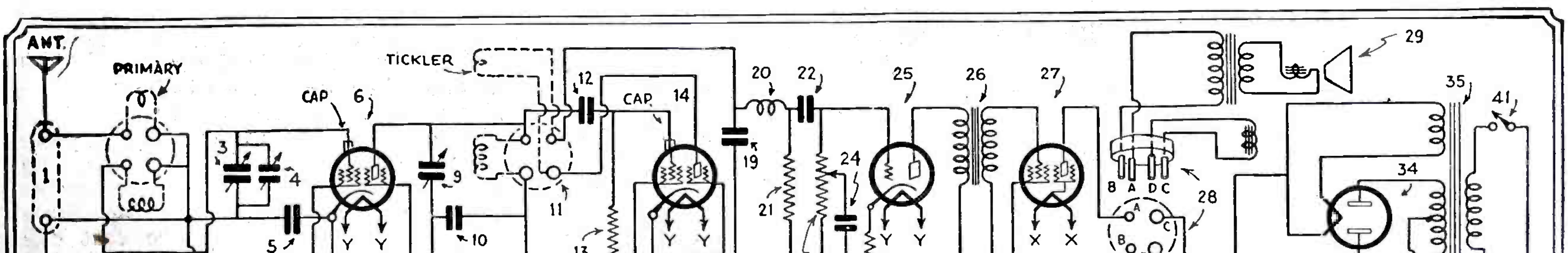
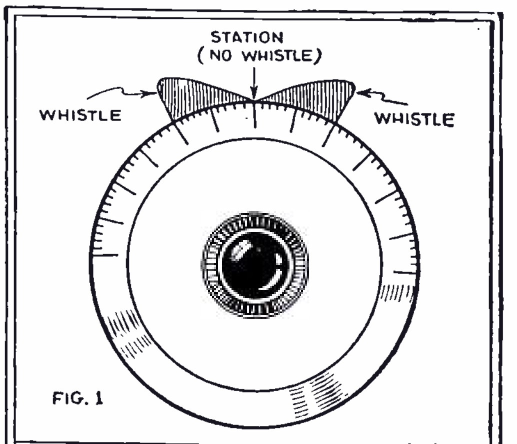
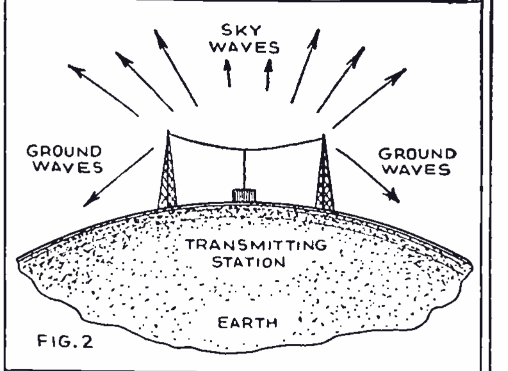
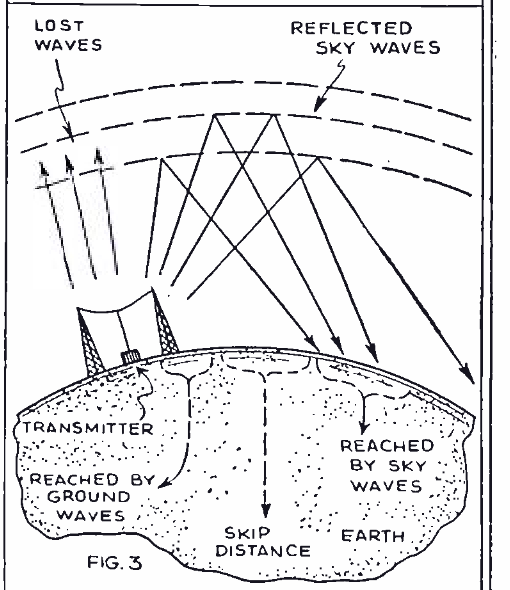
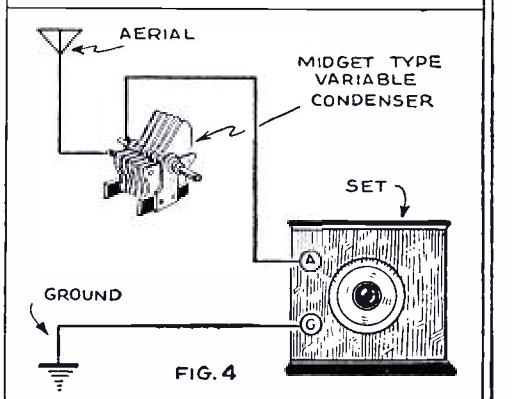


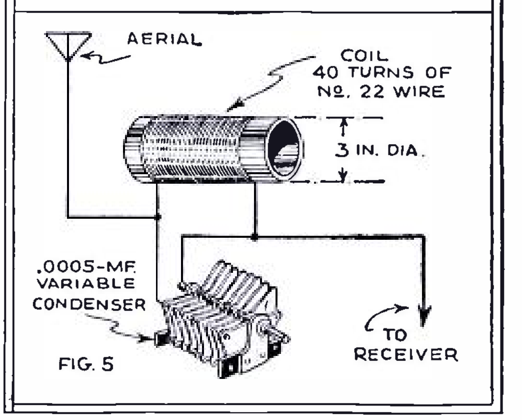
The Short-Wave "Pentode Four" has been very cleverly worked out by Mr. Cisin. With its many really excellent features, it could hardly have a simpler wiring diagram than the one shown.











Above: Illustrating how signal is tuned in by zero-beat; sky and ground waves; reflection and skip-distance effects, and methods for eliminating "dead-spots."

The SHORT-WAVE BEGINNER

By C. W. PALMER

Mr. Palmer explains how to tune a short-wave receiver; the importance of listening at the right time; skipping and fading effects; dead-spots — and how to eliminate them.

Tuning the Short Wave Receiver

No. 4 of a Series

● THE knack of operating a short-wave receiver correctly is usually learned only after considerable trying on the part of the operator, whether he is a beginner or a "dyed-in-the-wool" veteran. Each receiver acts a little differently from any other and we must find the best way to handle our set, by continuous trying.

Probably more short-wave sets fail to give satisfaction because of incorrect handling than for any other reason. The novice invariably manipulates the tuning dials much too rapidly. Due to the fact that several stations may often be tuned in and out within the space of one division on the tuning dial, it must be turned very slowly even with a vernier dial, or the stations will be passed by without being heard. The ability to turn the dials slowly and patiently must be acquired. We are all used to the regular broadcast receivers which may be tuned roughly until the station is heard and then adjusted to the best point. This habit of tuning the latter receivers makes the task of correctly tuning our short-wave set even more difficult.

Two Methods of Tuning

There are two methods of tuning regenerative receivers. (The Beginner's Receiver is a set of this type.) The first way is to set all controls such as the volume control, antenna series condenser, etc., at the point where the loudest music is heard on local stations. Then advance the regeneration control (volume control on the Beginner's Set) until the set drops into oscillation. We will remember from a previous explanation that the set is oscillating when a slight hiss is heard which suddenly stops with an abrupt click as we turn the regeneration control to the right. The period where the hissing noise is heard is known as *regeneration* and the set is extremely sensitive when operated in this condition. If we turn the regeneration control until the set is oscillating and then turn the tuning dial, a whistle will be heard whenever a broadcasting station is passed. This whistle is caused by the oscillation of the receiver (which is just like a miniature transmitter) interfering with the waves sent out from the broadcasting station. When the whistle is heard, all we have to do is to turn the regeneration control back until the set passes the point of oscillation and is regenerating. We may also have to slightly readjust the tuning dial to obtain the greatest volume.

If the incoming signal is fairly strong, we will find that the program comes through clear and free of the whistle. However, if the signal is weak, the whistle will dominate the voice or music and clear signals will not be heard. In this case, the "zero-beat" method of tuning is more satisfactory.

To tune by the "zero-beat" method, turn the regeneration control until the set just passes into oscillation. Then tune the set very carefully until it is at the critical point between the two whistles which identify the presence of a station, at which it will be found that no whistle is heard. At this point there is no whistle because the signal generated by the receiver corresponds exactly to that of the broadcasting station and they do not interfere with each other. Figure 1 illustrates zero-beat tuning.

You can tell when the point of zero-beat is reached by turning the tuning dial slightly to one side or the other. The slightest deviation on either side will cause the whistle to reappear. Zero-beating is an excellent means of fishing for weak or far distant stations, as the set is in a very sensitive condition when oscillating. Many distant stations that you cannot hear at all when the set is regenerating can be tuned in with sufficient strength to at least identify them, if you zero-beat them.

Time Differences

When trying to receive distant or foreign stations, the difference between the time at the locality of the receiver and the transmitter must be remembered.

It is possible to receive great distances on short waves with very simple equipment. However, to receive these far-away stations, intelligent handling of the receiver is necessary. For instance, it would be rather foolish for us to listen for a station in Paris that signs off at 12 midnight at a time later than 7 p.m. in New York, for it is 12 midnight in the former city at this time.

Greenwich Time is the system of time accepted in all countries to have a world standard. Greenwich Mean Time is noon at the moment when the mean sun passes over the meridian of Greenwich, England. Standard Time is the time accepted over a large area, such as Eastern Standard Time, which covers the east coast of the United States. The true local time may vary almost an hour in this area, even though the accepted time is the same in any part.

The meridian of Greenwich, England, has been taken as the prime meridian and there are twenty-four standard meridians around the earth, differing by 15 degrees longitude east and west. These meridians were established in order that the time in any part of the earth may

(*Continued on page* 381)

$500.00 Short Wave Builder's Prize Contest

$100 In Monthly Prizes For Best Models

In the May number of SHORT WAVE CRAFT, we announced, in considerable detail, this new contest and the rules for those desiring to enter sets in the contest. For the benefit of those who did not read the original announcement in the May number, we mention here some of the more important points that you should bear in mind.

The closing date for the September contest is given below. The keynote of this contest is expressed by the single word—SIMPLEST.

Short wave set builders may submit any one of the following apparatus:

SHORT WAVE SET
SHORT WAVE ADAPTER
SHORT WAVE CONVERTER

You will please note that the set must be BUILT BY YOU and furthermore THE SETS THEMSELVES must be sent, PREPAID, preferably by express, to the editorial offices of SHORT WAVE CRAFT. Remember that WORKMANSHIP will be one of the strong factors that the judges will have in mind in awarding prizes. Sets may be sent with or without phones or loud-speaker. Data is given below on the length of descriptive article, diagrams and other information required by the judges. Have your article typewritten, if at all possible; diagrams need not be finished mechanical drawings, as our draughtsmen will re-draw diagrams for publication, but make neat sketches in ink. All coil and condenser data must be given; also all resistor and speaker (or phones) ohmic or impedance values.

FIRST PRIZE	$50.00
SECOND PRIZE . . .	25.00
THIRD PRIZE	12.50
FOURTH PRIZE . . .	7.50
FIFTH PRIZE	5.00

RULES FOR $500.00 SHORT WAVE BUILDER'S CONTEST

During the contest period, SHORT WAVE CRAFT will award a total of $500.00 in prizes in an important new contest. You are asked to build a home-made short wave set which should fill one or more of the following requirements: 1, Simplicity; 2, Compactness; 3, Ingenuity; 4, Novelty of Circuit Used; 5, Portability; 6, Workmanship.

Read carefully the text of the adjoining article, and observe the following simple rules:

1.—Short wave sets submitted may be in either of the following classes:
"Straight" S-W Receiving Set (battery operated or A.C. operated).
Short Wave Converter.
Short Wave Adapter.

2.—Sets must be home-made and built by contestants themselves. Manufactured sets are absolutely excluded from this contest.

3.—Sets submitted may be for ONE, TWO, THREE and NOT MORE THAN FIVE TUBES. Any type of tube as selected by the builder can be used. Crystal operation or crystal-tube combinations allowable, at the option of builder. Sets may be of any size or shape, at the option of the builder.

4.—In order to win a prize, it is necessary that the set itself be submitted to the editors. The five best models submitted each month will be awarded the prizes as scheduled here.

5.—All sets submitted to SHORT WAVE CRAFT Magazine will be returned to their owners after they have been judged and described for the benefit of SHORT WAVE CRAFT readers in the magazine.

6.—This is a monthly contest, which began May 1st, 1932, and will last for five months. Each monthly contest closes on the 1st of the following month. Thus the contest for September closes Midnight October 1st, 1932, at which time all entries for this month must be in the editorial offices of SHORT WAVE CRAFT. The fourth prize-winning announcements will be made in the November, 1932, issue of SHORT WAVE CRAFT.

7.—Every set must be accompanied by an article written by the builder, and contain not more than 2,000 words, giving minute instructions with wiring (schematic) diagram, list of parts with values of all resistors, condensers, coil data, including number of turns, etc., how the set was built, its operating characteristics, what stations have been received with it, and other information considered important by the builder. Such article should be typewritten or written in ink, and should be sent separately by mail, and should not be included with the set itself!

8.—All sets must be shipped in strong wooden boxes, NEVER in cardboard boxes. All sets must be sent "prepaid"! Sets sent "charges collect" will be refused. SHORT WAVE CRAFT Magazine cannot be held responsible for breakage in transit due to improper packing of sets. Before packing the set, be sure to affix tag with string giving your name and address to the set itself. IN ADDITION, PUT YOUR NAME AND ADDRESS ON THE OUTSIDE OF THE WRAPPER OF THE PACKAGE.

9.—Employes and their families of SHORT WAVE CRAFT are excluded.

10.—The judges will be the Editors of SHORT WAVE CRAFT Magazine, and the following short wave experts: Robert Hertzberg, Clifford E. Denton. Their findings will be final.

11.—Address all letters, packages, etc., to Editor, SHORT WAVE BUILDER'S CONTEST, care SHORT WAVE CRAFT Magazine, 96-98 Park Place, New York.

When to Listen In

Yucatan, Mexico

● "HERE'S a station that has not yet been mentioned in SHORT WAVE CRAFT. It's a radio telephone station in Merida, Yucatan, Mexico, and comes in just above FYA (on 25.63 meters) every night from 6 to 7:30 p.m., E. D. S. T. They broadcast phonograph records and then a man calls 'Volla Volla Mexico!' and carries on a conversation with another man. About one meter below FYA I receive the other end of the conversation, but I don't know the call letters of either station.

"Another new station is KEJ, Bolinas, California, on 9,010 kc., which transmits programs to KGMB at Honolulu, Hawaii. For the benefit of Super-Wasp owners, it comes in about ten points on the dial above W2XAF, and can be identified by the call, 'Hello, Koko Head.' Still another station I have heard is PSH, Rio de Janeiro, calling Buenos Aires on 10,260 kc."—*Ernest Lehman, 842 Milton Place, Woodmere, L. I.*

Any Stations in Greece?

We have received several letters from readers inquiring about short-wave broadcasting stations in Greece. To the best of our knowledge there are no such stations in the country, but, then, new stations pop up unexpectedly and you can never tell. If you have any "dope" on this matter, please write to us and give full details.

Another in Brazil

William O'Brien, 609 West 1st Street, Fulton, N. Y., writes:

"I have what I believe is a new short-wave station for your list. The station is PRGA, Rio de Janeiro, Brazil, on 31.58 meters. I have heard it on or about 7 p. m. E. S. T. for a period of two weeks.

"I also compliment you on such a fine magazine. It is the best short-wave magazine on the newsstand. Have heard a few short-wave stations such as PRGA, W3XAL, W2XE, XDA, W8XAL, W9XF, W9XAA, W8XK, VE9GW, VE9CL, HKD and G5SW. I have also heard many amateur and code stations. I would like to correspond with other short-wave hounds. I am interested in transmitters.'

Good Reception

● DAVID BROWN, of 132 Pine Street, Woodmere, L. I., seems to be enjoying good results from his short-wave receiver. The following letter from him is of interest.

"Your magazine deserves much credit for the accurate list of short-wave transmissions published. I have a three-tube regenerative outfit and have had much luck with it. I would like to give some information on what I call the "Big Three of the Air" during the evening from 8 o'clock Eastern Daylight Saving Time to 10 o'clock.

"EAQ, Madrid, Spain, is a 20-kw. station on 30.3 meters and is easily identified. Announcements are made in Spanish and English. The Spanish announcer gives the phonetic call. The English announcement follows. Toward the end of the program the English announcer acknowledges reports of reception. They sign off promptly at 10 o'clock.

"LSX comes on at 9. The announcements are in Spanish, as follows: 'LSX. Transradio Buenos Aires.' Music is the usual fare. They sign off with the San Lorenzo march at 10 p. m.

"PROH is the station of the Radio Club of Rio de Janeiro. Announcements are made in English, French, and Spanish. The English announcements are as follows: 'PROH, the experimental station of the Radio Club of Rio de Janeiro.' Their wavelength is 31.75 meters and is right above W2XAF.

"Information about other powerful transmitters is as follows:

"The Service de la Radiodiffission at Paris maintains the French Colonial station. Announcements are as follows: 'Allo allo. Ici Paris, station Radio Colonial.' Their wavelength is 25.63 meters. Every Monday there is an English program sponsored by the Veterans of Foreign Wars. This program is especially intended for American listeners.

"The old standby, G5SW, Chelmsford, England, has fifteen minutes of news items immediately following the midnight chimes of Big Ben. This program is of interest to American listeners because it gives British views on American news events. They close down at 7:15 p. m. with the announcement: 'G5SW, the British Broadcasting Corporation station to the British colonies, is now closing down. Good night, everybody, good night.'

"All this information is authentic because the stations have verified my reports and I consistently listen to them. I should like to hear from owners of the old regenerative circuit as to their results. I will answer all letters."

SHORT WAVE STATIONS OF THE WORLD

ALL SCHEDULES EASTERN STANDARD TIME: ADD 5 HOURS FOR GREENWICH MEAN TIME

Wavelength (Meters)	Frequency (Kilocycles)	Call Letters	Address and Schedule
13.93	21,540	W8XK	Westinghouse Electric, East Pittsburgh, Pa. 7:30 a.m.-noon.
16.87	17,780	W3XAL	National Broadcasting Co., Bound Brook, N. J.
		W9XF	Downers Grove, Ill.
19.56	15,330	W2XAD	General Electric Co., Schenectady, N. Y. Broadcasts 3-6 p.m. daily; 1-6 p.m. Sat. and Sunday.
19.65	15,270	W2XE	Wayne, N. J.
19.68	15,240		Pontoise (Paris), France. 9:30-12:30 a.m. Service de la Radiodiffusion, 103 Rue de Grenelle, Paris.
19.72	15,210	W8XK	Westinghouse Electric & Mfg. Co., East Pittsburgh. 7:30 a.m. to 5 p.m.
		DJB	For address, see listing for DJA. Mondays, 10-11 p.m.
19.83	15,120	HVJ	Vatican City (Rome, Italy) Daily, 5:00 to 5:15 a.m.
		JIAA	Tokio, Japan. Irregular.
19.99	15,000	CM6XJ	Central Tuinucu, Cuba, Irregular.
20.50	14,620	XDA	Trens-News Agency, Mexico City, 2:30-3 p.m.
20.95	14,310	G2NM	Gerald Marcuse, Sonning-on-Thames, England. Sundays, 1:30 p.m.
21.50	13,940	......	University of Bucharest, Bucharest, Roumania, 2-5 p.m., Wed., Sat.
23.35	12,850	W2XO	General Electric Co., Schenectady, N. Y. Antipodal program 9 p.m. Mon. to 3 a.m. Tues. Noon to 5 p.m. on Tues, Thurs. and Sat.
		W2XCU	Ampere, N. J.
		W9XL	Anoka, Minn., and other experimental relay broadcasters.
23.38	12,820	......	Director General, Telegraph and Telephone Stations, Rabat, Morocco. Sun., 7:30-9 a.m. Daily 5-7 a.m. Telephony.
25.63	11,920	FYA	Pontoise, France. 1-3 p.m. daily.
25.24	11,880	W9XF	National Broadcasting Co., Downers Grove (Chicago), Ill. 9-10 p.m. daily.
25.26	11,870	VUC	Calcutta, India. 9:45-10:45 p.m.; 8-9 a.m.
		W8XK	Westinghouse Electric, East Pittsburgh, Pa. 4-10 p.m.
25.34	11,840	W9XAO	Chicago Federation of Labor, Chicago, Ill. 7-8 a.m., 1-2, 4-5:30, 6-7:30 p.m.
25.36	11,830	W2XE	Wayne, N. J.
25.42	11,800	VE9GW	W. A. Shane, Chief Engineer, Bowmanville, Canada. Daily,1-4 p.m.
25.45	11,790	W1XAL	Boston, Mass.
25.47	11,780	VE9DR	Drummondville, Quebec, Canada. Irregular.
25.50	11,760	XDA	Trens-News Agency, Mexico City. 3-4 p.m.
25.53	11,750	G5SW	British Broadcasting Corporation, Chelmsford, England. Mon. to Sat., 1:45-7:15 p.m.
		VE9JR	Winnipeg, Canada. Weekdays, 5:30-7:30 p.m.
29.30	10,250	TI4	Amondo Cespedes Marin, Heredia, Costa Rica. Mon. and Wed., 7:30 to 8:30 p.m.; Thurs. and Sat., 9:00 to 10 p.m.
30.3	9,890	EAQ	Transradio Espanola, Alcala, 43-Madrid, P.O. Box 951, Spain. 11:30 p.m.-1 a.m.; 6-8 p.m., daily; 1-3 p.m. Saturday.
31.10	9,640	HSP2	Broadcasting Service, Post and Telegraph Department, Bangkok, Siam. 9-11 a.m. daily.
31.28	9,590	VK2ME	Amalgamated Wireless, Ltd., 47 York St., Sydney, Australia. Sun., 1-3 a.m. 5-9 a.m., 9:30-11:30 a.m.
31.30	9,580	W3XAU	Byberry, Pa., relays WCAU daily.
31.33	9,570	W1XAZ	Westinghouse Electric & Mfg. Co., Springfield, Mass. 6 a.m.-10 p.m. daily.
		SRI	Poznan, Poland. Tues. 1:45-4:45 p.m., Thurs. 1:30-8 p.m.
31.38	9,560	DJA	Reichspostzentralamt, 11-15 Schoenberge Strasse (Berlin). Konigswusterhausen, Germany. Daily, 8 a.m.-7:30 p.m.
31.48	9,530	W2XAF	General Electric Co., Schenectady, N. Y., 5-11 p.m. daily.

