HUGO GERNSBACK
Editor

SHORT WAVE CRAFT

May

WORLD'S LARGEST SHORT WAVE CIRCULATION

SPECIAL HAM NUMBER

World-wide
10 Meter Converter
See Page 12

25¢
IN U. S. AND CANADA

THE RADIO EXPERIMENTER'S MAGAZINE

Introducing

the NEW DOERLE

6-TUBE BANDSPREAD RECEIVER

Licensed under RCA and Hazeltine patents

- ★ Continuous bandspread tuning from 9½ to 625 meters.
- ★ An ideal DX receiver for the long distance SW fan or communications receiver for the transmitting amateur.
- ★ Beautiful, large, illuminated, dual pointer, multi-colored, airplane type dial of great beauty.
- ★ Operates from either single wire type aerial or noise-free doublet.
- ★ Volume control—stage aligning trimmer—and tone controls.
- ★ Unusually smooth acting regeneration control.
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- ★ Highly efficient, low loss ribbed plug-in coils, are a large factor in the amazing sensitivity and selectivity of this receiver. Coils are of the large 3 winding variety and are color coded for easy identification.

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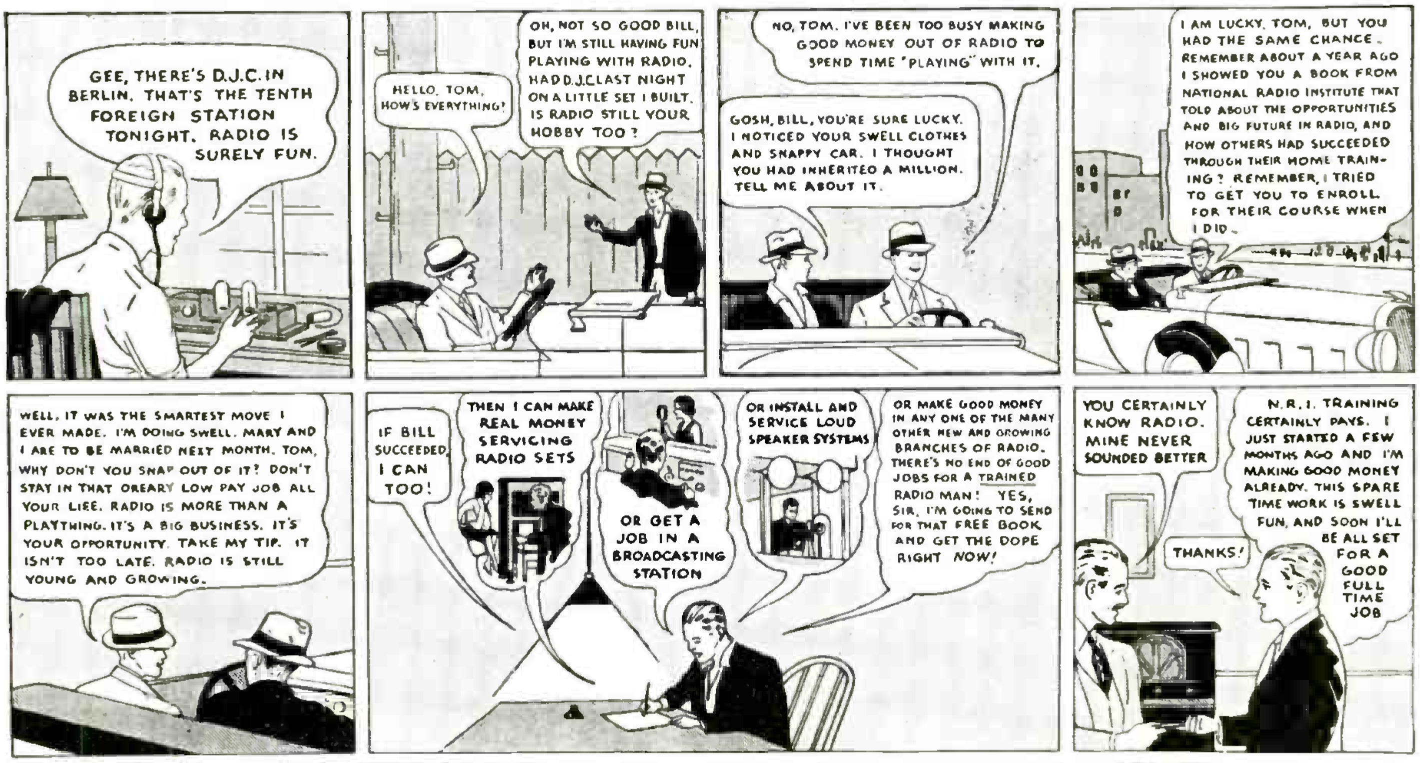

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J. E. SMITH, President
Nat'l Radio Institute, Dept. 6EB3
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IN THIS ISSUE: PROMINENT SHORT-WAVE AUTHORS

Sprayberry • Shuart • Schrage • McEntee • Doerle • Hooton • Lynch

HUGO GERNSBACK
Editor

SHORT WAVE CRAFT

H. WINFIELD SECOR
Managing Editor

GEORGE W. SHUART, W2AMN
Associate Editor

Contents for May, 1936

Features in the June FAN Issue

A 3 band short-wave receiver for the S-W "Fan," by George W. Shuart, W2AMN.

A De-Luxe A.F. Amplifier for use with any S-W receiver.

An Improved "low-cost" Transmitter using the new R.C.A. 830 B tubes, having an output of 200 watts.

A 5-meter Transmitter-Receiver—uses metal tubes, by Henry B. Plant, W6DKZ.

3½" Waves Transmitted 16 miles, by Dr. Irving Wolf and Dr. E. G. Linder.

A modulator for Mr. McEntee's 5-Meter Transmitter described in the present issue—described in detail by Howard McEntee, W2FHP.

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OUR COVER

● This month's cover painting depicts a very interesting new 10-meter Short-Wave Converter. It was designed and built by G. W. Shuart and brought in stations from all parts of the world on 10 meters, when used with a standard receiver. Full details for constructing this 10-meter World-Wide Converter are given on page 12.

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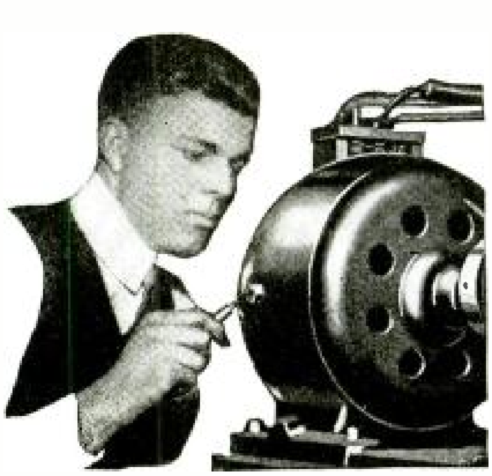

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HUGO GERNSBACK, EDITOR H. WINFIELD SECOR, MANAGING EDITOR

SHORT WAVE CRAFT

New Short-Wave Interference

An editorial by HUGO GERNSBACK

● BEFORE the broadcasting era, no one was much concerned with electrical wave effects which were set loose in space, for the simple reason that there was no one who could have objected to stray waves.

But with the advent of ultra-sensitive radio receivers of all types, the situation changed immediately. The public has a right to complain when radio reception is marred by all sorts of man-made static. It is bad enough to listen to natural static about which, so far, not much has been done, but when it comes to the other kind, the public expects that the authorities will take some sort of cognizance of the situation, and put in effect adequate remedies.

This has been the case with a good deal of man-made static, and now-a-days municipalities and electric light companies cooperate to do away with the nuisance. The public utility companies also do this from a purely selfish viewpoint, because they realize that when radio programs are continuously marred by man-made static, the public will not use their radio sets and consequently no electric current will be used. In turn, the electric light corporations suffer thereby, and it is thus to their interest to see that the nuisance is done away with. It is usually not very difficult to do this, particularly when we have to do with leaking transformers, leaking insulators, and various automatic, contact arrangements which include even the harmless-appearing electric heating pad and many others. There are, however, several other instrumentalities which have lately created a great deal of havoc. These are: 1—X-ray machines of all types; 2—short-wave *fever* apparatus, or the so-called diathermic machines, used in an ever-increasing number by physicians in the treatment of various diseases.

During the past year, it was found that particularly on the short-wave bands, there was quite a good deal of a mysterious short-wave interference which baffled the "scouts" no end, and incidentally created a tremendous amount of interference.

The emissions were mysterious because they kept popping up all over the country in the most unexpected places. There was no regularity about the transmissions, not only in the intensity, but the frequency (wave lengths) changed continuously. This was particularly true on frequencies from 30 meters downwards. The effect seemed to be a carrier, very broad and loud. It not only bothered individuals who had short-wave sets, but annoyed amateurs, the United States Navy Department, R.C.A. Communications, and The American Telegraph and Telephone Company, where it interfered with communication between ships and land. Not only was interference noted in the United States, but it extended to foreign countries as far as Australia.

The Naval Communication's Reserve undertook to clear the mystery which became popularly known under the term "The Shadow." It took a good deal of sleuthing to run down the interference, and finally it was found that the problem had its origin, particularly, in the short-wave field of therapeutic machines which are used by physicians more and more of late.

These machines are complete radio transmitters in miniature form. They have the regulation transmitting type power tubes and usually have an intensity of from 100 to 300 watts. These machines are used to cure various afflictions, particularly boils and all conditions in which we have to do with pus. Such machines are remarkable in clearing up boils, carbuncles and the like in short order.

But, while these machines are curing one ill, they also give rise to thousands of others, namely, *interference in the various radio bands!* The machine may operate on one frequency, but as adjustments are made of the electrodes between which the patient is placed, the frequency changes. This is what makes for additional mischief. It can readily be seen why a number of machines of this type can raise untold havoc with radio sets all over the country, because short-wave transmissions of this type do not necessarily cause interference in the locality in which they operate, but can create a most powerful disturbance a thousand, or even three thousand, miles away!

It is curious that the Federal Communications Commission did not immediately take steps to remedy the situation. In the first place we actually have in these machines, real radio transmitters, and it is against the radio law to operate a transmitter without a license. It can be seen that if no steps are taken to remedy the situation, in time there will be so much interference on the short-wave bands that it will be impossible to listen to any transmission. The sensible thing to do would be to have all owners of such machines licensed by the Commission. Secondly, anyone operating such a machine should be required to operate it inside of an electrical shield, so that no radio waves could penetrate to the outside. This is a rather simple thing to do, and the only point is that it may prove somewhat inconvenient and make for additional expense. The electrical shield to which I refer is simply a room completely screened by means of a metal screen. This would have to include ceiling, flooring, as well as doors and windows. This shield would have to be grounded. Then any machine operating in such a room would create no outside disturbance at all, and there would, therefore, be no more interference from that particular machine. If too costly to build such a shield, it is even possible to have a collapsible portable shield which would inclose the machine and the patient; this would be a cage, measuring about six feet on each side and six feet high. Again this cage would have to be grounded so that no waves should pass to the outside. There will, of course, be other solutions which might even be simpler, and which I am sure will be evolved before long.

The main thing at the present time is that the Federal Communications Commission will find it necessary to act promptly, if chaos is not to overtake the short-wave bands.

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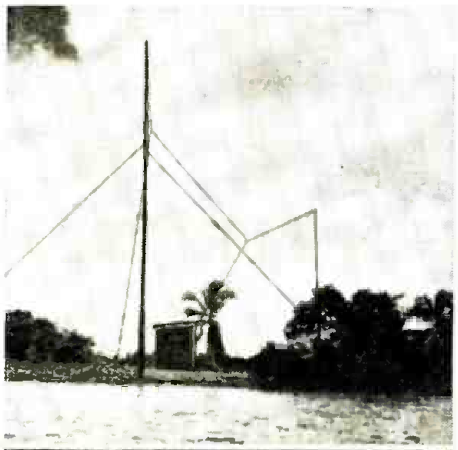
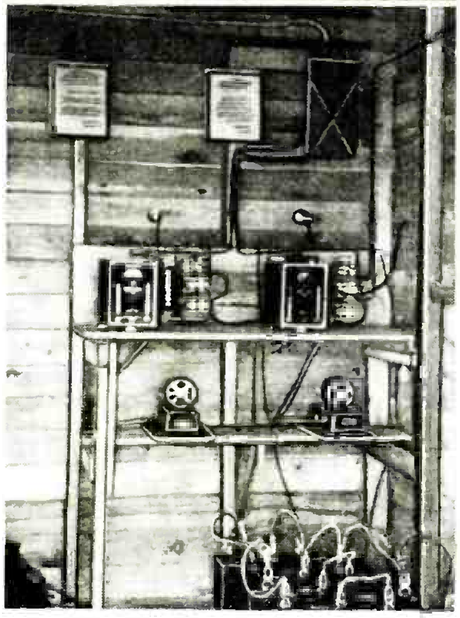
How 5-Megacycle Waves Bridged Hurricane Break

By F. B. Woodworth
Radio Development Department, Bell Telephone Laboratories

Short Waves have indeed performed some very unusual services in an emergency—read how 5 mc. waves carried telephone traffic over a 40-mile "break" in the New York-Havana circuit.



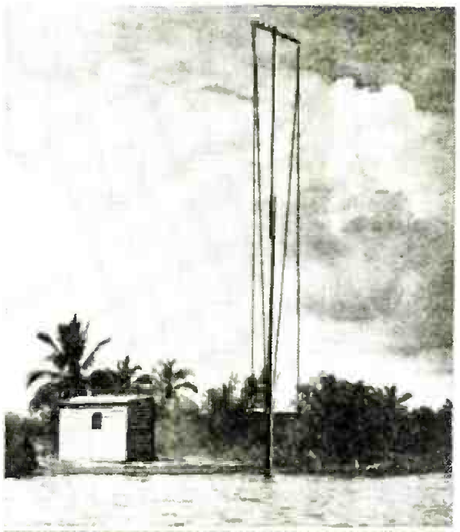


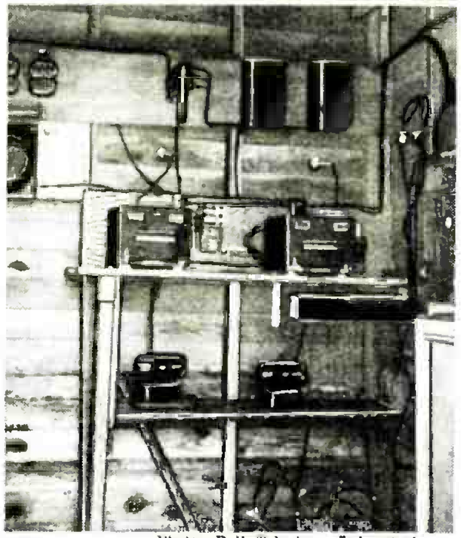
The vertical quarter-wave transmitting antennas were suspended from a messenger wire supported by two poles.

In the transmitter shack, two 19A transmitters are mounted on a shelf with their dynamotors immediately beneath them.

● EARLY this winter a tropical hurricane swept across the Florida Keys, completely demolishing large sections of the Florida East Coast Railway along a *forty-mile* stretch from Tavernier to Vaca Key. The telephone pole line runs along the railroad right-of-way between Miami and Key West, where it connects to the Havana cables, thus forming part of the route between the United States and Cuba. In some places the railroad fills were washed away, allowing the poles to topple over. In other places, high water lifted the rails and ties from the roadbed, and the wind blew them against the poles, knocking them down. Where the poles were on the windward side of the railroad, they remained standing. The damage to all communication and transportation services in the vicinity was so severe that it was several days before the true extent of the devastation could be determined. It then became apparent that it would be advantageous to postpone plans for the restoration of the telephone lines until more information could be obtained regarding the plans for restoring the railroad and highway, and until different methods of taking care of the telephone service could be studied. It was, therefore, decided to bridge the gap temporarily by radio, and applications for station licenses were rushed to Washington.

Within eighteen hours after this decision had been reached all equipment for two radio circuits in each direction was on board a train bound for Florida, and B. L. Dayton of the Long Lines Department and the author were on their way to supervise the installation of the two terminals, assisted by J. F. Andrews of the Long Lines Department who was already in Florida. One of the terminals was to be located near Tavernier and the other at Big Pine Key, thirty-five miles east of Key West. Two line gangs were sent from Alabama and Louisiana by boat to Key West and thence by automobile to Big Pine Key. Here they immediately set to work clearing away the underbrush, dynamiting in *(Continued on page 38)*

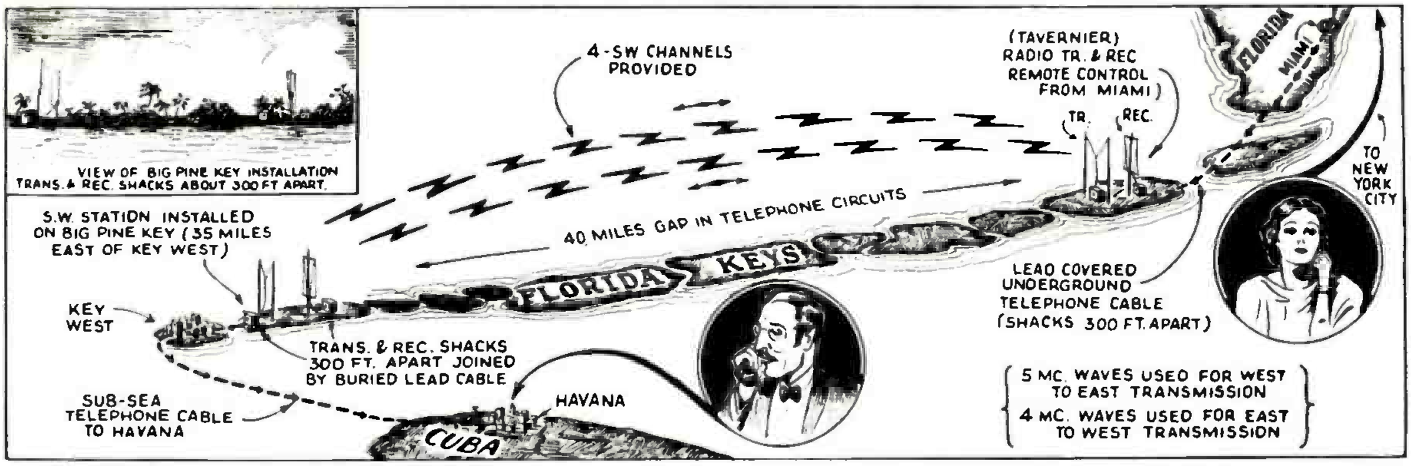




Photos Bell Telephone Laboratories.

Only a single pole was used for the receiving antennas—one being attached to each end of a cross-arm.

Mounting arrangements for the 12A type receiver, in the receiver shack, are similar to those for the transmitters.



Picture diagram above shows how telephone experts used 5 mc. waves to provide four telephone channels over a 40-mile "break" in the New York-Havana telephone circuit, the break having been caused by a hurricane.

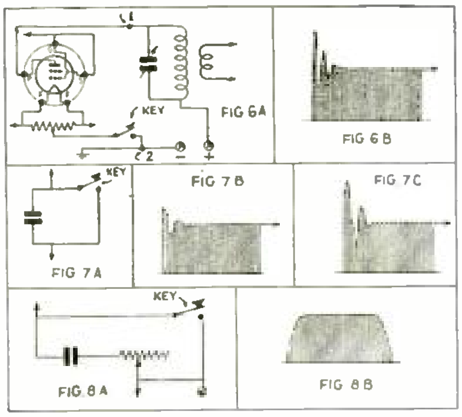
"HAM" Applications of the Cathode-Ray Oscillograph

By F. L. Sprayberry

Are you obtaining the proper percentage modulation from your transmitter? How much audio distortion do you have? How much "ripple" voltage is present in your power supply output? These and other important and perplexing problems which are forever confronting the "Ham" are quickly and easily checked up by means of the cathode-ray oscillograph, as clearly explained by Mr. Sprayberry.

The RCA cathode-ray oscillograph, a typical model of this newest scientific instrument for analyzing conditions in a radio or an electrical circuit.

● IT IS indeed hard to imagine anything in the way of auxiliary equipment for use by the "Ham" which could have more value than *Cathode Ray Oscillograph* equipment. Factors which have in the past been difficult to solve in connection with transmitter adjustments are made a matter of routine by this equipment. Adjustments such as amplifier minimum distortion, operating class, modulation percentage, prevention of overloading, neutralization coupling requirements and numberless other problems bearing directly on the success of the transmitter, may be made quickly and effectively.



One of the greatest problems the Ham has to contend with is to establish smooth "keying"; the cathode ray oscillograph, as the diagrams above indicate, help to solve this problem nicely.

Many of the "high-lights" typical of what the Ham can do with Cathode Ray apparatus are pointed out in the following paragraphs. Numerous other tests will suggest themselves at every turn. It is no longer necessary to wait for a report from some remote point in order to know whether or not signals are being sent properly. With the aid of Cathode Ray equipment the "ham" can determine this himself at the transmitter.

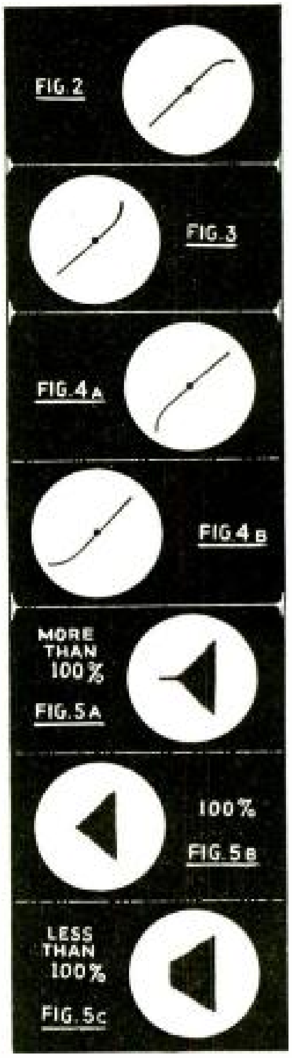
Tests on Typical Low-Power Transmitter

A low-powered transmitter has been chosen for the purpose of these tests, which is typical with the average amateur. The problems solved here, moreover are largely general, applying as well to broadcast and commercial equipment.

Detecting Audio Distortion

Audio distortion is best tested one stage at a time. This avoids the necessity of an audio signal generator and quickly localizes the stage where the distortion exists. Turn on the power of the transmitter and the oscillograph, and focus the beam for a 1 mm. (1 millimeter is about 1/25 inch) spot on the center of the target or screen of the *oscillograph*. Connect the left horizontal and lower vertical plates to the transmitter ground. Now connect both the top vertical plate and the right horizontal plate to the amplifier input within the instrument, one for each set of plates, and adjust the vertical plate bias so that the beam will rest at the center of the screen. Connect the right horizontal free plate to the 56 tube grid (1) on the transmitter voice amplifier and the vertical plate lead to the cathode (2) of the second 56 tube (output). Excite the amplifier with some sound (voice, phonograph record, etc.) and adjust the gain of both oscillo-

(*Continued on page 52*)



Typical "oscillograms," showing percentage of modulation and also indicating degree of distortion.

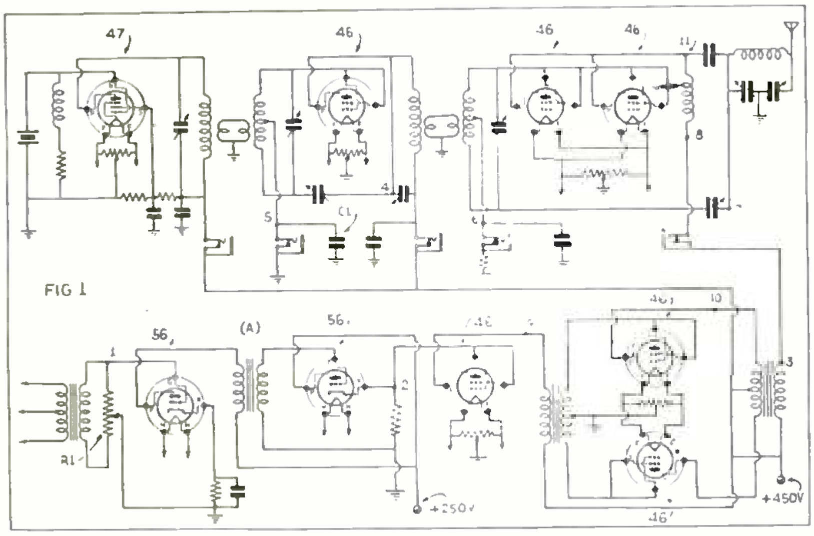


Diagram at left shows typical Ham transmitter circuit, and the numbers at various points indicate where test connections are made to the cathode ray oscillograph.

Penobscot Tower, Detroit, home of the new 10-meter broadcast station W8XWJ (9.488 meters or 31.6 mc. to be exact).

B. C. Programs Now on

How to Build a Converter or

● W8XWJ, the ultra high-frequency experimental broadcast station of the Detroit News, and "little brother" of WWJ, made its initial appearance on the air January 29 with a special dedicatory program depicting the advancement of radio broadcasting and the early days of short wave transmission.

A great field has recently been opened in this little explored portion of the short-wave spectrum, from which—no doubt—many advances in in the art of radio communication will be made in the near future; and like WWJ, pioneer on the broadcast band, W8XWJ is one of the first few on the "ultra short-waves."

Located atop the Penobscot Building, Detroit's tallest skyscraper, 650 feet above ground, W8XWJ will command an "optical range" of many miles, which to date appears to be of advantage on these frequencies.

The transmitter itself, as well as the associated audio equipment, is of the most modern "high-fidelity" design and was built by RCA. It consists of a crystal-controlled oscillator using an AT cut crystal, operating on 3950 kc. followed by three frequency-doubler R.F. amplifier stages, in order to raise the frequency to the operating wavelength of 9.488 meters, on 31.6 megacycles. Following the third doubler-stage is a straight-amplifier or buffer-stage. This buffer-stage in turn is coupled to the final modulated class "C" amplifier which employs four high frequency type 800 tubes, connected in a push-pull parallel circuit.

The audio system consists of the standard RCA high fidelity speech amplifier driving a push-pull class "B" modulator employing a pair of 203-A's, which effectively fully modulates the 100 watts of carrier.

During the first few weeks the station will only be on the air between 2 and 5 and 7 and 10 p. m. EST daily and Sundays from 2:30 to 7:30 p.m., carrying the programs regularly broadcast by WWJ. However, after the necessary adjustments are made and the testing completed, W8XWJ will inaugurate a more elaborate schedule of transmission and broadcast many unusual and interesting programs not heard on the regular broadcast channels.

Realizing that only a comparatively few would be able to hear the station due to the fact that only a small percentage of even the latest model all-wave receivers are capable to tuning to this extremely high frequency, it was decided to furnish those who cared to build their own receivers or "converters" with diagrams and instructions. Thus the potential audience would grow much more rapidly.

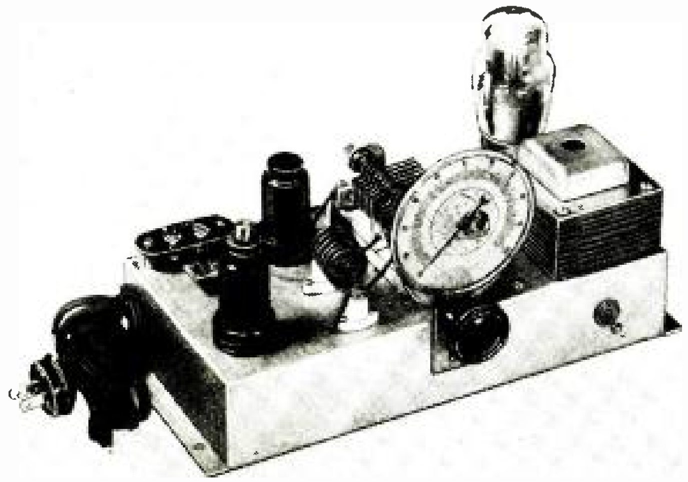
In designing the converter many things had to be taken into consideration in order to make it applicable to practically all receivers and at the same time keep the cost low and retain ease of construction for those whose fundamental knowledge of such devices is somewhat limited. It consists of one of the new high efficiency metal tubes as a converter, a type 6L7, with a separate triode as an oscillator. A plate coil tuned to approximately 1500 kc. was found to materially increase the conversation gain over the choke and condenser method of coupling. The secondary of this coupling transformer provides a fairly good "match" to the antenna coil of most "broadcast" receivers. A separate power supply is incorporated in the converter design, thus eliminating the necessity of bringing out the high voltage lead from the BC set.

The receiver described was designed by J. L. Murray, prominent consulting radio engineer of Detroit, and is of the super-heterodyne type having broadly-tuned "resistance-coupled" I.F. stages. The converter tube is of the metal type, as are all the tubes in this receiver with the exception of the rectifier, and is used in an "autodyne" circuit. Provision was made, however, to replace the resistance I.F. with broad-tuned high frequency intermediate transformers and add a separate oscillator tube at a later date. Both the receiver and converter have proven very satisfactory.

W8XWJ's 9.48 meter transmitter; the speech amplifier and control panel appear at right of photo.

Directions for Building the 10-Meter Converter . . .

● DRILL the chassis and mount all tube sockets, transformers, tuning condensers and coils as shown in the picture. Connect the high voltage leads of the power transformer, one to each plate of the 80 tube socket, the plate connections being the contacts in which the smaller pins of the tube fit. To the larger terminals of this socket connect the 5-volt winding of the power transformer. One end of the 6.3 volt winding connects to terminal 2 of each of the other two tube sockets, the other end of the winding connecting terminal 7 of these sockets. These connections should be made with twisted insulated wire. Attach 110-volt cord with switch in series. From the center tap of the high voltage winding attach a wire to the chassis at the nearest point. From one side of the 5-volt winding, a wire is run to the choke coil and to the red wire of one of the 8 mf. electrolytic condensers. The other end of this choke coil connects to the point marked X and to the red wire (Continued on page 45)



The "Converter" for receiving 9.48 meter waves on your present B.C. receiver.

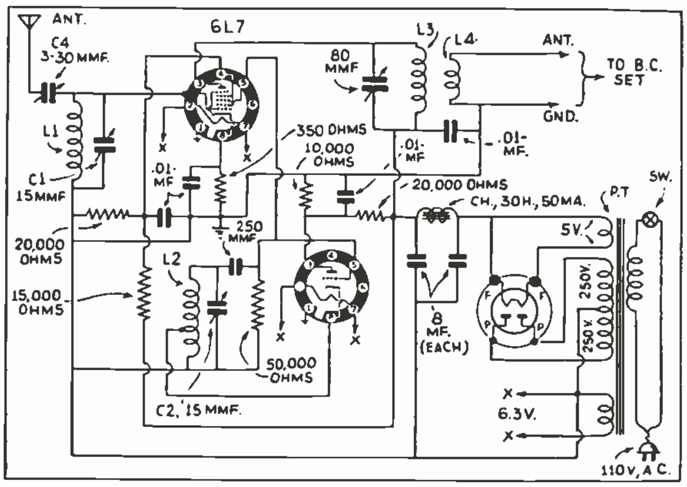


Diagram of S-W converter of simple design.

10 Meters—How to Receive Them

Superheterodyne to Pick Up 10-Meter Stations

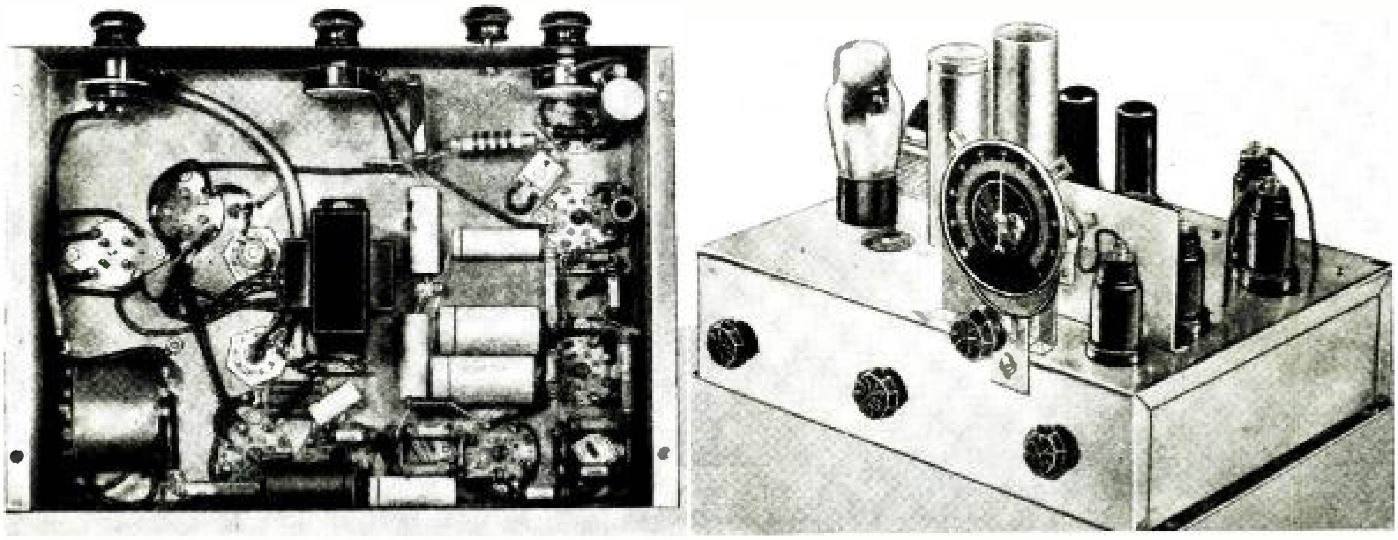
The High Frequency Superheterodyne Receiver

● THE receiver is assembled on a 9x12 base, 3 inches deep. It consists of a 6K7R.F. amplifier, 6J7 as a combination detector and oscillator, 2-6K7 tubes as resistance coupled intermediate frequency amplifier, a 6F6 connected as a hi mu triode as second detector and a 6F6 as pentode output.

The R.F. stage is similar to those used in an elaborate super-regenerative receiver. It adds more gain, eliminates receiver radiation and eliminates antenna resonance from the detector circuit. The suppressor screen voltage on the detector should be adjusted so that it oscillates mildly over the tuning range, and at this setting the receiver is most sensitive. A semi-variable coupling condenser is used to couple the R.F. stage to the detector. It is connected about midpoint of the detector coil to prevent overload of this circuit and to allow for greater gain in the detector stage. The detector uses a grid leak for obtaining smooth oscillation and detection. The I.F. frequency is low enough that a grid leak detector is quite efficient. An R.F. choke is used in the detector cathode instead of a tap on the grid coil. This forms a common grid and plate impedance so that the tube oscillates at the frequency determined by the tuned grid circuit.

The value of the screen and suppressor voltage and the size of grid condenser and leak are chosen so as to obtain oscillation, but not super-regeneration. The detector heterodynes the high frequency signals into the I.F. amplifier—a form of the Dow oscillator. The I.F. amplifier uses two stages of moderate gain. The values of resistors and capacities are selected so that the amplifier peaks at about 50 kc. with a band width of approximately 50 kc., allowing for true hi fidelity reception. The values of capacities and grid leaks are selected so as to prevent amplification of audio frequencies in the I.F. amplifier.

Eliminating tuned circuits in the I.F. stages results (Continued on page 44)



Front and bottom views of 10-meter "super-het" receiver. For the more ambitious, this super-het will prove very interesting.

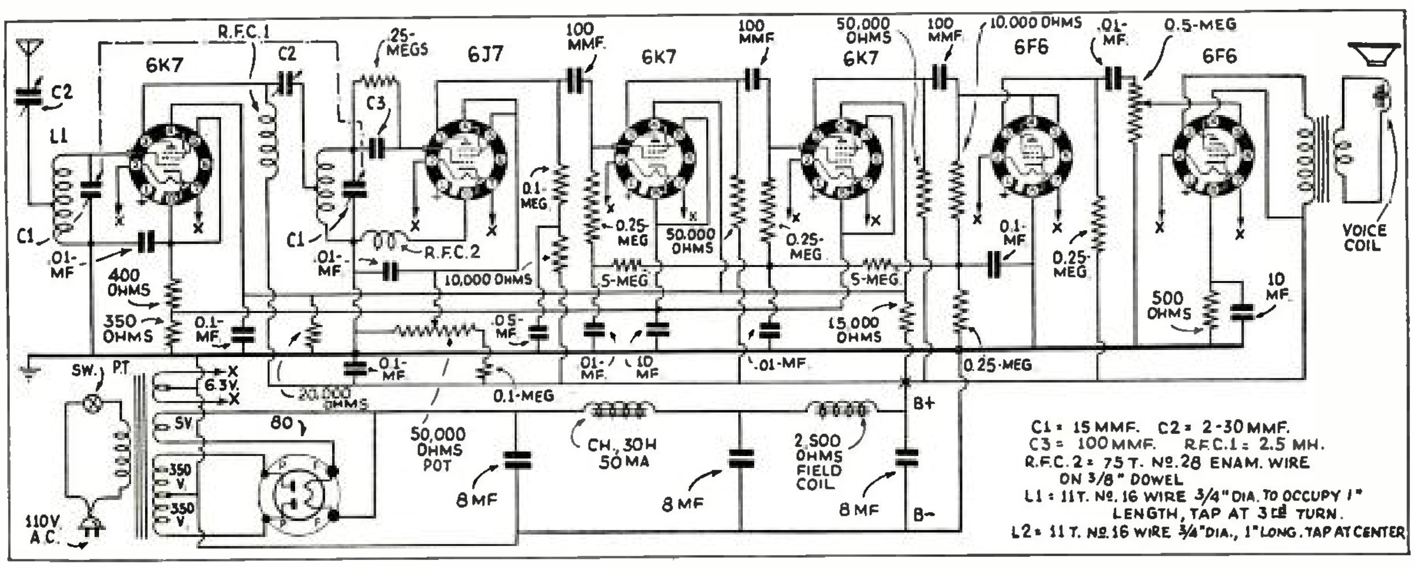
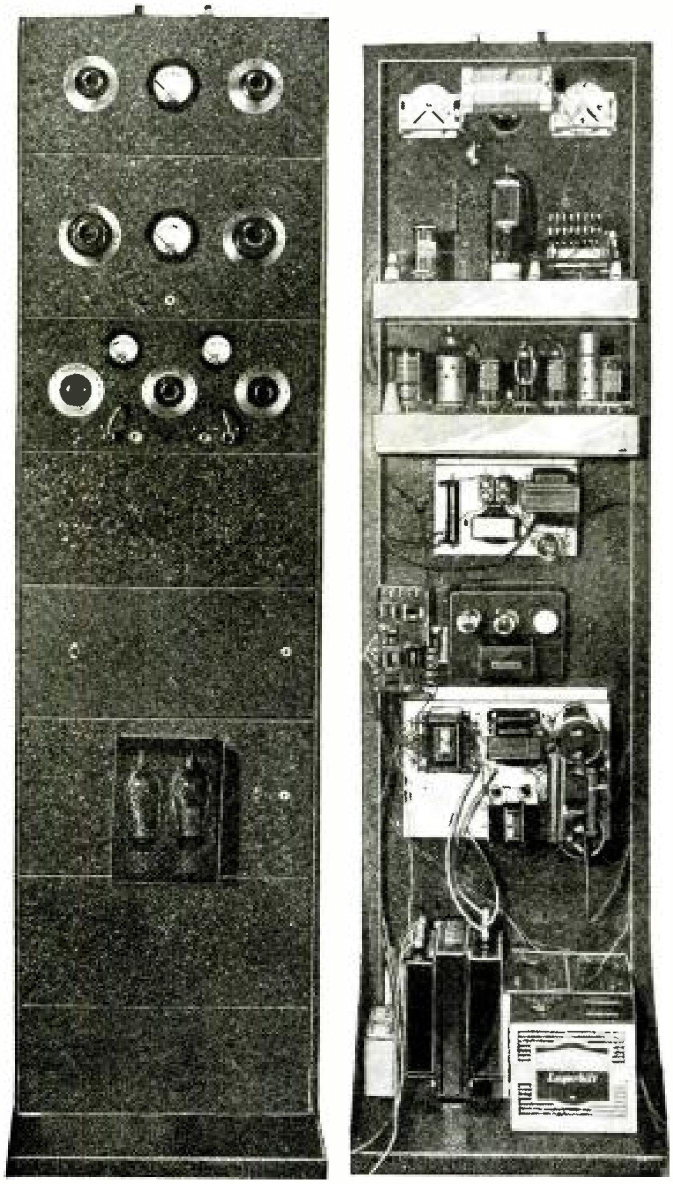


Diagram for the complete 10-meter "super-het". For those who may not be satisfied to tie the "Converter" to their "present" receiver, this complete "super-het" will provide the answer to their 10-meter reception problems.

W2AMN's All-Band



Photos at left—close-up, showing front view of the rack and panel transmitter, also rear view in the photo to the right.

● LAST month we described the low power stages of the new transmitter at W2AMN. In this article we will discuss the remaining equipment including the *final amplifier*, the *power-supply* and the *modulation* unit.

CW Output Is Over 200 Watts

As explained previously the *final amplifier* employs one of the new high-power pentodes. This tube was chosen because of its many excellent features. First it is a screen-grid tube, which means that no neutralizing is necessary. This alone is a distinct advantage. The second remarkable feature is its very modest excitation requirements. Two or three watts is more than sufficient for full output. Then, the third feature is the low audio power requirements when the suppressor grid is modulated; only a few watts are required. Of course for *phone*, the carrier output is considerably reduced, but even then the transmitter is capable of working plenty of "DX." The carrier output for *phone* is around 50 watts; with 200 watts on modulation peaks. For CW the output is well over 200 watts. Not a low-power tube by any means.

Rack Stands 6 Feet High

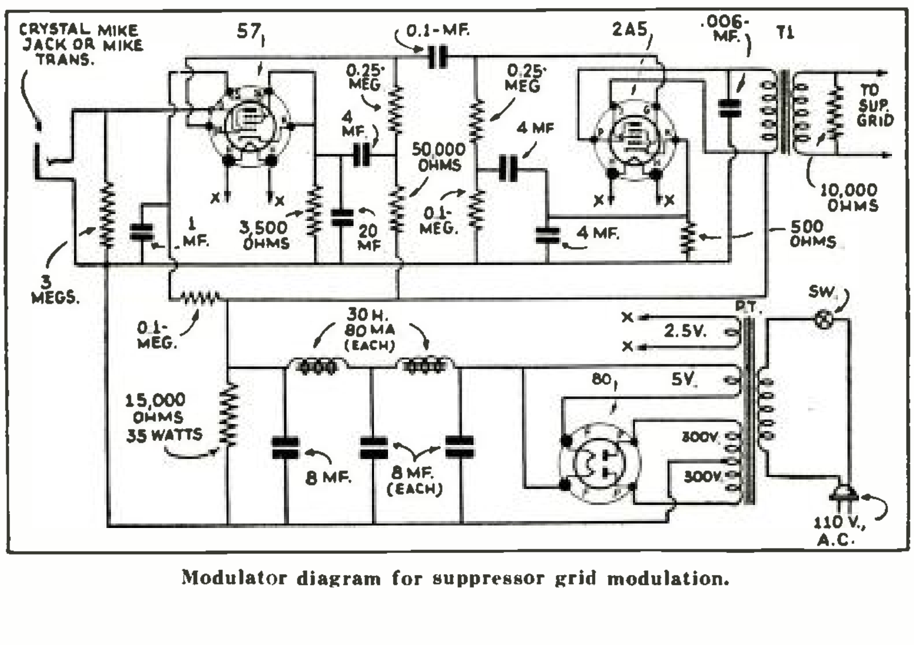
The entire transmitter as can be seen in the photos, is built on a standard 19 inch steel rack and stands six feet high. Looking at the front view we see that the antenna impedance - matching network and the antenna meter occupy the top panel. This panel is 8¾ inches high. Next below this is the *final amplifier* and the plate milliammeter for that stage on a 10¾ inch panel. The dial on the right is the grid tuning and the one on the left is for plate tuning. The jack under the meter is for reading the grid current of this stage. One of the lower small-size meters is used for this purpose. The next two lower panels are the *exciter* and the *power supply* for it and which were described last month. Then below the exciter power supply is the *modulator* for the suppressor grid mounted on an 8¾ inch panel. The next panel is for the high voltage power supply and the 866 rectifiers can be seen mounted on the front. For safety we have constructed a wire cage to cover the tubes. This is made of ¼ inch mesh wire netting and given a coat of black enamel. The panel is the same size as the final. The panels below this are blank and behind them are the high voltage transformer and the bias batteries.

In order to facilitate movement of the transmitter a cradle with ball bearing casters was made to fit under it.

Shunt Feed Used in Plate Circuit

In the diagram of the final amplifier stage, we find that *series feed* is used in the *grid circuit* and parallel feed in the plate circuit. There was a good reason for using parallel or shunt feed, in the plate circuit. There is liable to be some slight loss of efficiency with this method, but remember we are using some 2,000 volts on the plate of the final and with *series* feed we would have high voltage on the coil and tuning condenser. The fact that we have to change the coil leaves us liable to serious consequences, should we fail to remember to pull the high voltage switch. With parallel feed the coil and condenser is at the same D.C. potential as the frame of the transmitter and there is no danger when coming in contact with both at the same time, even if the "B" plus is on.

It is advisable to be extremely careful when working around a transmitter of this type. 2000 volts can cause serious trouble as many past experiences have shown.



Modulator diagram for suppressor grid modulation.

Transmitter

By George W. Shuart, W2AMN

Part 2—In this article Mr. Shuart describes his modern all pentode transmitter in detail. Complete information is given on the power supplies, modulators, R.F. power amplifier, and antenna system. This transmitter will operate on all amateur bands down to 10 meters using either phone or code. Remarkable results have been obtained on 10 meter phone with this transmitter, which has "worked" Europe, Asia and Africa! It features the new "high-power" pentode transmitter tube.

The complete transmitter in operation. The operating room of W2AMN, showing Mr. Shuart at the controls.

Link Coupling Used Between Buffer and Final Stages

Link coupling was used between the last *buffer* and the *final* stage because of its simplicity and efficiency. In the output circuit we have used the matching network to facilitate the use of a single wire end-fed antenna, which was the best one that could be erected at the writer's QRA. Any other method of course may be used. As the diagram shows plenty of by-pass condensers were used and the reward is absolute stability, even with no tube shield and with no partition between the *input* and *output* circuits. They are of course well separated but should they not be so separated, the shielding would be recommended.

Power Supply

In the power supply diagram we find that for the high voltage a 2,300 volt Thordarson split primary transformer is used. With choke input and under full load this transformer will deliver a full 2,000 volts. When the two Primaries are connected in series the output voltage is 1,000 and this connection should be used while tuning adjustments are being made, in order that no serious damage will be done in case of a maladjustment. After all adjustments have been made, save the antenna connection, the primaries are connected in parallel and the antenna connected and necessary coupling and tuning adjustments are made.

Control Relays

We also see that there are relays for controlling the circuits which are to be switched "on" and "off" during operation of the transmitter. These relays are of the *self-locking* type and only a slight touch of a push-button is necessary to perform the operation required.

In parallel with the relay contacts are toggle switches so that the transmitter may be located at a distance from the button board and still, if adjustments are necessary, the transmitter may be operated right from the switches on the panel. One relay opens the B-minus of the exciter and the primary of the high voltage transformer for standby during operation. This is a double-pole, single-throw affair. The other relay turns on all filaments and heaters as well as the primary of the low voltage power supply.

Throughout the parts list and diagrams the values and voltage ratings of the parts are given. These should be followed closely for proper results. Especially the (Continued on page 62)

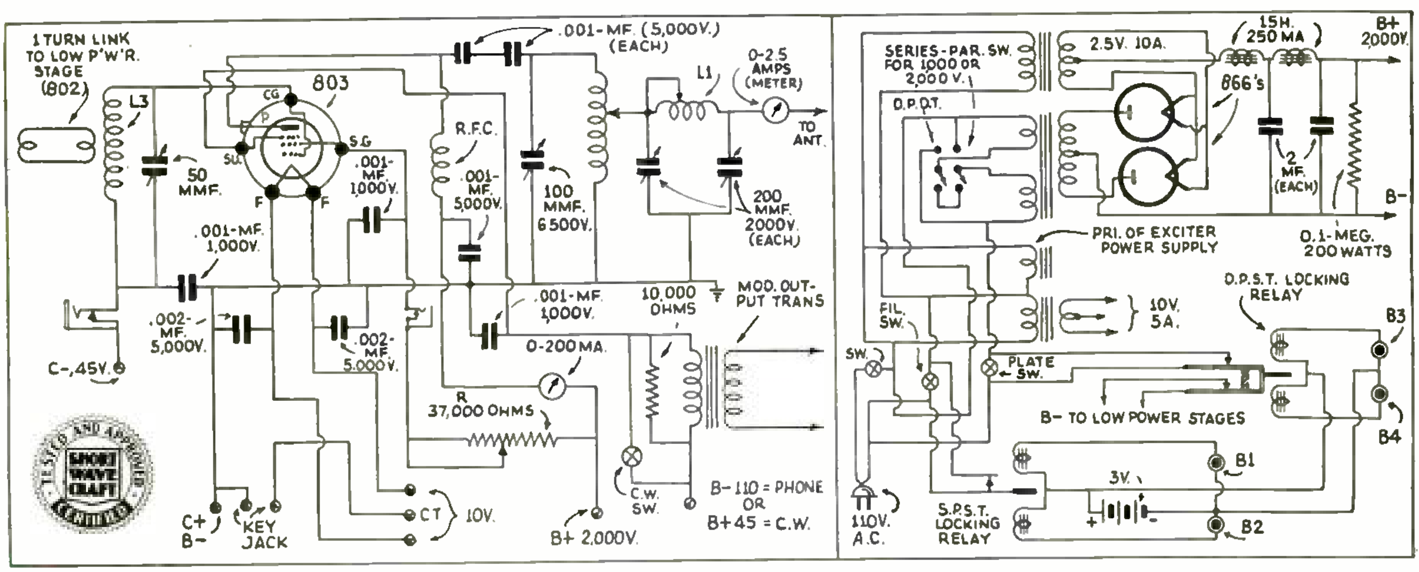
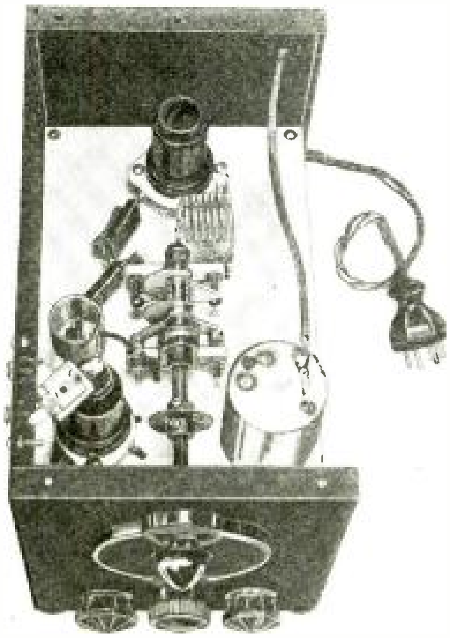


Diagram of the R.F. power amplifier and the high-voltage power-supply, together with the push-button "relay" switching arrangement.

WORLD-WIDE 10-Meter Converter

By George W. Shuart, W2AMN

"DX" with a vengeance! And how! This 10-meter converter rolls the "foreigns" in like "locals"! Simply connect it up with your present receiver and hear "R8" signals from the other side of the world—on 10 meters!



Front view of 10-meter S-W converter. It brings in 10-meter stations "Red-Hot" on your present receiver, if it tunes down to 2,000 kc.

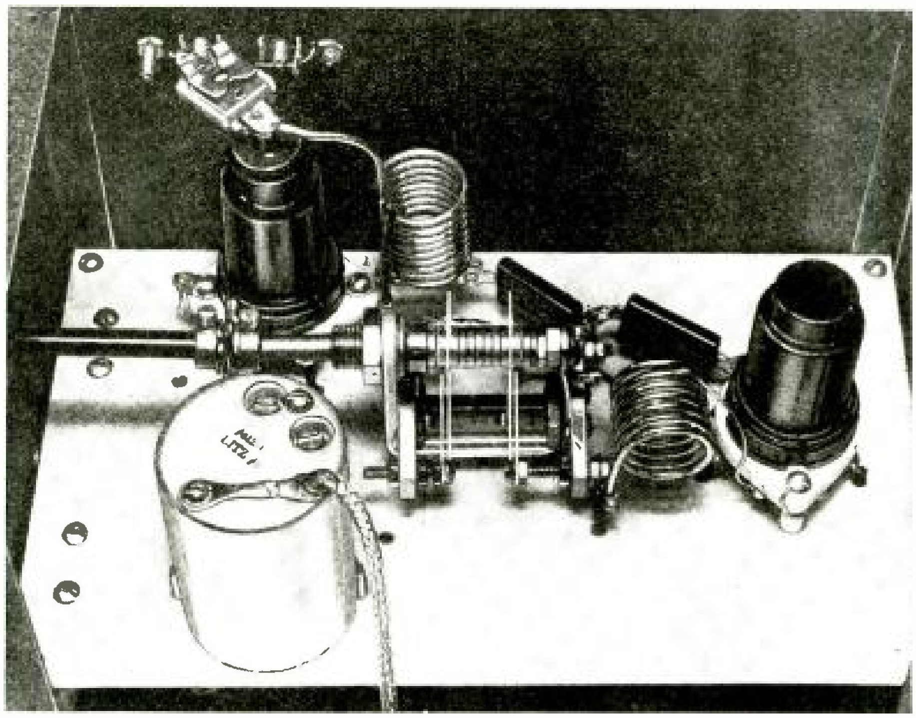
● THE ten meter amateur band is now at its peak, in so far as performance is concerned. Almost any morning one can hear European, Asian and African stations. And not R1 or R2, but from R6 to R8! For the Ham who wants to have an interesting time and work plenty of DX this band offers a wonderful opportunity.