Wavelength (Meters)	Frequency (Kilocycles)	Call Letters	Address and Schedule
31.49	9,520	OXY	Skamleboek, Denmark. 2-7 p.m daily.
31.55	9,510	VK3ME	Amalgamated Wireless, Ltd., 47 York St., Melbourne, Australia. Wed. and Sat., 5-6:30 a.m.
31.70	9,460	......	Radio Club of Buenos Aires, Argentina.
32.00	9,375	EH9OC	Berne, Switzerland. 3-5:30 p.m.
32.26	9,290	......	Rabat, Morocco. 3-5 p.m. Sunday, and irregularly weekdays.
35.00	8,570	RV15	Far East Radio Station, Khabarovsk, Siberia. 5-7:30 a.m.
38.6	7,790	HBP	League of Nations, Geneva, Switzerland. 3-8 p.m., irregular.
39.80	7,530	......	"El Prado," Riobamba, Ecuador. Thurs., 9-11 p.m.
40.00	7,500	......	"Radio-Touraine," France.
40.20	7,460	YR	Lyons, France. Daily except Sun., 10:30 to 1:30 a.m.
40.50	7,410	......	Eberswalde, Germany. Mon., Thurs., 1-2 p.m.
40.70	7,370	X26A	Nuevo Laredo, Mexico. 9-10 a.m.; 11 a.m.-noon; 1-2; 4-5; 7-8 p.m. Tests after midnight. I.S.W.C. programs 11 p.m. Wed. A.P. 31.
40.90	7,320	ZTJ	Johannesburg, So. Africa. 9:30 a.m.-2:30 p.m.
41.46	7,230	DOA	Doeberitz, Germany.
41.50	7,220	HB9D	Zurich, Switzerland. 1st and 3rd Sundays at 7 a.m., 2 p.m.
		......	Budapest, Hungary 2:30-3:10 a.m., Tu., Thurs., Sat. Budapest Technical School, M.R.C., Budapest, Muegyetem.
41.67	7,195	VS1AB	Singapore, S. S. Mon., Wed. and Fri., 9:30-11 a.m.
42.00	7,140	HKX	Bogota, Colombia.
42.70	7,020	EAR125	Madrid, Spain. 6-7 p.m.
42.90	6,990	CT1AA	Lisbon, Portugal. Fridays, 5-7 p.m.
43.00	6,980	EAR110	Madrid, Spain. Tues. and Sat., 5:30 to 7 p. m.; Fri., 7 to 8 p.m.

(NOTE: This list is compiled from many sources, all of which are not in agreement, and which show greater or less discrepancies; in view of the fact that most schedules and many wavelengths are still in an experimental stage; and that wavelengths are calculated differently in many schedules. In addition to this, one experimental station may operate on any of several wavelengths which are assigned to a group of stations in common. We shall be glad to receive later and more accurate information from broadcasters and other transmitting organizations, and from listeners who have authentic information as to calls, exact wavelengths and schedules. We cannot undertake to answer readers who inquire as to the identity of unknown stations heard, as that is a matter of guesswork; in addition to this, the harmonics of many local long-wave stations can be heard in a short-wave receiver.—EDITOR.)

Wavelength (Meters)	Frequency (Kilocycles)	Call Letters	Address and Schedule
43.60	6,875	F8MC	Casablanca, Morocco. Sun., Tues., Wed., Sat.
46.10	6,480	TGW	Guatamala City, Guat. 8-10 p.m.
46.70	6,425	W9XL	Anoka, Minn.
46.70	6,425	W3XL	National Broadcasting Co. Bound Brook, N. J. Relays WJZ, irregular.
46.72	6,420	RV62	Minsk, U.S.S.R. Irregular.
47.00	6,380	HC1DR	Quito, Ecuador. 8-11 p.m.
47.35	6,335	VE9AP	Drummondville, Canada.
		CN8MC	Casablanca, Morocco. Mon. 3-4 p.m., Tues. 7-8 a.m., 3-4 p.m. Relays Rabat.
47.81	6,270	HKC	Bogota, Colombia. 8:30-11:30 p.m.
48.00	6,250	HKA	Barranquilla, Colombia. 8-10 p.m. ex. Mo., Wed., Fri.
48.62	6,170	HRB	Tegucigalpa, Honduras. Monday, Wednesday, Friday, Saturday 5-6 p.m. and 9-12 p.m.
48.86	6,140	W8XK	Westinghouse Electric and Mfg. Co., East Pittsburgh, Pa. 5 p.m.-midnight
48.99	6,120	......	Motala, Sweden, "Rundradio," 6:30-7 a.m., 11-4:30 p.m. Holidays, 5 a.m. to 5 p.m.

Wavelength (Meters)	Frequency (Kilocycles)	Call Letters	Address and Schedule
48.99	6,120	W2XE	Columbia Broadcasting System, 485 Madison Avenue, New York, N. Y. 7:00-a.m. to midnight.
		FL	Eiffel Tower, Paris. 5:30-5:45 a.m., 5:45-12:30, 4:15-4:45 p. m.
		......	Toulouse, France. Sunday, 2:30-4 p. m.
49.10	6,110	VE9CG	Calgary, Alta., Canada.
49.15	6,100	W3XAL	National Broadcasting Company, Bound Brook, N.J., Irregular.
		VE9CF	Halifax, N. S., Canada. 6-10 p.m., Tu., Thu., Fri.
49.17	6,095	VE9GW	Bowmanville, Ontario, Canada. 4-10 p.m.
49.18	6,100	W9XF	Downers Grove, Ill.
49.31	6,080	W9XAA	Chicago Federation of Labor, Chicago, Ill. 6-7 a. m., 7-8 p.m., 9:30-10:15, 11-12 p.m. Int. S.-W. Club programs. From 10 p.m. Saturday to 6 a.m. Sunday.
49.40	6,070	VE9CS	Vancouver, B. C., Canada. Fridays before 1:30 a.m. Sundays, 2 and 10:30 p.m.
		......	Johanesburg, South Africa. 10:30 a.m.-3:30 p.m.
49.46	6,065	SAJ	Motala, Sweden. 6:30-7 a. m., 11 a.m. to 4:30 p.m.
49.50	6,060	W8XAL	Crosley Radio Corp., Cincinnati, O. Relays 6:30-10 a.m., 1-3 p.m., 6 p.m. to 2 a.m. daily. Sunday after 1 p.m.
49.50	6,060	VQ7LD	Imperial and International Communications, Ltd., Nairobi, Kenya, Africa. Monday, Wednesday, Friday, 11 a.m.-2:30 p.m.; Tuesday, Thursday, 11:30 a.m.-2:30 p.m.; Saturday, 11:30 a.m.-3:30 p.m.; Sunday, 11 a.m. - 1:30 p.m.; Tuesday, 3 a.m.-4 a.m.; Thursday, 8 a.m.-9 a.m.
		W3XAU	Byberry, Pa. Relays WCAU.
49.59	6,050	VE9CF	Halifax, N. S., Canada. 11 a.m.-noon, 5-6 p.m. On Wed., 8-9; Sun., 6:30-8:15 p.m.
		HKD	Barranquilla, Columbia.
49.67	6,040	PK3AN	Sourabaya, Java. 6-9 a.m.
		W4XB	Lawrence E. Dutton, care Isle of Dreams Broadcasting Corp., Miami Beach, Fla.
49.75	6,030	VE9CA	Calgary, Alta., Canada.
49.96	6,005	VE9DR	Canadian Marconi Co., Drummondville, Quebec. 6-10 p.m. daily.
49.97	6,000	YV2BC	Caracas, Venezuela. 7:45-11 p.m. daily ex. Mon.
		......	Eiffel Tower, Paris, France. Testing, 6:30 to 6:45 a.m.; 1:15 to 1:30, 5:15 to 5:45 p.m., around this wave.
		VE9CU	Calgary, Canada.
49.97	6,000	......	Administration des P. T. T., Tananarive, Madagascar. Tues., Wed., Thurs., Fri., 9:30 - 11:30 a.m. Sat. and Sun., 1-3 p.m.
50.26	5,970	HVJ	Vatican City (Rome). 2-2:15 p.m., daily. Sun., 5-5:30 a.m.
50.80	5,900	HKO	Medellin, Colombia. 8-11 p.m., except Sunday.
51.40	5,835	HKD	Barranquilla, Colombia. 7:45-10:30 p.m. Mon., Wed. 8-10:30 p.m.; Sunday 7:45-8:30 p.m. Elias J. Pellet.
52.50	5,710	VE9CL	Winnipeg, Canada.
54.02	5,550	W8XJ	Columbus, Ohio.
58.00	5,170	OK1MPT	Prague, Czechoslovakia. 1-3:30 p.m., Tues. and Fri.
		PMY	Bandoeng, Java.
		PMB	Sourabaya, Java.
60.30	4,975	W2XV	Radio Engineering Laboratories, Inc., Long Island City, N. Y. Irregular.
62.56	4,795	W9XAM	Elgin, Ill. (Time signals.)
		W3XZ	Washington, D. C.
		W9XL	Chicago, Ill.
67.65	4,430	DOA	Doeberitz, Germany. 6-7 p.m., 2-3 p.m., Mon., Wed., Fri.
70.00	4,280	OHK2	Vienna, Austria. Sun., first 15 minutes of hour from 1 to 7 p.m.
70.20	4,273	RV15	Far East Radio Station, Khabarovsk, Siberia. Daily, 3-9 a.m.
7.05	42,530	......	Berlin, Germany. Tues. and Thurs., 11:30-1:30 p.m. Telefunken Co.

(Continued on opposite page)

SHORT WAVE STATIONS OF THE WORLD

(Continued from opposite page)

Short Wave Broadcasting Stations

80.00	3,750	F8KR	Constantine, Tunis, Africa. Mon. and Fri.
		I3RO	Prato Smeraldo. Rome, Italy. Daily, 3-5 p.m.
82.90	3,620	DOA	Doeberitz, Germany.
81.24	3,560	OZ7RL	Copenhagen, Denmark. Tues. and Fri. after 6 p.m.
128.09	2,342	W7XAW	Fisher's Blend, Inc., Fourth Ave. and University St., Seattle, Washington.

Experimental and Commercial Radio-Telephone Stations

Wavelength (Meters)	Frequency (Kilocycles)	Call Letters	Address and Schedule
9.68	31,000	W8XI	Pittsburgh, Pa.
10.79	27,800	W6XD	Palo Alto, Calif. M. R. T. Co.
11.55	25,960	G5SW	Chelmsford, England, Experimental.
11.67	25,700	W2XBC	New Brunswick, N. J.
12.48	24,000	W6XQ	San Mateo, Calif.
			Vienna, Austria, Mon., Wed., Sat.
14.00	21,420	W2XDJ	Deal, N. J.
			And other experimental stations.
14.01	21,400	WLO	American Telephone & Telegraph Co., Lawrence, N. J., transatlantic phone.
14.15	21,130	LSM	Monte Grande, Argentina.
14.27	21,020	LSN	(Hurlingham), Buenos Aires, Argentina.
14.28	21,000	OKI	Podebrady, Czechoslovakia.
14.47	20,710	LSY	Monte Grande, Argentina. Telephony.
14.50	20,680	LSN	Monte Grande, Argentina, after 10:30 p.m. Telephony with Europe.
		LSX	Buenos Aires. Telephony with U. S.
		FSR	Paris-Saigon phone.
14.54	20,620	PMB	Bandoeng, Java. After 4 a.m.
14.89	20,140	DWG	Nauen, Germany. Tests 10 a.m.-3 p.m.
15.03	19,950	LSG	Monte Grande, Argentina. From 7 a.m. to 1 p.m. Telephony to Paris and Nauen (Berlin).
		DIH	Nauen, Germany.
15.07	19,906	LSG	Monte Grande, Argentina. 8-10 a.m.
15.10	19,850	WMI	Deal, N. J.
15.12	19,830	FTD	St. Assise, France.
15.45	19,400	FRO, FRE	St. Assise, France.
15.55	19,300	FTM	St. Assise, France. 10 a.m. to noon.
15.58	19,240	DFA	Nauen, Germany.
15.60	19,220	WNC	Deal, N. J.
15.94	18,820	PLE	Bandoeng, Java. 8:40-10:40 a.m. Phone service to Holland.
16.10	18,620	GBJ	Bodmin, England. Telephony with Montreal.
16.11	18,620	GBU	Rugby, England.
16.33	18,370	PMC	Bandoeng, Java.
16.35	18,350	WND	Deal Beach, N. J. Transatlantic telephony.
16.38	18,310	GBS	Rugby, England. Telephony with New York. General Postoffice, London.
		FZS	Saigon, Indo-China. 1 to 3 p.m. Sundays.
16.44	18,240	FRO, FRE	Ste. Assise, France.
16.50	18,170	CGA	Drummondville, Quebec, Canada. Telephony to England.
16.57	18,100	GBK	Bodmin, England.
16.61	18,050	KQJ	Bolinas, Calif.
16.80	17,850	PLF	Bandoeng, Java ("Radio Malabar").
		W2XAO	New Brunswick, N. J.
16.82	17,830	PCV	Kootwijk, Holland. 9:40 a.m. Sat.
16.87	17,780	W8XK	Westinghouse Eleteric and Mfg. Co., Saxonburg, Pa.
17.00	17,640		Ship, Phones to Shore: WSBN, "Leviathan"; GFWV, "Majestic"; GLSQ, "Olympic"; GDLJ, "Homeric"; GMJQ, "Belgenland"; work on this and higher channels.
17.25	17,380	JIAA	Tokio, Japan.
17.34	17,300	W8XL	Dayton, Ohio.
		W6XAJ	Oakland, Calif.
		W9XL	Anoka, Minn., and other experimental stations.
17.52	17,110	WOO	Deal, N. J. Transatlantic phone.
		W2XDO	Ocean Gate, N. J. A. T. & T. Co.
17.55	17,080	GBC	Rugby, England.
18.40	16,300	PCL	Kootwijk, Holland. Works with Bandoeng from 7 a.m.
		WLO	Lawrence, N. J.
18.50	16,200	FZR	Saigon, Indo-China.
18.56	16,150	GBX	Rugby, England.
18.68	16,060	NAA	U. S. Navy, Arlington, Va. Time signals, 11:57 to noon.
18.80	15,950	PLG	Bandoeng, Java. Afternoons.
18.90	15,860	FTK	St. Assise, France. Telephony.
18.93	15,760	JIAA	Tokio, Japan. Up to 10 a.m. Beam transmitter.
19.60	15,300	OXY	Lyngby, Denmark. Experimental.
20.65	14,530	LSA	Buenos Aires, Argentina.
20.70	14,480	GGBW	Radio Section, General Post Office, London, E. C. 1. Rugby, England.
		WNC	Deal, N. J.
20.80	14,420	VPD	Suva, Fiji Islands.
21.17	14,150	KKZ	Bolinas, Calif.
22.38	13,400	WND	Deal Beach, N. J. Transatlantic telephony.
23.46	12,780	GBC	Rugby, England.
24.41	12,290	GBU	Rugby, England.
24.46	12,250	FTN	Ste. Assise (Paris), France. Works Buenos Aires, Indo-China and Java. On 9 a.m. to 1 p.m. and other hours.
		GBS	Rugby, England.
		PLM	Bandoeng, Java. 7:45 a.m.
24.68	12,150	GBS	Rugby, England. Transatlantic phone to deal, N. J. (New York).
		FQO, FQE	Ste. Assise, France.
24.80	12,090	......	Tokio, Japan. 5-8 a.m.
24.89	12.045	NAA	Arlington, Va. Time signals, 11:57 to noon.
		NSS	Annapolis, Md. Time signals, 9:57-10 p.m.
24.98	12,000	FZG	Saigon, Indo-China. Time signals, 2-2:05 p.m.
25.10	11,945	KKQ	Bolinas, Calif.
25.65	11,680	YVQ	Maracay, Venezuela. (Also broadcasts occasionally.)
25.68	11,670	KIO	Kahuhu, Hawaii.
26.00	11,530	CGA	Drummondville, Canada.
26.10	11,490	GBK	Bedmin, England.
26.15	11,470	IBDK	S.S. "Elettra," Marconi's yacht.
26.22	11,435	DHC	Nauen, Germany.
26.44	11,340	DAN	Nordeich, Germany. Time signals, 7 a.m., 7 p.m. Deutsche Seewarte, Hamburg.
27.30	10,980	ZLW	Wellington, N. Z. Tests 3-8 a.m.
28.20	10,630	PLR	Bandoeng, Java. Works with Holland and France weekdays from 7 a.m.; sometimes after 9:30.
28.44	10.540	WLO	Lawrence, N. J.
		VLK	Sydney, Australia. 1-7 a.m.
28.80	10,410	PDK	Kootwijk, Holland.
		KEZ	Bolinas, Calif.
		LSY	Buenos Aires, Argentina.
28.86	10,390	GBX	Rugby, England.
29.54	10,150	DIS	Nauen, Germany. Press (code) daily; 6 p.m., Spanish; 7 p.m., English; 7:50 p.m., German; 2:30 p.m., English; 5 p.m., German. Sundays: 6 p.m., Spanish; 7:50 p.m., German; 9:30 p.m., Spanish.
30.15	9,950	GBU	Rugby, England.
30.30	9,890	LSN	Buenos Aires, phone to Europe.
		LSA	Buenos Aires.
30.64	9,790	GBW	Rugby, England.
30.75	9,750	......	Agen, France. Tues. and Fri., 3 to 4:15 p.m.
		WNC	Deal, N. J.
30.90	9,700	WMI	Deal, N. J.
30.93	9,600	LQA	Buenos Aires.
31.23	9,600	LGN	Bergen, Norway.
32.13	9,330	CGA	Drummondville, Canada.
32.21	9,310	GBC	Rugby, England. Sundays 2:30-5 p.m.
32.40	9.250	GBK	Bodmin, England.
32.50	9,230	FL	Paris, France (Eiffel Tower). Time signals 4:56 a.m. and 4:56 p.m.
32.59	9,200	GBS	Rugby, England. Transatlantic phone.
33.26	9,010	GBS	Rugby, England.
33.81	8,872	NPO	Cavite (Manila), Philippine Islands. Time signals 9:55-10 p.m.
		NAA	Arlington, Va. Time signals 9:57-10 p.m., 2:57-3 p.m.
33.98	8.810	WSBN	S.S. "Leviathan."
34.50	8,690	W2XAC	Schenectady, New York.
34.68	8,650	W2XCU	Ampere, N. J.
34.68	8,650	W3XE	Baltimore, Md. 12:15-1:15 p.m., 10:15-11:15 p.m.
		W2XV	Radio Engineering Lab., Long Island City, N. Y.
		W8XAG	Dayton, Ohio.
		W4XG	Miami, Fla.
		W3XX	Washington, D. C.
			And other experimental stations.
34.74	8,630	WOO	Deal, N. J.
		W2XDO	Ocean Gate, N. J.
35.02	8.550	WOO	Ocean Gate, N. J.
35.50	8,450	PRAG	Porto Alegre, Brazil. 8:30-9:00 a.m.
36.92	8.120	PLW	Bandoeng, Java.
37.02	8,100	EATH	Vienna, Austria. Mon. and Thurs., 5:30 to 7 p.m.
		JIAA	Tokyo, Japan. Tests 5-8 a.m.
37.80	7,930	DOA	Doeberitz, Germany. 1 to 3 p.m. Reichpostzentralamt, Berlin.
38.00	7,890	VPD	Suva, Fiji Islands.
		JIAA	Tokio, Japan (Testing).
38.30	7,830	PDV	Kootwijk, Holland, after 9 a.m.
38.60	7,770	FTF	Ste. Assise, France.
		PCK	Kootwijk, Holland. 9 a.m. to 7 p.m.
39.15	7,660	FTL	Ste. Assise.
39.40	7,610	HKF	Bogota, Colombia. 8-10 p.m. p.m.
39.74	7,520	CGE	Calgary, Canada. Testing. Tues., Thurs.
43.70	6,860	KEL	Bolinas, Calif.
			Radio Vitus, Paris, France. 4-11 a.m., 3 p.m.

(Continued on next page)

"STAR" SHORT WAVE BROADCASTING STATIONS

The following stations are reported regularly by many listeners, and are known to be on the air during the hours stated. Conditions permitting, you should be able to hear them on your own short-wave receiver. All times E.S.T.

G5SW, Chelmsford, England. 25.53 meters. Monday to Saturday, 1:45 p.m. to 7:15 p.m. Broadcasts the midnight chimes of Big Ben in London at 7 p.m.

HVJ, Vatican City. Daily 5 to 5:15 a.m on 19.83 meters; 2 to 2:15 p.m. on 50.26 meters; Sunday 5 to 5:30 a.m. on 50.26 meters.

VK2ME, Sydney, Australia. 31.28 meters. Sunday morning from 1 to 3 a.m.; 5 to 9 a.m.; and 9:30 to 11:30 a.m.

VK3ME, Melbourne, Australia. 31.55 meters. Wednesday and Saturday, 5 to 6:30 a.m.

Pointoise, France. On 19.68 meters. 9:30 a.m. to 12:30 p.m.; on 25.16 meters, from 1 to 3 p.m.; and on 25.63 meters from 4 to 6 p.m.

Konigs-Wusterhausen, Germany. On 31.38 meters daily from 8 a.m. to 7:30 p.m.

HKD, Barranquilla, Colombia. On 51.4 meters, Monday, Wednesday and Friday, 8 to 10:30 p.m.; Sunday, 7:45 to 8:30 p.m.

VE9GW, Bowmanville, Ontario, Canada. 25.42 meters, from 1 to 10 p.m.

HRB, Tegucigalpa, Honduras. 48.62 meters. Monday, Wednesday, Friday and Saturday, 5 to 6 and 9 to 12 p.m.

TI4, Heredia, Costa Rica, Central America. 29.3 meters. Monday and Wednesday, 7:30 to 8:30 p.m.; Thursday and Saturday, 9 to 10 p.m.

EAQ, Madrid, Spain. 30.3 meters. 11:30 p.m. to 1 a.m.; 6 to 8 p.m. daily; 1 to 3 p.m. Saturday.

RV15, Khavarovsk, Siberia. 70.2 meters. Daily from 3 to 9 a.m.

SHORT WAVE STATIONS OF THE WORLD

(Continued from preceding page)

Experimental and Commercial Radio-Telephone Stations

Wavelength (Meters)	Frequency (Kilocycles)	Call Letters	Address and Schedule
43.80	6,840	CFA	Drummondville, Canada.
44.40	6,753	WND	Deal, N. J.
44.99	6,660	F8KR	Constantine, Algeria, Mon., Fri., 5 p.m.
		HKM	Bogota, Colombia. 9-11 p.m.
45.50	6,560	RFN	Moscow, U.S.S.R. (Russia) 2 a.m.-4 p.m.
46.05	6,515	WOO	Deal, N. J.
62.80	4,770	ZL2XX	Wellington, New Zealand.
63.00	4,760	Radio LL	Paris, France.
63.13	4,750	WOO	Ocean Gate, N. J.
63.79	4,700	WIXAB	Portland, Me.
72.87	4,116	WOO	Deal, N. J.
71.72	4,105	NAA	Arlington, Va. Time signals, 9:57-10 pm., 11:57 a.m. to noon.
92.50	3,256	W9XL	Chicago, Ill.
95.00	3,156	PK2AG	Samarang, Java.
96.03	3,124	WOO	Deal, N. J.
97.53	3,076	W9XL	Chicago, Ill.
			Motala, Sweden, 11:30 a.m.-noon, 4-10 p.m.
193.5	1,550	W2XCE	Passaic, N. J.