One of the most important parts of the ten meter "gear" is the *receiver*, most of the older "ham" receivers do not take in the ten meter band, and it is for these that this converter was designed. This *converter* will work with any *fairly* sensitive superheterodyne and its performance will be more than gratifying. There is nothing complicated in the construction or operation of the converter and its constructional cost is very nominal indeed.

Only 2 Tubes Required

Only two tubes are used and by glancing at the diagram and remembering that only two tubes are used, one will naturally ask—where is there anything unusual in this arrangement? Well, to be frank, it does not "look" exceptional. But—contrary to expectations, there is tremendous *gain* in this converter. Yes, we said *gain!* And experience has proved it.

The most unusual point is that we have *regeneration* in this converter and it presents no unusual problem. It just naturally comes about of its own accord here in the first detector circuit. This *regeneration* makes the detector very *sensitive* and *selective*. So selective in fact that tuning presented a real problem. At first we expected that the oscillator and detector circuits could be ganged and would "track" with slight difficulty, due to the detector being exceptionally *broad* on the high frequencies. But operation showed that there was an "Ethiopian in the woodpile" that we had not expected to find.



Close-up side view, with cover removed, of the 10-meter converter—it uses but 2 tubes.

Feed-back Put to Work

The rule in this case is—if you can't get rid of it, *then put it to work!* We found that the detector circuit, when unloaded, would oscillate with the oscillator grid coil in its circuit even when the oscillator tube was removed. With the connections employed enough feed-back took place to cause oscillation, but with the antenna coupled to the grid of the detector it stopped. The antenna coupling thus has a control upon this feed-back and this means that for maximum sensitivity, *loose coupling* should be employed. A peculiar thing this, when the coupling is tightened—the sensitivity decreases and naturally the (Continued on page 51)

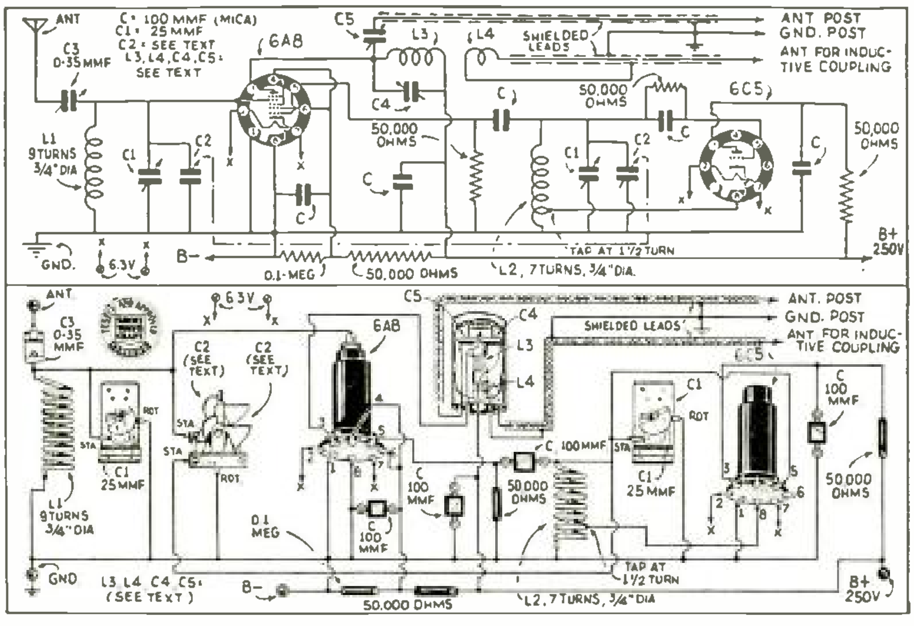


Diagram for building the 10-meter S-W converter.

The A-B-C of Frequency MODULATION

By Wilhelm E. Schrage

Professor Edwin H. Armstrong, well-known to every short-wave enthusiast, for his numerous contributions to the radio art, recently demonstrated his very latest development—"Frequency Modulation." Mr. Schrage has endeavored with the aid of suitable analogies, to explain in a simple manner just how the Armstrong system of "frequency modulation" works.

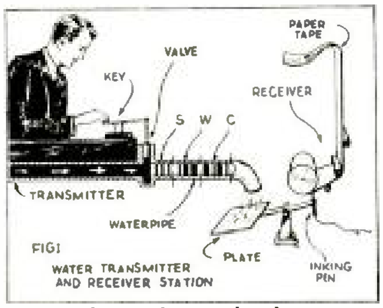
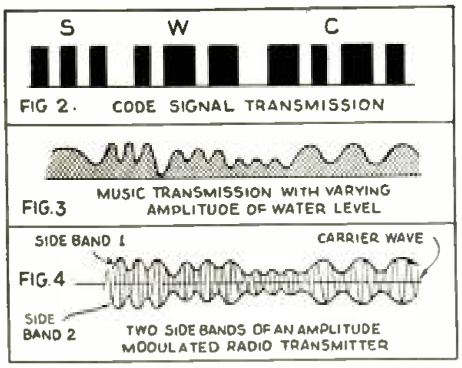


Fig. 1 above shows simple "water jet" analogy of modulation, the signals being transmitted over one water pipe in this instance.

● FROM the time radio made its debut up to the present a tremendous amount of work has been done in the research laboratories of many countries to effect a decrease of radio interference. So far as the disturbing noise are concerned, which frequently are created by various electrical appliances actual remedies and circuit tricks have been found which can eliminate all interference of this kind. If the radio listeners are still bothered by a considerable amount of these disturbances, despite the fact that all necessary remedies are well-known and ready to be applied, it is not a technical problem, but rather, a *financial* one.



Diagrams above show graphically various aspects of modulation.

Lightning Streak vs. Radio Signal

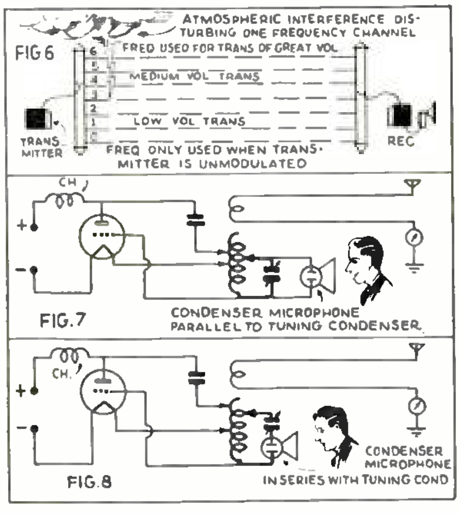
However, so far as atmospheric interference is concerned, even optimistic scientists had discarded all hope that somewhere, some inventor would find a remedy. The main reason for this quite pessimistic opinion was the actual fact, that all radio transmitters in use at present do not radiate as much power into the air as is discharged by one single streak of lightning illuminating the skies for a single split-second.

This argument obviously hits the mark, and indicates impressively that all the tremendous work done by mankind to master the powers of nature may be likened to the effect of a mosquito biting an elephant. However, experience has shown that in a fight between a weak antagonist and a strong one, the strong one may not always win—if the weak one knows how to take advantage of his peculiar abilities.

One road only to march upon: An interesting example is the present conflict between Ethiopia and Italy. A well-trained army equipped with all the weapons modern science could provide is apparently blocked by an enemy which has the ability to march barefoot over roads not usable by a modern motorized army.

Strange as it may seem, a similar situation to that between the strong Italian and the weak Ethiopian armies now exists between the power radiated by the radio stations and the lightning flashes which are constantly being discharged into the atmosphere around the world.

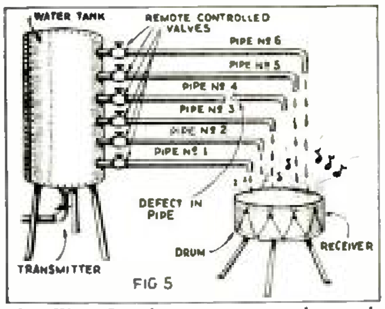
Until recently radio waves and lightning flashes had to "march" upon the *same* broad road, but thanks to a new invention perfected by the famous radio pioneer, Major Edwin H. Armstrong, there are made available tiny roads for the radio waves which cannot be used by the powerful lightning. Radio waves may now "march" unmolested towards their destination without the danger of being pressed against the "embankments" by a powerful lightning streak, rushing with all its fury over this "common road."



These diagrams show the principle of radio transmission by means of "frequency modulation," operating with several sets of frequency bands (Fig. 6). Figs. 7 and 8 show how a simple condenser-type microphone may establish simplest form of "frequency modulation."

Armstrong's Frequency Modulation

The method by which this remarkable progress in radio communication has been accomplished is called "*frequency modulation.*" This method of modulating a radio transmitter has been known as long as has modern radio communication, but it has been redesigned and improved by Major Armstrong in the last ten years to such an extent that it can now be used for radio transmission.



In Fig. 5, above, an analogy is shown of the new "frequency modulation" system, the signal being carried by numerous channels or pipes.

Signal Transmission by Means of Water

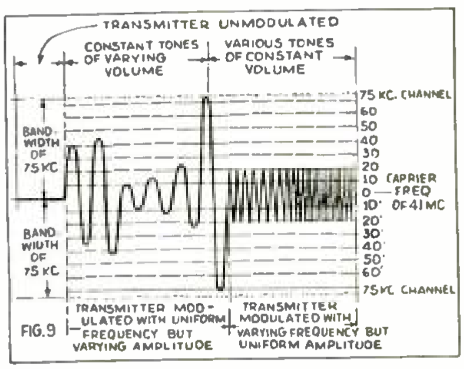
Before we go into the technique of *frequency modulation* it may be of value to demonstrate by means of an easily understandable experiment the function of *amplitude modulation,* which is exclusively used for all kinds of radio transmitters now in operation. But since radio waves are invisible we shall take a *visible medium* to demonstrate amplitude modulation. The best suitable medium for comparison with radio waves is water, and that it is quite possible to use water as a means of communication will be demonstrated by Fig. 1, which shows at the left side a "*water-transmitter*" and at the right side a "*water-receiver.*"

Code Signal Transmission

To transmit code signals from the transmitter to the receiver the operator uses a valve which interrupts the flowing water into long and short periods, actually consisting of dot and dash impulses. These water impulses are directed against a disc, at the receiving end the disc having an inking pen or stylus which is moved by the incoming code impulses over long or short periods against a paper-tape, where the message is written down as code signals. Experienced readers have recognized already that this communication system by means of water operates in about the same manner as a radio transmitter sending out code signals.

But music transmission: In case music or speech is to be radiated by a trans-

(Continued on page 49)



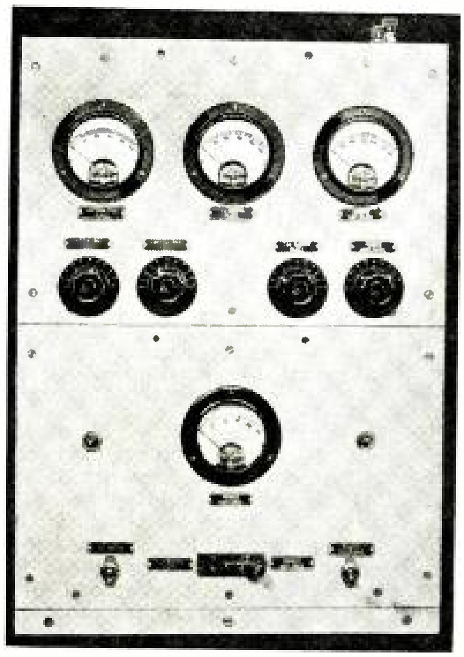
What the actual frequency band employed by Major Armstrong looks like, when modulated.

A Modern

By Howard G. McEntee, W2FHP

This Month's $20.00 Prize Winner

Mr. McEntee describes a real "hot" M.O.P.A. transmitter in which a pair of 801's have been added to the well-known "89" transmitter described by W2AMN in a past issue. Excellent performance has been obtained from this transmitter and in order to "clean-up" the 5-meter band, we strongly recommend the MOPA. True, the modulated oscillator has served as a "key" to the ultra-high frequencies, but it is high time it is laid aside for the more up-to-date transmitter, such as the one here described.



Front view of Mr. McEntee's excellent 5-meter transmitter—she sure packs a mean wallop!

● AFTER working for several years with various types of modulated oscillators, finally ending up with about the most advanced and efficient type of all, the "long lines" transmitter, a hankering was felt for something still more stable, and one that could be received on the best of "superhets" with no trouble. The logical choice, of course, was the M.O.P.A. and it remained only to settle upon the *tube line-up*. The "89" transmitter* described by George Shuart seemed to offer great possibilities, since low cost receiving tubes are used, and it was assumed that two 89's in push-pull would drive any medium low-power *final stage*. Since highest efficiency for the power used was the aim, two 801's, which are generally conceded to be "tops" for 5 meter transmission, were chosen. Though they cost a little more than ordinary 10's, their smoothness of operation and high output leaves little to be desired.

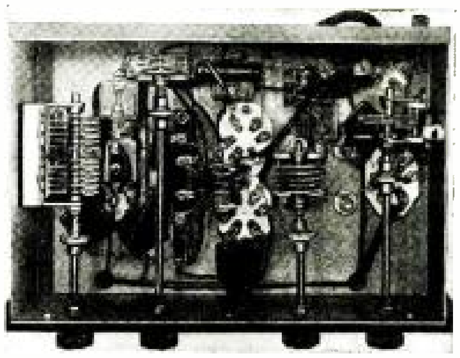
"Pressdwood" Rack and Panel Used

Now that the tube line-up was selected, matters proceeded at a fast pace. A rack had to be planned and this was built from ¾" pine throughout, with top and panels of ¼" pressdwood. The panels are each 14"x9¼". A strip 14"x¾" is placed along the bottom front wooden frame member. The frame and the top are enamelled black, and the panels and two chassis, French gray.

As we had no desire to see the 801's "go up in smoke" if excitation failed for any reason, fixed bias was used on them, as well as on the 89 buffers. Two sliders on the C bias voltage divider allow any bias from zero to around minus 200V. The bias runs about 30V for the 89's and 125V for the 801's, with the 475 and 550V, respectively, on the plates. The bias filter choke is a small midget type, as was the bias supply transformer TI. The latter should be capable of supplying 250V and 50 ma., with a 6.3V, 3 A. heater winding, which is used for the 89's and all the meter lighting bulbs. The transformer in the original had no 6.3V winding so a separate filament transformer was needed.

Power Transformer "Specs"

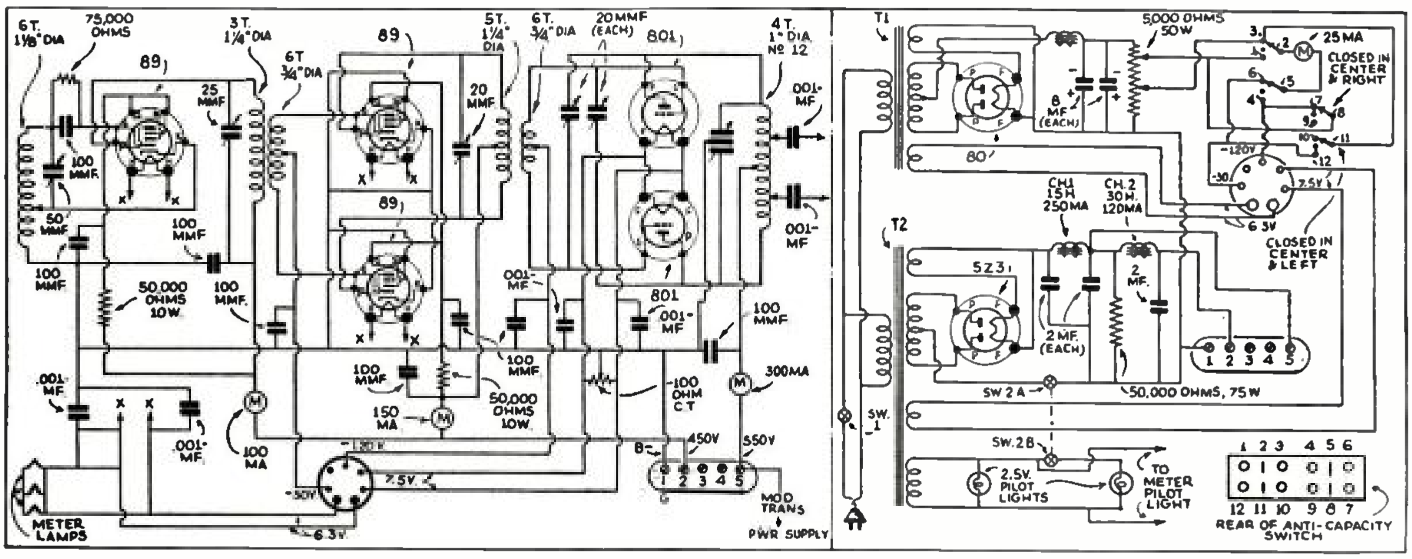
The power transformer is rated at 600V at 200 ma. It has a 7½ V. winding, and a heavy 2½ V. winding, besides those for high voltage and rectifier. There was no use for the 2½ V. winding except to light all pilot lamps in the power supply unit. The heavy filter choke is a 250 ma., 15 H. unit, while CH2 gives added filtering for the 89's and drops the voltage somewhat, which is desirable.



Bottom view of the Radio Frequency unit of the transmitter.

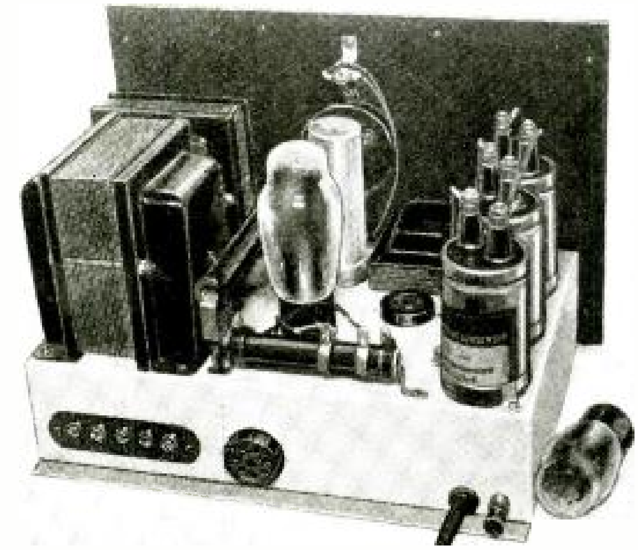
The 25 ma. grid current meter is fitted with a switch SW3 to change it from the buffer to P.A. grid circuit. How-

*See Feb. 1936 Issue; Page 602.



Complete wiring diagram showing how to build Mr. McEntee's 5-meter modern type trans

5-Meter Transmitter



The two photos above show the R.F. amplifier at the right and the power supply unit at the left.

ever, it is hardly ever used for the buffers so this switch may be omitted and the meter left in the P.A. grid lead.

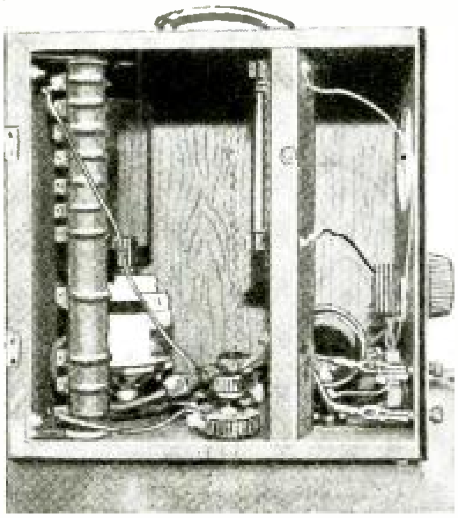
All the meters have small slots cut in the top of the case so that a pilot lamp can shine through to give indirect lighting. The slot is covered with celluloid to keep out dust. While this lighting doesn't add any efficiency to the transmitter, it certainly improves the appearance. The pilot lamp connected to SW 2B lights only when the high voltage is on.

(Continued on page 42)

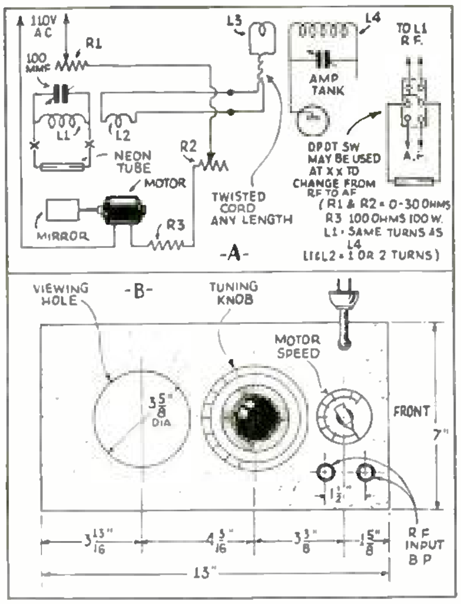
A NEON Tube Oscilloscope

A Low-Cost Instrument for Checking Modulation

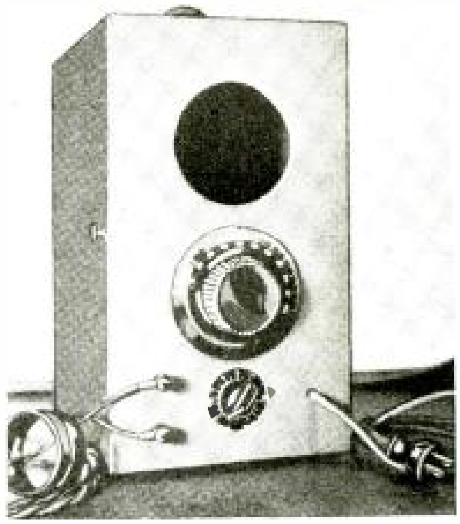
By A. C. Stansfield, W1COL



Front view of the Neon tube oscilloscope, which, at slight cost provides the "Ham" with an instrument for checking his modulation.



The drawing above shows a front panel lay-out and also diagram of connections of the Neon tube oscilloscope.



A peek at the inside of the Neon tube oscilloscope.

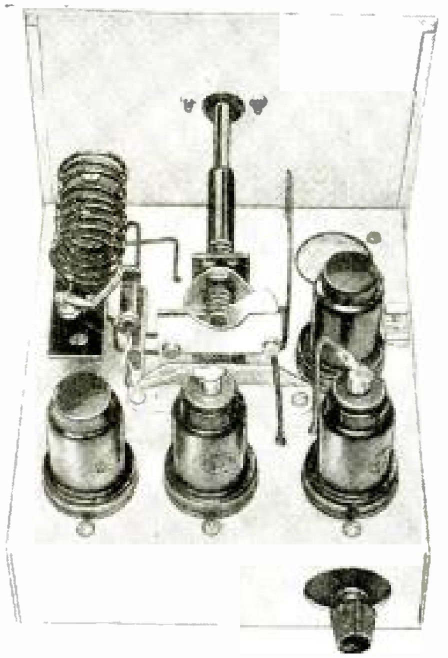
● HOW many conscientious radio Amateurs have wanted to own an oscilloscope or oscillograph to actually see how their transmitted signals appeared? The cost of such an instrument has probably been more than the average amateur pocketbook could stand, reaching upward from $50. Most Amateurs, having this amount to spend, would probably decide that $50 worth of additional transmitting watts would be more to advantage. Yet, the oscilloscope is just as essential a piece of apparatus as the monitor—and who would be without a monitor—particularly the Amateurs operating phone stations. That a phone signal—even correctly modulated—occupies far more space in the radio spectrum than its C.W. brother, is a known fact. If this same phone signal is *overmodulated*—frequency modulated—*it is not only emitting a distorted signal, but is widening its band of frequency occupancy, so that it is* "hogging the air"—to put it bluntly!

There is no question but that the true American Amateur is desirous of doing his part in keeping within the Federal limitations and respecting the right of the *(Continued on page 55)*

5-Meter Super-Regenerator

By H. G. Cisin, M. E.

This Four Metal-Tube Set Ideal for Amateur and Experimental Reception



Rear view of 5-meter super-regenerative metal-tube receiver.

● EXPERIENCE has demonstrated that the properly designed super-regenerative circuit is superior to a super-heterodyne for *ultra-short wave* reception. This is not because the super can not be made sensitive enough, nor because it cannot be made broad enough for stand-by reception. As a matter of fact, if these were the only requirements, the super-heterodyne would undoubtedly be preferable.

However, on five to ten meters, the super-heterodyne circuit—if sensitive enough for amateur requirements—is disqualified for such use, due to the fact that it picks up too much auto-ignition and similar noise interference. A super-regenerative circuit, if designed so that the detector is super-regenerating quite strongly, has a much better *signal-to-voice* ratio for average moderate intensity signals and hence this circuit is the writer's choice for *ultra high frequency* reception.

When using this type of super-regenerative circuit, however, it is necessary to guard against extreme radiation, by employing an R.F. stage ahead of the detector. This R.F. stage does not increase the "gain" to any extent, but it does serve to prevent receiver radiation.

The 6K7 R.F. tube is coupled to the 6J7 detector as shown in the schematic diagram. This method allows an adjustment of coupling and therefore does not load the detector input circuit too much. The R.F. signal completes its circuit through the internal capacities of the 6J7 tube, and external circuit to ground capacities. An R.F. choke input is used with tuned receiving antenna.

The super-regenerative detector circuit is of the type known as the blocking grid-leak system. It will be noted that the grid leak return is to a high positive potential. While it would be possible to use the ordinary type of blocking-grid leak with ground return, and still obtain equal sensitivity, the high voltage return prevents detector overloading on strong signals and also results in improved tone quality. The effect is somewhat similar to A.V.C. since signals are all received at approximately the same volume. Hence the manual control in the audio circuit is more than ample.

Front panel view of 5-meter super-regenerative receiver.

The standard Colpitts oscillator circuit is employed in the detector. The internal capacities of the 6J7 tube act as the voltage-divider elements, producing the desired oscillation. By using a high value grid-leak, a negative voltage is built up due to the grid current. The decrement of the circuit and the values of the constants includ-

(*Continued on page 40*)

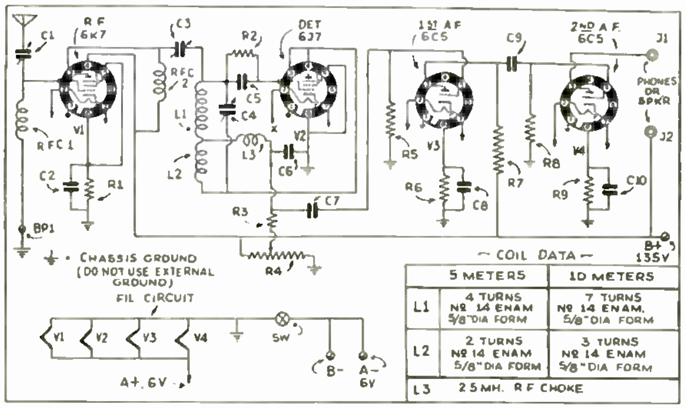


Diagram of Mr. Cisin's 5-meter receiver.