Airport Stations

Wavelength (Meters)	Frequency (Kilocycles)	Call Letters	Address
98.95	3,030	VE9AR	Saskatoon, Sask., Canada.
53.25	5,630 }	WQDP	Atlanta, Ga.
86.00	3,490 {	WSDE	Tuscaloosa, Ala.
		WSDB	Jackson, Miss.
		KGUK	Shreveport, La.
		KGUF	Dallas, Tex.
		KGUC	Fort Worth, Tex.
		KGUL	Abilene, Tex.
		KGUG	Big Springs, Tex.
		KGUA	El Paso, Tex. (Southern Air Transport Lines.)
53.53	5,600 }	WQDU	Aurora, Ill.
94.52	3,170 {	KQQ	Iowa City, Iowa.
		KQM	Des Moines, Iowa.
		KMP	Omaha, Neb.
		KRF	Lincoln, Neb.
		KMR	North Platte, Neb.
		KQE	Cheyenne, Wyo.
		KQC	Rock Springs, Wyo.
		KQD	Salt Lake City, Utah.
		KKO	Elko, Nevada.
		KJE	Reno, Nevada.
		KFO	Oakland, Calif.
		KRA	Boise, Idaho.
		KDD	Pasco, Wash. (Boeing Air Lines).
51.00	5,560 }	WAEF	Newark, N. J.
96.77	3,100 {	WAEE	Camden, N. J.
		WAED	Harrisburg, Pa.
		WAEC	Pittsburgh, Pa.
		WAEB	Columbus, Ohio.
		WAEA	Indianapolis, Ind.
		KGTR	St. Louis, Mo.
		KSY	Tulsa, Okla.
		KSW	Amarilla, Tex.
		KSX	Albuquerque, N. M.
		KGPL	Kingman, Ariz.
		KGTJ	Las Vegas, Nev.
		KSI	Los Angeles, Calif.
		KGTD	Wichita, Kan.
		KST	Kansas City, Mo. (Transcontinental Air Transport).

Television Stations

Wavelength (Meters)	Frequency (Kilocycles)	Call Letters	Address and Schedule
3.75 to 5 meters—60 to 80 megacycles.			
5.96 to 6.18 meters—48.5 to 50.3 megacycles.			
6.52 to 7.14 meters—42 to 46 megacycles.			
		W8XF	The Goodwill Station, Pontiac, Mich.
		W3XE	Philco Radio, Philadelphia, Pa.
		W8XL	WGAR Broadcasting Co., Cleveland Ohio.
6.89	43,500	W9XD	Milwaukee Journal, Milwaukee, Wis.
		W3XAD	Camden, N. J. (Other experimental television permits: 48,500 to 50,300 k.c., 43,000-46,000 k.c.).
101.7 to 105.3 meters—2,850 to 2,950 kc.			
		W1XAV	Short Wave & Television Corp., Boston, Mass. 1-2, 7:30 to 10:30 p.m. daily ex. Sun. Works with W1XAU 10-11 p.m.
		W2XR	Radio Pictures, Inc., Long Island City, N. Y. 4 to 10 p.m. exc. Sundays. Silent 7-7:30 Sat.
105.9	2,833	W6XAN	Los Angeles, Calif.
		W7XAB	Spokane, Wash.
105.3 to 109.1 meters—2,750 to 2,850 kc.			
		W2XAB	Columbia Broadcasting System, 485 Madison Ave., N. Y. 8:00-10:00 p.m. Sight and Sound Transmission daily except Saturday and Sunday.
		W2XBO	Long Island City, N. Y.
		W3XE	Philco Radio, Philadelphia, Pa.
		W9XAA	Chicago, Ill.
		W9XG	Lafayette, Ind. 60 holes, 1,200 r.p.m. Tuesdays and Thursdays, 2:00 p.m., 7:00 p.m., 10:00 p.m.
108.8	2,758	VE9CI	London, Ont., Canada.
130.1 to 136.1 meters—2,200 to 2300 kc.			
		W9XAL	First National Television Corp., Kansas City, Mo.
136.1 to 142.9 meters—2,100 to 2,200 kc.			
		W2XBS	National Broadcasting Co., New York, N. Y., 1,200 R.P.M., 60 lines deep, 72 wide, 2-5 p.m., 7-10 p.m. ex. Sundays.
		W2XR	Radio Pictures, Inc., Long Island City, N. Y. 48 and 60 line. 5-7 p.m.
		W3XAD	R. C. A.-Victor Co., Inc., Camden, N. J.
		W2XCW	Schenectady, N. Y.
		W8XAV	Pittsburgh, Pa. 1,200 R. P.M., 60 holes. 1:30-2:30 p.m., Mon., Wed., Fri.
		W9XAP	Chicago, Ill.
		——	Kansas State Agricultural College, Manhattan, Kans.
142.9 to 150 meters—2,000 to 2,100 kc.			
		W2XAP	Jersey City, N. J.
		W2XCR	Jersey City, N. J. 3-5, 6-9 p.m. ex. Sun.
		W3XK	Wheaton, Maryland, 10:30 p.m.-midnight exc. Sun. Works with W3XJ.
		W2XCE	Passaic, N. J. 2-3 p.m. Tues., Thurs., Sat.
		W8XF	The Goodwill Station, Pontiac, Mich.
142.9 to 150 meters—2,000 to 2,100 kc.			
		W9XAO	Western Television Research Co., Chicago, Ill.
		W9XAA	Chicago, Ill.

Police Radio Stations

Wave-length (Meters)	Frequency (Kilo-cycles)	Call Letters	Location
121.5	2,470	KGOZ	Cedar Rapids, Ia.
		KGPN	Davenport, Ia.
		WPDZ	Fort Wayne, Ind.
		WPDT	Kokomo, Ind.
		WPEC	Memphis, Tenn.
		KGPI	Omaha, Neb.
		WPDP	Philadelphia, Pa.
		KGPD	San Francisco, Cal.
		KGPM	San Jose, Cal.
		KGPW	Salt Lake City, U.
		WRDQ	Toledo, Ohio
		......	Klamath F'ls, Ore.
122.0	2,458	WPDO	Akron, Ohio
		WPDN	Auburn, N. Y.
		WPDV	Charlotte, N. C.
		WRDH	Cleveland, Ohio
		WPDR	Rochester, N. Y.
		WPEA	Syracuse, N. Y.
122.4	2,450	WPDK	Milwaukee, Wis.
		WPEE	New York, N. Y.
		WPEF	New York, N. Y.
		WPEG	New York, N. Y.
		KGPH	Okla. City, Okla.
		KGPO	Tulsa, Okla.
		KGPZ	Wichita, Kans.
122.8	2,442	KGPX	Denver, Col.
		WPDF	Flint, Mich.
		WPEB	Gr'd Rapids, Mich.
		WMDZ	Indianapolis, Ind.
		WPDL	Lansing, Mich.
		WPDE	Louisville, Ky.
		KGPP	Portland, Ore.
		WPDH	Richmond, Ind.
123.4	2,430	WPDI	Columbus, Ohio
		KGPP	Portland, Ore.
123.8	2,422	KSW	Berkeley, Cal.
		WMJ	Buffalo, N. Y.
		KGPE	Kansas City, Mo.
		KGPG	Vallejo, Cal.
		WPEK	New Orleans, La.
		WPDW	Washington, D. C.
124.1	2,416	KGPB	Minneap'lis, Minn.
		WPDS	St. Paul, Minn.
124.2	2,414	WPDY	Atlanta, Ga.
		KGPS	Bakersfield, Cal.
		WCK	Belle Island, Mich.
		WPDX	Detroit, Mich.
		WRDR	Grosse Point Village, Mich.
124.2	2,414	WMO	Highland Park, Mich.
		KGPA	Seattle, Wash.
		WPDA	Tulare, Cal.
175.15	1,712	KGPJ	Beaumont, Tex.
		WPDB	Chicago, Ill.
		WPDC	Chicago, Ill.
		WPDD	Chicago, Ill.
		WKDU	Cincinnati, Ohio
		KVP	Dallas, Tex.
		KGPL	Los Angeles, Cal.
		KGJX	Pasadena, Cal.
		WPDU	Pittsburgh, Pa.
		KGPC	St. Louis, Mo.
		......	Wichita F'ls, Tex.
189.5	1,574	WRDS	E. Lansing, Mich.
		WMP	Fram'gham, Mass.
		KGPY	Shreveport, La.
1123	257	WBR	Butler, Pa.
		WJL	Greensburg, Pa.
		WBA	Harrisburg, Pa.
		WMB	W. Reading, Pa.
		WDX	Wyoming, Pa.

Marine Fire Stations

Wave-length (Meters)	Frequency (Kilocycles)	Call Letters	Location
187.81	1,596	WRDU	Brooklyn, N. Y.
		WKDT	Detroit, Mich.
		WCF	New York, N. Y.
192.4	1,558	WEY	Boston, Mass.
		KGPD	San Francisco, Cal.

SHORT WAVE QUESTION BOX

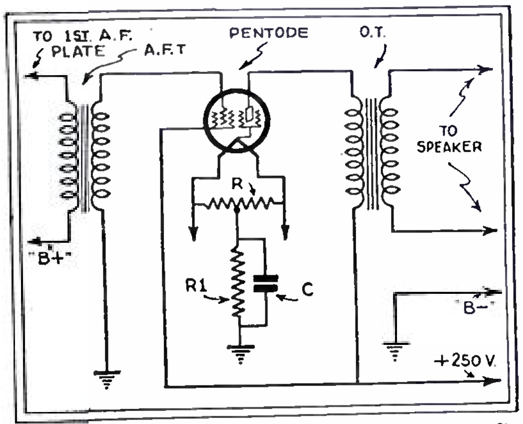
Edited by R. WILLIAM TANNER

ADDING PENTODE TO SUPER-WASP

Harrison Henkle and eight others ask:

Q. For diagram showing how to add a pentode to a Pilot A.C. *Super Wasp?*

A. The diagram is given in these columns. The bias resistor R1 is 400 ohms, by-passed by a 2-mf. condenser. R is a 20 to 60 ohm center-tapped filament resistor. The output transformer in the receiver will have to be replaced with one suitable for a pentode tube.



How to connect a pentode to an A.C. Super-Wasp.

NEON CRATER TUBE CONNECTION

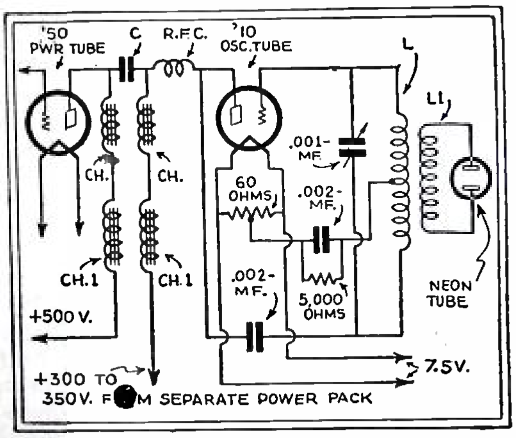
E. L. Kelly, Glens Falls, N. Y., inquires:

Q. What method do you consider best for connecting a neon crater lamp to a '50 power tube for television reception?

A. I have found that with '50 or '45 power tubes better results and longer neon tube life can be obtained by using the power audio tube to modulate an oscillator, the oscillator functioning to both light and modulate the neon. A '10 oscillator can be used for a '50 power tube and a '71A for a '45. Connections are shown in these columns. The chokes CH should be 6-henry iron core units. CH1 are both 30 henries. C is a 2 mf. 1,000-volt condenser. I have tuned oscillators to various frequencies but prefer approximately 300-400 kc. The coil L may consist of 150 turns of No. 18 bell wire on a 4-inch diameter form, tuned by a .001-mf. variable condenser. L1 depends upon the type of neon tube employed, since no two makes have the same internal resistance. A total of 50 to 75 turns of No. 18 will generally be sufficient. These should be wound on a form slightly smaller than L, so that it can be slid in or out of L to vary the coupling and illumination. L is tapped in center.

Q. In the R.F. amplifier of a television receiver, would you advise transformer or impedance coupling?

A. If you have not a high frequency compensating audio amplifier, the choke-condenser combination will probably result in broader tuning to pass the required 100 kc. band; however, transformers can be properly designed to pass 100 kc.



The '10 tube acts as an oscillator to both light and modulate the neon tube.

VOLUME CONTROL

Victor Strinck, Philadelphia, Pa., writes:

Q. I recently built a two-tube, '24 detector and '27 A. F. receiver, but no volume control was specified. Can you tell me how one may be added?

A. The simplest volume control would be a 250,000- to 500,000-ohm variable resistor connected across the secondary of the A.F. transformer.

REBUILDING CONDENSER

A. Kuilos, Detroit, Mich., desires to know:

Q. How to rebuild a .00035-mf. 17-plate condenser for use in a short-wave set?

A. Remove all but approximately four rotor and three stator (or four stator and three rotor; it makes no difference). The effective capacity will then be close to .00014 mf.

TRANSMITTING ANTENNA

O. Oleson, Ambrose, N. D., wants to know:

Q. The size of antenna, single wire, to work in 160 and 80 meter bands. No feed wires are desired and one end is to be brought directly to transmitter.

A. The antenna should be approximately 120 feet long and used with a counterpoise, about 6 to 8 feet above ground, of similar length. It will be necessary to work this antenna on the second harmonic for 80-meter operation.

Q. How would such an antenna be coupled to the tank circuit?

A. The antenna and counterpoise would be connected to the leads of the antenna coupling coil with a series condenser somewhere in the circuit. The position of the condenser is not important.

CRYSTAL SUPERHET vs. STENODE

Arthur Pellison, Wilson, Kansas, writes as follows:

Q. In the May issue there is a description of a Crystal Superhet short-wave receiver. Can this circuit compare with the Stenode Radiostat circuit in tone quality, selectivity and sensitivity?

A. You have the wrong viewpoint of both circuits. The Stenode is a superhet with a quartz oscillating crystal at the I.F. input to increase selectivity. The Crystal Detector Superhet as described in the May issue employs a carborundum crystal rectifier as a second detector. The use of this type of detector greatly improves tone quality.

HOWLING AND MOTOR-BOATING

F. M. Hall, Edmonton, Alberta, Canada, encloses circuit and asks:

Q. What makes the circuit howl and motorboat even with proper plate voltages and a 100,000-ohm resistor across the first A.F.T. secondary?

A. The circuit is OK. Probably the audio transformers are placed so as to offer some degree of coupling between the two stages. Try changing their position and space at least 4 inches.

RESISTOR PROBLEMS

C. McCredie, Detroit, Mich., wants to know:

Q. Why a filament rheostat and two fixed resistors in the circuit on page 17, May issue?

A. The list of parts, page 17, states three 30-ohm rheostats. The two fixed resistors should then be 30-ohm rheostats.

Q. Should the volume control R4 be 10,000 ohms, as stated, or higher?

A. A value of 10,000 ohms will reduce the amplification to a very low value, since it is shunted directly across the transformer secondary. This should be either a 250,000- or 500,000-ohm unit.

CHANGING RECEIVER TO A.C.

R. Cunningham, Portland, Ore., wants to know:

Q. If the receiver on page 258 of the Dec.-Jan. issue can be changed for A.C. operation?

A. The circuit for A.C. changes is shown in these columns. The R.F. choke in the detector plate circuit should be a good short-wave type. The variable resistor across the secondary of the audio transformer is very essential. It should be adjusted so that no *fringe howl* is heard at the point of oscillation in the detector. The value is 250,000 or 500,000 ohms. The output transformer must be one designed for use with low-mu tubes.

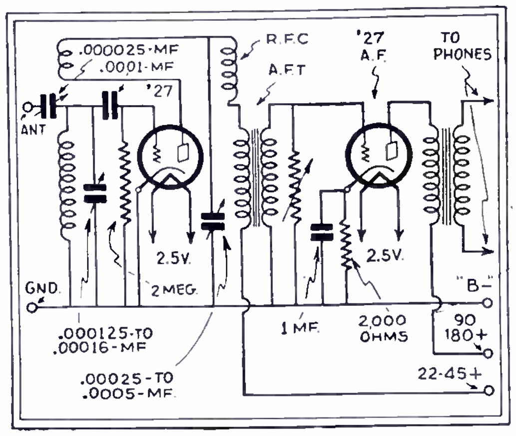


Diagram showing how to convert a battery receiver to A.C.

Q. What size voltage divider should I use across output of an A-minus power-pack in order to supply proper voltages for this two-tube set?

A. It will be necessary to employ a variable voltage divider of between 15,000 and 25,000 ohms, having two sliding taps.

NOISE FROM POWER LINES

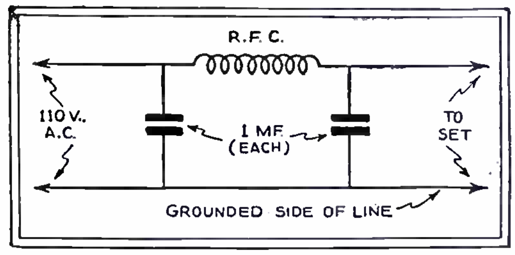
Cecil Jordan, San Francisco, Cal., writes:

Q. Is there any method of eliminating or decreasing noises due to defective power lines?

A. There are three methods whereby such noises, also static, can be suppressed. In their order of efficiency these are: McCaa Anti-Static method, Resonance Wave-Coil (with rejector circuit), and the Rogers underground antenna. A description of these would require more space than is available in any one issue of SHORT WAVE CRAFT; therefore I would advise you to purchase some text-books.

Q. Can you print a circuit of a filter which is connected in the 110-volt lines?

A. This circuit is shown in these columns. Such filters can be purchased very cheaply.



A 110-volt line filter to eliminate noise.

The Horizontal Diamond Shaped Antenna

By E. BRUCE*

By tilting a single antenna to the proper angle the same effect can be secured as that previously attained by the use of three antennas at transmitter and receiver, besides preserving the directional selectivity.

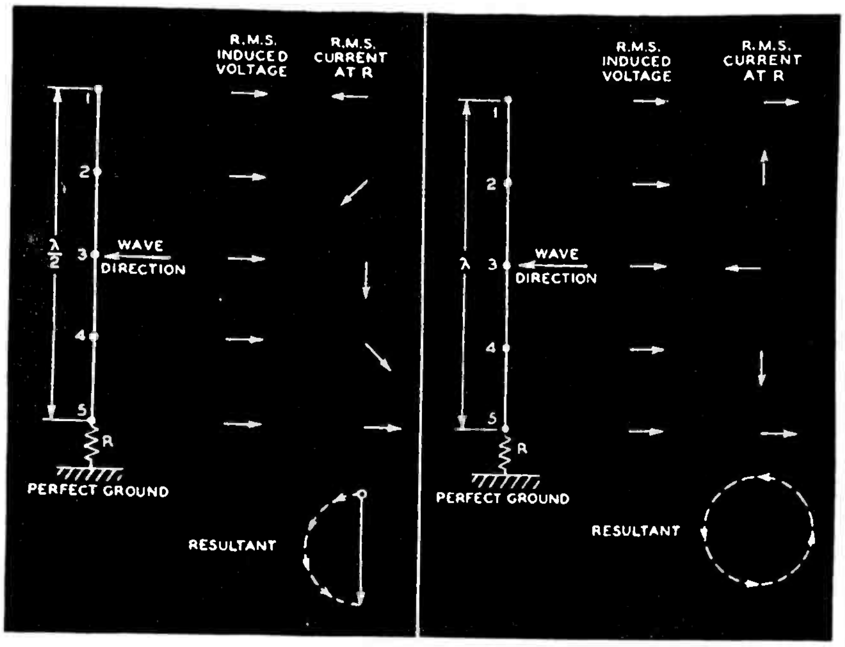


Fig. 1a and 1b—The voltages induced by a horizontally propagated wave in a vertical half-wave antenna (above, left) are all in phase. On reaching the receiver, the resulting currents are out of phase: the vector resultant is the diameter of a half-traced circle. For a full-wavelength antenna (above, right), summing the vectors traces a complete circle, and the resultant is zero.

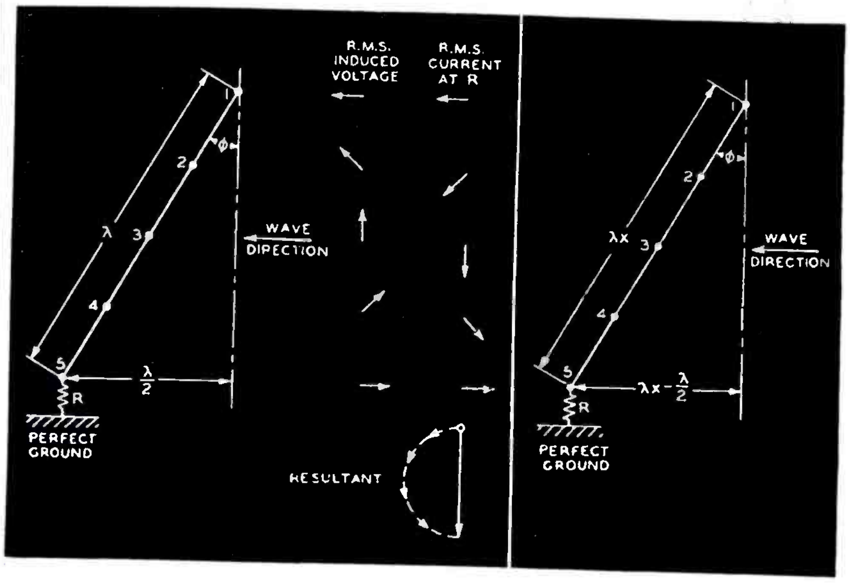


Fig. 2a and 2b—The antenna shown above in Figs. 1a and 1b also will give optimum reception if properly tilted (above, left). There is a proper tilt for an antenna of any length (above, right).

● IN USE on the Bell System's *short wave* transoceanic circuits, directive antennas have amply proven their value. As was anticipated, their selectivity of direction has effected economies in the power output of transmitters, and has increased the ratio of the signal in receivers to the noise coming from static, from neighboring electrical equipment and from sources inherent in receiver circuits. Justified by these successes, the continued development of directive antenna systems has now brought forth a new system having many definite advantages over its predecessors.

Most prominent among these advantages, perhaps, is the preservation of directional selectivity over a far greater range of frequencies. Thus to transmit and receive the daylight, dusk and night frequencies used on a transoceanic channel, one transmitting and one receiving antenna can replace the three transmitting and three receiving antennas required heretofore. The much simpler mechanical structure of the new antenna further reduces the antenna cost per channel. For these and other reasons, antennas of the new type have been installed for use on the Bell System's new radio-telephone links with Bermuda, Rio de Janeiro, and Honolulu.

For reception the new antenna employs wires of such lengths, and at such angles to the favored direction of reception, as to cause a maximum current in the receiver from voltages induced by a wave advancing from that favored direction. For transmission the antenna is basically similar. The principles by which the lengths and angles are determined can best be explained by regarding the voltages induced in a receiving wire as lumped along the wire, producing elementary currents which separately traverse the wire to the receiver where they add vectorially.