The LAMB "Noise Silencer"

● WHILE there has been much talk about eliminating or reducing man-made interference, it remained for James J. Lamb, technical editor of *Q.S.T.* to really solve the problem.

So far as we have been able to determine, this is really the only successful method that has ever been proposed or introduced, insofar as the elimination or reduction of noise is concerned. After a great amount of research and study of the character of the various types of noises picked up on the average short-wave set, Mr. Lamb decided that this noise was of such a nature that even if the receiver was inoperative at each impulse of the interfering noise, material alteration of the received signals would not be noticed by the ear. The "pistol shot" or "machine-gun" variety of noise heard in the average short-wave set has actually been caused to "commit suicide" in a very ingenious manner. By referring to the circuit diagram, we find that this noise—as well as the signal—is taken from the grid of the second I.F. stage which uses a 6L7 tube. The noise is then amplified through a 6J7 metal tube and it is then rectified by a 6H6 full-wave rectifier. The resulting D.C. is then applied to the injector grid of the 6L7 second I.F. amplifier tube, from which the signal and noise were originally taken. It can be readily seen that as the strength of the noise increases, the quenching voltage applied to the injector grid as a result of this noise also increases. Thus, the noise is used to cut down the "gain" of the receiver, and the real result is that the noise is cancelled. Through the use of a control indicated as a "noise thresh-hold adjustment" in the diagram, the limits

(*Continued on page 39*)

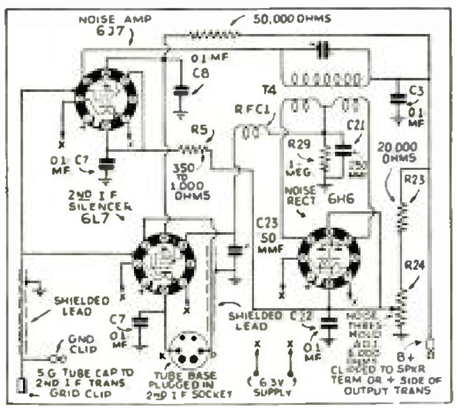
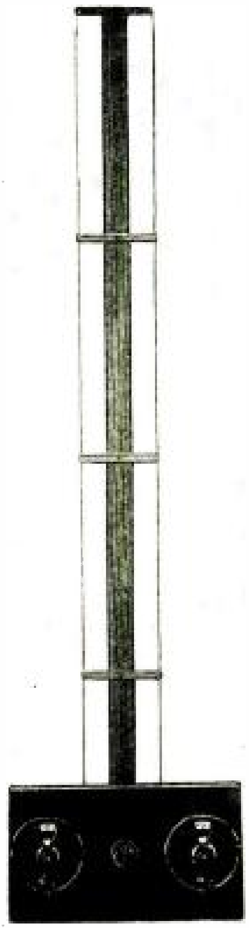


Diagram above shows the relatively simple circuit devised by Mr. James Lamb for noise suppression; the device as shown in the diagram above is connected to the I.F. stages of a good super-set receiver.

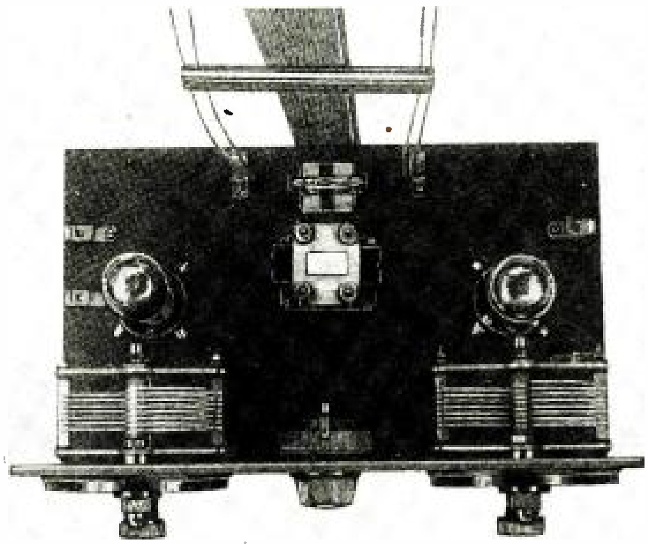
A "LOOP AERIAL" S-W Receiver

By Walter C. Doerle

Mr. Doerle this month describes a very interesting 2-tube receiver, using ordinary type 30 battery tubes, the principal feature being a Loop Antenna, which combines a regeneration feature also.



A view of the novel receiver here described with its loop aerial.



Top or plan view of the "loop aerial" short-wave receiver here described. It uses two type 30 tubes.

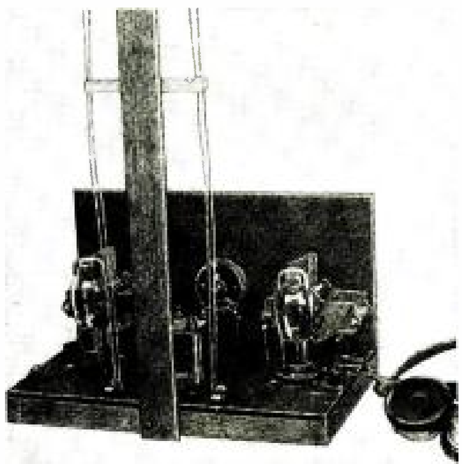
● BY golly it seems strange that short-wave materials are so sparse among the many radio listeners today and stranger still when one considers the many available opportunities in the short-wave field of activity. For instance, there exists many short-wave publications and one of the best as rated by a college professor known to the author puts *Short Wave Craft* as the "tops." Here you find versatile and "dated" doings in short-wave radio, but when social contacts are made, you don't even find at least a very simple short-wave set in your friends' homes.

To fathom this lack of short-wave materials will require some time for solution. However the problem is brought to a conclusion by offering you the description and photos of a short-wave receiving set that can be built at "popular-prices" cost.

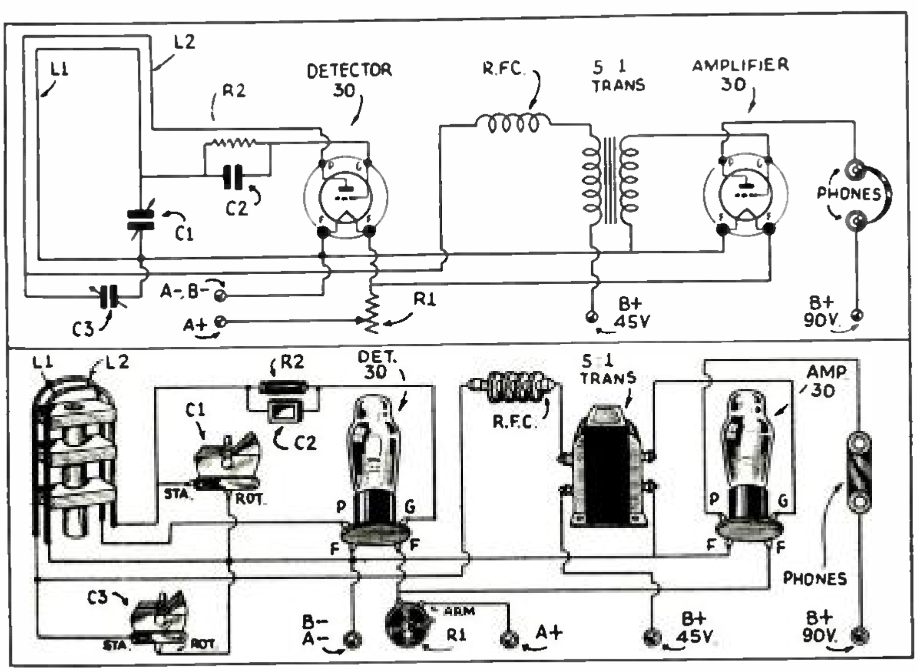
No doubt Frank Buck is without a peer in "bringing 'em back alive" and considering the human elements, human growth and limitations of one desirous of owning a short-wave receiver, a challenge is put to you to build this set, which will bring radio stations in "alive" from the darkest corners of the short-wave globe. And we didn't say "knock" 'em cold," but "bring 'em in alive." So here goes.

Guidance Facts For Constructors

The parts for the tuning panel and subpanel have been spread apart a bit



Rear view of the 2-tube "loop antenna" S-W receiver.



Hook-up for the loop aerial receiver.

so as to impress the fact on you that this set is very simple and the number of pieces which comprise it have been reduced to minimum essentials—still retaining the conventional 7"x12" size of panels.

The control panel has mounted on it the two vernier dials, each with its .00035 mf. variable condenser and in the center of this panel is the 10-ohm rheostat and knob which permits controlling the filament voltage for the two type-'30 tubes. Then on the left hand is the station-tuning condenser C1, across which is connected the "loop" L1 (and incidentally the so-called *secondary* winding of plug-in coils of other receivers). While on the right-hand side is the regeneration condenser C3 connected in series with the loop L2 (so-called *tickler* coil in usual set) between the plate of the detector and its filament negative side. Why this method of loops—will be given more consideration in the last few paragraphs of this article. At present we have more constructional matters to elaborate upon so that you are not detained with items labelled as "advantages" and "disadvantages."

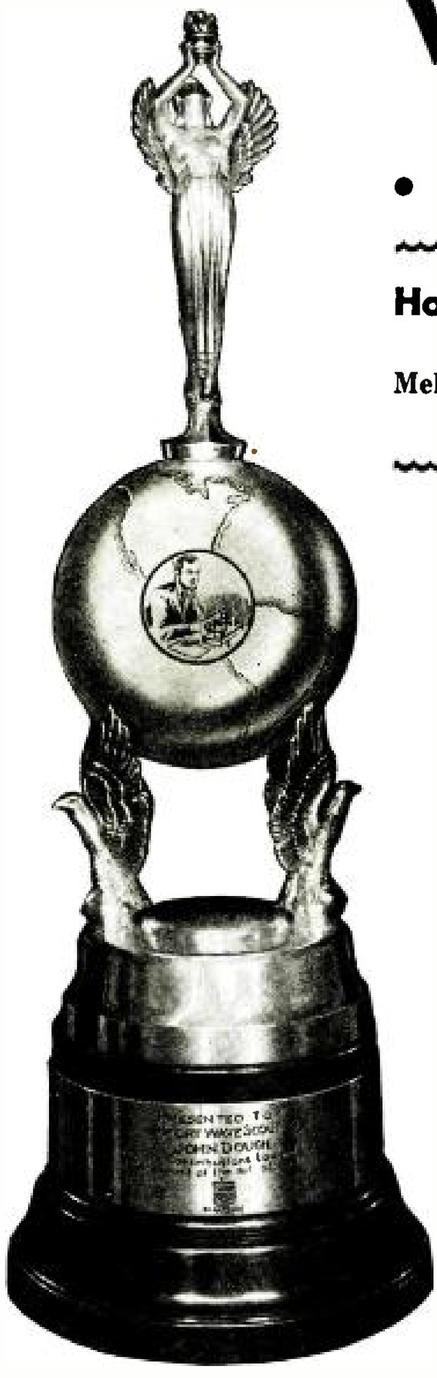
(Continued on page 59)

SHORT WAVE . . SCOUTS

TWENTY-SIXTH "TROPHY CUP"

Presented to
SHORT WAVE SCOUT
C. T. SCRIMSHER
New Britain, Conn.

For his contribution toward the advancement of the art of Radio
by
SHORT WAVE CRAFT
Magazine



26th TROPHY WINNER

62 Stations—45 Foreign

● THE 26th trophy is awarded to Short-Wave Scout, C. T. Scrimsher, New Britain, Conn. Mr. Scrimsher had a total of 62 veris, 45 of which were located outside of the United States.

The receiver used by the winner was a 1936 Philco, model 116 B employing 11 tubes. With this receiver was used a Philco all-wave antenna

(Continued on page 50)

United States Stations

W1XAL—6040 kc.—University Club. Boston, Mass.
W1XK—9570 kc.—Relays WBZ. Westinghouse Elect. & Mfg. Co., Boston. Mass.
W2XAF—9530 kc.—Relays WGY. General Electric Co., Schenectady, N.Y.
W2XAD—15330 kc.—Same as above.
W3XAU—6060 kc.—Relays WCAU. Newton Square, Pa.
W3XAU—9590 kc.—Same as above.
W3XAL—6100 kc.—Relays WJZ. National Broadcasting Co., Bound Brook, N.J.
W3XAL—17780 kc.—Same as above.
W4XB—6040 kc.—Relays WIOD. Miami Beach, Fla.
W8XK—6140 kc.—Relays KDKA. Westinghouse Elect. & Mfg. Co., Pittsburgh, Pa.
W8XK—11870 kc.—Same as above.
W8XK—15210 kc.—Same as above.
W8XK—21540 kc.—Same as above.
W8XAL—6060 kc.—Relays WLW. Crosley Radio Corp., Cincinnati, Ohio.

Honorable Mention Awards

L. Lachorlt, University, Ala.
Melbourne O. Sharpe, Knoxsville, Tenn.
C. G. Hurtads, Curacao, P.W.I.

W9XF—6100 kc.—Relays WENR. National Broadcasting Co., Chicago, Ill.
W9XAA—6080 kc.—Relays WCFL. Chicago Fed. of Labor, Chicago, Ill.
W9XBS—6425 kc.—Relays WMAQ. National Broadcasting Co., Chicago, Ill.

Foreign Stations

CRCX—6090 kc.—Canadian Radio Broadcasting Commission. Bowmanville, Canada.
CJRO—6150 kc.—James Richardson & Co., Winnipeg, Canada.
COCD—6130 kc.—"La Voz de Aire." Havana, Cuba.
COC—6010—kc.—Now COCO. Havana, Cuba.
XEBT—5990 kc.—Relays XEB. Mexico City, Mexico.

(Continued on page 50)

● ON this page is illustrated the handsome trophy which was designed by one of New York's leading silversmiths. It is made of metal throughout, except the base, which is made of handsome black Bakelite. The metal itself is quadruple silver-plated, in the usual manner of all trophies today.

It is a most imposing piece of work, and stands from tip to base 22½". The diameter of the base is 7¾". The diameter of the globe is 5¼". The work throughout is first-class, and no money has been spared in its execution. It will enhance any home, and will be admired by everyone who sees it.

The trophy will be awarded every month, and the winner will be announced in the following issue of SHORT WAVE CRAFT. The winner's name will be hand engraved on the trophy.

The purpose of this contest is to advance the art of radio by "logging" as many short-wave phone stations, amateurs excluded, in a period not exceeding 30 days, as possible by any one contestant. The trophy will be awarded to that SHORT WAVE SCOUT who has logged the greatest number of short-wave stations during any 30-day period.

Trophy Contest Entry Rules

● THE rules for entries in the SHORT WAVE SCOUT Trophy Contest have been amended and 50 per cent of your list of stations submitted must be "foreign." The trophy will be awarded to the **SHORT WAVE SCOUT** who has logged the greatest number of short-wave stations during any 30 day period; (he must have at least 50 per cent "foreign" stations). This period need not be for the immediate month preceding the closing date. The complete list of rules appeared in the September issue of this magazine.

In the event of a tie between two or more contestants, each logging the same number of stations (each accompanied by the required minimum of 50 per cent "foreigns") the judges will award a similar trophy to each contestant so tying. Each list of stations heard and submitted in the contest must be sworn to before a Notary Public and testify to the fact that the list of stations heard were "logged" over a given 30 day period, that reception was verified and that the contestant personally listened to the station announcements as given in the list.

Only commercial "phone" stations should be entered in your list, no "amateur transmitters" or "commercial code" stations. This contest will close every month on the 25th day of the month, by which time all entries must be in the editors' hands in New York City. Entries received after this date will be held over for the next month's contest. The next contest will close in New York City March 25th; any entries received after that date will be held over till the next month.

The winner each month will be the person sending in the greatest number of verifications. Unverified stations should not be sent in, as they will not count in the selection of the winner. At least 50 percent of the verifications sent in by each listener must be for stations located outside of the country in which he resides! In other words, if the contestant lives in the United States at least 50 percent of his "veries" must be from stations outside of the United States. Letters or cards which do not specifically verify reception, such as those sent by the Daventry stations and, also by commercial telephone stations, will not be accepted as verifications. Only **letters or cards which "specifically" verify reception of a "given station," on a given wave length and on a given day, will be accepted!** In other words it is useless to send in cards from commercial telephone stations or the Daventry stations, which state that specific verifications will not be given. Therefore do not put such stations on your list for entry in the trophy contest!

SHORT WAVE SCOUTS are allowed the use of any receiving set, from a one-tuber up to one of sixteen tubes or upwards, if they so desire.

When sending in entries, note the following few simple instructions: Type your list, or write in ink, **pencilled matter is not allowed.** Send verification cards, letters and the list all in one package, either by mail or by express prepaid; **do not split up the package.** Verification cards and letters will be returned, at the end of the contest, to their owners; the expense to be borne by SHORT WAVE CRAFT magazine.

In order to have uniformity of the entries, when writing or typing your list, observe the following routine: USE A SINGLE LINE FOR EACH STATION; type or write the entries IN THE FOLLOWING ORDER: Station call letters; frequency station transmits at; schedule of transmission, if known (all time should be reduced to Eastern Standard which is five hours behind Greenwich Meridian Time); name of station, city, country; identification signal if any. Sign your name at the bottom of the list and furthermore state the type of set used by you to receive these stations. State total No. stations.

WORLD-WIDE SHORT-WAVE REVIEW

—Edited By C. W. PALMER

The Fly-Wheel Dial

● A NEW dial has appeared in several new French sets, known as the gyroscopic dial—from its similarity in operation to the gyroscopic compass with its rapidly spinning flywheel.

This dial is meant to facilitate tuning on the short-wave bands. When you tune the set, the reduction ratio slows down the movement of the tuning condenser to make station location easy. But when, as is often the case on the short waves, you desire to shift to another part of the band, you simply give the knob a "spin," and the heavy flywheel keeps it moving. Then, at the desired point, a touch stops the dial for close tuning.

This spinning dial is also useful in locating stations, as a spin will carry the condenser across the band, sufficiently slow so that a carrier will usually be heard. Then, a slight turning back is all that is needed to find the station.

This dial was shown in *Science et la bie* (Paris).

A 5-Meter Super-Regenerative Set

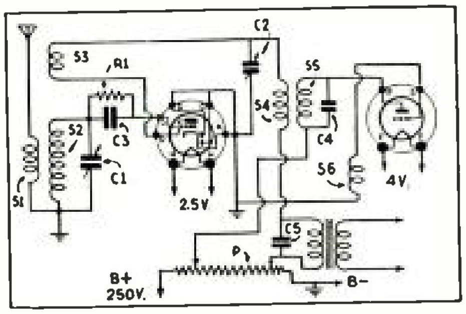
● AN unusual use of the American 2A6 tube was mentioned in the latest issue of *Radio-Ref* (Paris).

The owner and constructor of amateur radio station F8VS has found that this tube has desirable characteristics for use as an ultra-high-frequency detector in a *super-regenerative* set, when used as a triode.

When used in this way, the diode plates and the cathode are tied together. This leaves the tube as a straightforward triode. The arrangement of the circuit is shown here. The second tube is the suppressor frequency generator, with the large honeycomb coils S4 and S5.

The coils S1, S2 and S3 are the usual tuning coils used for 5-meter regenerative or super-regenerative sets. The other values are indicated on the circuit.

Experimenters, who like to try new circuit hints might try the 2A6 in this new and unusual way. *(This type of tube was advocated in George Shuart's "Hiss-less" superregenerator; see Nov. 1935 issue S.W.C.—Editor.)*



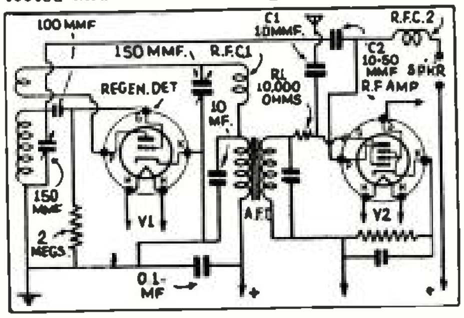
"Hams" will find of interest the 5-meter Super-regenerative receiver hook-up shown in the accompanying diagram; it was devised by a French amateur.

● **The Editors have endeavored to review the more important foreign magazines covering short-wave developments, for the benefit of the thousands of readers of this magazine who do not have the opportunity of seeing these magazines first-hand. The circuits shown are for the most part self-explanatory to the radio student, and wherever possible the constants or values of various condensers, coils, etc., are given. Please do not write to us asking for further data, picture-diagrams or lists of parts for these foreign circuits, as we do not have any further specific information other than that given. If the reader will remember that wherever a tuned circuit is shown, for instance, he may use any short-wave coil and the appropriate corresponding tuning condenser, data for which are given dozens of times in each issue of this magazine, he will have no difficulty in reconstructing these foreign circuits to try them out.**

A S.W. Reflex Set

● A RECENT issue of *CQ-MB* (Berlin) a magazine published for radio amateurs, contained the circuit of a short-wave set which experimenters in this country will find interesting.

It is a reflex of two tubes, in which the pentode acts as an untuned R.F. amplifier; the triode acts as regenerative detector and the pentode serves a second purpose of A.F. amplifier. The signal is fed to the grid of the pentode through C1. It is amplified and then passed through condenser C2 to the grid of the detector. It is detected and then fed through the A.F. transformer to the pentode control grid and is amplified at audio frequencies.



A clever Reflex circuit; the triode is the detector.

The values of the parts in this experimental circuit are given. With a few changes, many short-wave sets can be converted to use this ingenious stunt. Why not try it, fellows?

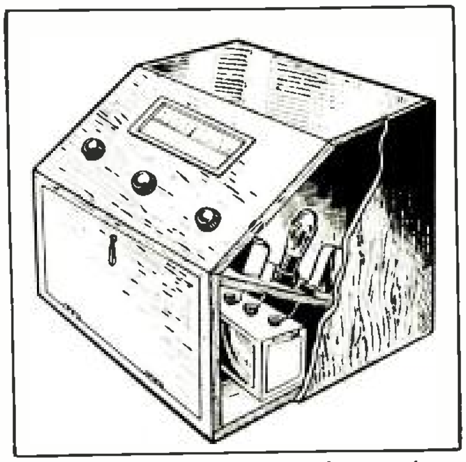
A Novelty in Cabinets

● EVERY once in a while, a really new and original idea is brought out in such an inauspicious way that we are inclined to accept it in a matter-of-fact manner, instead of giving it the attention it deserves.

Such an idea appeared recently in *Practical and Amateur Wireless*, (London).

It has been the practice of set builders in that country to make their sets on wooden or metal subpanels, with upright panels on the front, similar to the sets made in the U.S. by home set-builders.

But it has become almost universal in that country to use slanting panels in commercial sets, to facilitate reading the tuning dials. In order to permit a home-built set of the type described above to look like a commercially made one, an ingenious experimenter mounted his set as shown in the illustration. This gave the desired result, as well as permitting him to use his favorite set without having to rebuild it.



The slanting control panel for receivers is, without a doubt, gaining in popularity daily in this country. One method of accomplishing this effect is shown above.

Incidentally, the front panel can be used to mount the dynamic speaker as well as conceal the batteries (if it happens to be a battery set).

The advantage of the sloping panel is obvious—American short-wave fans will find it a distinct advantage in tuning.

S.W. Coil Making

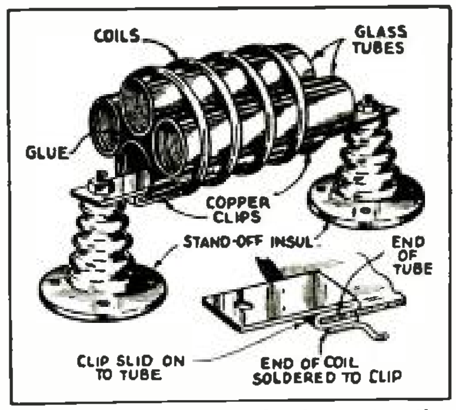
● A NOVEL and efficient way to make ultra-short-wave coils is by the method shown in the illustration here. It consists of four glass tubes, such as test tubes, around which is wound the wire forming the actual coil.

The use of such small tubes makes the coils almost self-supporting, that is, they have the least possible amount of insulating material to cause losses.

The coils with their glass supports are mounted by means of clips made from sheet metal, bent as shown. The metal supports also form coil connections, by soldering the ends of the coil wire to them. Stand-off insulators can be used to mount the coils, or other methods can be devised.

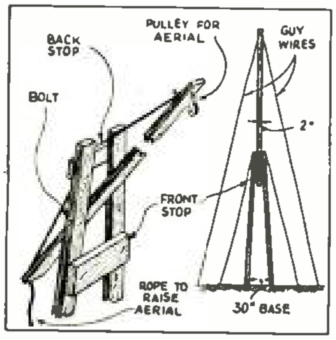
The glass tubes on which the coils are wound can be small bottles, such as the type in which aspirin is sold, for larger coils, test tubes will serve nicely. Celluloid cement will serve to hold the four tubes together for winding.

This novel coil winding hint was shown in an issue of *Practical and Amateur Wireless* (London) recently.



Above—A novel method of constructing an insulating form on which to wind short-wave coils—it is made from several glass tubes; even test tubes may be used.

$5.00 Prize



"ONE-MAN" AERIAL MAST

Here is an idea for a "one-man" aerial mast; I erected one 50 ft. high. I do a lot of aerial work and I find this to be the easiest way to get them up and down. I take two pieces 2" x 3" and spread one end about 30" and the other 2", and nail these in position with a 1" x 2" board. Next I drill a hole about 6" from the top; this is where the upper portion of the mast is fastened. The top piece is usually a 24 ft., 2" x 2" piece. A hole is drilled about 6 ft. from one end. This piece fits between the other two and is bolted. You will notice that the top piece is now on a pivot. The guy wires are all attached and the lower section of the mast can be raised by pushing up with the top portion. A rope should be attached to the short end of the top piece.—C. R. Vogler.

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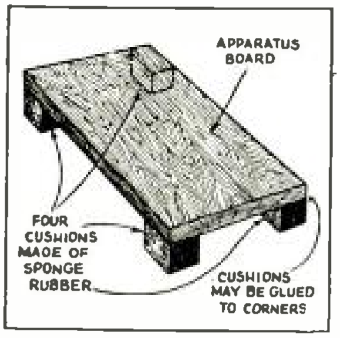

ELIMINATING TRANSMITTER VIBRATIONS

The frequency-stability of a breadboard transmitter, employing the much used Hartley or pushpull circuits, can be greatly improved by mounting the board on sponge rubber cushions, of the same width, length and thickness, placed under each of the four corners of the board. The sponge rubber cushions compensate for shifts in frequency due to jarring the instruments. W9SPJ used this method with considerable success. Most "ham" stations worked reported remarkable stability of signals, upon learning that the circuit employed was the single 210 Hartley, using two 81's in the rectifier supply with 500 volts in the plate circuit.—Justin M. Walker.

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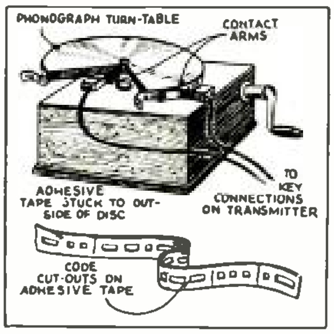


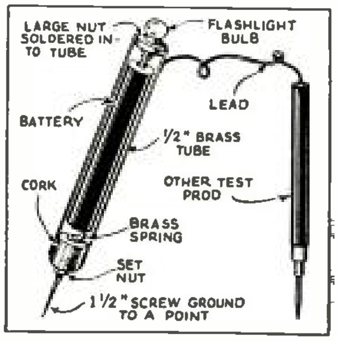
AUTOMATIC KEY

When this key is hooked to the transmitter it will send what you desire endlessly. The arm was made of scrap tin and hooked to a suitable base. (Note—make your cuts in the tape wide enough so that the point of the arm fits into them.) Of course you will have to experiment with the slots to suit your own taste.

For beginners who are learning the code, this is a valuable instrument when connected to an audio oscillator.—Charles Simmons, Jr.

$5.00 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 awarded eight months' subscription to SHORT WAVE CRAFT. 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.



NOVEL TEST PROD

I hope the rest of the fellows can find as many uses for this "kink" as I have. One will find first a brass or metal tube, which is 5½ inches long by ½ inch inside diameter. Next solder into one end a nut which a flashlight bulb will screw into. After this find a plain cork which will fit into the tube, and punch a small 1½ inch screw, that has been filed to a point through it. Then take a small brass strip, drill a hole in one end, and bend into a "U" shape for a spring. Next slip the bolt through this, then through the cork and fasten with a set-screw. Then solder an 18 inch wire, which is fastened to an ordinary test prod, to the top of the brass tube, slip a pen-light battery in and insert the cork. The test prod is now complete and ready for use.—Dave McGuire.

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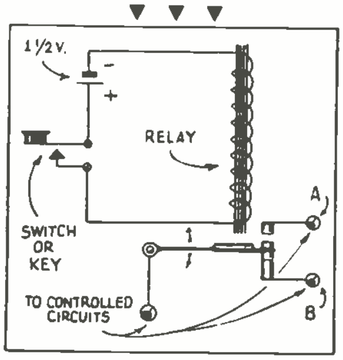

ALL PURPOSE RELAYS

Here is a useful kink which will put some of that "junk box" material to work. On many of the old "B" eliminators and trickle chargers, a small relay is used to throw the A.C. line to charger or eliminator. These relays are very sensitive, and require only a 1½ volt dry cell to operate. They may be used as a SPST or SPDT relay. The writer is using two of these units in a remote-controlled transmitter. One is used as a "standby" switch, while the other is used as a "keying" relay. The keying relay responds perfectly up to 25 wpm, which happens to be the writer's limit.—W. C. Bellheimer.

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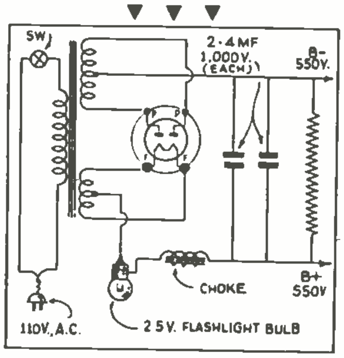

BULB AS FUSE

Herewith is a kink that I believe would help a lot of "hams," in the positive high voltage lead between the filament center tap of the rectifying tube. I use a 2½ volt bulb before the "HV" goes into the choke. Now if you should happen to blow a filter condenser or a plate blocking condenser or if anything should happen to cause a direct "short" on the power-supply, this bulb will burn out and not do any harm to the rectifier tube of the 83 type, which won't stand a lot of "shorting." In case you draw an excessive amount of mills (M.A.) caused by overload the bulb will light up and warn you.—N. S. Preson.

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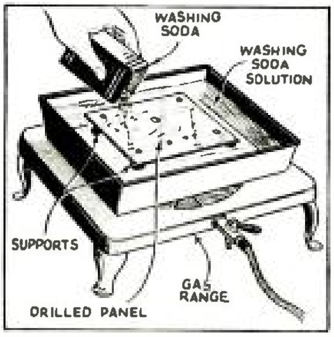

PROF. FINISH FOR PANELS

Here is a solution to the problem of having a professional like finish on aluminum panels without the use of lye. After the panel is all drilled, make a solution of two handfuls of washing soda and two quarts of water. Lay the panel "face-up" in a pan that will hold the panel when it is supported by four supports. These supports may be made of stone or other like substances. The panel must be completely covered with this solution. It is now only necessary to boil the panel in the solution until all traces of dirt and scratches disappear. Then rinse the panel in cold water and dry it.—Edward Koch.

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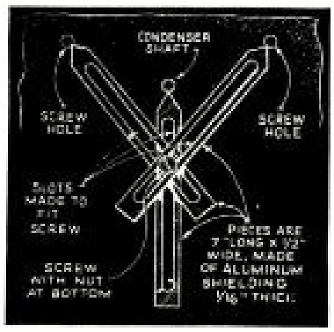

DRILLING GAUGE

While this kink is not new or original with me, I pass it along to the readers of Short Wave Craft. It is rather difficult at times to mount condensers requiring two or more mounting holes. By slotting three strips, as shown in the drawing, and holding them together with a screw, the mounting holes can be drilled accurately.—Melvin E. Conwell.

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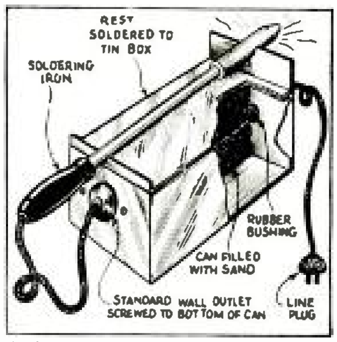
IRON HOLDER

After having much trouble with the soldering iron stand sliding all over the bench, I hit upon the following idea: I filled a square tin can with sand and



wired it over the soldering iron as shown in the diagram. This provides a relatively heavy stand, and is more convenient in every respect than manufactured ones.—H. F. Dann.

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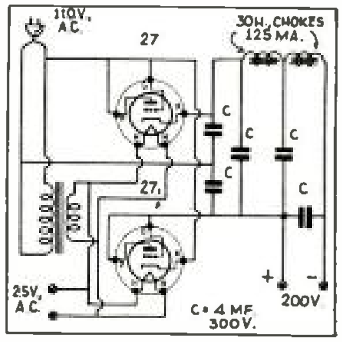

HANDY POWER SUPPLY

Recently, when in need of a power supply, I constructed one with parts found in my junk box and it gave very satisfactory results. Therefore, I am passing this along to the readers of Short Wave Craft as a "Kink." Although it is not original by any means, I feel that a great many readers will be interested in it.—Robert Lyon.

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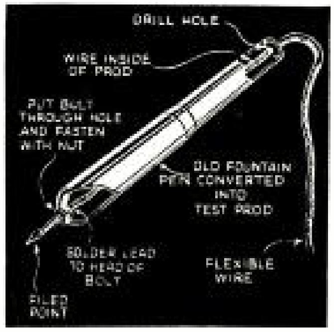


NEW USE FOR OLD FOUNTAIN PEN

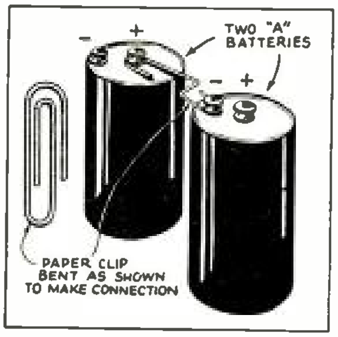
I built a testing instrument and needed a pair of test prods, and the following idea was carried out.

Two old fountain pens, which were of no particular value, were procured and remodeled as shown in the sketch. A screw projects from one and forms the point or tip, while the cord or test-lead runs up through the fountain pen and out the other end.—Jim Morris.

▼ ▼ ▼

PAPER CLIP CONNECTOR

Here is a "Kink" for Short Wave Craft. I used a bent paper clip as a connector between two dry cells. This is quite a time-saver, especially as many connections are to be made. The forming of the paper clip is clearly shown in the drawing.—Harry Wrasko.



Oh! for a Ham "Shack" Like One of These

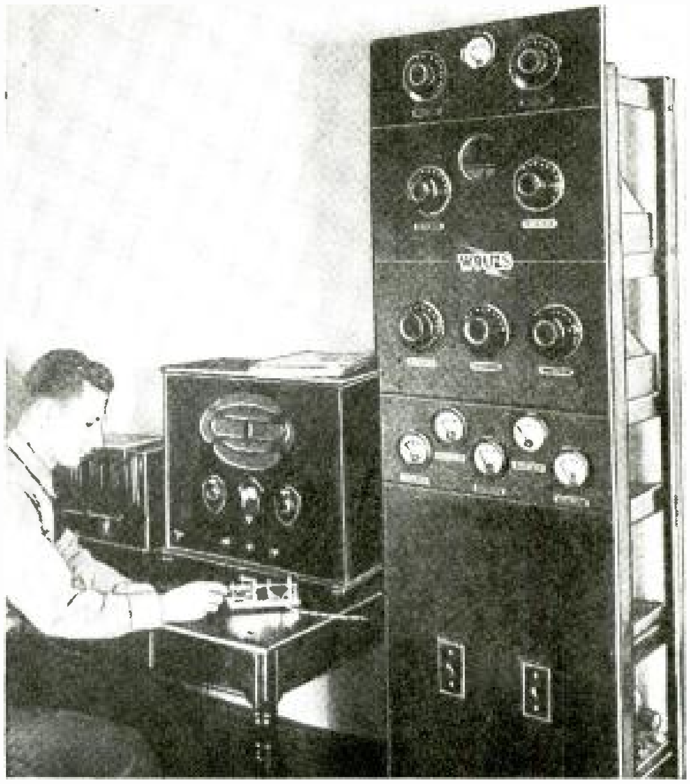
Prize Winner—Lieut. W. W. Johler

Editor, SHORT WAVE CRAFT:

Short Wave Craft has formed part of my technical library for the past number of years. I would be interested in having the picture of my "rig" published in this popular magazine.

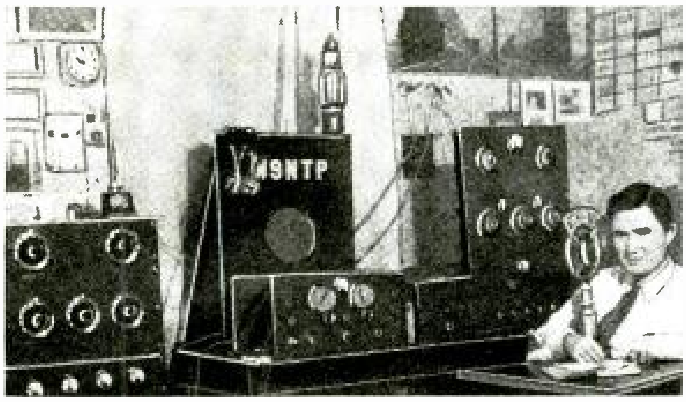
The "rig" shown in the photo is located at Kemper Military School, Boonville, Missouri. It is operated by licensed cadets and faculty officers. It enables cadets who have their license to continue with the fascinating hobby and stimulates interest in radio in many others.

The "rig" as shown is of metal chassis construction in a wooden rack. The bottom three racks contain a 1,250 volt power supply, with a pair of 66's for the final plate, 800 volt power-supply, with two 83's in parallel for the oscillator and buffer, separate filament transformers for each stage, and bias for the final. Above that are a 59 tri-tet crystal *(Continued on page 61)*



Prize this month goes to Lt. W. W. Johler's "rig."

W9NTP Has Efficient "Ham" Station



Ambitious array of Transmitters and Receivers in Billy Brentlinger's Ham "Shack."

Editor, SHORT WAVE CRAFT:

I sure get a big kick out of *Short Wave Craft* with all the interesting circuits and ideas etc. I started reading *Short Wave Craft* when it was published just every two months. I enjoy looking over the pictures of the "ham" stations, several of whom I have talked to several times, but I didn't know how they looked.

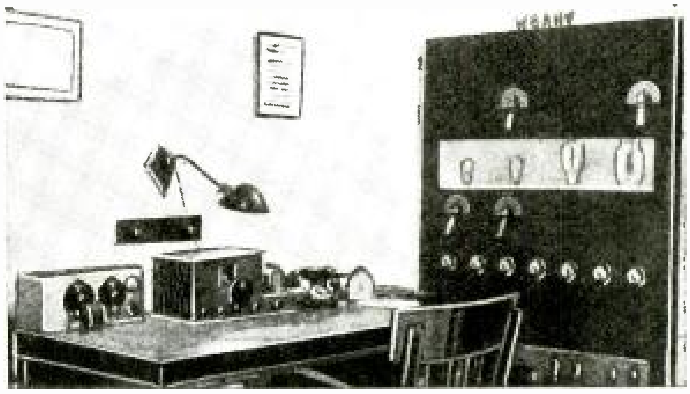
The outfit on the left side belongs to W9NBZ, my radio pal. It is a 47 xtal osc. 2-46's buffer or doubler, a 203A in the final amp. with about 200 watts input which is modulated by four 46's in class "B."

The outfit on the right is my old "ether pusher." It is a 47 xtal osc., 46 buffer or doubler, a pair of 46's in parallel in the final amp. with about 40 to 50 watts *(Continued on page 61)*

Paul Bauerle's Station at Lansing, Mich.

Editor, SHORT WAVE CRAFT:

I have been a reader of your radio magazine for some time. The tubes used in my transmitter are 47 crystal, 210 doubler, 211 buffer, 204A final amplifier with 400 *(Continued on page 61)*



Paul Bauerle's "Ham" Shack at Lansing, Mich.

Amateur Radio Station VU2FY, India

From India! Amateur Transmitting and Receiving Station of O. A. F. Spindler, call VU2FY.

Editor, SHORT WAVE CRAFT:

This magnificent amateur radio station is located in tropical south India, eleven degrees from the Equator. It is owned and operated by Mr. O. A. F. Spindler, a leading Amateur of International fame.

On the right of the photo may be seen the crystal-controlled Xmitter, which is built in three tiers. The bottom tier houses the power supply, which is from A.C. mains, stepped up and rectified. The center tier houses the modulator, and the upper tier the high-frequency components. Two crystals are used, the use of either being controlled by a change over switch, giving four frequencies, one on 14 mc., two on 7 mc. and one on 3.5 mc.

To the left of the transmitter may be seen the General Radio wavemeter and the loud-speaker which is used when signals are too strong for phones.

At the right of the operating table may be seen the speech amplifier, which is built in a steel cabinet, and connected to the modulator by shielded cable to avoid pick-up from transformers.

In the center of the table may be seen the monitor with the change-over switch from receiver to monitor just in front.

At the left of the table are two receivers, the Eddystone Amateur Bands Two, and the Eddystone Screened Grid Scientific Three, which is used for DX fone work. Both receivers are connected to the power supply in parallel, *(Continued on page 61)*

A Sensitive 4-Tube "Regen." Superhet

By Harry D. Hooton, W8KPX

We are glad to present this article by Mr. Hooton describing his new 4-tube superheterodyne. By using multi-purpose tubes and employing regeneration in the first detector, very good sensitivity is obtained. This set also features the new iron-core I.F. transformers. Complete details are given by Mr. Hooton in the accompanying text.

Front view of Mr. Hooton's regenerative superhet.

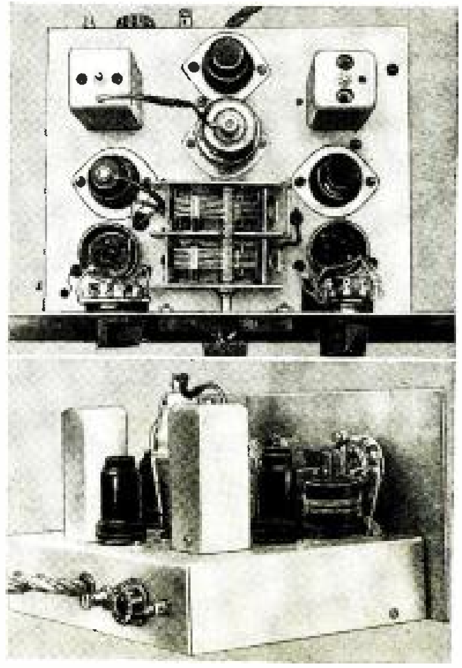
● THE super-heterodyne, long considered a luxury by the average short wave fan, is now almost a necessity for use on the crowded *amateur* and *short-wave broadcast* bands. The author has for some time desired a "really good" superhet, with plenty of gain and selectivity, for general DX (distance) work but, since he is limited to the use of batteries for receiver power supply, the cost and upkeep of an "eight" or "ten" tube set would be considerable.

The use of regenerative circuits offer many interesting possibilities for simplifying superheterodyne design and construction. As pointed out in the "Super-Gainer" article on page 470, December 1935 *Short Wave Craft*, a single regenerative first detector provides almost as much gain and image selectivity as can be obtained from two or more R.F. stages using the most expensive construction. The author's own experience with the new all metal tubes has convinced him that these, because of their ease of oscillation, extreme quietness and self-shielding qualities, are ideal for use in regenerative R.F. and mixer circuits. Therefore, it was decided to design a high-gain superhet around a regenerative first detector, metal tubes and the new *iron-core* I.F. transformers. The finished receiver is described in this article.

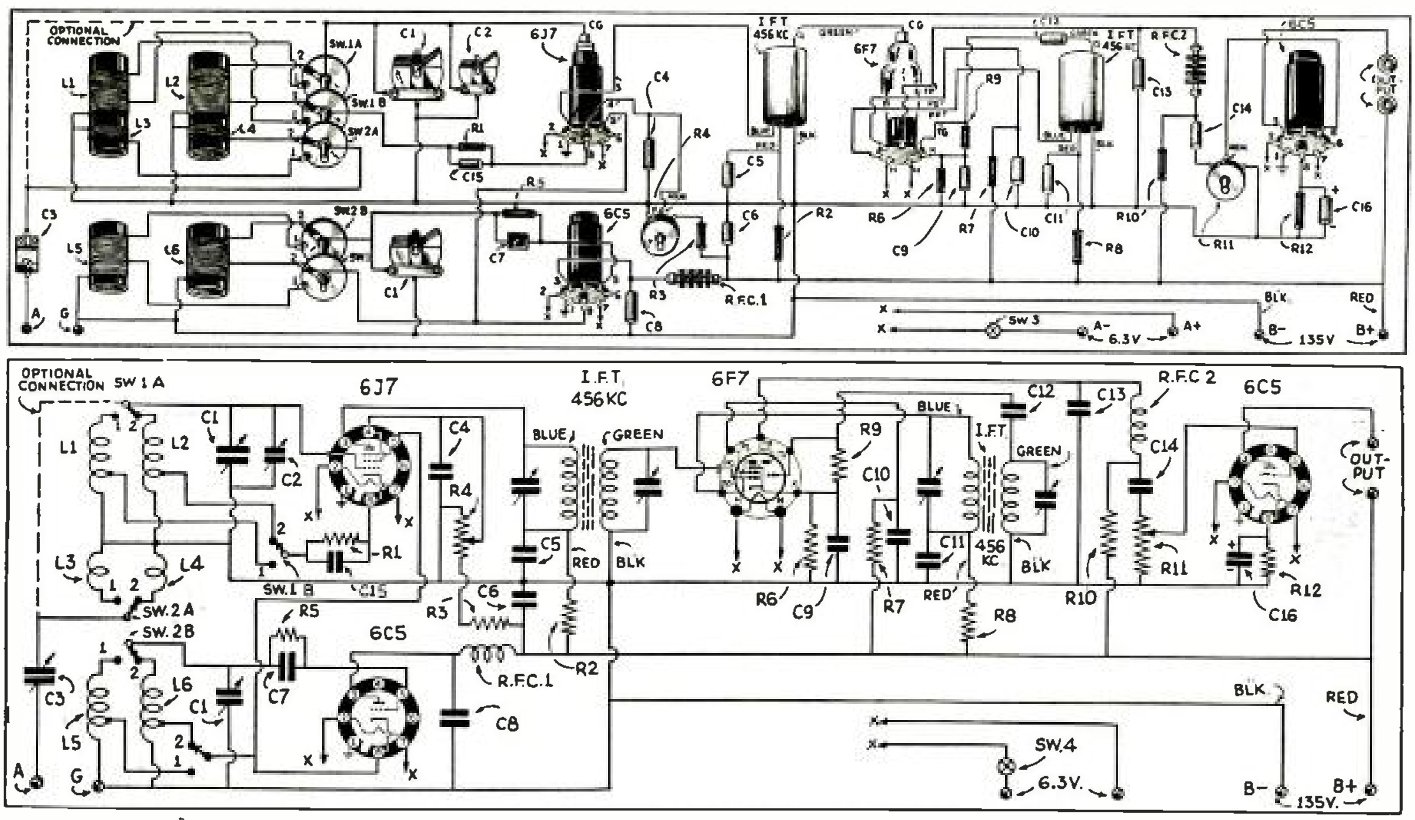
First Detector Is Electron-Coupled

As shown in Fig. 1, the first detector is of the familiar electron-coupled type, almost identical with the detector circuit of the average regenerative receiver. The *oscillator* is of the conventional variety, the tickler being placed in the cathode circuit for increased stability. The output of the oscillator is coupled to the first detector by the suppressor-injection method. The new high efficiency all-metal tubes are used in both circuits—a 6J7 as first detector and a 6C5 as oscillator. The output of the 6J7 is fed to one of the new iron-core I.F. transformers which is tuned to a frequency of about 456 kc. This is in turn connected to the pentode section of a 6F7 triode-pentode tube where the I.F. signal is amplified and then fed through another iron-core I.F. transformer to the triode portion of the 6F7 which acts as a *second detector*.

The overall gain of the iron-core transformers and the 6F7 tube is about equal to that obtained from the usual two stages of I.F. and detector using the ordinary air-core I.F. transformers. This receiver (*Continued on page 54*)



Rear view, showing the placement of the parts.

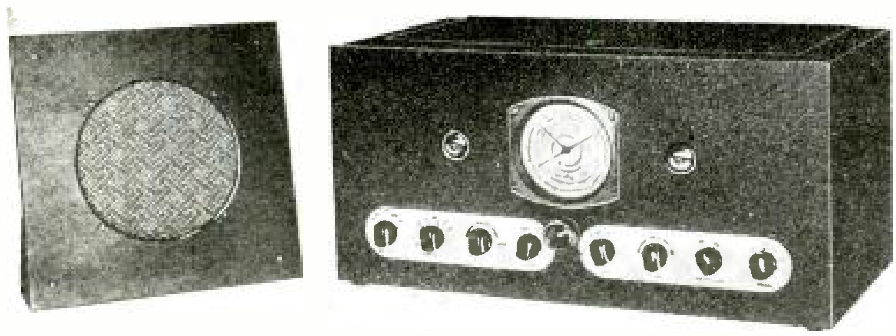


Schematic and physical diagram for the complete superheterodyne short-wave receiver, which employs a regenerative detector.

WHAT'S NEW In Short-Wave Apparatus

The short-wave apparatus here shown has been carefully selected for description by the editors after a rigid investigation of its merits

New ACR-175 Amateur Communication Receiver
Has Range of 5 to 600 Meters Continuous



Cumplete ACR-175 Amateur Communications Receiver with loud-speaker furnished with the set.

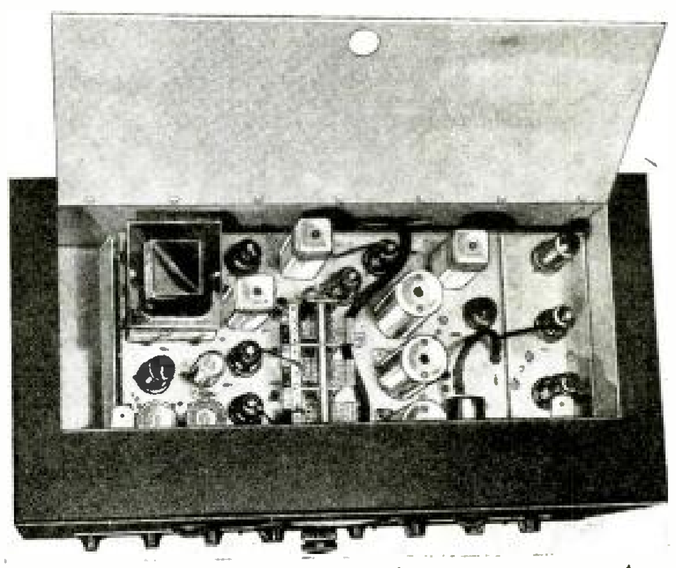
● THE ACR-175 Amateur Communication Receiver presents a combination of advanced features not found in receivers selling at considerably higher prices. The ACR-175 has been designed to meet the rigorous requirements of receiver performance necessary to maintain communication in the crowded popular amateur bands. An advanced degree of selectivity, sensitivity and ease of operation is now available.

A superheterodyne circuit is employed with one tuned R.F. stage for ranges A, B and C (500 kc. to 15,500 kc.), thus assuring low image-frequency response and high signal-to-noise ratio. A separate rejection filter is placed in the antenna circuit to minimize interference from powerful commercial stations operating near the I.F. frequency. Iron-core transformers in the I.F. amplifier provide unusually high gain and added selectivity. A quartz crystal, having special orientation and dimensions, assures unusual single-signal response heretofore unattainable. An electron-ray tube serves the dual function of tuning meter and indicator for measuring the strength of incoming signals.

All the controls on the ACR-175 are conveniently located on the front panel. The coils are fixed and selected by a switch. The sensitivity control is calibrated logarithmically in terms of microvolts of signal input to the receiver. The value of signal-input voltage is read when a deflection just begins to occur on the face of the electron-ray tube. This method of signal measurement in units of absolute value is more accurate and dependable than the arbitrary values now in vogue. A "stand-by" switch removes the plate voltage from the tubes and illuminates a green pilot light, but leaves the heaters lighted and ready for immediate operation. Headphones and speaker, or headphones only, may be used.

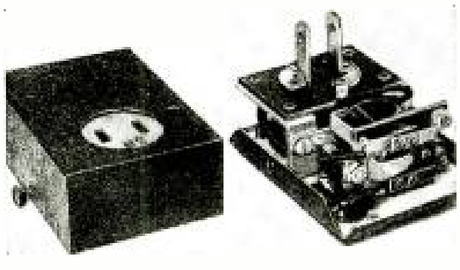
Ease of tuning and band-spread are provided by two large diameter knobs mounted concentrically on the tuning shaft. The inner knob operates at a low ratio (20 to 1) and permits any range to be traversed rapidly. The outer knob operates at a higher ratio (100 to 1) and permits extremely fine tuning. A unique dial permits the positive logging of stations of any frequency without re-setting to a reference point. The main scales are calibrated in megacycles and are traversed by a double-ended pointer, one end of which also covers a coarse scale of nine equidistant divisions serving as a vernier index. A slightly longer

(*Continued on page* 61)



Interior view of the ACR-175, showing neat arrangement and accessibility of the parts and tubes. (No. 539.)