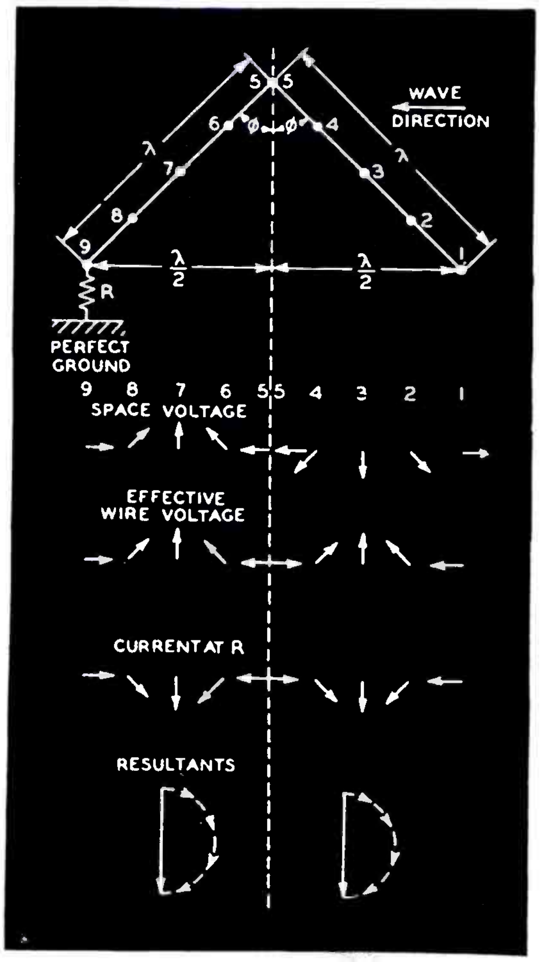


Fig. 4—The V-shaped antenna provides an array of two tilted wires, which not only reinforce each other but leave the optimum direction of response unaltered over a considerable range of frequencies.

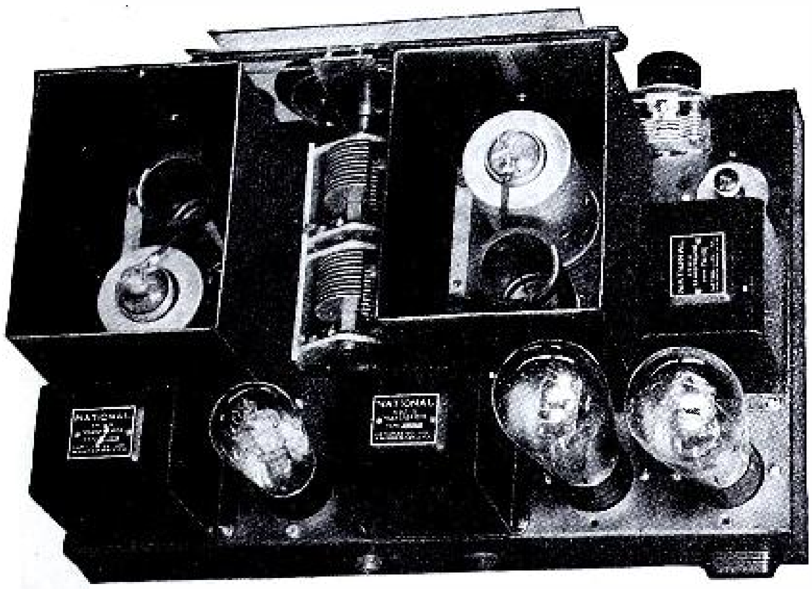
By increasing the length of a vertical wire exposed to horizontally propagated waves, and matching its impedance by the load at its base, the load power increases until the length of the wire reaches one-half the length of the approaching wave. When this point is reached, the current in the receiver can be represented vectorially (Fig. 1a) by the diameter of the circle whose semi-circumference is traced in summing the elementary vectors. If the length of the wire is further increased, this circle is more nearly closed and the resultant becomes smaller. When the wire reaches a full wavelength, the circle is completely closed, and no current flows in the receiver (Fig. 1b).

This example illustrates a fact true of a single-wire antenna not only when upright but when inclined at any angle to the direction of a wave. The current at the receiver end of any wire will be a maximum when summation of the elementary current vectors in it traces a semi-circumference, or in other words when

(*Continued on page* 364)

* Of the Radio Research Division, Bell Telephone Laboratories.

If You Want the MAXIMUM *in* Short-Wave Performance



this NATIONAL A.C. SW-58 *will Give it to You*

The new NATIONAL SW-58 Short-Wave Receiver gives utmost sensitivity, extremely low background noise combined with unequalled flexibility and ease of control.

EMPLOYS FUNDAMENTAL CIRCUIT OF WELL KNOWN NATIONAL SW-5 & SW-45

As in the well-known and universally used NATIONAL SW-5 and SW-45 Receivers, the TRF circuit is employed in the new NATIONAL SW-58 because of definitely better signal-to-noise ratio. This is recognized by people in serious communication and experimental work, but the SW-58 offers a number of improved features never before found in TRF receivers.

GREAT R.F. GAIN REAL R.F. SELECTIVITY WITH THE NEW 58 TUBES

The high mutual conductance and low output capacity of the new SHORT WAVE R.F. PENTODE 58 tubes, employed in the NATIONAL SW-58 THRILL BOX, give great R.F. gain, even on very short waves. Selectivity in the R.F. stage, heretofore impossible of accomplishment, is secured in the SW-58 through the higher plate impedance of the new tubes, plus

"CONTROLLED SELECTIVITY"

An entirely new feature found only in the SW-58. This allows the receiver to be operated at the best selectivity consistent with signal strength and conditions of reception. This is possible only because of the exceptional degree of isolation between the R.F. and detector circuits, brought about through special stage and tube shielding and a new isolated rotor gang condenser described below. Thus volume can be controlled on the R.F. circuit without affecting in the least degree the sensitivity or selectivity of the tuned circuits.

NEW ISOLATED-ROTOR GANG CONDENSER

As mentioned above, a new design of gang tuning-condenser with isolated rotors, prevents interlocking and is an essential contribution to this new order of isolation between R.F. and detector circuits. 270° plates are employed, a standard NATIONAL CO. practice, and insulation is ISOLANTITE.

IMPROVED R-39 LOW LOSS TRANSFORMERS FOR USE WITH 58 TUBES

A special type of R-39 transformer with materially higher plate impedance to go with new 58 tubes. Fitted with a special NATIONAL 6-prong base to isolate all circuits, to eliminate detrimental effects of coupling always found when an attempt is made to employ a 5-terminal connection for the three different windings.

PLUG-IN COILS IN THE SW-58 FOR BEST PERFORMANCES

For greatest flexibility and day-in, day-out reliability, plug-in coils are best. NATIONAL CO. knows how to make efficient band-selector switches for certain types of short-wave circuits, but for a set like the SW-58, used for everyday commercial operation on leading airlines, steamship companies, and by amateurs for serious communication work, plug-in coils are definitely superior.

TYPE 100 SHORT WAVE RADIO FREQUENCY CHOKE

Another reason for the better performance of the SW-58 THRILL BOX is the new Type No. 100 Short Wave R.F. Choke. Four narrow spaced sections are universal wound on an Isolantite form. The extreme low distributed capacity of less than 1.mmf. is of vital importance in securing uniform detection over the entire SW range.

NEW TUBE-ISOLATORS AND STAGE SHIELDING

A different design of tube-isolator or shield is employed in the SW-58. This has been specially developed to take full advantage of the new screening employed in the design of the new SW RF Amplifier Tubes. The RF and Detector Circuits are completely enclosed in individual compartments which with the new tube isolators give an entirely new order of isolation between circuits, avoiding stray-coupling between coils.

NEW FULL-VISION VELVET-VERNIER DIAL

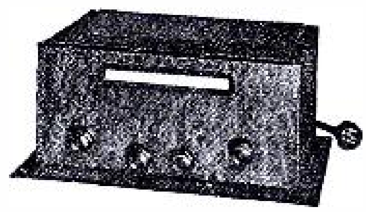
In keeping with the times, the SW-58 has a new Full-Vision Velvet-Vernier Dial with a linear scale of unusual length, so that the operator may see at a glance the approximate setting in the band being used at the moment. Has all the characteristic smoothness of the Velvet Vernier Dials.

NEW NATIONAL ISOLANTITE SOCKETS

Coil and R.F. tube-sockets are the new NATIONAL design, made of Isolantite, reducing the often overlooked losses at these points. Thus in every detail, the SW-58 has been improved and corrected for those frequently ignored losses that can otherwise easily occur at very high frequencies.

PUSH-PULL AUDIO FULL A.C. OPERATION POWER SUPPLY R.C.A. LICENSED

The SW-58 has a push-pull audio output through two 245 tubes, assuring excellent quality and ample volume for loud speaker reception of short-wave broadcasts. There is a phone-jack, of course. Operation is full AC with a special SW Power Supply, with extra shielding and filter sections for hum-less operation. R.C.A. Licensed. Also made for battery operation.



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A. C. SW-58 THRILL-BOX

Made by the Makers of the Famous Velvet Vernier Dials

The Horizontal Diamond Shaped Antenna

By E. BRUCE

(*Continued from page* 362)

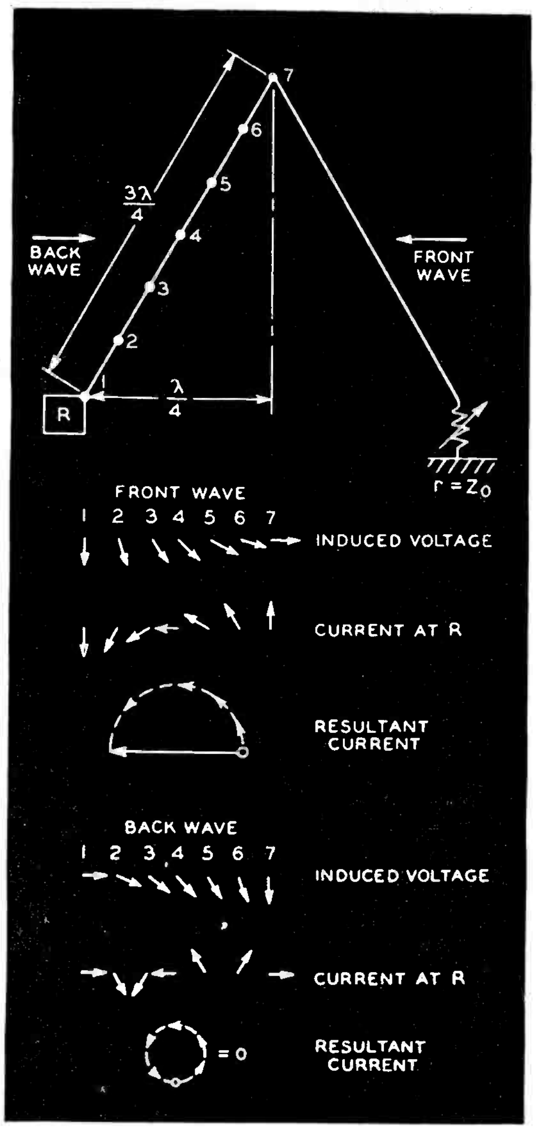

Fig. 5—A wave coming from the back of a V-shaped antenna whose legs are three-quarters of a wavelength long, produces elementary currents whose phase at the receiver changes twice as rapidly as when the wave comes from the front, and which thus cancel there.

only the elementary currents originating at its two ends are opposite in phase at the receiver.

To achieve this condition, a wire longer than a half wavelength can be tilted at such a vertical angle to the direction of the wave that the phase difference in the voltages, induced at the ends of the wire, compensates for the increase in the length of the path which the more distantly produced current must travel. Fig. 2a shows how this takes place for a wire one full wavelength long. It can be shown that the optimum tilt of any wire will be that at which the wire is one-half wavelength longer than its projection on the direction of motion of the wave (Fig. 2b). This principle permits increasing the length of the antenna to any desired value, and achieving thereby the increased output and directivity which always attend increased dimensions.

Furthermore, as the antenna is lengthened, the necessary readjustment of the tilt angle diminishes, as shown in Fig. 3. It is this fact which permits the use of longer tilted-wire antennas over larger frequency ranges. Thus if an antenna, whose length was ten times the wavelength for which it was designed, were used to receive another frequency such that the antenna was only eight wavelengths long, the inaccuracy of tilt would be merely two degrees. This error would take effect only as a nearly inappreciable alteration in the direction of optimum response.

Like other antenna elements, tilted wires can be combined into arrays of the most various sorts. The effectiveness of tilted wires over broad frequency ranges is of such practical value that only those arrays which do not restrict the frequency range have been extensively developed by these Laboratories.

One such is the V-shaped combination of two wires shown in Fig. 4, whose added exposure of wire appreciably improves its directional characteristics and thus its signal output. Another advantage is its further extension of the breadth of the frequency range to which it is applicable. The tilt-angle errors, when the antenna is used at frequencies other than the optimum, are opposite for the two legs of the V, and thus cancel in the combination, leaving the optimum direction of response unaltered.

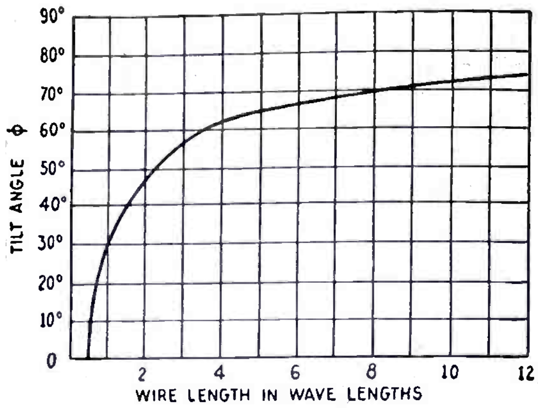

Fig. 3—The optimum tilt of an antenna approaches ninety degrees as the antenna is lengthened.

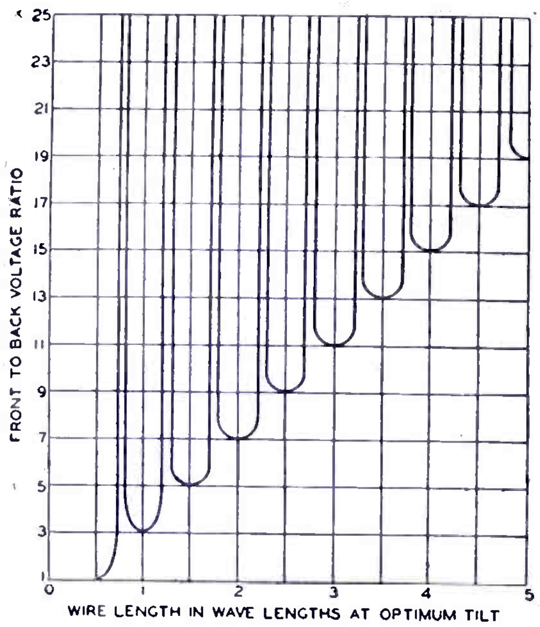

Fig. 7—V-shaped antennas the lengths of whose legs are even integral multiples of one-quarter wavelength have the lowest front-to-back ratios but these minima become larger as the wire lengthens.

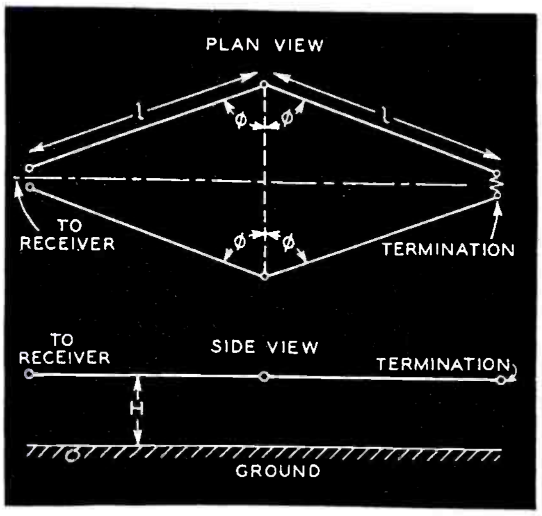

Fig. 8—When one "V" balances another in a diamond-shaped array, the terminating impedance need not be grounded, but can be connected between the far ends of the two V's.

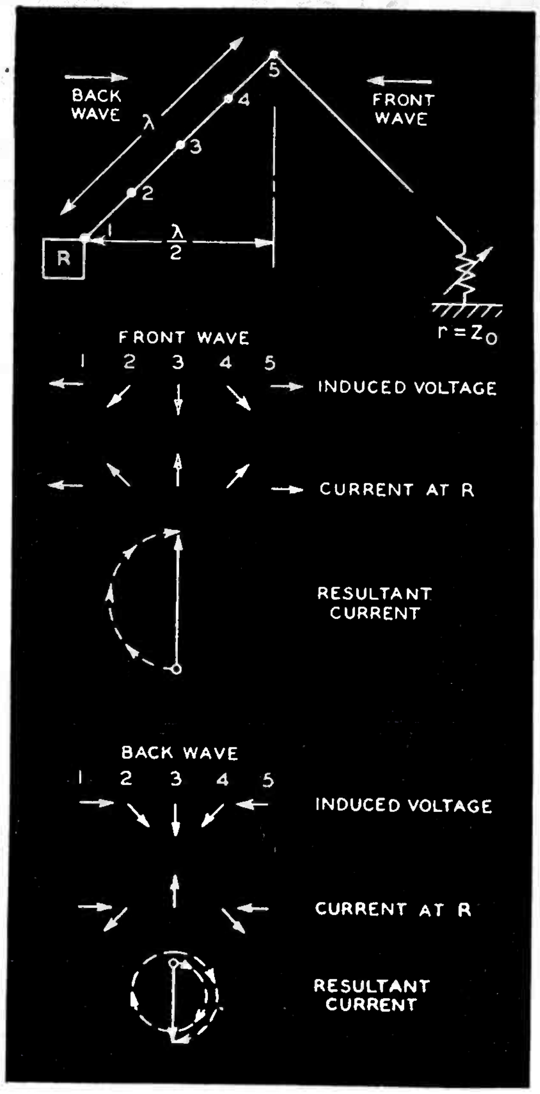

Fig. 6—A V-shaped antenna whose legs are a full wavelength long, responds to waves from the back one-third as strongly as to waves from the front.

If the far end of any of these antennas were left open, there would have to be considered, in summing the elementary currents, not only those directly propagated to the receiver but also those propagated in the other direction and reflected back to the receiver from the open end. In practice, however, the far end of a tilted-wire antenna is terminated to ground through an impedance, equal to the characteristic impedance of the antenna, which absorbs all currents reaching that end.

It is this termination which achieves directional asymmetry, establishing a front and a back to the antenna so that it will respond strongly to signals from the front and inappreciably to signals from the back. Fig. 5 shows that such an antenna can theoretically have an infinite front-to-back ratio, and indeed it is an experimental fact that the ratio is limited only by the physical rigidity of the antenna in space. It can be shown that an optimally tilted wire will have an infinite front-to-back ratio if its length is an odd integral multiple of one-quarter wavelength.

It might appear that this prescription of length would restrict the frequency range within which any particular antenna would exhibit an adequate front-to-back ratio. The frequencies for which the ratio is lowest are those for which the wire length is an even integral multiple of one-quarter wavelength. For a wire one wavelength long, for example, the resultant when the wave approaches from the back is

(*Continued on page* 366)

The Season's Big Radio Sensation!

16-TUBE ALL-WAVE *only* $39.95

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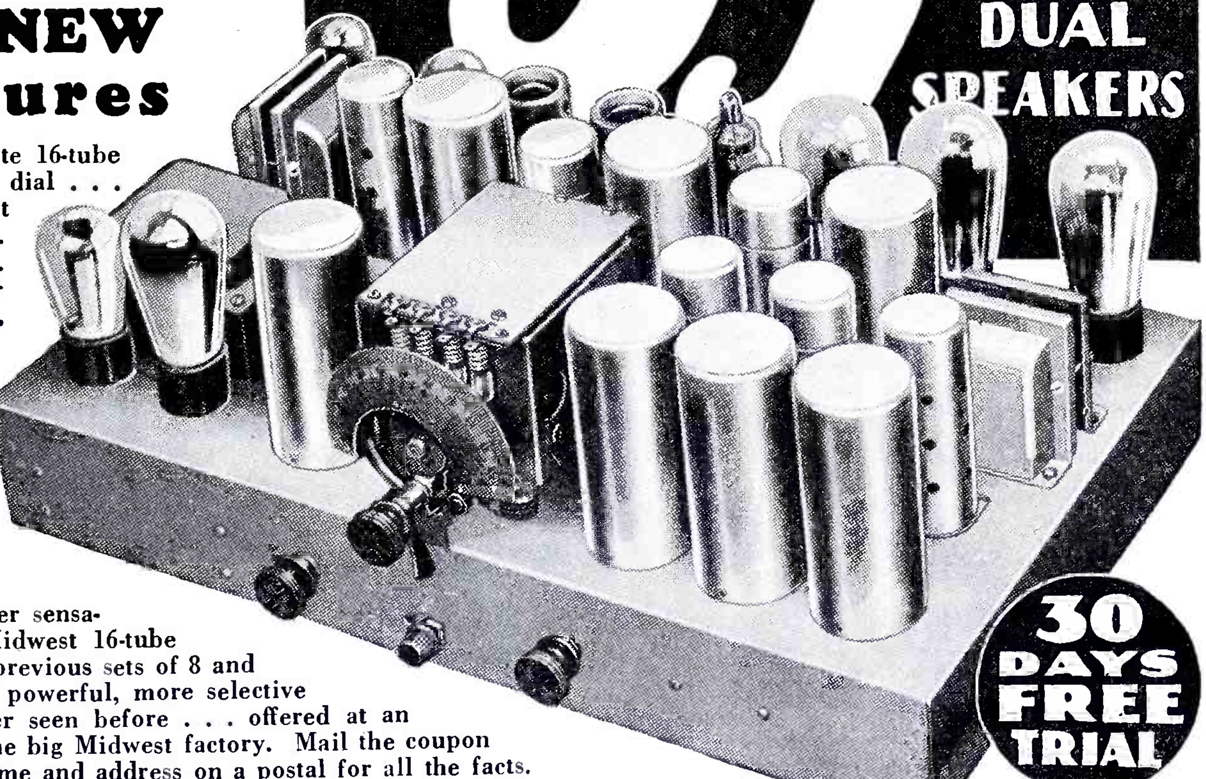
ALL THE NEW 1933 Features



WHAT a radio! One complete 16-tube chassis with one dual-ratio dial . . . new Super-Heterodyne circuit with a range of 15 to 550 meters . . . STATOMIT Tuning Silencer . . . New Class "B" Push-Push Power Amplifier . . . Color-Lite Tuning . . . Full band automatic Volume Control...Duplex Duo-Diode Detection . . . Dual-Ratio Single Dial . . . No Trimmers, No Plug-in Coils, No Tuning Meter or Neon light required . . . Fractional Microvolt Sensitivity . . . Dual Powered (2 separate Power transformers) . . . Hull-Floating ing Variable Condenser . . . Low Operating Cost . . . and many other sensational new features. The new Midwest 16-tube set actually uses less current than previous sets of 8 and 9 tubes. A bigger, better, more powerful, more selective finer toned radio than you've ever seen before . . . offered at an amazingly low price direct from the big Midwest factory. Mail the coupon or send name and address on a postal for all the facts.