AN AUTOMATIC ANTENNA SWITCH

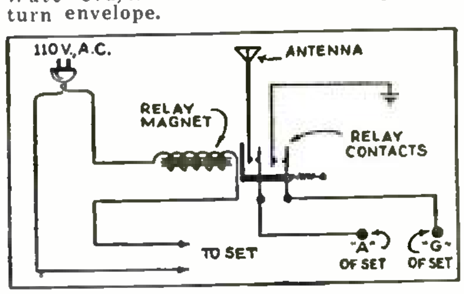


An automatic antenna switch fitted with a relay which connects the aerial and ground to the particular set plugged into the 110-volt socket on the box. (No. 537).

● FOR those desiring to operate more than one receiver from an antenna system, such as for demonstration purposes in sales rooms, this automatic antenna switch is an extremely valuable piece of apparatus. It is not designed to permit the operation of a number of receivers *simultaneously* from a single antenna, but so connects the circuit that when the A.C. switch of the receiver is turned "on", the antenna and ground are automatically connected to the receiver.

For the benefit of those interested in the circuit, a schematic diagram is given and it can be seen that the field of the relay is in series with the 110-volt lead going to the set. The relay is a double-pole, single-throw affair having fairly heavy contacts. Amateurs, experimenters and Hams may adapt this relay or the principle involved to perform some very novel operations. For instance, if connected properly this relay can be made to turn on the "transmitter" automatically, when the receiver is turned "on." Many other uses, of course, will suggest themselves to the average experimenter.

Our Information Bureau will gladly supply manufacturers' names and addresses of any items mentioned in *Short Wave Craft*. Please enclose stamped return envelope.



Hook-up of the new automatic antenna device, showing relay magnet connection and armature contacts.

The HF-20 S.-W. Transmitter

By Guy Stokely, E.E.

Note the neat and business-like appearance of the HF20 S-W Transmitter designed by Mr. Stokely, who is well-known to the short-wave fraternity. (No. 530)

● THE latest contribution of Eilen Radio Laboratories to the transmitting amateur is model HF-20 amateur band short-wave transmitter. Using the popular and low-priced 2A5 tubes, crystal control, and of an unusually lost cost and efficient design, this makes an ideal low-powered radio telegraph and phone transmitter for the beginner as well as the old timer. It is capable of supplying 20 watts of crystal-controlled power on the 40-80-160 meter bands and a good 15 watts of power on the 20 meter band. For the phone enthusiast, model HV—500 power supply and model M-10 modulator is available, allowing a carrier of 15 watts to be obtained.

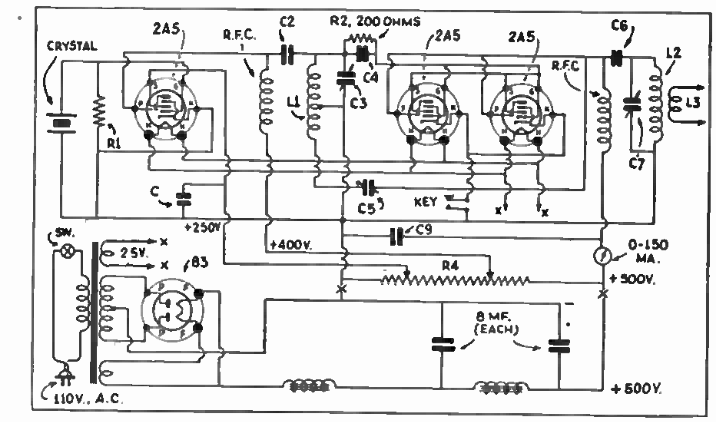
Referring to the electrical circuit diagram we find the 2A5 tube to be used as an R.F. pentode crystal controlled oscillator, the output of which is capacity coupled to the grids of a type 2A5 power amplifier. Crystal control is used in preference to the older self-excited circuits, due to the high order of frequency stability obtainable (a factor of prime importance in the present day crowded amateur bands). Shunt feed is used in the plate circuit of the oscillator in order to simplify mechanical construction. The screen-grid is operated at a positive potential of approximately 200 volts and is adequately by-passed by the condenser C1. The plate, fed through the RF choke is operated at about 400 volts. It is essential that a good R.F. choke be used in order to avoid R.F. leakage back into the power supply and the resulting neutralizing difficulties. The oscillator plate tuning circuit is located in the grid circuit of the 2A5 amplifier and results in an exceptionally efficient energy transfer. Grid leak bias is used on the R. F. stage and shunt feed is used in its plate circuit for the same reasons as previously outlined. The antenna coupling coil L3 is wound upon the same form as L2, due attention being paid to proper spacing for maximum energy transfer in designing the coils. The use of plug-in crystals and coils throughout, allows full output to be obtained on any of the amateur bands in common use.

In the lower section of the circuit diagram is shown the power supply. Full-wave rectification using the popular 83 mercury vapor tube is used. A two-section filter with swinging choke input is used and insures absolutely pure D.C. carrier free from all traces of A.C. hum. A tapped voltage divider allows the proper voltages for the screens and oscillator to be obtained.

The modulator consists of a type 53 tube with both of its grids tied together, and both plates tied together. It operates as a class A driver for the class "B" modulator, also using a type 53 tube. When used with a single button microphone this speech amplifier is ample for exciting the class "B" modulator to its full 10 watts output.

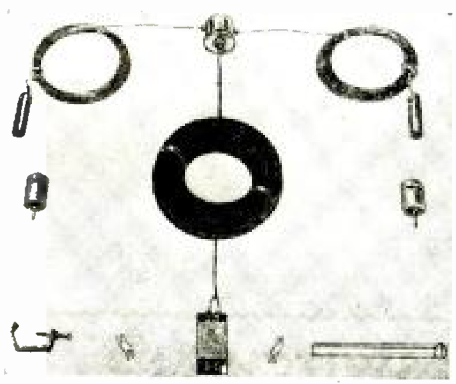
R1—50,000 ohms. R2—200 ohms. R3—50,000 ohms. R4—50,000 ohms, 25 watt divider. C1—C8—C9—.0005 mf. mica. C2—C4—C6—.0001 mf. mica. C3—C7—.00014 mf. variable. C5—.00005 mf. neut. cond.

This article has been prepared from data supplied by courtesy of Eilen Radio Laboratories.



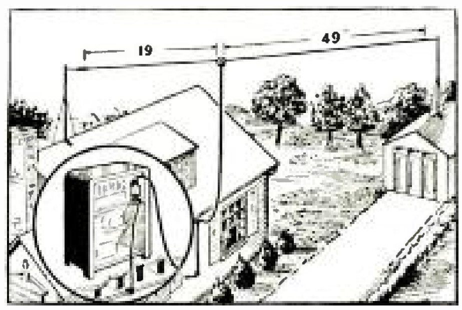
Wiring diagram of the HF20 S-W transmitter which is capable of supplying 20 watts power on the 40-80-160 meter bands, and 15 watts on the 20-meter band.

New Doublet for All-Wave Reception



New all-wave R.C.A. doublet antenna "kit," which comes already to install with all joints made for insulators attached. (No. 531).

● THE accompanying diagram and photo show the new R.K. 40 antenna which has been designed for all-wave reception. It comes complete, ready to install and no assembly of parts is required for its installation. It is merely necessary to attach each end of the doublet to circuits such as poles, trees. etc., and make a simple connection to the receiver. The cost of this antenna is very nominal and it should markedly improve reception on any all-wave receiver, which is not already connected to a doublet of good design. The transmission line designed for this antenna is designed to efficiently convey the electric wave energy picked up by the doublet antenna proper, down to the receiver. The receiver coupling unit or transformer matches the impedance of the transmission line to the input receiver circuits. This greatly simplified antenna system provides adequate coverage on both short and long-wave broadcast bands, with a minimum of installation work. The transmission line is of the transposed or twisted type. The antenna comes complete with strain insulators attached and the transmission line cable is 75 feet long. Any one can install an antenna of this type in a very short time. This article has been prepared from data supplied by the courtesy of the R.C.A. Manufacturing Company.

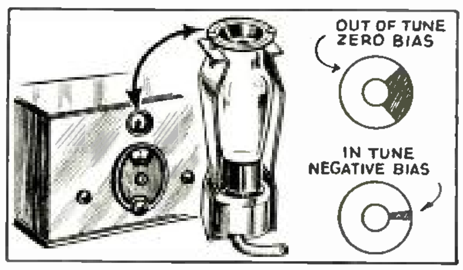


Typical installation of new R.C.A. all-wave doublet antenna.

"Mystic-Eye" Tuning Unit

● EVERY one today is looking for some easier and more accurate way of tuning in stations on their receiver. One of the newest and nominally-priced tuning or resonance indicators is the "Mystic Eye" tuning unit here illustrated. It can be mounted on practically any receiver and it resembles a modified cathode-ray tube which causes a variable band of light to appear on the target at the end of the tube, the band widening out as the station is tuned farther away from the resonance point, and narrowing down to a thin line, as the station is tuned into perfect resonance.

Your old set can now be brought up-to-date by adding one of these simple tuning units. Any one at all handy with tools can install the device, and it is very simple to connect, full instructions accompanying the tube and the circuit diagram which comes with it. All you have to do is to drill a small hole in the panel of the cabinet, mount the tuning unit and escutcheon plate, connect the colored wires according to the diagram accompanying the device and your set is right up-to-date, so far as a *tuning indicator* is concerned. This article has been prepared from data supplied by the courtesy of the Empire Radio Corp.



The "Mystic-Eye" tuning unit adaptable to any type receiver. (No. 532.)

NEW APPARATUS FOR THE "HAM"

● TWO new tubes have recently been introduced. One is the type 830B which can be used as a modulator, R.F. amplifier or oscillator.

This tube has a rated plate dissipation of 60 watts. The outstanding feature is that the plate connection is brought out through a cap at the top of the bulb.

Another new tube which should interest those amateurs working on the ultra-high frequency is the 834. This tube can be operated on frequencies as high as 350 megs., 100 megs. at rated input, and above this frequency a slight reduction in input power is necessary.

For the benefit of those interested in these tubes we are re-printing data obtained from the R.C.A. Manufacturing Co. covering the characteristics and operating conditions of both these tubes. Watch for articles in the coming issues of *Short Wave Craft* in which these tubes will be employed.

830 B TENTATIVE CHARACTERISTICS

Filament Voltage (A.C. or D.C.)—10 volts.
Filament Current—2 amperes.
Amplification Factor—25.
Direct Interelectrode Capacitances (Approx.): Grid-plate—11 mmf.; Grid-filament—5 mmf.; Plate-filament—1.8 mmf.

Two New Tubes the "Ham" Will Like

Bulb—T-16.
Cap—Small Metal.
Base—Medium 4-Pin Bayonet.

MAXIMUM RATINGS AND TYPICAL OPERATING CONDITIONS

As A-F Power Amplifier and Modulator—Class B.
D.C. Plate Voltage—1000 max. Volts.
Max-Signal D.C. Plate Current—150 max. Milliamperes.
Max-Signal Plate Input—150 max. Watts.
Plate Dissipation—60 max. Watts.

Typical Operation—2 Tubes:

Unless otherwise specified, values are for 2 tubes

Filament Voltage (A.C.)—10—10 Volts.
D.C. Plate Voltage—800—1000 Volts.
D.C. Grid Voltage (Approx.)— —27— —35 Volts.
Peak A-F Grid-to-Grid Voltage (Approx.)—250—270—Volts.
Zero-Sig. D.C. Plate Current—20—20 Milliamperes.
Max-Sig. D. C. Plate Current—280—280 Milliamperes.
Load Resistance (per tube)—1500—1900 ohms.
Effective Load Res. (Plate-to-plate)—6000—7600 Ohms.
Max-Sig. Driving Power (Approx.)—5—6 Watts.
Max-Sig. Power Output (Approx.) 135—175 Watts.

As R-F Power Amplifier—Class B Telephony

Carrier conditions per tube for use with a max. modulation fact. of 1.0

D.C. Plate Voltage—1000 max Volts.
D.C. Plate Current—100 max. Milliamperes.
Plate Input—90 max. Watts.
Plate Dissipation—60 max. Watts.

Typical Operation:

Filament Voltage (A.C.)—10—10 Volts.
D.C. Plate Voltage—800—1000 Volts.
D.C. Grid Voltage (Approx.)— —27— —35 Volts.
Peak R-F Grid Voltage (Approx.)—85—85 Volts.
D.C. Plate Current—95—85 Milliamperes.
D.C. Grid Current (Approx.)—7—6 Milliamperes.
Driving Power (Approx.) — 9 — 6— Watts.
Power Output (Approx.) 23—26 Watts.

As Plate-Modulated R.F. Power Amplifier—Class C Telephony

Carrier conditions per tube for use with max. modulation fact. of 1.0

D.C. Plate Voltage—800 max. Volts.
D.C. Grid Voltage— —300 max. Volts.
D.C. Plate Current—100 max. Milliamperes.
D.C. Grid Current—30 max. Milliamperes.
Plate Input — 80 max. Milliamperes.
Plate Dissipation—40 max. Watts.

Typical Operation:

Filament Voltage (A.C.)—10—10 Volts.
D.C. Plate Voltage—600—800 Volts.
D.C. Grid Voltage (Approx.)— —140— —150 Volts.
Peak R.F. Grid Voltage (Approx.)—255—265 Volts.
D.C. Plate Current—95—95—Milliamperes.
D.C. Grid Current (Approx.)—30—20 Milliamperes.
Driving Power (Approx.)—7—5 Watts.
Power Output (Approx.)—38—50 Watts.

As R.F. Power Amplifier and Oscillator—Class C Telegraphy

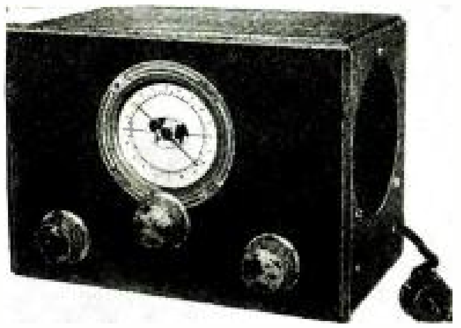
Key-down conditions per tube without modulation

D.C. Plate Voltage—1000 max. Volts.
D.C Grid Voltage— —300 max. Volts.

(*Continued on page 57*)

3-Tube Set Equals Five

By William Green

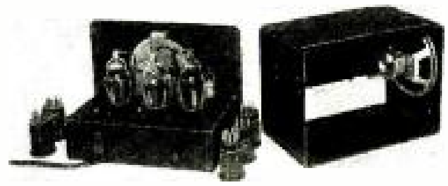


Front view of the new "Fulltone V" A.C.-D.C. receiver, in which three tubes do the work of five. (No. 528.)

● WHAT does the amateur and short wave fan really want in a short wave receiver?

The following brief outline indicates what the great majority want, as compiled from numerous suggestions. The receiver must have as few tubes as is consistent with good reception and operation. This eliminates the tiny one-tube "midget," as well as the enormous multi-tube monster. It must be completely self-contained as well as light and compact. The day of the external amplifier, power supply and speaker are definitely over. Universal operation on either A.C. or D.C. is important. The receiver must really bring in those distant "elusive" foreign stations with ease and volume, and in addition must be sufficiently selective for local reception. The speaker should operate with good volume on all stations, with good tone and clarity. A high signal-to-noise ratio is essential. Above all it must be simple to operate, easy to build, and low in cost.

It's already beginning to sound like a description of the perfect receiver, but these are only the more important essentials. Here are some additional features in our receiver: It must be hum-free, have continuous band-spread, easy reading dial, good shielding and be portable, trouble free and fool-proof.



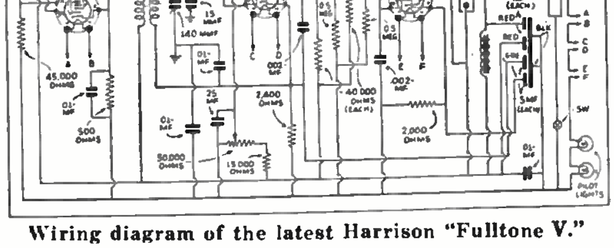
This photo shows a view of the chassis and also the metal cabinet for the "Fulltone V."

The circuit diagram shown on this page is that of the final job built by the author and incorporating every feature mentioned above. A full *five-tube* circuit is used by means of dual-purpose tubes—6D6, 6F7, 12A7, providing R.F., detector, two audio stages and rectifier. The 6D6 is the "high-gain" R.F. tube, through which the antenna is coupled to the detector. This is inductively coupled by means of a three-winding coil to the pentode section of the 6F7 tube.

The detector is remarkably smooth operating. This has been accomplished by the proper use of sufficient by-pass condensers, and control of regeneration by a potentiometer varying the screen voltage. This same tube has a triode section, which is utilized as the first audio stage. Its output couples into the next duplex tube, the 12A7. The pentode section of the 12A7 is the audio output tube, while the diode section serves as the power supply rectifier. A 350 ohm line resistor, filter choke, and a 12,12,5,5, mf. electrolytic condenser complete the power supply. A good filter circuit makes reception free of all hum and tunable hum on all frequences. The coil ranges are:

Color	Range in Meters	Range in Kc.
Blue	9 to 15	20 to 33 mc.
Green	15 to 37	8100 to 20 mc.
Yellow	37 to 92	3250 to 8100 mc.
Red	92 to 205	1450 to 3250 mc.
Brown	192 to 425	700 to 1550 mc.
Black	300 to 625	480 to 1000 mc.

This article has been prepared from data supplied by courtesy of Harrison Radio Co.



Wiring diagram of the latest Harrison "Fulltone V."

Names and addresses of manufacturers of apparatus described on this and following pages furnished upon receipt of 3-cent stamp; mention No. of article.

THE RADIO AMATEUR

Conducted by Geo. W. Shuart

Radio Amateur Course

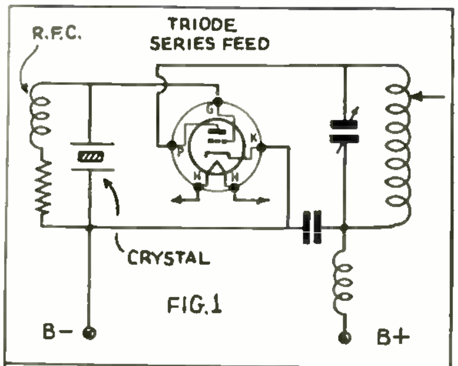


FIG. 1

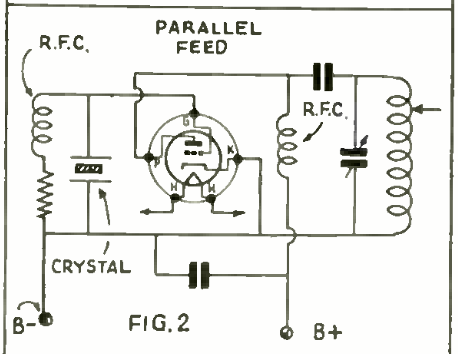


FIG. 2

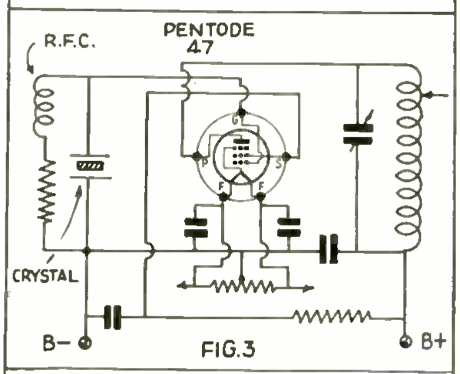


FIG. 3

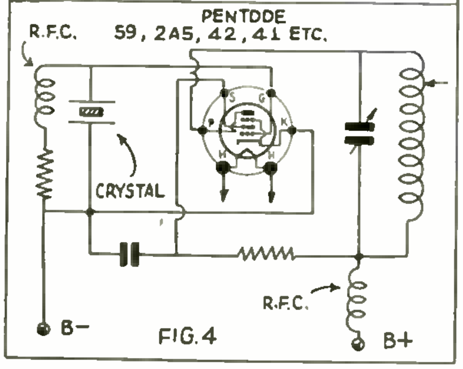


FIG. 4

Above we have the triode and pentode crystal oscillator, using conventional circuits.

9th lesson—Many points are given here for the selection of tubes used in low-power exciter stages

● THE choice of tubes for the *oscillator, buffer*, or *multiplier* stages of a transmitter is always quite a problem to the amateur. Also the circuits to use are numerous, especially with the recent tube developments. In Fig. 1, we have the conventional triode *crystal oscillator* circuit; with this tube the crystal is used in the grid circuit and oscillation is brought about when the plate circuit is tuned to approximately the crystal frequency. This circuit was the first to be used among amateurs when crystals were still a *luxury*. Either series or parallel plate feed may be used in this circuit. Fig. 1 shows the *series* method, while Fig. 2 is the same set-up but with *parallel* feed. Number 2 allows the rotor plate tuning condenser to be independent of the high voltage, and it can be mounted on a metal panel or chassis with no insulation.

The next popular crystal circuit was that using the 47 pentode; this was a considerable improvement over the former circuits. In Fig. 3, we find the conventional 47 pentode, which proved to be an excellent crystal controlled oscillator and allowed less R.F. crystal current; thus lightening the load on the crystal. In Fig. 4 we have the same circuit except that the heater—cathode type tube is used; such as the 59, 2A5, etc. There is little advantage in this circuit over the 47 aside from the fact that the heater is separate and no filament by-pass condensers are necessary.

Tritet Oscillator

Later developments in pentode circuits brought forth the well-known Tritet oscillator is shown; this is a modification of the Dow oscillator. In this circuit we can multiply the crystal frequency in the plate tuned circuit, independent of the crystal oscillatory circuit. However, the plate circuit can not be tuned to the crystal frequency because of insufficient internal shielding in the tube. This circuit is shown in Fig. 5, and a number of different type of tubes may be used as is indicated. A more flexible adaption of this same circuit is shown in Fig. 6 where the screen grid pentode tubes are used, the shielding in these tubes is sufficient to allow plate circuit to be tuned to the crystal frequency or an harmonic of it. Here the power pentodes such as the 802, RK23, etc., may be used, or the pentode receiving type tubes where only low-power

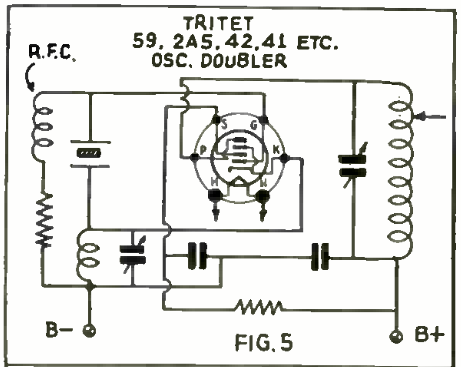


FIG. 5

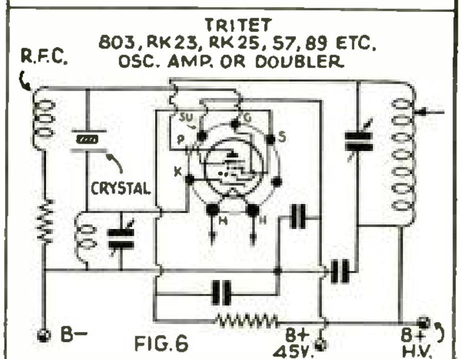


FIG. 6

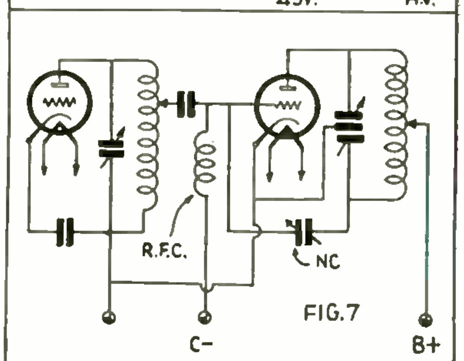


FIG. 7

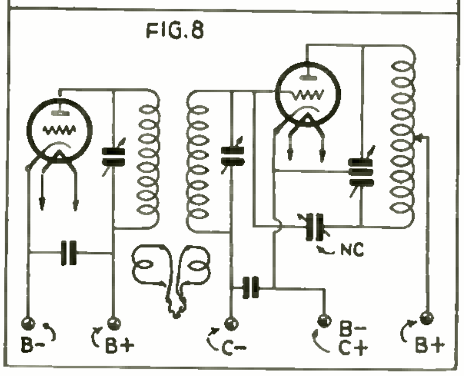
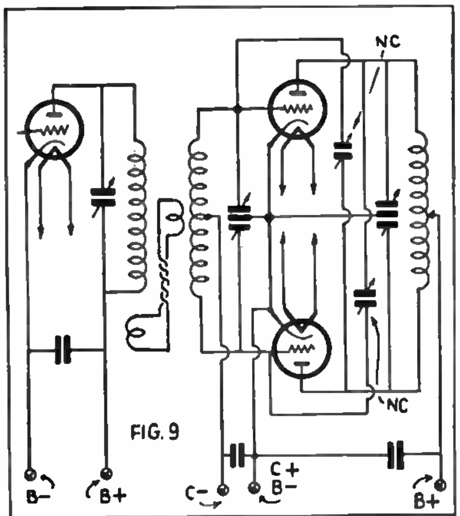
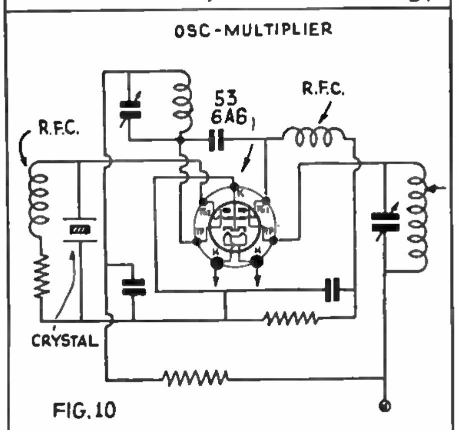
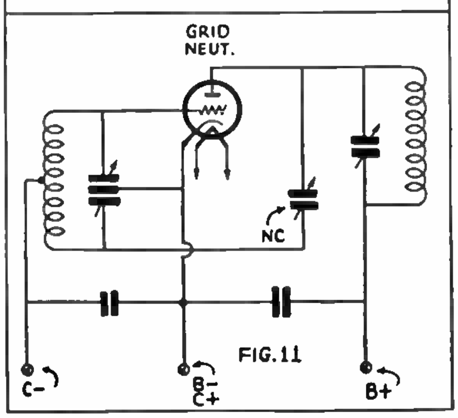


FIG. 8

Here we have the oscillator—multiplier and also neutralized amplifier and doubler.







Here we have various types of multiplier and buffer stages.

Many suggestions are given in this lesson regarding the type of tubes which may be used in the low-power stages of a transmitter, where "frequency multiplication" is necessary.

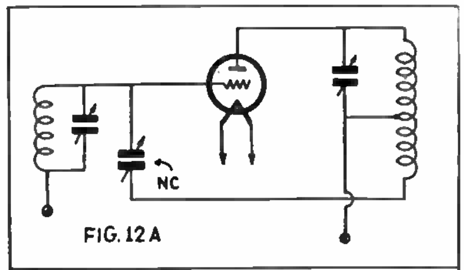
stages are required. Where a number of multiplications are necessary, the *receiving type* tubes, such as the 57 and 58, are recommended, because of their low cost, and very respectable power "out-put." In the receiving type tubes, though there seems to be little advantage in applying a positive potential to the suppressor, while in the power-type tubes this does increase the out-put appreciably.

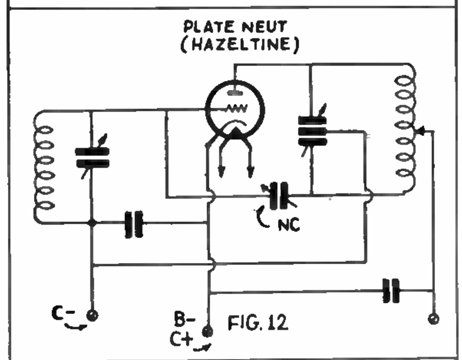
Neutralization

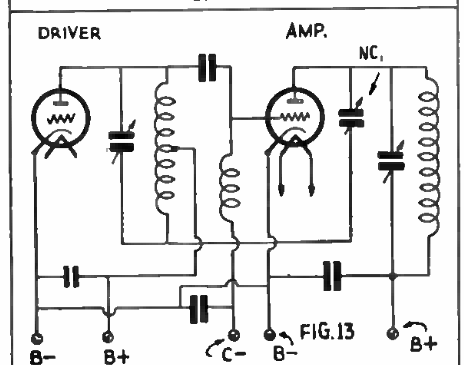
So much for the oscillator circuits. We now consider Fig. 7 in which an amplifier tube is added to the oscillator. Here we have a triode neutralized amplifier when operating on a crystal frequency. For a frequency multiplication *neutralization* is not absolutely necessary, although the neutralizing condenser and the tapped coil arrangement should be employed, because a certain amount of regeneration may be obtained by the proper adjustment of this condenser N.C. and thus increase the harmonic out-put considerably. Those who have not tried this method of *frequency doubling* will be well rewarded with a considerable increase in "output," through the use of the neutralizing condenser, which then becomes merely a *feed-back control.* The coupling between the two stages in this instance is *capacitive.*

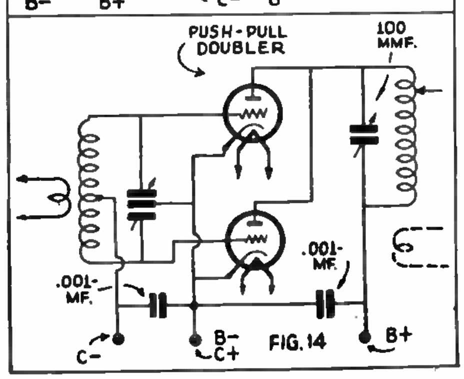
Link Coupling

In Fig. 8 we have both the grid and plate circuits of the amplifier tuned and link coupled to the preceding stage. This *link coupling* may consist of one or two turns connected with a twisted pair of insulated wires coupled to both tank circuits. This is a recommended method where the extra coil and condenser can be incorporated conveniently in the set-up, although where a great many multiple stages are used, as pointed out *(Continued on page 46)*

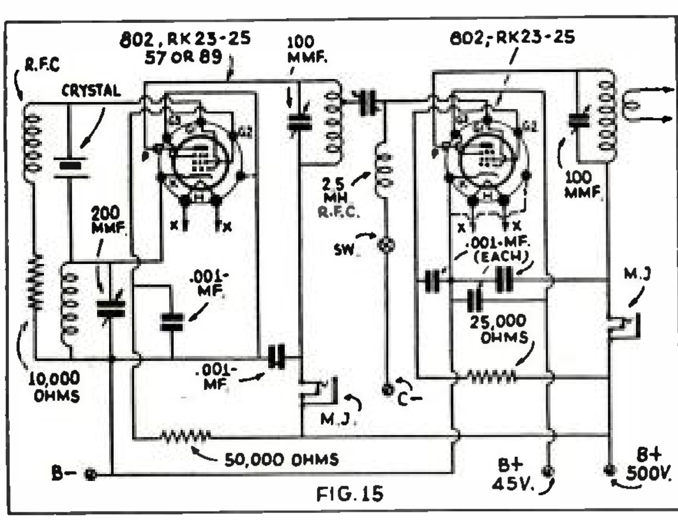




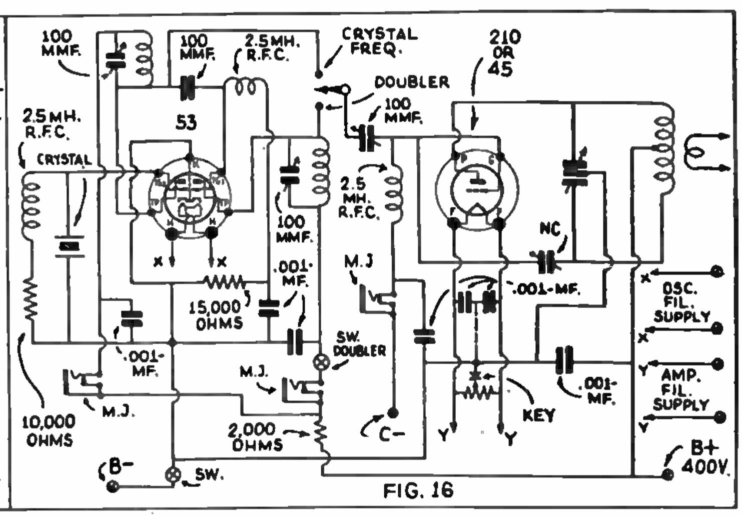




Different methods of neutralizing and also push-pull doubler.

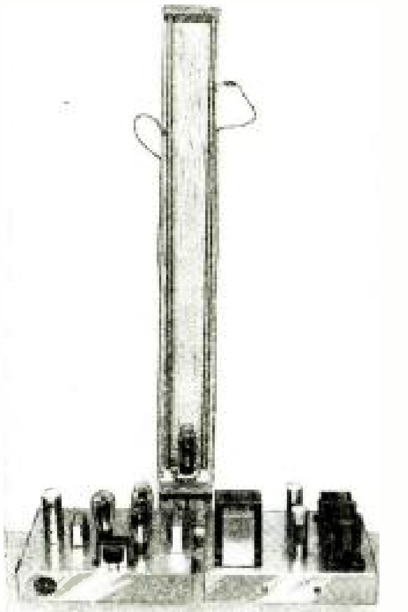


The dual pentode exciter unit, which will operate on any one of three bands, with one crystal and drive the average medium-power amplifier.



Above: The 53 twin triode is used as an oscillator and multiplier. This will also excite the average medium-power "final" amplifier.

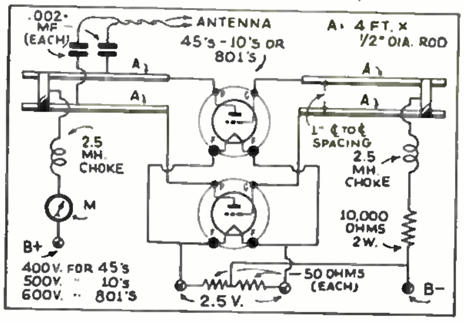
A Long-Lines Oscillator and Modulator



● The long-lines oscillator introduced by *Short Wave Craft* in the latter part of 1934, is now available in commercial form. In this particular one, which is shown in the photograph, a number of different tubes may be used. For instance, if the Ham wishes to start out with a relatively low power a pair of 45's may be employed as oscillators, while for higher power a pair of 210's or 801's with from five to six hundred volts on the plates. The one-half inch copper tubes which form the long-lines circuit are four feet long, and at the high R.F. potential ends are mounted on small stand-off insulators. A wooden frame is also used to increase the mechanical rigidity. This solves the problem of supporting the rather awkward four foot metal tubes. Clips to these vertical rods are in the form of copper ground-clamps which wrap around the copper tubing and make a real low-resistance connection. For changing frequency "shorting bars" are used; these bars either increase or decrease the effective length of the circuits and thus decrease or increase the frequency. As a companion unit to this oscillator, there is available a modulator which employs a pair of 46's in class B in the output stage. As a *driver* a single 46 connected as a triode is used. For amplification into this circuit, a 57 is employed in a triode connection. There is sufficient gain in this circuit for the av-

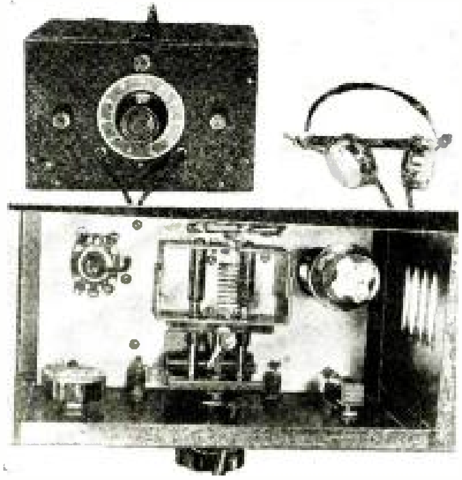
(*Continued on page 61*)

Photo at the left shows the new Eagle "Long-Lines" oscillator with modulator and power supply. Diagram at right shows connections. (No. 533.)



Constant Hi-"Q" 2.5 to 10 Meter Set

By A. G. Heller



Photos above show front and top views of the new constant "High-Q" 2.5 to 10-meter receiver. (No. 534.)

● ONE of the first essentials for successful short-wave receiver design, or for that matter any type of receiver, is the use of an efficient coil for the tuned circuit. The primary requisite for this unit is a high "Q" factor, and this factor should be as constant as possible over the entire tuning range, with a given tuning capacity.

This novel unit is so constructed that for any rotation of the tuning shaft the condenser plates enmesh or disengage on a sliding principle. Simultaneously with this action, the tuning coil which is mounted as shown in the illustration, expands or contracts (depending upon whether the capacity is increased or decreased) and consequently the coil undergoes a change in inductance which is related to the change made in capacity and frequency. At the same time the effective *distributed capacity* (which is a potent figure in high frequency work) is varied inversely with the frequency. Thus we have in effect a tuning coil, and condenser combination whose "Q" factor remains practically constant as the condenser and frequency range is varied. Two separate coils are employed for the 10, 5 and 2½ to 1½ meter ranges. Each is of space-wound construction, so that even the normal distributed capacity of each is at a minimum. The 5 and 2½ to 1½ meter coil is of edge-wise wound ribbon wire, in accordance with theoretical and practical engineering rules which govern the design of such coils. The insulation material employed consists of Victron in all important positions. This article has been prepared from data supplied by courtesy of Insuline Corp. of America.

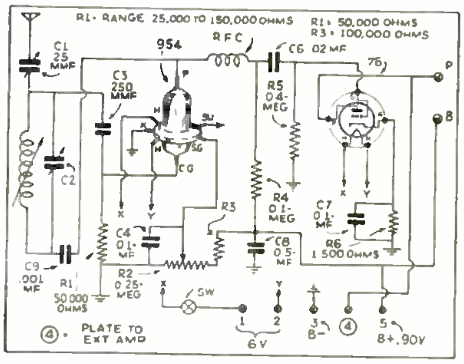


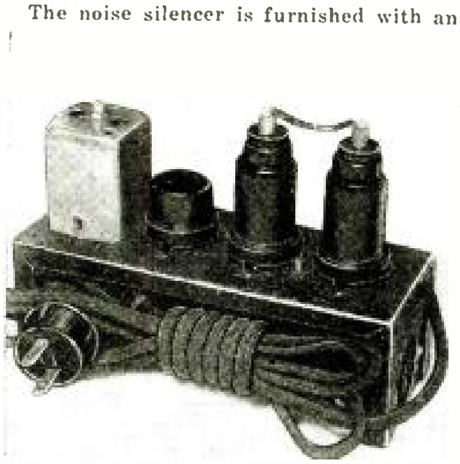
Diagram showing connections of the simple parts used in the constant "High-Q" receiver.

Noise Silencer

● THE famous *noise suppressor* recently introduced by Jim Lamb of *Q.S.T.* is now commercially available. The unit shown in the photograph can be used with any sensitive superheterodyne receiver and is very simple to attach to your present set.

The noise silencer is furnished with an adapter which is plugged into the last I.F. amplifier tube socket of the receiver. The very simple manner in which this can be attached to your receiver permits even the most inexperienced short-wave "Fan" to avail himself of the excellent qualities of the instrument; no technical knowledge is necessary. The noise silencer measures 7½x5½x3 inches and no external power-supply is necessary. An A.C.-D.C. heater circuit arrangement is employed, which permits the tubes to be run directly from the 110-volt line. Repeated tests have proven that this *silencer* will overcome the difficulties experienced by a great majority of the noises picked up on the short-wave bands. By means of a manual control a pre-adjustment is made which limits the maximum strength of the interfering noise. In other words, the average noise will never exceed the strength of the desired signal.

This article prepared from data supplied by courtesy of United Radio and Tel. Co.



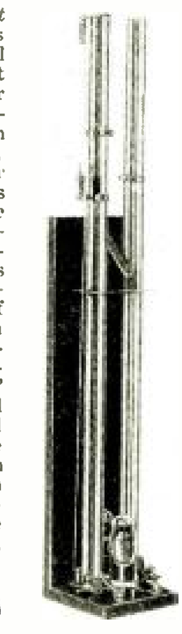
A nominally-priced "noise silencer" now available on the market. (No. 535).

5-Meter "Long-Lines" Xmitter

By C. A. Wyeth

● THE great popularity of the so-called "long lines" 5-meter oscillator presented in *Short Wave Craft* one and one-half years ago, has induced several manufacturers to market them. The oscillator shown in the photo is designed to operate with various types of tubes, such as the 45's, 10's, or 801's. The vertical bars are chromeplated and the various fittings are finished in jet black. Needless to say, this presents an extremely pleasing appearance. A number of other features have been incorporated in this instrument, such as specially designed, "shorting" clips, which can be slid up and down the vertical tubes, and also for the antenna connections. Each of these are provided with insulated handles, permitting adjustment of the transmitter to be made.

(*Continued on page* 62)



Efficiently built and handsomely finished "Long-Lines" Oscillator. (No. 536.)

Names and addresses of manufacturers of apparatus described on this and following pages furnished upon receipt of 3-cent stamp; mention No. of article.

CORRECTED AND REVISED Monthly

Short-Wave Stations of the World

Complete List of Broadcast and Telephone Stations

We present herewith a revised list of the short-wave broadcasting, experimental and commercial radiophone stations of the world. This is arranged by frequency, but the wavelength figures are also given for the benefit of readers who are more accustomed to working with "meters."

All the stations in this list use telephone transmission of some kind and can be identified by the average listener. Note: Stations marked with a star ★ are the most active and easily heard stations and transmit at fairly regular times.

Please write to us about any new stations or other important data that you learn through announcements over the air or correspondence with the stations themselves. A post card will be sufficient. We will safely return to you any verifications that you send in to us. Communications of this kind are a big help.

Stations are classified as follows: C—Commercial phone. B—Broadcast service. X—Experimental transmissions.

Around-the-Clock Listening Guide

Although short-wave reception is notorious for its irregularity and seeming inconsistency (wherein lies its greatest appeal to the sporting listener), it is a good idea to follow a general schedule as far as wavelength in relation to the time of the day is concerned. The observance of these simple rules will save time.

From daybreak till 3 p.m. and particularly during bright daylight, listen between 13 and 19 meters (21540 to 15800 kc.).

To the east of the listener, from about 1 p.m.-8 p.m., the 25-35 meter will be found very productive. To the west of the listener this same band is generally found best from about 8 p.m. until 9 a.m. (After dark, results above 35 meters are usually much better than during daylight.) These general rules hold for any location in the Northern Hemisphere.

Short-Wave Broadcasting, Experimental and Commercial Radiophone Stations

NOTE: To convert kc. to megacycles (mc.) shift decimal point 3 places to left: Thus, read 21540 kc. as 21.540 mc.

21540 kc. W8XK
-B- 13.93 meters
WESTINGHOUSE ELECTRIC
PITTSBURGH, PA.
7-9 a.m.; relays KDKA

21530 kc. ★GSJ
-B- 13.93 meters
DAVENTRY
B.B.C., BROADCASTING HOUSE, LONDON, ENGLAND
6-8:45 a.m.

21520 kc. W2XE
-B- 13.94 meters
ATLANTIC BROADCASTING CORP.
485 Madison Ave., N.Y.C.
Relays WABC 7.30-11 a.m.

21420 kc. WKK
-C- 14.01 meters
A. T. & T. CO.
LAWRENCEVILLE, N. J.
Calls Argentina, Brazil and Peru, daytime

21080 kc. PSA
-C- 14.23 meters
RIO DE JANEIRO, BRAZIL
Works WKK Daytime

21060 kc. WKA
-C- 14.25 meters
LAWRENCEVILLE, N. J.
Calls England noon

21020 kc. LSN6
-C- 14.27 meters
HURLINGHAM, ARG.
Calls N. Y. C.
6 a. m.-5 p. m.

20700 kc. LSY
-C- 14.49 meters
MONTE GRANDE ARGENTINA
Tests Irregularly

20380 kc. GAA
-C- 14.72 meters
RUGBY, ENGLAND
Calls Argentina, Brazil, mornings

19900 kc. LSG
-C- 15.08 meters
MONTE GRANDE, ARGENTINA
Tests irregularly, daytime

19820 kc. WKN
-C- 15.14 meters
LAWRENCEVILLE, N. J.
Calls England, daytime

19650 kc. LSN5
-C- 15.27 meters
HURLINGHAM, ARGENTINA
Calls Europe, daytime

19600 kc. LSF
-C- 15.31 meters
MONTE GRANDE, ARGENTINA
Tests irregularly, daytime

19355 kc. FTM
-C- 15.50 meters
ST. ASSISE, FRANCE
Calls Argentina, mornings

19345 kc. PMA
-B,C- 15.51 meters
BANDOENG, JAVA
Calls Holland early a.m.
Broadcasts Tues., Thur., Sat., 10:00-10:30 a.m. Irregular

19220 kc. WKF
-C- 15.60 meters
LAWRENCEVILLE, N. J.
Calls England, daytime

19160 kc. GAP
-C- 15.66 meters
RUGBY, ENGLAND
Calls Australia, early a.m.

18970 kc. GAQ
-C- 15.81 meters
RUGBY, ENGLAND
Calls S. Africa, mornings

18890 kc. ZSS
-C- 15.88 meters
KLIPHEUVEL, S. AFRICA
Works Rugby 6:30 a.m.-12 n

18830 kc. PLE
-C- 15.93 meters
BANDOENG, JAVA
Calls Holland, early a. m.

18620 kc. GAU
-C- 16.11 meters
RUGBY, ENGLAND
Calls N. Y., daytime

18345 kc. FZS
-C- 16.35 meters
SAIGON, INDO-CHINA
Phones Paris, early morning

18340 kc. WLA
-C- 16.38 meters
LAWRENCEVILLE, N. J.
Calls England, daytime

18310 kc. GAS
-C- 16.38 meters
RUGBY, ENGLAND
Calls N. Y., daytime

18270 kc. ETA
-C- 16.42 meters
CHIEF ENGINEER
P. O. Box 283, ADDIS ABABA, ETHIOPIA
Irregularly

18250 kc. FTO
-C- 16.43 meters
ST. ASSISE, FRANCE
Calls S. America, daytime

18200 kc. GAW
-C- 16.48 meters
RUGBY, ENGLAND
Calls N. Y., daytime

18135 kc. PMC
-C- 16.54 meters
BANDOENG, JAVA
Phones Holland, early a. m.

18115 kc. LSY3
-C- 16.56 meters
MONTE GRANDE, ARGENTINA
Tests irregularly

18040 kc. GAB
-C- 16.63 meters
RUGBY, ENGLAND
Calls Canada, morn. and early aftn.

17810 kc. PCV
-C- 16.84 meters
KOOTWIJK, HOLLAND
Calls Java, 6-9 a. m.

17790 kc. ★GSG
-B- 16.86 meters
DAVENTRY,
B.B.C., BROADCASTING HOUSE, LONDON, ENGLAND
6-8:45 a.m., 9 a.m.-12 n.

17780 kc ★W3XAL
-B- 16.87 meters
NATIONAL BROAD. CO.
BOUND BROOK, N. J.
Relays WJZ, Daily exc. Sun. 9 a.m.-1 p.m.

17775 kc. PHI
-B- 16.88 meters
HUIZEN, HOLLAND
Used irregularly

17760 kc. ★W2XE
-B- 16.89 meters
ATLANTIC BROADCASTING CORP.
485 Madison Ave., N.Y.C.
Relays WABC 11 a.m.-1 p.m.

17760 kc. DJE
-B- 16.89 meters
BROADCASTING HOUSE
BERLIN, GERMANY
8:05-11 a.m.

17760 kc. IAC
-C- 16.89 meters
PISA, ITALY
Calls ships, 6:30-7:30 a. m.

17310 kc. W3XL
-X- 17.33 meters
NATIONAL BROAD. CO.
BOUND BROOK, N. J.
Tests Irregularly

17120 kc. WOO
-C- 17.52 meters
A. T. & T. CO.,
OCEAN GATE, N. J.
Calls ships

17080 kc. GBC
-C- 17.56 meters
RUGBY, ENGLAND
Calls Ships

16270 kc. WLK
-C- 18.44 meters
LAWRENCEVILLE, N. J.
Phones Arg., Braz., Peru, daytime

16270 kc. WOG
-C- 18.44 meters
OCEAN GATE, N. J.
Calls England, morning and early afternoon

16240 kc. KTO
-C- 18.47 meters
MANILLA, P. I.
Calls Cal., Tokio and ships 8-11:30 a.m.

16233 kc. FZR3
-C- 18.48 meters
SAIGON, INDO-CHINA
Calls Paris and Pacific Isles

15880 kc. FTK
-C- 18.90 meters
ST. ASSISE, FRANCE
Phones Saigon, morning

15810 kc. LSL
-C- 18.98 meters
HURLINGHAM, ARGENTINA
Calls Brazil and Europe, daytime

15760 kc. JYT
-X- 19.04 meters
KEMIKWA-CHO, CHIBA-KEN, JAPAN
Irregular in late afternoon and early morning

15660 kc. JVE
-C- 19.16 meters
NAZAKI, JAPAN
Phones Java 3-5 a.m.

15620 kc. JVF
-C- 19.2 meters
NAZAKI, JAPAN
Phones U.S., 5 a.m. & 4 p.m.

15415 kc. KWO
-C- 19.46 meters
DIXON, CAL.
Phones Hawaii 2-7 p.m.

15370 kc. ★HAS3
-B- 19.52 meters
BUDAPEST, HUNGARY
Broadcasts Sundays, 9-10 a.m.

15360 kc. DJT
-X,C- 19.53 meters
REICHSPOSTZENSTRALAMT,
ZEESEN, GERMANY
Works with Africa and broadcasts 11 p.m.-1 a.m.

15355 kc. KWU
-C- 19.53 meters
DIXON, CAL.
Phones Pacific Isles and Japan

15340 kc. DJR
-B,X- 19.56 meters
BROADCASTING HOUSE,
BERLIN, GERMANY
1:30-3:30 a.m.

15330kc. ★W2XAD
-B- 19.56 meters
GENERAL ELECTRIC CO.
SCHENECTADY, N. Y.
Relays WGY 10 a.m.-2 p.m.

15310 kc. GSP
-B- 19.6 meters
DAVENTRY
B.B.C., BROADCASTING HOUSE,
LONDON, ENGLAND
Irregular

15290 kc. LRU
-B- 19.62 meters
"EL MUNDO"
BUENOS AIRES, ARGENTINA, S. A.
Testing 6-7:45 and 11-11:45 p.m. Soon on regular daily schedule.

15280 kc. DJQ
-B- 19.63 meters
BROADCASTING HOUSE
BERLIN, GERMANY
12:30-3, 8:05-11 a.m.

15270 kc. ★W2XE
-B- 19.65 meters
ATLANTIC BROADCASTING CORP.
485 Madison Av., N.Y.C.
Relays WABC daily, 1-6 p.m.

15260 kc. GSI
-B- 19.66 meters
DAVENTRY,
B.B.C., BROADCASTING HOUSE, LONDON, ENGLAND
12:15-2:15 p.m.

15250 kc. W1XAL
-B- 19.67 meters
BOSTON, MASS.
Irregular, in morning

15245 kc. ★TPA2
-B- 19.68 meters
"RADIO COLONIAL"
PARIS, FRANCE
Service de la Radiodiffusion
98, bis, Blvd. Haussmann
6.55-11 a.m.

15220 kc. ★PCJ
-B- 19.71 meters
N.V. PHILIPS' RADIO
EINDHOVEN, HOLLAND
Tues. 3-6 a.m.
Wed. 7-11 a.m.

15210 kc. ★W8XK
-B- 19.72 meters
WESTINGHOUSE ELECTRIC & MFG. CO.
PITTSBURGH, PA.
9 a.m.-7 p.m.
Relays KDKA

15200 kc. DJB
-B- 19.74 meters
BROADCASTING HOUSE
BERLIN, GERMANY
3.50-11 a.m.

(All Schedules Eastern Standard Time)

15180 kc. GSO
-B- 19.76 meters
DAVENTRY
B.B.C., BROADCASTING HOUSE.
LONDON, ENGLAND
4-5:45 p.m.

15140 kc. ★GSF
-B- 19.82 meters
DAVENTRY,
B.B.C., BROADCASTING HOUSE, LONDON, ENGLAND
9 a.m.-12 n.

15120 kc. ★HVJ
-B- 19.83 meters
VATICAN CITY
ROME, ITALY
10:30 to 10:45 a.m., except Sunday
Sat. 10-10:45 a.m.

15110 kc. DJL
-B,X- 19.85 meters
BROADCASTING HOUSE, BERLIN, GERMANY
6:30-8 a.m.

15090 kc. RKI
-C- 19.88 meters
MOSCOW, U.S.S.R.
Phones Tashkent near 7 a.m. and relays RNE on Sundays irregularly

15070 kc. PSD
-C- 19.91 meters
RIO DE JANEIRO, BRAZIL
Calls N.Y., Buenos Aires and Europe, daytime

15055 kc. WNC
-C- 19.92 meters
HIALEAH, FLORIDA
Calls Central America, daytime

14980 kc. KAY
-C- 20.03 meters
MANILA, P. I.
Phones Pacific Isles

14950 kc. HJB
-C- 20.07 meters
BOGOTA, COL.
Calls WNC, daytime

14600 kc. JVH
-B,C- 20.55 meters.
NAZAKI, JAPAN
Phones Europe 4-8 a.m.
Irregular 12 m-1 a.m.
Mon. and Thurs. 4-5 p.m.