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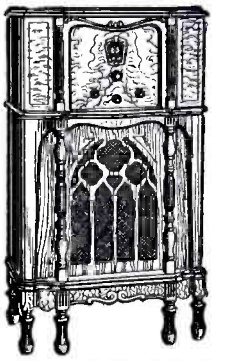

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Don't be satisfied with less than a Midwest 16-tube A. C. radio. A receiver covering only the regular broadcast waves is *only half a set.* Improvements in short-wave programs have made ordinary broadcast sets obsolete. The Midwest gives you regular, foreign, police and amateur broadcasts in one single dial set. No converter or any extra units required.

Remember, you buy DIRECT FROM THE MAKERS. No middlemen's profits to pay. You get an absolute guarantee of satisfaction or money back. You try any Midwest 30 DAYS before you decide to keep it. Then, if you wish, you can pay in small monthly amounts that you'll scarcely miss. Mail coupon for full details or write us a postal.

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Two sensational values: a 6-tube super-het for standard-wave reception and a 9-tube ALL-WAVE, both using the new AIR CELL "A" battery that never needs recharging. Low factory prices. Coupon brings details. Mail it NOW!

Read These Letters from Midwest Owners

Just two of the *thousands* of letters praising Midwest Radios.

Gets France, Spain, Italy, Japan
"Have received foreign short-wave stations such as FYA, France; EAQ, Madrid, Spain; I2RO, Rome, Italy; and last but not least, JIAA, Tokyo, Japan. I really think the Midwest set is a miracle."
A. F. GRIDLEY,
Sarasota, Fla.

W8XK—W3XAL—W1XAZ—W2XAF
I am very much satisfied in every way with my Midwest Radio. I heard Sydney, Sunday 3 A.M., also W8XK, W3XAL, W1XAZ, W2XAF, in the evening. On the regular band have some 55 stations so far.
Aug. Balbi, 1427 Myra Ave.,
Los Angeles, Calif.

Investigate! Mail Coupon NOW!

Get the Midwest catalog. Learn the facts about Midwest 9, 12 and 16-tube ALL-WAVE sets. Learn about our sensationally low factory prices, easy payment plan and positive guarantee of satisfaction or money back. Don't buy any radio until you get the big new Midwest catalog. Just sign and mail the coupon or send name and address on a postal.

RUSH THIS COUPON FOR AMAZING FREE TRIAL OFFER AND BIG BEAUTIFUL CATALOG

USER AGENTS
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Dept. 114,
Cincinnati, Ohio.

Without obligation on my part send me your new 1933 catalog, and complete details of your liberal 30-day free trial offer. This is NOT an order.

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Town . . . . State . . . .

MIDWEST RADIO CORP.

DEPT. 114 (Est. 1920) CINCINNATI, OHIO

The Diamond Shaped Antenna

(Continued from page 364)

up to five wavelengths as shown in Fig. 7.

But even when a wave arriving from the back has one of these unfavorable frequencies, the signal it produces in an antenna can be cancelled by permitting an equal and opposite signal to be reflected from the antenna's far end. This can be accomplished by adjusting the terminating impedance so that it differs from the characteristic impedance of the antenna. It can be shown that the desired cancellation will occur for the most unfavorable frequencies when the termination equals the antenna's characteristic impedance times the cosine of the angle between wave direction and wire. Since this cosine approaches unity as the wire lengthens (Fig. 3), the necessary adjustment of the terminating impedance for long wire is quite small. By making the terminating impedance a compromise between the ideals for the most favorable and the most unfavorable frequencies, large front-to-back ratios can be secured for a long optimally tilted wire over its entire useful range of frequencies.

The instability of the resistance of a ground contact with varying weather conditions, and the not inappreciable signal-pick-up of its connecting leads, has dictated the combination of two V-shaped antennas into a diamond-shaped array (Fig. 8). Here the balancing effect of the two V's removes the necessity for a ground connection.

Of such an antenna the optimum direction of response in the horizontal plane remains the same over a frequency range of two to one, although the directivity becomes somewhat less sharp as the frequency becomes less favorable. The vertical-plane directivity in the optimum horizontal direction is dependent on the length of each leg, the tilt angle of the component wires, and the height of the whole antenna above ground. The low response to horizontally propagated waves discriminates against man-made interference originating near the ground. —*Bell Laboratories Record.*

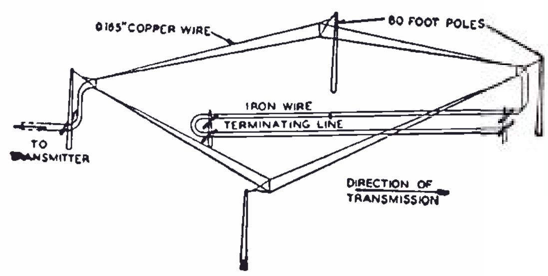
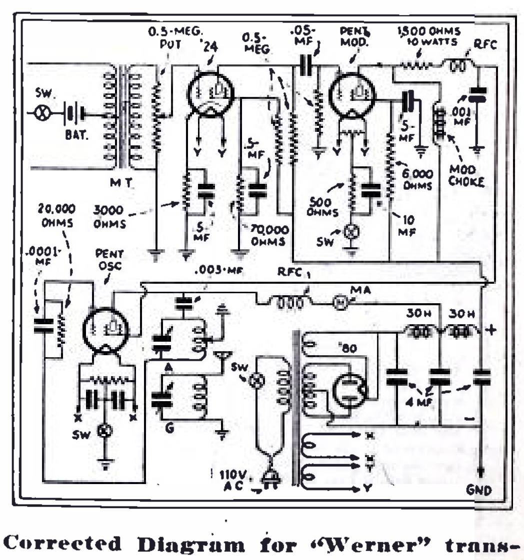


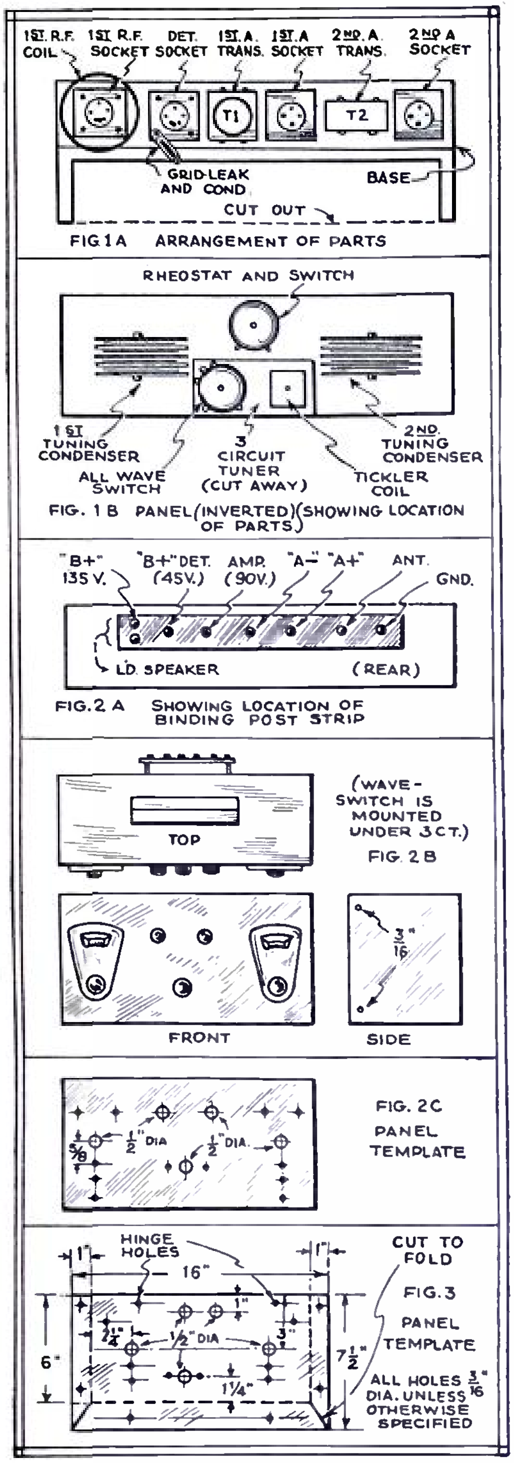
Fig. 9—For transmitting antennas, a terminating impedance of the required dissipating ability has been found in a long two-wire iron transmission line, shorted at the far end.



Corrected Diagram for "Werner" transmitter, page 216, August issue.

L. Johnson's 2nd Prize

(Continued from page 349)



quency coil, the first radio frequency tube socket, the grid-condenser and grid-leak, the detector tube socket, the first audio transformer, the first audio tube socket, the second audio transformer and the last audio or power tube socket are mounted on the inverted tray in the order mentioned, reading from left to right and facing the panel.

All-Wave Coils—The secondary of the first radio frequency coil and the three-circuit tuner are tapped in three places. Run your three-strand cables from these points to the stationary contacts of the rotary switch, which should leave one secondary connection. It might be well to mention that on the three-circuit tuner the rotating coil is the tickler and not the secondary. The bare connection on the rotary switch is left that way and is an "off" position. As mentioned before, there are four connections on the secondary coils. The one farthest from the primary is left *free* and is not included in the cable connections.

A Hammarlund 2-35 mmf. balancing condenser was connected between the grid of the second tube and the plate of the first tube, but is not essential to successful operation.

Parts List

1 Pacent or Amsco 20-ohm rheostat (R1 and Sw.1).
2 Pilot Capacigrad .0005-mf condensers (C1 and C2).
1 Radio Trading Co. all-wave kit for .0005-mf. condensers, R.F. (3CT).
1 Best rotary shorting contact switch, 4-contact, 2-pole (2, Sw.2).
2 Kurz-Kasch vernier dials.
1 Mignon 5-to-1 ratio cub audio transformer (T2).
1 Small standard upright 3-to-1 audio transformer (T1).
1 Carter type E-4 4-ohm fixed resistance, optional (R3).
1 Hammarlund 2-34 mmf. balancing condenser, optional (C5).
4 Pacent or Benjamin 4-prong sockets (S1, S2, S3, S4).
1 Polymet .0005-mf fixed Micamold midget condenser (C4).
1 Coil hook-up wire.
1 Lug package.
1 Screw and nut assortment.
1 Copper sheet, 9 x 16 inches.
1 Union Hardware utility chest, 14 x 6 x 6½ inches.
2 Bakelite knobs for tickler and all-wave switch.
8 Binding posts.
1 Bakelite strip, 8 x 1½ x ¼ inches.
1 Freshman or Polymet .00025-mf grid condenser with clips (C3).
1 2-4 megohm grid leak (R2).
1 Rubber sheet, 9 x 16 x ¼ inches.
18 inches of three-strand speaker or battery cord.

Coil Data

Primary	*Secondary*	*Tickler*
7 turns No. 26 D.S.C.	51 turns No. 28 D.S.C. tapped at 7th & 19th turns.	28 turns No. 28 D.S.C.
2¾-inch diameter tube.	2¾-inch diameter tube (same tube as primary).	2-inch diameter tube.

How to Become a Radio Amateur

(Continued from page 345)

'40. This tube has an amplification factor of 30 and will in a measure make up for the lack of the additional ratio of the transformer used in the other amplifier. We follow this with a '71 as in the other case, in order that we may be assured of about the same output. As before, we use either an output transformer or a choke coil and condenser.

The coupling resistors and their mounts, together with the coupling condensers for each stage, are connected as shown in Fig. 6. The bias for the '40 is about 1½ volts negative, while for the '71 it is as before. The plate series resistance for the '40 is between 150,000 and 250,000 ohms and its grid resistor is 500,000 ohms. The coupling condensers are .01 micro-farad (mf.) capacity. Plate current adjustments should be made by the use of a milliammeter, with no signal voltage applied. The resistors in the plate circuits of the various tubes should be of such a value that normal plate current flows in each respective plate circuit. For the '40 this is .2 milliampere (m.a.) and for the '71 this is 12 milliamperes (m.a.).

Several stages of the type '40 tubes may be necessary to give you the amount of amplification you desire; three to four stages of *resistance coupling* can be put together, with the assurance that they will work. That is more than can be said of as many transformer-coupled stages unless the ratio is very low. Also, we are more confident of the quality when we use resistance coupling; again, if we have in mind television, resistance coupling will have to be used if we wish to retain fidelity of image reproduction. The frequencies used in television have a range far greater than the range of the usual coupling transformer and it is here that resistance coupling is so superior—its frequency range will take in our present-day attempts at least.

Ultra-Seven All-Wave Super-het

(Continued from page 341)

to make the diagram easier to follow. The filaments of the seven tubes form a part of a series circuit, which also includes a dial light (76), an "on-off" switch (72) and a resistor (73). The latter serves the purpose of cutting down the line voltage from 110 volts to the proper value, such that each tube filament will be supplied with its rated voltage of 6.3 volts.

Three Tuning Condensers "Ganged"

Tuning is accomplished using single dial control. The secondary of the antenna coil, the secondary of the detector coil and the grid winding of the oscillator coil are each tuned by a .0002-mf Hammarlund midget condenser. These condensers are unsurpassed for short-wave work and have many advantages, including small size, high ratio of minimum to maximum capacity, low losses and accurate construction. The three Hammarlund condensers are ganged together with a metallic coupling between (3) and (10) and a flexible coupling between (10) and (15). Condenser (15) is out of phase with the other two condensers. That is to say, when the rotor plates of (3) and (10) are completely in mesh with the stator plates, plates of condenser (15) will be partly out.

The tickler winding on the antenna coil (2) is shunted by a very small variable condenser (4) which is used for bringing the primary into resonance with the secondary and to compensate or adjust for varying antenna lengths. The 50,000-ohm Electrad potentiometer (21) varies first the detector screen-grid voltage, thus providing a means of regeneration control. The other potentiometer (69) furnishes a means of regulating the screen-grid voltages of the intermediate tubes (28) and (39).

The toggle switch (71), located on the panel front, is used to cut off plate current from the oscillator when the set is to be operated on the short-wave band. In this case, tube (13) acts as a combination first detector and autodyne oscillator. For broadcast reception, switch (71) is closed and the oscillator (19) is again permitted to function.

The R.F. chokes used at (25), (31A), (35), (43), (47), (52) and (64), each by-passed by small fixed condensers, act as isolators and filters. Isolating the various portions of the circuit in this thorough manner adds perceptibly to the overall efficiency of the receiver. The chokes specified are mounted on small bakelite forms and are of special low-loss construction. No other type should be substituted. They have an inductance of 7950 microhenries.

"Control Box" a Feature

The various battery leads, filament leads, meter connections, etc., are brought out of the set in a cable, terminating in a nine-prong Jones plug. This plug fits into a suitable socket on the control box, shown in the illustration, alongside the set. The box contains an electrolytic filter condenser and the variable resistor (73) which is in series with the filaments. A duplex toggle switch is mounted on the cover. It opens or closes the 110-volt A.C. or D.C. line and the B-minus circuit in the same operation. There are five binding posts on the front wall of the box. From left to right, looking at the box, these are B-plus 135 volts, B-plus 90 volts, B-minus and the two posts provided for connecting an 0 to 1 ma. meter in the circuit. The meter may be used for visually tuning in short-wave stations. Incidentally, visual tuning is far more effective than any other method of tuning.

A special fusible cap plug is used for connecting the control box to the 110-volt source. This contains two 500-ma. Instrument Littelfuses in series with each side of the line. These fuses are approved by the Board of Fire Underwriters and furnish ample protection to the tubes and parts of the radio receiver.

The "Ultra-Seven" does not require a ground. In the model illustrated, a flexible wire attached to the socket terminal and leading directly from the primary of coil (2) provides the antenna connection. This wire may be observed at the right of the set. Of course, a binding post may be used for the antenna connection if desired. The loud speaker is connected at the rear of the set, the terminals being plugged into two pin-jacks.

Constructional Notes

The construction of the "Ultra-Seven" is straightforward and presents no difficulties. The chassis is constructed from sheets of 16-gauge aluminum, supported by ½-inch aluminum angles. The dimensions of panel, various shelves, angles, etc., are given in the accompanying drawings. The initial framework consists of two rectangles 12⅛ x 5⅝ inches, each, made of ½-inch width aluminum angle strips. The two rectangles are fastened 4 inches apart by means of six ⅜-inch wide angles. This construction is clearly shown in Fig. 1. Tube sockets (28), (39), (49) and (60) are mounted on shelf "A" as shown. Speaker pin-jacks are also mounted on this shelf. This shelf also carries the upright shelf "B" (Fig. 1-A), on which the I.F. transformers are mounted, and upright shelf "C" (part of A), which carries the electrolytic condenser (61), metal case condenser (57), 3-volt flashlight battery (51), etc. A U-shaped aluminum shield forms a separate compartment for tube (39). (See Fig. 3.)

Shelf "A" is mounted on brackets which are supported by the tin shelf "H." "H" acts as a shield and in turn is fastened directly to the framework. Shelf "D" (Fig. 4) carries the sockets for tubes (5), (13) and (19), the tubes being mounted in an inverted position. This shelf is supported on four 1-inch length pieces of brass tubing fastened to the angle framework.

Upright aluminum shelves "E" and "F" (Fig. 5) divide the R.F. stage, the first detector and the oscillator stages into separate shielded compartments. They are fastened to the framework. These upright shields are also used for mounting the three Hammarlund variable condensers (3), (10) and (15).

The coil sockets (2) and (9) are mounted on brass tubing supports and brackets as shown. The supports are fastened to the upright shelf "G," the sockets being held about 1½ inches from the shelf. The socket (14) for the oscillator coil is mounted on the upright shelf "G" (Figs. 6A and 6B), being supported on ½-inch long hollow brass rods as illustrated. The drum dial is fastened to the front panel.

The coil sets are wound according to the table of coil winding directions, using the new Hammarlund short-wave coil forms. These coil forms are especially well adapted for short-wave worfl. The material used is extruded isolantite, which closely approximates the qualities of fused quartz. Lowest losses and absolute stability assure maximum sensitivity and selectivity.

The panel is now prepare (see Fig. 7), holes being cut for plugging in coils (2) and (9) and for the drum dial escutcheon plate. Mounting holes are also drilled for the drum dial control shaft, for the potentiometers (21) and (69), for the toggle switch (71) and for the small antenna tuning condenser (4). These parts are mounted, but the panel is not fastened to the chassis until most of the wiring is completed.

Condenser (15) fastens to the drum dial at the left and to the flexible coupling at the right. Likewise, condenser (10) is connected to the flexible coupling at the left and to the metallic coupling at the right. Special condensers may be obtained with shafts extended on both sides or standard condensers may be used by removing the brush contacts at the left.

In wiring the set, flexible hook-up wire is used throughout. Filaments are wired first, then following the usual routine of wiring in the order named, grid circuits, plates, cathodes, negative returns, by-pass condensers, etc. In wiring screen-grid tubes, be sure to make screen-grid connections at the socket terminals and control-grid connections at the caps. Use care in wiring the 138-A pentode, making socket connections according to the instructions provided with the tube. Note that one of the grid connections is made to the cathode within the tube and that this requires no external wiring. Use special care in wiring the sockets used for coils (2), (9) and (14), as the receiver cannot function with the coil windings incorrectly hooked up.

After the wiring is completed, the intermediate stages must be tuned to 115 kc., using an oscillator such as the Weston or Readrite. The set is then balanced, final adjustment being made of the variable condenser ganging.

Operating Instructions

Correct battery voltage is imperative. Do not use "B" batteries after voltage reading falls below 40 volts on a 45-volt battery. Do not use a ground with this receiver. Practically any length of aerial may be used. Where local interference is unusually bad, use only a *very short aerial.*

The detector control should be advanced as far to the right as possible, without introducing a howl. The intermediate volume control (69) increases volume when turned to the right. The setting of the balancing condenser (4) is important. For best results, it is usually set towards its minimum capacity.

Complete List of Parts Required for the Portable "Ultra-Seven" Superhet

- 3 Hammarlund midget variable condensers, .0002-mf., type MC-200M (3, 10, 15).
- 1 Hammarlund midget variable condenser, .00008-mf., type MC-75M (4).
- 1 Hammarlund padding condenser, 700 to 1,000 mmf., type MICS-10000 (78).
- 8 Hammarlund isolantite short-wave coil forms, 6-prong, type CF-6. (Four sets of two coils each, one antenna coil (2), one detector coil (9). See coil winding directions.)
- 2 Hammarlund 6-prong isolantite sockets (2, 9).
- 1 Hammarlund 5-prong isolantite socket (14).
- 1 Hammarlund flexible coupling (between condensers (10) and (15).
- 1 Metallic coupling (between condensers (3) and (10).
- 3 Automatic Winding Co. intermediate frequency transformers, complete with I.F. coils, tuning condensers and shields: 115 kc. (23, 24), (33, 34), (45, 46).
- 7 Automatic Winding Co. R.F. chokes (25, 31A, 35, 43, 47, 52, 64).
- 1 Silver-Marshall 131P oscillator coil (14 A, B, C) or coil wound according to directions on Hammarlund isolantite short-wave coil form, type CF-5.
- 2 Electrad 50,000-ohm potentiometers, type RI-205 (21, 69).
- 3 Electrad Truvolt 400-ohm flexible resistors (7), (30), (41).
- 1 Electrad Truvolt 1,000-ohm flexible resistor (38). Note: Used to control oscillation. Try smaller or larger values as needed.
- 1 Electrad Truvolt 1,500-ohm flexible resistor (62).
- 1 Electrad Truvolt 2,000-ohm flexible resistor (17A).
- 1 Electrad Truvolt wire-wound resistor, 300 ohms, type C-3, with clip moved to 250-ohm position (73). Note: A 250-ohm rheostat may be substituted, provided this will carry 300 mils. without undue heating.
- 4 I.R.C. (Durham) 2-megohm metallized resistors, type M.F.4½ (27, 37, 50, 67).
- 1 I.R.C. (Durham) 5-megohm metallized resistor, type M.F.4½ (12).
- 2 I.R.C. (Durham) 20,000-ohm metallized resistors, type M.F.4 (22, 70).
- 1 I.R.C. (Durham) 25,000-ohm metallized resistor, type M.F.4 (58).
- 1 I.R.C. (Durham) 50,000-ohm metallized resistor, type M.F.4 (17).
- 2 Aerovox .1-mf. (each section) double section metal case condensers, type 260-21 (6, 8), (18, 25A).
- 2 Aerovox .1-mf. (each section) triple section

metal case condensers, type 260-31 (29, 31, 32), (40, 42, 44).
1 Aerovox .00015-mf. mica condenser, type 1460 (11).
1 Aerovox .00025-mf. mica condenser, type 1460 (16).
1 Aerovox .0005-mf. mica condenser, type 1460 (77).
5 Aerovox .002-mf. mica condensers, type 1460 (26, 36, 48, 53, 54).
2 Aerovox .01-mf. mica condensers, type 1450 (20, 63).
2 Aerovox .25-mf. metal case condensers, type 260 (74, 75).
1 Aerovox .5-mf. metal case condenser, type 260 (57).
1 Aerovox 1-mf. metal case condenser, type 260 (68).
1 Aerovox 4-mf. dry electrolytic condenser, type E5-4 (small can) (61).
1 Aerovox 8-mf. dry electrolytic condenser, type E5-8 (78).
1 Trutest 30-henry audio choke (77).
1 Eby twin "speaker" jack (65, 66).
7 5-prong wafer-type sockets (5, 13, 19, 28, 39, 49, 60).
1 Drum dial with escutcheon plate and 3-ampere pilot light (76).
1 Antenna binding post or antenna flexible lead (1).
5 Binding posts for control box.
1 110-volt type single-throw, double-pole flush-plate toggle switch (72, 72A).
1 Single-pole, single throw Cutler-Hammer toggle switch (71).
4 Arcturus 136-A screen grid tubes (5, 13, 28, 39).
2 Arcturus 137-A tubes (19), (49).
1 Arcturus 138-A tube (60).
1 3-volt flashlight battery (51).
1 22½-volt "C" battery (56).
*1 Trutest audio transformer, ratio 3½ to 1, AF-8, type 2A325 (55).
*1 Trutest audio choke, 30-henry.
1 Weston D.C. milliammeter (0 to 1 range), model 301, for visual tuning.
1 Littelfuse fusible cap, No. 1037, with two ½-ampere, 500-volt instrument Littelfuses, type 1046 (79).
1 Small Wright-De Coster No. 255 reproducer (66A), 6¾ inches diameter (6-volt field for storage battery operation or 110-volt field if operated from line).
1 Control box (See Fig. 14).
1 Jones plug (9-prong) with corresponding socket.
1 Bakelite panel 12¾ x 11¾ x 3/16 inches (See Fig. 7).
3 Aluminum shields, same size as shields containing I.F. transformers, 2⅛ inches diameter by 2¼ inches high. Shield "X" containers (25, 26, 27), Shield "Y" containers (35, 36, 37), Shield "Z" containers (47, 48, 50).

Note.—Numbers in parentheses refer to corresponding numbers used to mark parts on diagrams.

* Trutest parts manufactured by Wholesale Radio Service Co. of New York City.

Data on Coils Used in the "Ultra-Seven" Superheterodyne

COILS (2) AND (9)

Coil Forms: Hammarlund Isolantite, 1½ inches diameter, 2½ inches long exclusive of knobs and prongs. Six-prong forms used.

9 TO 15 METERS:
Secondary, 2⅝ turns of No. 16 enamel.
Primary, 1⅝ turns of No. 34 enamel.
Tickler, 3 turns of No. 32 double silk.

14.5 TO 25 METERS:
Secondary, 6¼ turns of No. 16 enamel.
Primary, 3⅝ turns of No. 34 enamel.
Tickler, 3 turns of No. 32 double silk.

23 TO 41 METERS (Coil Set No. 1):
Secondary, 11⅝ turns of No. 18 enamel.
Primary, 7⅝ turns of No. 34 enamel.
Tickler, 3 turns of No. 32 double silk.

40 TO 70 METERS (Coil Set No. 2):
Secondary, 19⅝ turns of No. 18 enamel.
Primary, 12⅝ turns of No. 34 double silk.
Tickler, 4 turns of No. 32 double silk.

65 TO 115 METERS:
Secondary, 34⅝ turns of No. 24 enamel.
Primary, 21⅝ turns of No. 34 double cotton.
Tickler, 4 turns of No. 32 double silk.

115 TO 200 METERS (Coil Set No. 3):
Secondary, 62⅝ turns of No. 28 enamel.
Primary, 38⅝ turns of No. 32 double silk.
Tickler, 5 turns of No. 32 double silk.

200 TO 360 METERS (Coil Set No. 4)
Antenna Coil (2)
Secondary, 130⅝ turns No. 32 double silk.
Primary, 60⅝ turns No. 32 double silk.
Tickler, 7 turns No. 32 double silk.
Detector Coil (9)
Secondary, 98⅝ turns No. 32 double silk.
Primary, 47⅝ turns No. 32 double silk.
Tickler, 7 turns No. 32 double silk.

350 TO 550 METERS (Coil Set No. 5)
Antenna Coil (2)
Secondary, 171⅝ turns No. 32 enamel.
Primary, 82⅝ turns No. 32 enamel.
Tickler, 9 turns No. 32 double silk.
Detector Coil (9)
Secondary, 166⅝ turns No. 32 enamel.
Primary, 82⅝ turns No. 32 enamel.
Tickler, 9 turns No. 32 double silk.

Note.—It may be necessary to add several turns to tickler winding of detector coil (9) to obtain desired regeneration.

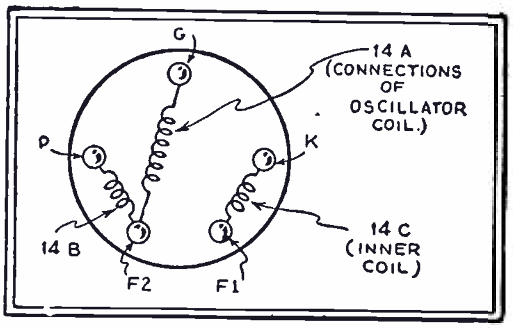
OSCILLATOR COIL (14 A, B, C)

Coil Form: Hammarlund Isolantite, 1½ inches diameter, 2½ inches long. Five-prong form used.

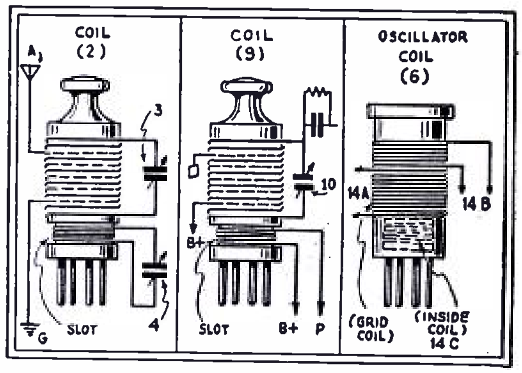
GRID COIL (14A):
82½ turns No. 28 enamel.

PLATE COIL (14B):
32⅔ turns No. 28 double silk.

INNER COUPLING COIL (14C):
50 turns No. 28 double silk. (14C) is wound on cardboard form which just fits inside isolantite form.



Detail of oscillator coil connections to 5-pin plug.



Detail of coil positions on forms used in the "Ultra-Seven" Super-het.

The intermediate frequency coils are "universal" wound with 800 turns of No. 36 S.S.C. wire each; tuned by Hammarlund adjustable condensers of 140-220 mmf. range. Each coil has an inductance of 6,900 microhenries or 6.9 millihenries. The I.F. coils are wound "universal" machine or "bank" style on a ½-inch diameter dowel. The I.F. is 115 kc.

Don't Miss the November Issue!

A SPECIAL BEGINNERS' NUMBER

of Interest to All S-W Experimenters.

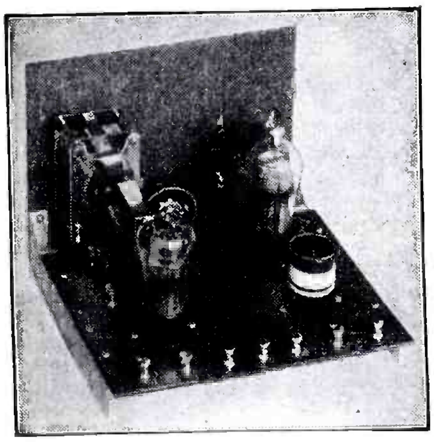
New DX Receivers

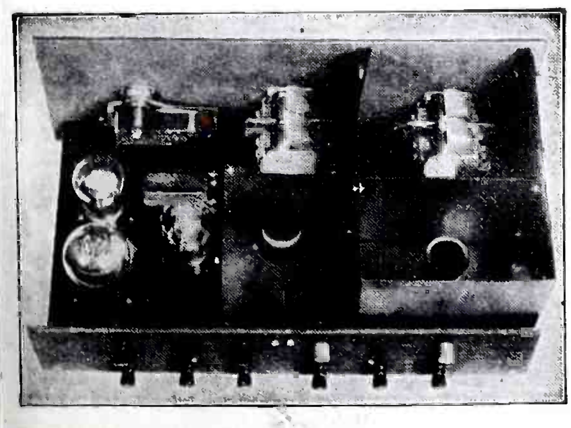
● DELFT RADIO COMPANY, Pacific Coast manufacturers engaged entirely in manufacturing short-wave and ultra-short-wave receivers, wavemeters, transmitters, etc., have introduced a very inexpensive line of powerful distance-getting short-wave receivers. Although converters are very convenient in some cases, a receiver designed especially for short-wave use will, as a general rule, give more distance and all-around satisfaction, and costs no more. The new receivers, besides having all modern improvements, also have several new features. Only the latest types of tubes are employed, giving maximum sensitivity and volume at unusually low cost. Both A.C. and D.C. models are available.

The new 2 and 4 tube models, as shown in the illustrations herewith, employ coils wound on special, long coil-forms, fitted with rings at the top for protecting the coil windings. A new degree of ease in tuning is provided, as well as great sensitivity per tube. Employing pentode detectors and pentode amplifying tubes, the sets are without doubt the most modern sets on the market in their price class.

The new 4-tube set is worthy of considerable favorable comment, for which space is necessarily limited. Like the sets described above, the modern pentode provides unusual sensitivity. A glance at the illustrations herewith will reveal some surprising facts. The set uses two 2-gang condensers, one section of each of which is used for convenient short-wave tuning, while at the higher wavelengths both sections are employed, thus giving *full broadcast-band coverage with a single coil.* Those who have tuned less modern receivers are acquainted with the inconvenience of changing coils to cover the broadcast band, for example, during some important broadcast. Both the input connections to the set and the coupling between tubes is automatically changed, thus making it unnecessary to use complicated switches of any kind. The latest types of coils are also used in the new 4-tube sets.

The 4-tube kits come completely put up, but not wired, and are supplied with complete instructions so that even those not understanding wiring hook-ups may build one of these sets. These employ the latest colored metal chasses and a trouble-proof shielded compartment for the radio frequency input tube, giving extremely large "gain." Wired models in A.C. and D.C. are also supplied, if desired.





New Delft 2 and 4 tube pentode receivers.

Band Spreading

(*Continued from page 332*)

that the capacity variation over a desired portion of the tuning curve is exceedingly small. If desired, the entire tuning range may be stretched over a frequency variation of a minute order. This is a highly efficient system of band-spreading, and solves both the tuning and the logging problems. The only objection to the system is that it definitely limits the receiver to a very small portion of the short-wave spectrum unless an inordinately large collection of coils is available—a severe limitation to practicability.

Use of Fixed and Variable Capacitors

A similarly desirable ratio between control adjustment and tuning capacity variation can be achieved by shunting the tuning inductor with a series of a fixed capacitor and a variable capacitor, as shown in Fig. 1. Condenser Cf is the fixed capacitor and Cv the control or variable condenser. The combined capacities of these condensers, or the tuning capacity Ct (neglecting circuit and distributed capacities) is equal to

$$C_{t1} = \frac{1}{\frac{1}{C_F} + \frac{1}{C_V}}$$

If we increase the capacity of the variable condenser by the amount ΔC, the capacity of Ct now is

$$C_{t2} = \frac{1}{\frac{1}{C_F} + \frac{1}{C_V + \Delta C}}$$

where Cf and Cv are the same as in equation (1).

The difference between Ct2 and Ct1, the change in the actual tuning capacity Ct, is obviously equal to

$$\Delta C_t = C_{t2} - C_{t1} = \frac{1}{\frac{1}{C_F} + \frac{1}{C_V + \Delta C}} - \frac{1}{\frac{1}{C_F} + \frac{1}{C_V}}$$

Simplifying,

$$\Delta C_t = \Delta C \times \left[\frac{C_F^2}{C_V^2 + 2C_V C_F + C_F^2 + C_V \Delta C + C_F \Delta C}\right]$$

As the portion of equation (4) in brackets is always a fraction, it is obvious that ΔCt is always less than ΔC. Inspection of the equation (or complete differentiation) will also suggest that the rate change of ΔCt will depend upon the ratio of fixed to variable capacities. The curve, Fig. 2, illustrates this relationship. It is evident that, by choosing a large variable condenser and a small fixed condenser, we can make the variation of Ct as small as we desire, over the entire dial range! The change in Ct will always necessarily be less than the capacity of the fixed condenser.

An objection will immediately be raised against this system on the grounds that it suffers from the same limitations as the special plate arrangement, and that for a similar degree of band-spreading the same number of coils will be required to cover the short-wave spectrum. This would be so were it not for the fact that band-spreading is necessary only over certain portions of the dial (broadcast or amateur, according to taste) and that this particular series-parallel arrangement can be approximated by incorporating the fixed condenser in the plug-in coil unit, two or three such units sufficing for band-spread requirements, while still permitting the use of standard coils for complete spectrum coverage.

A Commercial Band-Spread System

The circuit of such an arrangement is shown in Fig. 3, while Fig. 4 shows the actual connections made in the National plug-in coils. The tuning condenser, capacity C1, is shunted about only the lower portion of the coil. The distributed capacity of the upper portion of the coil functions as the fixed capacity in Fig. 1. We thus have a fairly large variable capacity working against a very low fixed capacity—the requirement for a low rate change in actual tuning capacity Ct. The trimming condenser, C2, is used merely to set the band-spread at the desired portion of the tuning curve. Grid condenser and grid leak are also incorporated in the coil unit shown in Fig. 5.

This arrangement, in conjunction with a 270-degree condenser and a scientifically designed dial, results in an ideal amateur receiver, both 20-meter and 40-meter bands being spread over fifty dial divisions about the center of the dial.

In designing such a unit, constants must be chosen so that the natural periods of any portion of the coil do not approach the tuned signal frequency, such a condition resulting in a great increase in the resistance of the coil. The L/C ratio of the National unit is particularly conducive to a high degree of sensitivity which is effectively conserved by the use of R-39 insulation.

Figure 6 shows the band-spread coil plugged into a standard short-wave receiver. Substitution of an ordinary coil automatically readjusts the receiver for the usual extension of frequency bands.

Transmitter From Neutrodyne

(*Continued from page 335*)

has an appreciable length compared with that of the antenna, the antenna should be shortened just the length of the ground lead. If a counterpoise is used in place of an antenna, it should be the same length as given above for the antenna and may extend in any direction, but the opposite direction is preferable. The radiating system is tuned to the transmitter frequency by means of the antenna series tuning condenser. There will be a sharp increase of plate current to the power amplifier as the radiating system is tuned through resonance. If the plate current is high at all settings of the antenna series condenser the coupling is probably too close. This means that the number of turns in use in the antenna pick-up coil should be reduced. If connecting the radiating system and tuning it has no noticeable effect on the plate current to the power amplifier, the system is probably too long or too short.

No antenna current indicator is necessary. If one is desired the filament of a deactivated 199 tube in series with the antenna will serve. It will glow at just about normal brilliancy with the antenna current that this transmitter can supply. The silvery coating within the tube may be evaporated by holding the end of the bulb over a hot flame for a time and so making a "window" through which the filament may be more readily observed.

Does the set really work? Well, on the very first test a station thirty miles away was "worked," who gave a very fine report. Next a station fifty miles away was "worked" and a similar report received, and this was followed by a report from a station nearly a hundred miles away. Not bad for daylight work and the very first time on the air! The night range is much greater of course. A pleasant surprise was that duplex telephony was possible with this transmitter. On account of the low power it is possible to transmit and listen-in at the same time and in the same band.

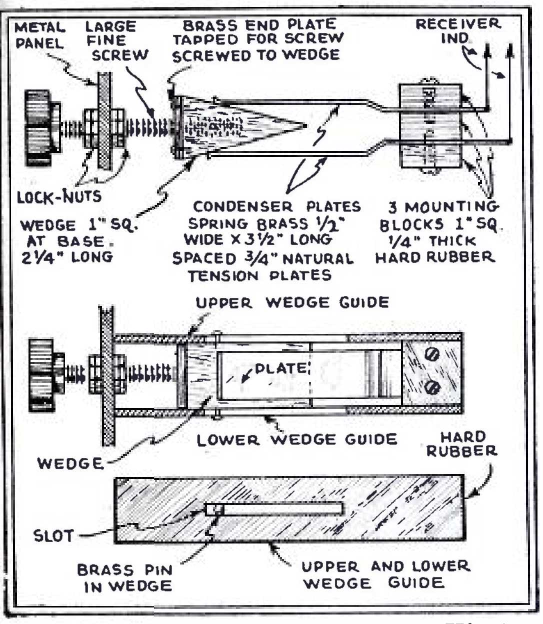
Tube Data Chart

Tube No. in fig. 1	*Type of Tube*	*Tube Use*	*Grid Bias*	*Plate Volt-age*	*Plate Curr. mills*
1	201A	M. Osc.	25,000 ohm g. l.	90	12
2	112A	P. Amp.	—27	90	14
3	201A	1st A. Amp.	(—1)	22½	0.5
4	201A	2d A. Amp.	—4½	90	2.5
M	171A	Mod.	—27	135	17

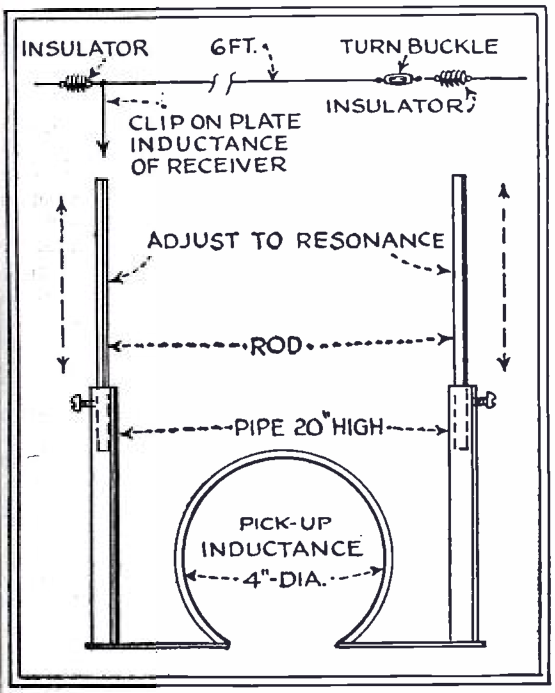
With a completely battery operated set, all the above values except plate currents are predetermined. The plate currents to the master oscillator and the power amplifier are determined by adjustments and load. Antenna coupling, etc., should be varied until the above values are approximated. The above values are also helpful when a "B" eliminator is used and no voltmeter is available.

Mysteries of the 5-Meter Band

(Continued from page 331).



Drawing above shows how Mr. West built his low-capacity, wedge-type variable condenser.



Above we see how Mr. West arranged his antenna inductance and the antenna itself.

turn or less of the micro-vernier condenser.

New Tubes May Spell Magic

Some bright youngster is going to incorporate this idea using the *new tubes* and will probably get some very good results if he bears in mind a few suggestions, such as keeping surplus metal out of the outfit; *not* using .0005 mf. variable condensers; using plenty of tuning inductance; and the minimum amount possible of variable tuning condenser. In other words, to build the *broadest* tuner possible, for even his broad tuner will be critically sharp at a distance.

One thing to remember is that in most receivers the regenerative control has an *interlocking* effect with the tuning control; and for this reason it should be as smooth as possible. Even then it will sometimes act as a *tuning control.*

The writer used a fine threaded machine screw, with its threads wound with low resistance wire. This was fitted with a knob, and by use of lock-nuts and washers, fastened to the metal panel. A hole was bored in a block of wood the size of the machine screw (plus wire); the screw inserted in the hole, and both ends of the wire fastened to the block. The machine screw was then carefully withdrawn for the first time, leaving the wire inside the block and with the same screw pitch as on control knob. Micro-adjustment of the filament was accomplished by simply short-circuiting the resistance wire. The voltage drop over the entire scale was approximately ¼ volt.

Again, some bright experimenter is going to couple this control with the screw action of the vernier variable and cause our engineering brothers to publish a page of mathematics whose entire substance probably amounts to the square of the voltage increases according to the square of the micro-microfarad decrease.

Nevertheless, all the foregoing is food for thought. With many now in the game, cooperation ought to be easy, not like in the early days when the experiments were conducted by the use of alarm-clock operated transmitters with the lonesome "ham" parked in a remote section and trying to receive five meters as hard as ever he can.

Antennas

The antenna for the receiver is not critical; a length of heavy stranded copper wire 6 feet long is sufficient. However, it must not wobble and should be stretched taut.

The transmitter antenna consists of two brass pipes ½-inch diameter and 20 inches long. These are the aerial and counterpoise. A length of brass rod slips inside each tube and is held in place by a screw.

L. Hulet's 3rd Prize Winner

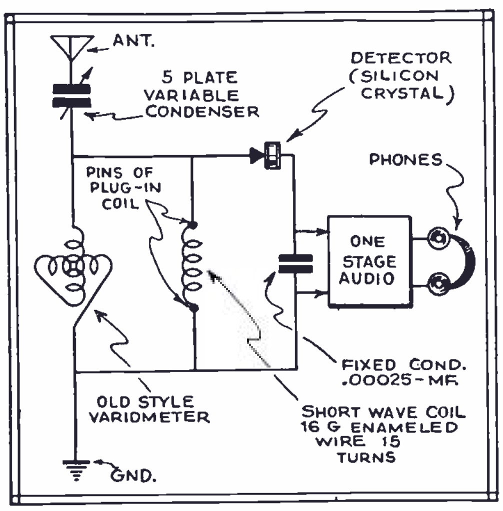
(Continued from page 349)

Apparatus Used

1 Old-style variometer (most any kind will do).
1 Crystal detector (natural silicon crystal of volcanic origin).
1 Five-plate condenser (any make).
2 Lorenz type coils, No. 16 En. wire. wound on 3½-inch diameter forms. There are two coils wound on similar forms, with 15 and 5 turns, respectively. wound on 3½-inch diameter forms.
For greater volume, have added one stage of audio:
1 Stromberg-Carlson audio transformer.
1 Cunningham tube.
1 20-ohm rheostat.
1 Fixed condenser, .00025-mf.

Calibration for 25-Turn Coil

Var. Dial	Condenser	Station	Meters
100	75	WFAB	231
100	60	WHOM	207
0	40	WPEG	122



Amateurs who made good

KEITH HENNEY

Keith Henney in a characteristic pose taken in his radio laboratory at Garden City, Long Island, New York.

O KEITH HENNEY, who is very well known to radio men, and who now holds the important position of Associate Editor of *Electronics*, sent us the following brief description of his many activities just before leaving on on extended trip, and we are sure that Mr. Henney's many admirers will want to know something about his rise in the realm of radio. Says Mr. Henney:

"My amateur days date from about 1914, having my first *spark* station in Marion, Ohio, 8ZD, about 1915. I got my first commercial license in 1916; sailed Great Lakes in summers thereafter. During the World War I was an operator for Shipping Board and Marconi Co. I also sailed on Kilbourne and Clark boats. Operated amateur stations at Harvard University in 1922-24; in 1925 went to *Radio Broadcast* to organize their Radio Laboratory to protect the advertising pages of the Quality Group of magazines (*World's Work, Scribners, Harpers, Atlantic Monthly* and *Review of Reviews*) from fly-by-night advertisers. There erected and operated stations 8-2GY and at my home 2EJ. Helped equip the Dyott Expedition to the *River of Doubt*. In 1930 left *Radio Broadcast* magazine to become associate editor of *Electronics*. Spent a year in the Bell Laboratories in 1924.

"In 1920 John Wiley and Sons published my book, *Principles of Radio*. Have written articles on scientific subjects for many magazines, including *World's Work* and *Review of Reviews*.

"Got A.B. degree from Western Reserve University in 1921, and A.M. from Harvard in 1925.

"A short-wave station is maintained at Garden City, Long Island, New York, where amateur and other short-wave stations are regularly listened to."

S-W League

(*Continued from page* 346)

Renewals or new licenses may be issued a reasonable length of time prior to the expiration of existing licenses, but must bear the exact date of issue, which must correspond with the date on form 756 forwarded to the radio division. Operators who fail to apply for renewal of their licenses on or prior to the date of expiration must be re-examined.

If, because of circumstances over which the applicant has no control, an operator is unable to apply for renewal of license on or prior to the date of expiration, an affidavit may be submitted to the radio division through the supervisor of radio or examining officer, attesting to the facts. After consideration by the radio division, advice will be forwarded to the supervisor of radio or examining officer in regard to the issuance of a renewal of the license.

Duplicate licenses.—Any operator applying for a duplicate license to replace an original which has been lost, mutilated, or destroyed will be required to submit an affidavit to the radio division through a supervisor of radio or examining officer, attesting to the facts regarding the manner in which the original was lost. The director of radio will consider the facts in the case and advise the supervisor of radio or examining officer in regard to the issuance of a duplicate license. Duplicates will be issued under the same serial number and date as the original, and will be marked "Duplicate" in red on the face of the license.

Re-examination.—No applicant who fails to qualify will be re-examined within three months from date of the previous examination. However, when an applicant for the radiotelegraph operator first-class or second-class license fails in the code examination, he may be re-examined the same day for any other class of license desired.

The Super Regenerator Four

(*Continued from page* 329)

in series with the H.T., since this is a more economical method than utilizing a potentiometer arrangement, especially as the receiver was battery-operated. This resistance (R1) is variable between 0-2 megohms. It should be adjusted so that the valve just oscillates. Strong oscillations are not desirable, and if they are too weak adjustment of C3 to the point where the detector breaks into oscillation periodically suppresses the quenching oscillations and produces an effect akin to motor-boating. A fractional turn of R1 corrects this and gives a satisfactory working condition. The reaction condenser is adjusted to give the best compromise between signal strength and background noise.

With R1 adjusted so that the quenching valve is inoperative, the set can be used as a straightforward Det.-L.F. arrangement, in which condition C.W. signals are receivable in the normal manner. When a telephony station is heard, V1 can be brought into action and the super-regenerative properties utilized to boost the signal for loud speaker reproduction.

Under super-regenerative conditions more reaction capacity is required at C3, which, of course, is in keeping with the theory, since the circuit L5, C4 will not reach the critical state for self-oscillation until its effective resistance is reduced to a lower level.

It will be noticed that the tuned grid coil L5 is provided with a center tap, to which point the grid return of the quenching circuit L1, C1, is joined. As one coil will not cover a sufficiently extensive waveband for normal purposes, and switching would be an undesirable complication, coils L3, L4, and L5 are wound on a six-pin form such as the new National six-pin forms. Two coil units have been prepared, which, in conjunction with the 0.00015-mf. condenser C4, cover wavebands from 21 to 36.5 meters and 25.5 to 76.5 meters respectively. The tuning system must be modified for ultra-short-wave reception, special coils and condensers being essential.

So far as the disposition of the components is concerned, it will suffice to say that, provided the usual care is observed and that those constituting the tuned circuit are suitable for short-wave use, no special precautions seem necessary, and if the constructor desires to exercise his constructive ingenuity he is at liberty to do so within reason.—*Courtesy of Wireless World (London).*

A Receiver That Laughs at Static

(*Continued from page 339*)

insulated from each other except through capacities. If we wish to house them in cabinets they must be insulated from each other. For the time being we will mount both parts of the system on a bakelite panel 7 x 14 inches in size, using a baseboard of the same size to mount the amplifier parts on at the same time. A connecting strip to connect our batteries to is mounted on the baseboard.

Figure 2A and B shows the panel and baseboard respectively. The large dials are the two tuning dials, while the two small ones are the regeneration control and the antenna coupling condensers respectively, one set for each tuning system.

We are going to use the type '30 tubes for detectors and the amplifier, as we have to use separate "B" batteries for all these tubes. It won't take as many as if we used the '31 or the '33 type tubes, although you may use them if you desire to. An amplifying transformer couples our detectors to the amplifier in such a way that energy from either detector energizes the amplifier. If the energies from the two detectors are equal and opposite at the same time, no signal will be transmitted by the amplifier; this is of course what we have been after.

Now that we have all the parts properly mounted we will make up a set of tuning coils. Starting with the 80-meter band we make two coils of 10 turns each, about 2 inches in diameter and of No. 16 wire. Then we make two more of 20 turns each with a tap at 10 turns, the diameter and wire size to be the same. The 10-turn coil connects between No. 1 and 2 and the 20-turn coil connects between Nos. 3, 4 and 5, the ends of the coils being to the right.

We are now ready to connect our "A" and "B" batteries. Each tube must have a separate "A" battery, so we connect two dry cells to each of our three tubes through a proper filament resistor and one 45-volt "B" battery to each detector, being certain that we make this important connection so that the negative of the "B" battery goes to the filament of one detector tube and the positive of the same "B" battery goes to the plate connection of the other tube through the radio frequency choke coil. The amplifier batteries are connected in the usual manner. Then we connect the amplifying transformer between the two positive connections of the two detector "B" batteries, the second connection going to the grid of the amplifier with a grid bias battery of minus 4.5 volts and a plate voltage through our phones of 90.

Now let's see what happens. Our antenna is connected through coupling condensers. We control our regeneration through the 100 mmf. regeneration condenser in each plate circuit and tune our two receivers by the two 100 mmf. tuning condensers. Let us tune one receiver to some signal in the amateur band and the other to a higher frequency signal in the same band. Detune them so that you obtain a 500-cycle tone frequency from one and an 800-cycle tone frequency from the other.

Let us now follow them through the system. The signal from the left receiver goes through the amplifying transformer to the plate of the tube in the left receiver and the signal from the right receiver goes through the amplifying transformer in the opposite direction to the plate of the tube in the right receiver. Both signals, because of the difference in tone frequency, will be impressed on the grid of the amplifying tube and we will hear them in the phones, one a 500-cycle signal and the other an 800-cycle signal. We will have lots of fun tuning to two different frequencies at the same time and listening to the conversations between two amateurs who are in contact with each other, doing this without the necessity of retuning for each signal, as we would have to do with our conventional tuners.

Now let us see what happens if we have some non-tunable interference. Suppose we set a buzzer going in the room. We tune to a signal with the left receiver and pull the tube out of the right receiver. The interference is very bad. Now we replace the tube in the right receiver and tune to some signal. We find that we can hear the signal which before was inaudible through the interference. To reduce the interference as much as possible, we carefully adjust our antenna condensers and regenerative feed back condensers until the interfernce is a minimum. The two tuning condensers are adjusted as close to the desired signal frequency as possible, one on one side of the carrier and one on the other side of the carrier, differing by an audio frequency which is passed on through the amplifying transformer to the amplifier.

Signals that could not be copied with just one of the receivers could be copied with no trouble at all when using both receivers and cancelling the interference at the amplifying transformer. It takes a little patience to make the proper adjustments, but the results are very worth while. To be able to listen to two frequencies in or out of the same amateur band makes listening-in even more desirable.

Many amateurs will find in this receiver a solution to their interference problems, and will build one for general all-around use. Such tubes as the '24 and '47 can be used, obviating "A" batteries. The circuit requirements for these tubes must, of course, be observed.

To reduce interference between circuits, the tuning coils should be turned at right angles to each other. When enclosed in a cabinet this precaution need not be followed. The coils themselves are so simple that no description is necessary. They can be made to suit conditions or can be found on plug-in forms to suit the maker. The radio frequency choke coils are wound with No. 30 wire on a 1-inch diameter cardboard tube 2 inches long and mounted on corks glued to the baseboard.

What to remember when building this receiver: Unless you use the separate heater type tubes you must use separate "A" batteries; you must use separate "B" batteries for any type of tubes; you must not ground the receivers directly, but through a .1 mf. condenser. You can ground the filament of the amplifier tube. You must be sure to make the plate connections of the two receivers just as shown: otherwise you undo what you have been trying to do. You can use as much amplification as you may desire. The connections for any additional amplification are conventional.

The present form of the receiver is as shown in the photo, each half of the receiver being in a section each side of the center section in which is the amplifier. This center section also has mounted on the front of the cabinet a two-section condenser by which the two halves are balanced to the aerial, the rotating part of the condenser being insulated from the cabinet. The two tuning condensers are insulated from direct ground connection with an insulating condenser mounted inside of the respective sections. This allows the tuning condensers to be mounted directly to the cabinet without insulating bushings. The amplifier tube is coupled to the two detector tubes through a regular amplifying transformer. Type '24 tubes are used throughout, and as they are of the separate heater type no separate "A" batteries are required, one filament transformer supplying all three tubes.

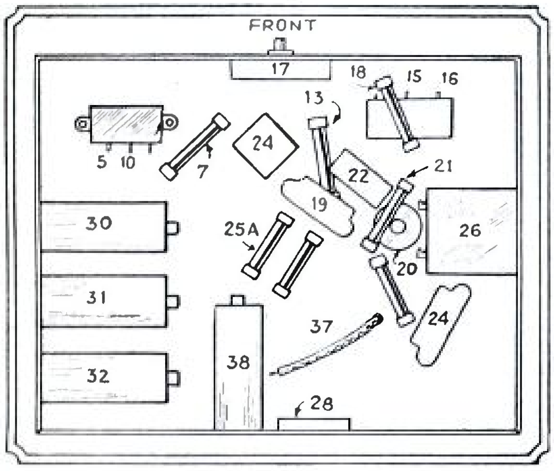
The cathodes are separately connected as shown in the diagram. The coil forms are as shown in the photo, being of the plug-in type readily obtainable. A pair is used for duplicate ranges. This allows reception of two stations in the same frequency band. This system was used by the writer during his drills with the Volunteer Communication Reserve net of the U. S. Naval Reserve while he controlled the Master Station NDF of the Third Naval District, allowing him to keep a listening watch on the Alternate Control Station NDB in New York on 4,045 kc. and at the same time working the reserve stations who were between 3,900 and 4,000 kc.

The number of turns for this range, 3,500 to 4,500 kc., is: plate turns, 15; tuning turns, 15; grid turns, 25; for other bands this is doubled or halved, the wire size being No. 24 B. & S. gauge. The circuit connections are as shown in the diagram.

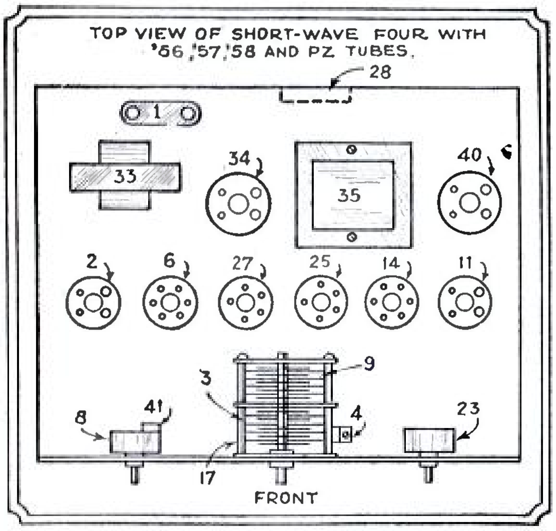
S-W Pentode 4

(*Continued from page* 355)

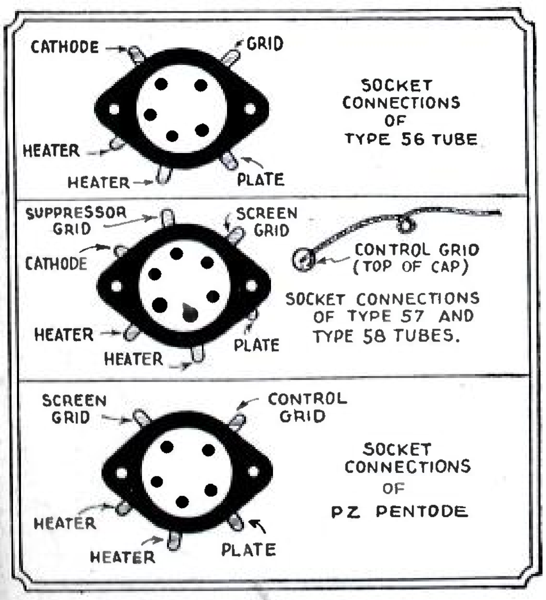
3 Aerovox 4 mf. dry electrolytic condensers, type E5-4 (TI can) (30, 31, 32).
1 Aerovox .0001 mf. mica condenser, type 1450 (12).
1 Aerovox .001 mf. mica condenser, type 1450 (19).
2 Aerovox .025 mf. mica condensers, type 1450 (22, 24).
2 Aerovox .1 mf. (each section) double section metal case condensers, type 260121 (5, 10) (15, 16).
1 I. R. C. (Durham) 75,000-ohm, 2-watt metallized resistor, type MR4.
1 I. R. C. (Durham) 2,000-ohm, 1-watt metallized resistor, type MF4 (25A).



Bottom view of Pentode Four.



Plan view of layout.



Details of socket connections.

1 I. R. C. (Durham) 200,000-ohm, 1-watt metallized resistor, type MF4 (21).
1 I. R. C. (Durham) 2 meg., 1-watt metallized resistor, type MF4 (13).
1 Amperite self-adjusting line voltage control, type 5A-5 (40).
1 *Trutest R.F. choke (20).
1 *Trutest audio transformer, 3-to-1 ratio, type 2C 1550 (26).
1 *Trutest power supply transformer, flush mounting type 2C 1492 (35).
1 *Trutest 30-henry choke (75 mils), type 2C 1571 (33).
1 *Trutest equalizer condenser, capacity 2 to 35 mmfs. (4).
1 *Trutest four-prong plug for speaker connection, No. 4B (28A).
3 Alden four-prong sockets, wafer-type (28A, 34, 40).
2 Alden five-prong sockets, wafer-type (25, 27).
2 Alden six-prong sockets, wafer-type (6, 14).
1 Crowe high ratio vernier dial with pilot light (36).
1 Eby twin binding post for aerial and ground connections (1).
1 Arcturus type 56 tube (26).
1 Arcturus type 57 tube (14).
1 Arcturus type 58 tube (6).
1 Arcturus PZ pentode power output tube (27).
1 Arcturus 180 tube full-wave rectifier (34).
1 aluminum chassis, 12 to 14 gauge, 13½ x 10¾ x 2½ inches high.
1 Wright-DeCoster dynamic speaker, infant model, with 2,500-ohm field and pentode (PZ, '47) type output transformer (29).

* Trutest products are marketed by Wholesale Radio Service Co. of New York.

Note: Numbers in parentheses refer to corresponding numbers marking parts on diagrams.

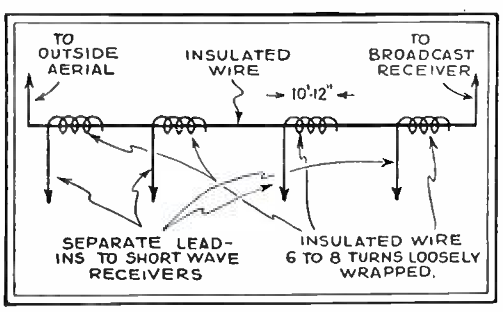
4 European Stations at Once!

(*Continued from page* 333)

the others had signed off or had faded out, so we can't increase the simultaneous reception record to five stations, although a fifth receiver, a National SW3 (center) was available.

The aerial employed for this stunt was a single wire totalling about 50 feet and connected permanently to an ordinary midget in an upstairs living room. The lead-in runs directly over the radio tables in the cellar. Short lengths of insulated wire from the aerial posts of the short-wave receivers were simply wrapped around the lead-in for a distance of about 10 inches, one right next to the other. The important thing to remember is that these individual wires were not actually connected to the lead-in, but were merely coupled to it capacitively. As many as six receivers have been operated successfully in this manner.

One of the interesting things observed during this test was that the fading of any one particular station was not always the same on the different receivers, when they were all tuned to that station. This seems to indicate that the receiving apparatus is sometimes responsible for annoying fluctuations in signal strength that are invariably blamed on atmospheric "conditions."



Connecting four sets to one aerial.

Coupling R. F. Stage

(*Continued from page* 347)

of 600 turns of No. 36 enameled wire is required; 100 turns per slot."

This circuit is highly efficient because the plate load more nearly approximates the plate impedance of the R.F. tube. L2 and L3 are the plug-in grid and tickler windings.

Probably the most efficient method of coupling is to use inductive coupling between the plate of the R.F. tube and the grid of the detector. This method is illustrated in Fig. 4. There is no possibility of leakage from the plate of V1 to the grid of V2. The primary, L1, should have an impedance as high as possible consistent with good selectivity. The ideal method would be to employ a one-to-one ratio transformer. However, the selectivity would be very poor, so the primary should have fewer turns. The ratio of turns between primary and secondary should be approximately 3 to 5. At frequencies above 10,000 kc., the ratio should be about 4 to 7.

When using a screen grid or pentode tube as a regenerative detector, the inductive coupling method will give much quieter operation than the other systems.

Audio Amplifiers

(*Continued from page* 347)

Figure 1 shows a simple audio system capable of giving very fine reproduction. Its chief drawback is that in most cases there is not enough volume for loud speaker operation.

By using a screen grid or R.F. pentode in the first audio stage and an output pentode in the second stage, it is possible to produce an amplifier giving good quality, together with ample volume. Such a system is illustrated in Fig. 2. By means of switch SW.1 the amplification of low frequency notes can be raised or lowered as desired. By adjusting potentiometer R4 the high frequency response can be raised or lowered.

Figure 3 illustrates what is probably the best scheme of adjusting frequency response. It consists of a resonating system so designed that it will be resonant towards the upper end of the audio band. As the circuit is shunted across the input to transformer A.F.1, the frequencies near the resonance point of the trap circuit will be by-passed to ground and hence will not appear in the output of the amplifier. By adjusting potentiometer A1 it is possible to alter the resonant frequency of the trap circuit. Low note response is boosted by closing SW.3.

Push-pull circuits do not offer any particular advantages in short-wave work, as the amplitude of signals is rarely sufficient to cause overloading of a single type '45, '47 or '42 tube in the output stage. If the receiver uses battery tubes, such as '31, '33, '38, '41, it may be advantageous to use push-pull or even "push-push" (Class B) amplification in the output stage to secure adequate undistorted output for speaker operation.

In the diagrams the source of biasing voltages is shown as batteries. This is merely for simplicity in the diagram, as any of the common schemes of obtaining bias by voltage drop through resistors may be employed if desired. The circuits may be used with either battery, automotive or A.C. tubes by making the usual changes in the filament circuits.

In diagram 3 the A.F. choke, L1, may be the primary or secondary of an A.F. transformer. Try both to see which works the better.—*M. Harvey Gernsback.*

Antenna Condenser

(*Continued from page* 353)

It will be noticed that the maximum wavelength reached by the lower band coils has been extended several meters. That is, a coil with a given wave band with the single condenser may be made to reach a few meters higher by switching both condensers into the circuit. This feature of the arrangement may be used to advantage with coils which fail to overlap.—*Edgar Grafton, Jr.*

Real 3-Tube Receiver

(Continued from page 344)

Another point of interest: the coil L2 is space-wound to decrease its distributed capacity. The coils require only a four-prong form, and may be wound on tube bases. However, better results are obtained by using slightly longer forms, which can be purchased cheaply. The coils are plugged into a standard tube socket. This is mounted on a small square of bakelite and raised about two inches from the panel by means of long screws. This makes it more accessible and keeps the field of the coil clear of conductors.

The coil L1, used to couple the antenna to the set, is rather important. It may be wound on a piece of ½-inch hard rubber rod and may be made plug-in. If the receiver is used with a short antenna, L1 should have a certain number of turns. This number is determined by experiment. Several of these coils may be wound having a different number of turns. For each particular band, the coil selected should be the one which gives the greatest signal strength. If an antenna of 50 feet or over is used, a ½-inch rod about two inches long wound full of No. 30 D.S.C. wire will do.

It is noticed that regeneration takes place in the screen grid of the detector, which gives the effect of using two tubes for a detector. Regeneration is consequently independent of the plate voltage. The regeneration and volume control are exceptionally smooth and perfectly quiet.

The tube shields are used to prevent the set from picking up A.C. hum inductively from nearby A.C. lines. They are not needed to prevent coupling or oscillation.

Little need be said about the adjustment or operation of this set. It oscillates very readily and will go down to about 10 meters without any trouble. The coils are easily wound and the tickler does not require critical adjustment. The farther apart L1 and L2 are spaced, the better will be the selectivity. However, a distance of one-fourth to three-eighths of an inch is a good value. The data for the construction of the coils are approximate and are only given for three coils, but more may be wound easily.

An attempt to tune the antenna choke with a parallel condenser provided little gain. However, a small variable condenser in series with the antenna did provide considerable gain when tuned. It is suggested that this idea be tried if more sensitivity is desired.

If a good "B" power pack is convenient, it may be used as a source of plate voltage. Dry batteries, however, will be found very suitable and will last a long time, due to the low current drain.

Data for Coils

Range	*L2*	*L3*
18 - 26 meters	6 turns	6 turns
37 - 63 meters	10 turns	15 turns
61 - 103 meters	17 turns	30 turns

All the above coils are wound with No. 28 D.S.C. wire.

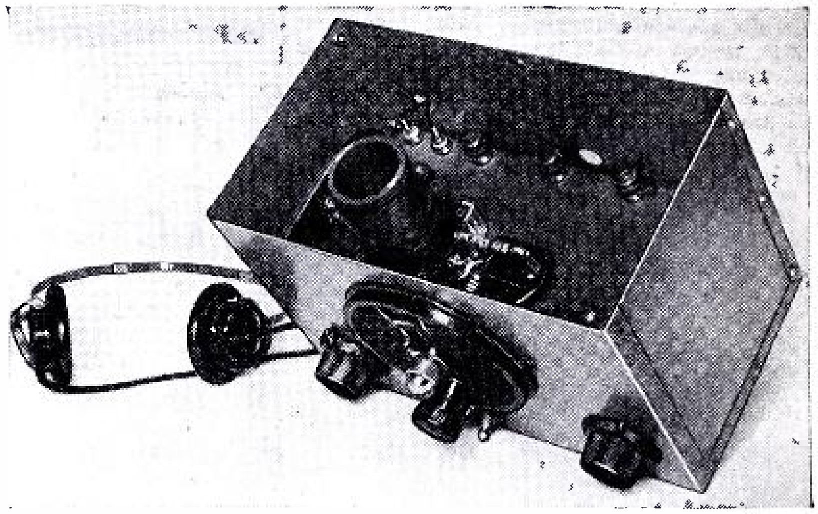
Constants of the Circuit

C —.006-mf. mica condenser.
C1—3-plate midget condenser.
C2—50-mmf. condenser.
C3—100-mmf. mica condenser.
C4—40-mmf. mica condenser.
C5—1-mf. fixed condenser.
C6—.01-mf. fixed condenser.
R1—500-ohm, 1-watt resistor.
R2—100,000-ohm, 1-watt resistor.
R3—5-megohm grid leak.
R4—500,000-ohm potentiometer.
R5—1,000-ohm, 1-watt resistor.
R6—50,000-ohm potentiometer.
R7—30-ohm center tap resistor.
SW1—Single-pole double-throw switch.
SW2—Single-pole single-throw switch.
L4—Aero Hi-Peak.
L5—National S-101 coupler.

Fourth Prize Winner — June Contest

Harold Johnson, Fargo, N. D., $7.50 Prize

In the last issue of SHORT WAVE CRAFT space did not permit the publication of the 4th prize winner's article (Harold Johnson), and we are pleased to present a description of Mr. Johnson's receiver herewith. This short-wave receiver worked very nicely on test; the regeneration control having been found extremely smooth. This set is self-contained, batteries and apparatus both being contained in the one cabinet.



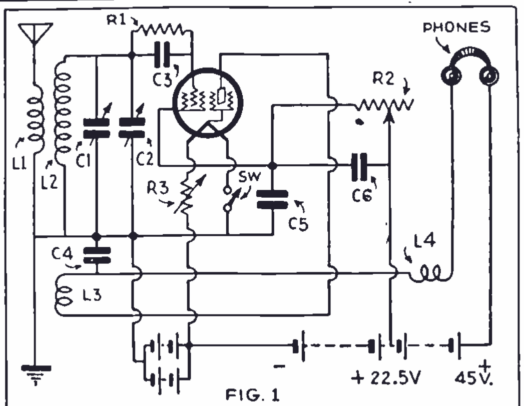


FIG. 1

C1 = .00005-MF. VAR COND	C6 = .25-MF. FIXED COND
C2 = .0001-MF. " "	R1 = 9 MEG. GRID LEAK
C3 = .0001-MF FIXED COND.	R2 = 0-500,000 OHM VAR. RES.
C4 = .0001-MF " "	R3 = BRADLEYSTAT
C5 = .006-MF " "	L4 = CHOKE COIL

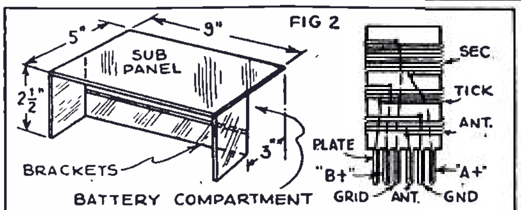


FIG 2

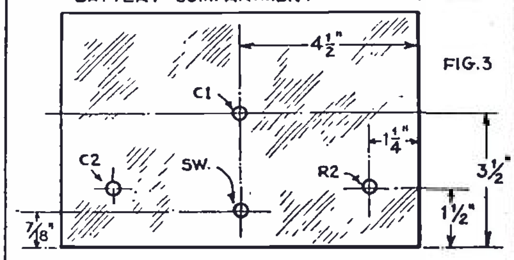


FIG. 3

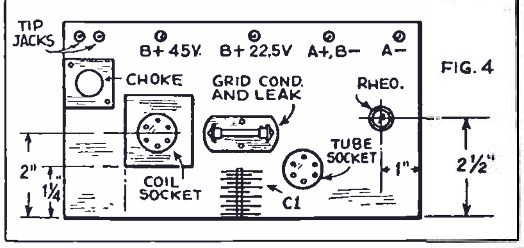


FIG. 4

The circuit which was finally adopted is shown in Fig. 1. This consists of a type 233 pentode in the conventional regenerative detector circuit. The set is inductively coupled to the antenna by means of the primary coil L1. The secondary coil L2 is tuned by the variable condensers C and C2. Condenser C1 is the main tuning condenser. Condenser C2 is not used as a tuning control but as a wave-length changer. When tuning, this condenser is set at *maximum, half,* or *minimum* capacity. Thus each of the four plug-in coils has three different ranges. This makes the set as easy to tune as a receiver having *twelve* National plug-in 6-prong forms, according to the specifications. Regeneration is controlled by the variable resistance R2. The filament supply consists of four flashlight cells wired in series parallel. Two small size 22.5 volt "B" batteries constitute the plate supply. Binding posts are provided so that external batteries may be used when desired.

The set is constructed in a metal cabinet measuring 5" wide by 6" high by 9" long. A wooden subpanel 5" wide by 9" long is mounted 2⅛" above the bottom of the cabinet. The front of the subpanel is supported by two small wooden brackets. The rear of the subpanel rests directly on the batteries. A strip of wood 1½" by 9" separates the battery compartment from the front of the set. See Fig. 2 for a sketch of this. The two variable condensers, the regeneration control, and the filament switch are mounted on the front panel as shown in Fig. 3. The regeneration control must be insulated from the panel by means of bakelite washers. The antenna and ground binding posts are mounted on the left end of the cabinet. The bypass condensers C5 and C6 are mounted on the wooden strip which forms one side of the battery compartment. The remaining parts are mounted on the subpanel as shown in Fig. 4. When all the parts have been mounted, the set should be wired according to the schematic diagram. This is so simple that no special instructions should be necessary. When the wiring has been completed and thoroughly checked, the batteries should be connected to the proper binding posts. Then insert the tube and the 95 to 200 meter coil. Connect the antenna and ground to the set. Turn on the switch and advance the filament rheostat until the tube just begins to glow. With condenser C2 set at maximum no trouble should be experienced in receiving broadcast signals in the vicinity of 200 meters when the regeneration control is advanced. If the set will not oscillate, increase the number of turns of the tickler. If the set goes into oscillation with a thud, reduce the size of the tickler. Also try different values of grid leak.

Practically all of the parts used in this receiver were on hand when the receiver was constructed. Persons who desire or must use new parts are advised to substitute parts of more modern design. The list of parts used in the receiver together with the recommended substitutes are given below:

COIL TABLE

L1	L2	L3
15-30 Meter Coil		
5 T. No. 26 dsc	4 T. No. 20 dsc	5 T. No. 26 dsc
30-60 Meter Coil		
6 T. No. 26 dsc	10 T. No. 20 dsc	5 T. No. 26 dsc
60-110 Meter Coil		
6 T. No. 26 dsc	20 T. No. 26 dsc	8 T. No. 26 dsc
95-200 Meter Coil		
8 T. No. 26 dsc	40 T No. 26 dsc	9 T. No. 26 dsc

Coils wound on National forms; ¼-inch spacing between windings.

C1—Pilot 13 plate midget condenser
C2—Pilot 23 plate midget condenser
C3—Sangamo .0001-mf. fixed condenser
C4—Polymet .001-mf. fixed condenser
C5—Pilot .006-mf. fixed condenser
C6—Muter .25-mf. fixed condenser
R1—Tobe 9 megohm grid leak
R2—Electrad 0-500,000 ohm Royalty 25 ohm resistor
R3—Bradleystat rheostat
L4—Wirco radio frequency choke coil
SW—ICA filament switch
4—National "6 prong" coil forms
1—National coil socket
1—5x6x9 metal cabinet (1—5x6x9 Alcoa aluminum can recommended)
1—Pilot Kilograd dial (National or Kurz-Kasch 3" dial recommended)
1—Silver-Marshall 5 prong tube socket (Eby wafer socket recommended)
2—Yaxley tip facks
6—Binding posts
2—Burgess type 4156 "B" batteries
4—Burgess No. 1 Unicells.

National U. S. W. Converter

(Continued from page 351)

setting of the oscillator is equal to the detector frequency plus the intermediate frequency. Under certain conditions, where the capacity of the tubes employed vary somewhat from normal, the padding condenser may be almost at its minimum capacity. It will now be found that by rotating the detector trimmer control the background noise will peak at approximately half capacity. Further reducing the regeneration will broaden the peak and reduce its amplitude, until finally it will no longer be apparent. Advancing the regeneration, the peak will increase until the point is reached where the detector actually goes into oscillation, at which time the converter will be practically inoperative, due to detector overload from its own oscillation and due to I.F. overload by the strong beat between detector and oscillator.

S-W Beginner

(Continued from page 356)

correspond in minutes and seconds with the Greenwich time, although the hours vary one hour forward or back for each meridian east or west of Greenwich. In the United States the standard times are: Eastern, 75 degrees west (five hours slower than Greenwich); Central, 90 degrees west (six hours slower); Mountain, 105 degrees west (seven hours slower), and Pacific, 120 degrees west (eight hours slower).

A very useful time conversion chart may be obtained by sending 10 cents in coin to the Superintendent of Documents, Government Printing Office, Washington, D. C., for a copy of Miscellaneous Publication No. 84, entitled "Standard Time Conversion Chart."

Skipping and Fading

A transmitting antenna sends out radiations which move in straight lines, as shown in Fig. 2. The waves which travel along the surface of the earth are called *ground waves* and those which are directed upward are the *sky waves*. Actually the ground and sky waves are identical, except for the direction of travel. The ground waves follow the surface of the earth and pass through mountains, cities, forests, etc., and are slowed down and weakened by these obstructions. This weakening effect is so strong that the ground waves are practically non-existent at 500 miles, depending of course on the wavelength and the power used. It is evident that if the ground waves alone were heard in our receivers, long distance transmission would be out of the question.

The sky waves do not travel in straight lines indefinitely, for if they did they would never return to the earth and would not affect our sets. According to the Heaviside layer theory, there exists around the earth's surface, at varying heights, an enveloping layer of ionized gas. This ionization may be caused by radiations of electrons or ultra-violet light from the sun. In any event, this layer is thought to be present around the earth. When the sky waves reach it, they are reflected from it as shown in Fig. 3 in a similar manner to the way light rays are reflected by a mirror.

This reflecting layer explains skipping. As seen from Fig. 3, the receiver may be located so far from the transmitter that it does not receive the ground waves. If the reflected sky waves return to the earth beyond the location of the receiver, no signal will be received. This reflection may also explain fading, for if the reflecting layer is not constant, the point at which the reflected wave hits the earth may vary, causing the signals to keep fading and returning.

Fringe Howl

A great many short-wave receivers are troubled with a condition known as *fringe howl* which prevents their correct operation. When the regeneration is increased just under the point of oscillation, the receiver starts to howl or hum. This trouble is not very prevalent in sets without amplification, but when the receiver uses two audio frequency stages, it often becomes unmanagable.

Increasing the amount of regeneration will stop it, but it is sometimes desirable to operate the set just under the point of oscillation. One simple method of eliminating the trouble is to connect a resistor of about 100,000 ohms (the grid leak type) across the secondary of the first audio transformer. Those of us who built the Beginner's Short-Wave Set will not be bothered with this difficulty yet, as we have not added the amplifier to the set.

Dead Spots

A great many short-wave sets are troubled with so-called *dead spots* or points on the dial at which the set will not oscillate.

In the first article of this series, we found that if a coil was placed in the proximity of another coil which was connected to a source of current, a current would also be picked up in the second coil. This may be expressed in the following manner: If a coil is coupled to a second coil with a current flowing, the first will absorb energy from the second.

This is what happens at the dead spots. For some reason, a circuit tuned to that particular frequency is absorbing current from the coils of the set. The trouble is most commonly caused by the aerial being tuned to that frequency and the energy is absorbed in the antenna system.

The solution to the problem is evident. The aerial must be tuned to a different wavelength at which there are no stations. This may be done in any one of three ways. The first is to change the dimensions of the aerial, either making it longer or shorter. This is not always practical, both because of structural difficulties and also because it is difficult to know what length will eliminate the trouble. It would be very disappointing to find that the wavelength of the aerial had been shifted to another waveband where stations might be received.

The second method is to connect a small variable condenser in series with the aerial lead, in order to tune it to another point on the scale at which no stations are heard.

The third method is to tune the aerial to an entirely different waveband, by connecting a coil and a condenser in the aerial circuit. A coil such as the one described in the article last month for eliminating broadcast interference will be suitable. It may be used for the dual purpose of changing the fundamental wavelength of the antenna and also stopping broadcast interference, by tuning it to the point where the broadcast station disappears and the oscillation returns. The dimensions of this wave-trap are repeated in Fig. 5 for the benefit of the reader.

Short Wave Events of the month

July 21—Belgian Independence Day, 4 to 5 p.m. (N. B. C.) (W8XK, 6,140 and 11,870 kc., KDKA.)

July 21—Preview of the Olympic Games, 12 midnight to 1 a.m. (N. B. C.) (W2XAF, 9,530 kc., WGY.)

July 21—Brazilian American Coffee, 5 to 5:30 p.m., E. D. S. T. (N. B. C.) (W8XK, 11,870 and 6,140 kc., KDKA.)

July 21—King Albert of Belgium speaking from Brussels, 6 to 6:50 p.m. (C. B. S.)

July 21—British Imperial Economic Conference from Ottawa, Canada, 11 to 11:50 a.m. (C. B. S.)

July 23—Frankfurt Music Festival from Frankfurt, Germany, 4 to 4:30 p.m. (C. B. S.)

July 31—Davis Cup Finals from Paris. France, 11 to 11:30 a.m. and 1 to 1:30 p.m. (C. B. S.)

August 1—Speeches by the Prince of Wales and President of France at unveiling of new war memorial at Thiepval, France, 10 to 11 a.m. (C. B. S.)

August 1 to 13, inclusive—Olympic Resumes, 12 to 12:15 a.m.. E. D. S. T. (N. B. C.) (August 13 program was subsequently cancelled.) (W8XK, 6,140 kc., KDKA.)

August 5—Short waves relayed orders from Capt. L. I. Gover, in the Marine Barracks at Washington, D. C., to a dress parade of marine reserves held at the Great Lakes Naval Station in Chicago, Ill. The marines at Chicago also marched to music played by the famous marine band in the Washington barracks, where Capt. Gover broadcast his commands. The orders were transmitted to Station KYW at Chicago, then through loud speakers on the parade grounds. (N. B. C.)

August 8—National Radio Forum. (N. B. C.) (W2XAF, 9,530 kc., WGY.)

August 11—President Hoover's Speech, 10 to 11 p.m. (N. B. C.) (Herbert Hoover's address of acceptance of the Republican renomination for the presidency of the United States was heard in Europe, Africa and South America, as well as in this country, through plans perfected by the National Broadcasting Company and associated stations. The speech, which was delivered Thursday, August 11, in Constitution Hall, Washington, shortly after 10 p.m., E. D. S. T., was carried throughout the United States over a coast-to-coast N. B. C. WEAF network. KDKA, Pittsburgh, short-waved the address over two frequencies—through W8XK on 6,140 kc., and through W3XK on 11,870 kc. WGY, in Schenectady. short-waved through W2XAF on 9,530 kc. These three transmitters covered Europe, South America and Africa. To reach the latter continent clearly, especially South Africa, W2XAF utilized a vertical antenna instead of the usual directional type.) (W2XAF, 9,530 kc., WGY; W8XK, 6,140 kc., KDKA.)

August 11—German Constitution Day, 4:30 to 5 p.m. (N. B. C.) (W2XAD, 15,330 kc., WGY.)

August 12—First rebroadcast from a glider in flight, using 5-meter wave pick-up. Voice of glider pilot, J. K. O'Meara, heard by N. B. C. listeners-in via Station WEAF. (N. B. C.)

August 13—Senator Guglielmo Marconi announces he has solved the problem of carrying on long distance radio communication by means of 57-centimeter waves (22.8 inches or a little more than ½ meter). Both phone and code messages were sent and received over a distance of 162 miles, or 270 kilometers.

August 15—Broadcast from airplane of Louise Thaden and Frances Marsalis attempting to break the women's endurance flight record, 4:45 to 5 p.m. (C. B. S.)

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Fil. Volts—2.5.
Fil. Current—5.0 Amp.
Max. Peak Inverse Volt.—7,500.
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Approx. Voltage Drop—11 volts.

List $7.50

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Super Control R.F. Amplifier Pentode Radio Frequency Intermediate Frequency of 1st Detector (battery operated) Receiver.

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If your local dealer cannot supply you with these special tubes you may order them direct from the factory by using the attached coupon accompanied by your money order or check.

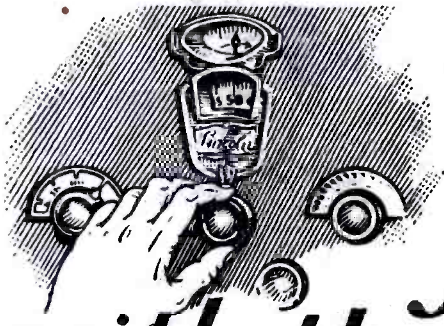
Send for pamphlet giving complete list and full data on all CERTIFIED TRIAD TUBES for Short - Wave use.

The TRIAD LINE is complete. It includes all types of standard Tubes as well as Photo-Electric Cells and Television tubes. CERTIFIED TRIAD TUBES are licensed by RCA, and are sold at the same list prices.

TRIAD MANUFACTURING CO. Pawtucket, R. I. SWC-3-6

Gentlemen:
Please send me......of the types........Certified Triad Tubes for which my cash / money order / check $........ is enclosed.

Name ....
Address ....
City .... State ....



Tune the NEW way *for* World-Wide Reception *with the* LINCOLN DE·LUXE·SW·33

SILENT TUNING...

The weakest carrier wave is registered on the signal indicator and can be tuned with precision and perfect silence without disturbing atmospheric noises.

SIGNAL INDICATOR

A meter directly above the dial indicates, not only the weakest signal, but allows the operator to tune into a signal perfectly. Guess work is entirely eliminated. Comparative signal strength is indicated.

UNDISTORTED HIGH AMPLIFICATION·

Three stages of push pull with new system of twin-grid detection allows tremendous undistorted amplification of the high gain I. F. amplifier. The handling power of this system seems to be unlimited and tremendous volume on weak signals can be had if desired.

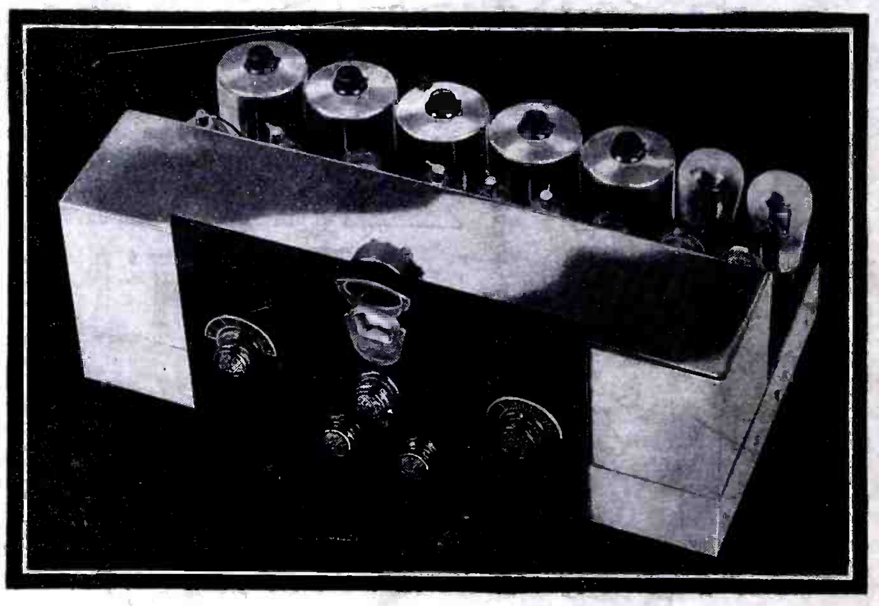
AUTOMATIC VOLUME CONTROL.....

There are two paramount advantages in good automatic volume level. First, in tuning from weak to strong signals; and secondly, in holding a steady volume level on fading stations which is so common in short wave reception. The effect of this new Lincoln feature is so efficient that a near-by stroke of lightning registers only a muffled sound in the speaker; it has the same effect on all sharp electrical interference.

NEW FIDELITY

Twin-grid detection preceded by push pull input I. F. transformers and followed by two stages of transformer coupled push pull stages, produces an undistorted register of a wide band of frequencies, giving a perfectly balanced output with realism hard to associate with radio.

All of the new reactions in the SW-33 model are what we all have wanted for years,—they are here for you today—thanks to Lincoln's foresight in radio possibilities.



THE NEW DEVELOPMENTS

have made the new DeLuxe SW-33 just about as ideal a receiver as one could hope to own. The use of five variable mu tubes controlled by the new twin grid second detector and followed by two transformer coupled push pull stages has opened the gates to new ideas of enjoyable distant reception.

The signal indicator locates carrier waves which are difficult to hear; many times the carrier is not being used or modulated as is the case in transatlantic phone. The signal indicator registers these silent carriers and enables you to be accurately tuned, ready for the voice to be heard.

WHEN THIS CARRIER IS TUNED, ATMOSPHERIC NOISES ARE REDUCED TO A MINIMUM, AUTOMATICALLY.

Distant stations can be tuned silently, and volume then brought up to desired strength (volume control does not affect sensitivity). Perfect volume level on short wave stations is another great asset in the new Lincoln. If you have ever tuned in a foreign short wave station, or even many of our short wave stations in the U.S.A., you will appreciate the great value of uniform volume level.

The performance of Lincoln equipment has been known the world over for years. Its use by Polar Expeditions, broadcasting stations, both domestic and abroad, U. S. Naval Station operators, and hundreds of super critical DX fans, has proved Lincoln's exceptional merit.

Complete equipment consists of chassis, power equipment, auditorium type speaker and complete set of laboratory tested tubes. Chassis is finished in highly polished nickel over copper and presents a handsome appearance. Precision laboratory construction is employed throughout, and every receiver is tested on distance before shipment.

Write for description of new developments and new sales plan which overcome the present defects in the present custom built radio merchandising.

LINCOLN
DeLuxe Receivers

LINCOLN RADIO CORPORATION
Dept. SWC12, 329 S. Wood St., Chicago, Ill.
Please send information on ☐ A.C. ☐ D.C. receivers.

Name ....
Address ....
City .... State ....
Print name and address plainly