14590 kc. WMN
-C- 20.56 meters
LAWRENCEVILLE, N. J.
Phones England morning and afternoon

14535 kc. HBJ
-B- 20.64 meters
RADIO NATIONS,
GENEVA, SWITZERLAND
Broadcasts irregularly

14530 kc. LSN
-C- 20.65 meters
HURLINGHAM, ARGENTINA
Calls N.Y.C. afternoons

14500 kc. LSM2
-C- 20.69 meters
HURLINGHAM, ARGENTINA
Calls Rio and Europe daytime

14485 kc. TIR
-C- 20.71 meters
CARTAGO, COSTA RICA
Phones Cen. Amer. & U.S.A. Daytime

14485 kc. HPF
-C- 20.71 meters
PANAMA CITY, PAN.
Phones WNC daytime

14485 kc. TGF
-C- 20.71 meters
GUATEMALA CITY, GUAT
Phones WNC daytime

14485 kc. YNA
-C- 20.71 meters
MANAGUA, NICARAGUA
Phones WNC daytime

14470 kc. WMF
-C- 20.73 meters
LAWRENCEVILLE, N. J.
Phones England morning and afternoon

14460 kc. DZH
-C,X- 20.75 meters
REICHSPOSTZENSTRALAMT, ZEESEN, GERMANY
Works on telephony and broadcasts 12 n.-2 p.m.

14440 kc. GBW
-C- 20.78 meters
RUGBY, ENGLAND
Calls U.S.A., afternoon

13990 kc. GBA
-C- 21.44 meters
RUGBY, ENGLAND
Calls Buenos Aires, late afternoon

13820 kc. SUZ
-C- 21.71 meters
ABOU ZABAL, EGYPT
Works with Europe 11 a.m.-2 p.m.

13635 kc. SPW
-B- 22 meters
WARSAW, POLAND
Mon., Wed., Fri. 11:30 a.m.-12:30 p.m.
Irregular at other times

13610 kc. JYK
-C- 22.04 meters
KEMIKAWA-CHO, CHIBA-KEN, JAPAN
Phones California till 11 p.m.

13585 kc. GBB
-C- 22.08 meters
RUGBY, ENGLAND
Calls Egypt & Canada, afternoons

13415 kc. GCJ
-C- 22.36 meters
RUGBY, ENGLAND
Calls Japan & China early morning

13390 kc. WMA
-C- 22.40 meters
LAWRENCEVILLE, N. J.
Phones England morning and afternoon

13345 kc. YVC
-C- 22.48 meters
MARACAY, VENEZUELA
Calls Hialeah daytime

13075 kc. VPD
-X- 22.94 meters
SUVA, FIJI ISLANDS
Daily exc. Sun. 12:30-1:30 a.m.

12840 kc. WOO
-C- 23.36 meters
OCEAN GATE, N. J.
Calls ships

12825 kc. CNR
-B, C- 23.39 meters
DIRECTOR GENERAL
Telegraph and Telephone Stations, Rabat, Morocco
Broadcasts, Sunday, 7:30-9 a.m.

12800 kc. IAC
-C- 23.45 meters
PISA, ITALY
Calls Italian ships, mornings

12780 kc. GBC
-C- 23.47 meters
RUGBY, ENGLAND
Calls ships

12396 kc. CT1GO
-B- 24.2 meters
PAREDE, PORTUGAL
Sun. 10-11:30 a.m., Tues., Thur., Fri. 1:00-2:15 p.m.

12290 kc. GBU
-C- 24.41 meters
RUGBY, ENGLAND
Calls N.Y.C., afternoon

12235 kc. TFJ
-B.C- 24.52 meters
REYKJAVIK, ICELAND
Phones England mornings, Broadcasts Sun. 1:40-2 p.m.

12150 kc. GBS
-C- 24.69 meters
RUGBY, ENGLAND
Calls N.Y.C., afternoon

12130 kc. DJS
-C.X- 24.73 meters
REICHSPOSTZENSTRALAMT, ZEESEN, GERMANY
Works phone and broadcasts 7-9 p.m.

12000 kc. RNE
-B- 25 meters
MOSCOW, U. S. S. R.
Sun. 6-9, 10-11 a.m., 12:30-6 p.m., 9-10 p.m.
Wed. 6-7 a.m.
Daily 12:30-6 p.m.

11991 kc. FZS2
-C- 25.02 meters
SAIGON, INDO-CHINA
Phones Paris, morning

11955 kc. ETB
-C- 25.09 meters
ADDIS ABABA, ETHIOPIA
See 18270 kc.

11950 kc. KKQ
-X- 25.10 meters
BOLINAS, CALIF.
Tests, irregularly, evenings

11940 kc. FTA
-C- 25.13 meters
STE. ASSISE, FRANCE
Phones CNR morning, Hurlingham, Arg., nights

11880 kc. ★TPA3
-B- 25.23 meters
"RADIO COLONIAL"
PARIS, FRANCE
4-5 a.m., 11:15 a.m.-6:05 p.m.

11870 kc. ★W8XK
-B- 25.26 meters
WESTINGHOUSE ELECTRIC & MFG. CO.
PITTSBURGH, PA.
5-10:30 p.m.
Fri. till 12 m
Relays KDKA

11860 kc. GSE
-B- 25.29 meters
DAVENTRY,
B.B.C., BROADCASTING HOUSE, LONDON, ENGLAND

11855 kc. DJP
-B,X- 25.31 meters
BROADCASTING HOUSE, BERLIN, GERMANY
12 n.-2 p.m.

11830 kc. W2XE
-B- 25.36 meters
ATLANTIC BROADCASTING CORP.
485 MADISON AVE., N. Y. C.
Relays WABC 6-10 p.m.

11820 kc. ★GSN
-B- 25.38 meters
DAVENTRY
B.B.C., BROADCASTING HOUSE,
LONDON, ENGLAND
12:15-2:15 a.m.

11810 kc. ★HJ4ABA
-B- 25.4 meters
P. O. BOX 50,
MEDELLIN, COLOMBIA
11:30 a.m.-1 p.m., 6:30-10:30 p.m.

11810 kc. ★2RO
-B- 25.4 meters
E.I.A.R.
Via Montello 5
ROME, ITALY
8:15-9 a.m., 9:15-11 a.m., 11:30 a.m.-12:15 p.m.

11800 kc. CO9WR
-X- 25.42 meters
P. O. Box 85
SANCTI SPIRITUS, CUBA
4-6, 9-11 p.m.
9 a.m.-12 n.

11795 kc. DJO
-B,X- 25.43 meters
BROADCASTING HOUSE, BERLIN, GERMANY
3-4:55 p.m.

11790 kc. W1XAL
-B- 25.45 meters
BOSTON, MASS.
Sun. 5-7 p.m.

11770 kc. ★DJD
-B- 25.49 meters
BROADCASTING HOUSE, BERLIN, GERMANY
11:35 a.m.-4:35 p.m.; 4:55-10:45 p.m.

11750 kc. ★GSD
-B- 25.53 meters
DAVENTRY,
B.B.C., BROADCASTING HOUSE, LONDON, ENGLAND
12:15-5:45 p.m., 6-8, 10-11 p.m.

11730 kc. PHI
-B- 25.57 meters
HUIZEN, HOLLAND
Daily exc. Tues. and Wed. 8-10 a.m., Sat. and Sun. 8-11 a.m.

11720 kc. ★CJRX
-B- 25.6 meters
WINNIPEG, CANADA
Daily, 8 p.m.-12 m.

11715 kc. ★TPA4
-B- 25.61 meters
"RADIO COLONIAL"
PARIS, FRANCE
6:15-9 p.m.
11 p.m.-1 a.m.

11680 kc. KIO
-X- 25.68 meters
KAHUKU, HAWAII
Tests in the evening

11560 kc. VIZ3
-X- 25.95 meters
AMALGAMATED WIRELESS OF AUSTRALASIA
FISKVILLE, AUSTRALIA
Calls Canada evening and early a.m.

11413 kc. CJA4
-C- 26.28 meters
DRUMMONDVILLE, QUE., CAN.
Tests with Australia irregularly in evening

11200 kc. XBJQ
-X- 26.79 meters
BOX 2825,
MEXICO CITY, MEX.
Irregular

11050 kc. ZLT4
-C- 27.15 meters
WELLINGTON, N. ZEALAND
Phones Australia and England early a.m. Also broadcasts irregularly on Sunday, 9-10 a.m.

11000 kc. PLP
-B-C- 27.27 meters
BANDOENG, JAVA
Relays NIROM programs 5:30-10 a.m. irregular on Sundays

10770 kc. GBP
-C- 27.85 meters
RUGBY, ENGLAND
Calls Sydney, Austral. early a.m.

10740 kc. ★JVM
-B,C- 27.93 meters
NAZAKI, JAPAN
Tues. and Fri. 2-3 p.m.

10675 kc. WNB
-C- 28.1 meters
LAWRENCEVILLE, N. J.
Calls Bermuda, daytime

10670 kc. ★CEC
-C- 28.12 meters
SANTIAGO, CHILE
Broadcasts Thurs., Sun. 8:30-9 p.m., Daily 7-7:15 p.m.

10660 kc. ★JVN
-B,C- 28.14 meters
NAZAKI, JAPAN
Phones Europe 3-8 a.m.
Mon. and Thurs. 4-5 p.m.
Daily 4-8 a.m.

10550 kc. WOK
-C- 28.44 meters
LAWRENCEVILLE, N. J.
Phones Arge., Braz., Peru, nights

10520 kc. VLK
-C- 28.51 meters
SYDNEY, AUSTRALIA
Calls Rugby, early a.m.

10430 kc. YBG
-C- 28.76 meters
MEDAN, SUMATRA
5:30-6:30 a.m., 7:30-8:30 p.m.

10420 kc. XGW
-C- 28.79 meters
SHANGHAI, CHINA
Calls Manila and England, 8-9 a.m. and California late evening

10410 kc. PDK
-C- 28.80 meters
KOOTWIJK, HOLLAND
Calls Java 7:30-9:40 a.m.

10410 kc. KES
-X- 28.80 meters
BOLINAS, CALIF.
Tests evenings

10350 kc. LSX
-C- 28.98 meters
MONTE GRANDE, ARGENTINA
Tests irregularly 8 p.m.-12 midnight.

10330 kc. IRK
-B-C- 29.04 meters
RUYSSELEDE, BELGIUM
Broadcasts 2:30-4 p.m.

10300 kc. LSL2
-C- 29.13 meters
HURLINGHAM, ARGENTINA
Calls Europe, evenings

10290 kc. DZC
-X- 29.16 meters
KONIGSWUSTERHAUSEN, GERMANY
Broadcasts irregularly

10260 kc. PMN
-B-C- 29.74 meters
BANDOENG, JAVA
Calls Australia 5 a.m.
Broadcasts Sun. 5:30-10 a.m.

10250 kc. LSK3
-C- 29.27 meters
HURLINGHAM, ARGENTINA
Calls Europe and U. S., afternoon and evening

10220 kc. PSH
-C- 29.35 meters
RIO DE JANEIRO, BRAZIL

10140 kc. OPM
-C- 29.59 meters
LEOPOLDVILLE, BELGIAN CONGO
Phones around 3 a.m. and 1-4 p.m.

10055 kc. ZFB
-C- 29.84 meters
HAMILTON, BERMUDA
Phones N. Y. C. daytime

10055 kc. SUV
-C- 29.84 meters
ABOU ZABAL, EGYPT
Works with Europe 1-6 p.m.

10042 kc. DZB
-C- 29.87 meters
ZEESEN, GERMANY
Works with Central America and broadcasts 2-4 p.m.

9950 kc. GCU
-C- 30.15 meters
RUGBY, ENGLAND
Calls N.Y.C. evening

9890 kc. LSN
-C- 30.33 meters
HURLINGHAM, ARGENTINA
Calls New York, evenings

9870 kc. WON
-C- 30.4 meters
LAWRENCEVILLE, N. J.
Phones England, evening

9860 kc. ★EAQ
-B- 30.43 meters
P. O. Box 951
MADRID, SPAIN
Daily 5:15-9:30 p.m.; Saturday also 12 n.-2 p.m.

9840 kc. JYS
-X- 30.49 meters
KEMIKAWA-CHO, CHIBA-KEN, JAPAN
Irregular, 4-7 a.m.

9800 kc. LSE
-C- 30.61 meters
MONTE GRANDE, ARGENTINA
Tests irregularly

9790 kc. GCW
-C- 30.64 meters
RUGBY, ENGLAND
Calls N.Y.C., evening

9760 kc. VLJ-VLZ2
-C- 30.74 meters
AMALGAMATED WIRELESS OF AUSTRALIA
SYDNEY, AUSTRALIA
Phones Java and N. Zealand early a.m.

9750 kc. WOF
-C- 30.77 meters
LAWRENCEVILLE, N. J.
Phones England, evening

9710 kc. GCA
-C- 30.89 meters
RUGBY, ENGLAND
Calls Arge. & Brazil, evenings

9675 kc. DZA
-C- 31.01 meters
ZEESEN, GERMANY
Works with Africa and broadcasts 5-7 p.m.

9635 kc. ★2RO
-B- 31.13 meters
E.I.A.R., ROME, ITALY
M., W., F., 6-7:30 p.m.
Tues., Thurs., Sat. 6-7:45 p.m.
Daily 1:30-5 p.m.

9625 kc. ★CT1AA
-B- 31.17 meters
LISBON, PORTUGAL
Tues., Thurs., Sat. 4:30-7 p.m.

9620 kc. YDB
-B- 31.19 meters
N.I.R.O.M.
SOERABAJA, JAVA
5:30-10 a.m.

9595 kc. ★HBL
-B- 31.27 meters
LEAGUE OF NATIONS
GENEVA, SWITZERLAND
Saturdays, 5:30-6:15 p.m.
Mon. at 1:45 a.m.

9595 kc. HH3W
-B- 31.27 meters
P.O. BOX 117,
PORT-AU-PRINCE, HAITI
1-2, 7-8 p.m.

9590 kc. HP5J
-B- 31.28 meters
APARTADO 867,
PANAMA CITY, PANAMA
11:45 a.m.-1 p.m., 7:30-10 p.m.

9590 kc. ★PCJ
-B- 31.28 meters
N. V. PHILIPS RADIO
EINDHOVEN, HOLLAND
Sun. 7:30-8:30 a.m., 1-2, 7-8 p.m.

9590 kc. ★VK2ME
-B- 31.28 meters
AMALGAMATED WIRELESS, LTD., 47 YORK ST.
SYDNEY, AUSTRALIA
Sun. 1-3, 5-9, 9:30-11:30 a.m.

9590 kc. W3XAU
-B- 31.28 meters
NEWTOWN SQUARE, PA.
Relays WCAU
Daily 12 n.-7:50 p.m.
Sun. 12 n.-7 p.m.

(All Schedules Eastern Standard Time)

9580 kc. LRX
-B- 31.32 meters "EL MUNDO" BUENOS AIRES, ARGENTINA Testing

9580 kc. ★ GSC
-B- 31.32 meters DAVENTRY, B.B.C., BROADCASTING HOUSE, LONDON, ENGLAND 4:15-5:45, 6-8, 10-11 p.m.

9580 kc. ★VK3LR
-B- 31.32 meters Research Section, Postmaster Gen'ls. Dept., 61 Little Collins St., MELBOURNE, AUSTRALIA 3:15-7:30 a.m., except Sun. also Fr. 10 p.m.-2 a.m.

9570 kc. ★W1XK
-B- 31.35 meters WESTINGHOUSE ELECTRIC & MFG. CO. SPRINGFIELD, MASS. Relays WBZ, 7 a.m.-1 a.m. Sun. 8 a.m.-1 a.m.

9565 kc. VUB
-B- 31.36 meters BOMBAY, INDIA 11 a.m.-12:30 p.m., Wed., Thurs., Sat.

9560 kc. ★DJA
-B- 31.38 meters BROADCASTING HOUSE, BERLIN 8.05-11 a.m., 4:55-10:45 p.m.

9540 kc. ★DJN
-B- 31.45 meters BROADCASTING HOUSE BERLIN, GERMANY 12:30-3, 3:50-11 a.m., 4:55-10:45 p.m.

9530 kc. ★W2XAF
-B- 31.48 meters GENERAL ELECTRIC CO. SCHENECTADY, N. Y. Relays WGY 4 p.m.-12 m. Sat. 12 n.-12 m.

9525 kc. LKJ1
-B- 31.49 meters JELOY, NORWAY 5-8 a.m., 11 a.m.-6 p.m.

9510 kc. ★VK3ME
-B- 31.55 meters AMALGAMATED WIRELESS, Ltd. 167 Queen St., MELBOURNE, AUSTRALIA Daily exc. Sun. 4-7 a.m.

9510 kc. ★GSB
-B- 31.55 meters DAVENTRY, B.B.C., BROADCASTING HOUSE, LONDON, ENGLAND 12:15-2:15 a.m., 12:15-5.45 p.m. 6-8 p.m.

9501 kc. PRF5
-B- 31.58 meters RIO DE JANEIRO, BRAZIL Irregularly 4:45-5:45 p.m.

9500 kc. HJU
-B- 31.59 meters NATL. RAILWAYS, BUENAVENTURA, COLOMBIA Heard between 8 and 11:30 p.m.

9450 kc. TG1X
-B- 31.75 meters MINISTRE de FOMENTO GUATEMALA CITY, GUATEMALA Irregular 6-11 p.m.

9428 kc. ★COCH
-B- 31.8 meters 2 B ST., VEDADO, HAVANA, CUBA Daily 8 a.m.-7 p.m. Sun. 11 a.m.-12 n., 8:30-9:30 p.m.

9415 kc. PLV
-C- 31.87 meters BANDOENG, JAVA Phones Holland around 9:45 a.m.

9330 kc. CJA2
-C- 32.15 meters DRUMMONDVILLE, CANADA Phones England irregularly

9280 kc. GCB
-C- 32.33 meters RUGBY, ENGLAND Calls Can. & Egypt, evenings

9170 kc. WNA
-C- 32.72 meters LAWRENCEVILLE, N. J. Phones England, evening

9125 kc. ★HAT4
-B- 32.86 meters "RADIOLABOR," GYALI-uT. 22 BUDAPEST, HUNGARY Sunday 6-7 p.m.

9060 kc. TFK
-C- 33.11 meters REYKJAVIK, ICELAND Phones London afternoons. Broadcasts irregularly.

9020 kc. GCS
-C- 33.26 meters RUGBY, ENGLAND Calls N.Y.C., evenings

9010 kc. KEJ
-C- 33.3 meters BOLINAS, CAL. Relays NBC & CBS Programs in evening irregularly

8795 kc. HKV
-B- 34.09 meters BOGOTA, COLOMBIA Irregular; 6:30 p.m.-12 m.

8775 kc. PNI
-C- 34.19 meters MAKASSER, CELEBES, N.I. Phones Java around 4 a. m.

8760 kc. GCQ
-C- 34.25 meters RUGBY, ENGLAND Calls S. Africa, afternoon

8750 kc. ZCK
-B- 34.29 meters HONGKONG, CHINA Relays ZBW Daily 11:30 p.m.-1:15 a.m. Mon. and Thurs. 3:7 a.m. Tues., Wed., Fri. 6-10 a.m. Sat. 6-11 a.m.

8730 kc. GCI
-C- 34.36 meters RUGBY, ENGLAND Calls India, 8 a. m.

8680 kc. GBC
-C- 34.56 meters RUGBY, ENGLAND Calls ships

8665 kc. CO9JQ
-X- 34.62 meters CAMAGUEY, CUBA 5:30-6:30, 8-9 p.m. daily except Sat. and Sun.

8590 kc. YNVA
-B- 34.92 meters MANAGUA, NICARAGUA 7:30-9:30 p. m.

8560 kc. WOO
-C- 35.05 meters OCEAN GATE, N. J. Calls ships irregular

8400 kc. HC2AT
-B- 35.71 meters CASSILLA 877 GUAYAQUIL, ECUADOR 8-11 p.m.

8380 kc. IAC
-C- 35.8 meters Pisa, Italy

8220 kc. ZP10
-B- 36.4 meters ASUNCION, PARAGUAY 7-9 p.m.

8214 kc. HCJB
-B- 36.5 meters QUITO, ECUADOR 7-11 p.m., except Monday Sun. 11 a.m.-12 n.; 4-10 p.m.

8190 kc. XEME
-B- 36.63 meters CALLE 59, No. 517 MERIDA, YUCATAN "LA VOZ de YUCATAN desde MERIDA 10 a.m.-12 n., 6 p.m.-12 m.

8185 kc. PSK
-C- 36.65 meters RIO DE JANEIRO, BRAZIL Irregularly

8036 kc. CNR
-B- 37.33 meters RABAT, MOROCCO Sunday, 2:30-5 p. m.

7975 kc. HC2TC
-B- 37.62 meters QUITO, ECUADOR Thurs., Sun. at 8 p.m.

7901 kc. LSL
-C- 37.97 meters HURLINGHAM, ARGENTINA Calls Brazil, night

7880 kc. JYR
-B- 38.07 meters KEMIKAWA-CHO, CHIBA-KEN, JAPAN 4-7:40 a. m.

7860 kc. SUX
-C- 38.17 meters ABOU ZABAL, EGYPT Works with Europe 4-6 p.m.

7854 kc. HC2JSB
-B- 38.2 meters GUAYAQUIL, ECUADOR 8:15-11:15 p.m.

7830 kc. YV9RC
-B- 38.31 meters CARACAS, VENEZUELA 7-11 p.m.

7799 kc. ★HBP
-B- 38.47 meters LEAGUE OF NATIONS, GENEVA, SWITZERLAND 5:30-6:15 p. m., Saturday

7715 kc. KEE
-C- 38.89 meters BOLINAS, CAL. Relays NBC & CBS Programs in evening irregularly

7630 kc. ZHJ
-B- 39.32 meters PENANG, MALAYA Daily 7-9 a.m. also Sat. 11 p.m.-1 A.M. (Sun.)

7620 kc. ETD
-C- 39.37 meters ADDIS ABABA, ETHIOPIA See 18270 kc.

7550 kc. TI8WS
-B- 39.74 meters "ECOS DEL PACIFICO" P. O. BOX 75 PUNTA ARENAS, COSTA RICA 6 p.m.-12 m.

7510 kc. JVP
-B,C- 39.95 meters NAZAKI, JAPAN

7380 kc. XECR
-B- 40.65 meters FOREIGN OFFICE, MEXICO CITY, MEX. Sun. 6-7 p.m.

7281 kc. HJ1ABD
-B- 41.04 meters CARTAGENA, COLO. Irregularly, evenings

7100 kc. HKE
-B- 42.25 meters BOGOTA, COL., S. A. Tue. and Sat. 8-9 p. m.; Mon. & Thurs. 6:30-7 p. m.

7080 kc. VP3MR
-B- 42.68 meters GEORGETOWN, BRI. GUIANA, S.A. Sun. 7:45-10:15 a.m. Mon. 3:45-4:45 p.m. Tues. 4:45-6:45 p.m. Wed. 4:45-7:45 p.m. Thur. 5-6:45 p.m. Sat. 4:45-7:45 p.m.

7074 kc. HJ1ABK
-B- 42.69 meters CALLE, BOLIVIA, PROGROSO-IGUALDAD BARRANQUILLA, COLOMBIA Sun. 3-6 p.m.

7030 kc. HRP1
-B- 42.67 meters SAN PEDRO SULA, HONDURAS Reported on this and other waves irregularly in evening

6996 kc. PZH
-B- 42.88 meters P. O. BOX 18, PARAMIRABO, DUTCH GUIANA Sun. 9:36-11:36 a.m. Mon. and Fri. 5:36-9:36 p.m. Tues. and Thur. 8:36-10:36 a.m., 2:36-4:36 p.m. Wed. 3:36-4:36, 5:36-9:36 p.m. Sat. 2:36-4:36 p.m.

6976 kc. HCETC
-B- 43 meters TEATRO BOLIVAR QUITO, ECUADOR Thurs. till 9:30 p.m.

6905 kc. GDS
-C- 43.43 meters RUGBY, ENGLAND Calls N.Y.C. evening

6900 kc. HI3C
-B- 43.48 meters LA RAMONA, DOM. REP. LA VOZdeRIO DULCE. 7:30-9:30 p.m.

6860 kc. KEL
-X- 43.70 meters BOLINAS, CALIF. Tests irregularly 11 a. m.-12 n.; 6-8 p. m.

6814 kc. HIH
-B- 44.03 meters SAN PEDRO de MACORIS DOMINICAN REP. 12:10-1:40 p.m., 7:30-9 p.m., Sun. 3-4 a.m. 4:15-6 p.m.

6755 kc. WOA
-C- 44.41 meters LAWRENCEVILLE, N. J. Phones England, evening

6750 kc. JVT
-B,C- 44.44 meters NAZAKI, JAPAN KOKUSAI-DENWA KAISHA, LTD., TOKIO

6710 kc. ★TIEP
-B- 44.71 meters LA-VOZ DEL TROPICO SAN JOSE, COSTA RICA APARTADO 257. Daily 7-10 p.m.

6672 kc. YVQ
-C- 44.95 meters MARACAY, VENEZUELA Broadcasts Sat. 8-9 p.m.

6660 kc. ★HC2RL
-B- 45.05 meters P. O. BOX 759, GUAYAQUIL, ECUADOR, S. A. Sunday, 5:45-7:45 p. m. Tues., 9:15-11:15 p. m.

6650 kc. IAC
-C- 45.11 meters PISA, ITALY Calls ships, evenings

6618 kc. ★PRADO
-B- 45.33 meters RIOBAMBA, ECUADOR Thurs. 9-11:45 p.m.

6611 kc. RV72
-B- 45.38 meters MOSCOW, U. S. S. R. 1-6 p. m.

6600 kc. HI4D
-B- 45.45 meters CIUDAD TRUJILLO, DOMINICAN REPUBLIC Except Sun. 11:55 a.m.-1:40 p.m.; 4:40-7:40 p.m.

6560 kc. HI4V
-B- 45:73 meters CIUDAD TRUJILLO, D.R. LA VOZde LA MARINA 5:10-6:40 p.m.

6550 kc. TIRCC
-B- 45.77 meters RADIOEMISORA CATOLICA COSTARRICENSE SAN JOSE, COSTA RICA Sun. 12:45-2:30, 6-7, 8-9 p.m.

6528 kc. HIL
-B- 45.95 meters CIUDAD TRUJILLO, D.R. Sat., 8-10 p.m.

6520 kc. ★YV6RV
-B- 46.01 meters VALENCIA, VENEZUELA 12 n.-1 p.m., 6-10 p.m.

6500 kc. HJ5ABD
-B- 46.15 meters MANIZALES, COL. 12-1:30 p. m., 7-10 p. m.

6450 kc. HJ4ABC
-B- 46.51 meters "LA VOZ de CAMBEBE," APARTADO 39 IBAQUE, COLOMBIA 7:30-11 p.m.

6447 kc. HJ1ABB
-B- 46.53 meters BARRANQUILLA, COL., S. A. P. O. BOX 715, 11:30 a.m.-1 p.m.; 4:30-10 p.m.

6425 kc. W9XBS
-X- 46.7 meters NATL. BROAD. CO. CHICAGO, ILL. Relays WMAQ. Irregular

6420 kc. HI1S
-B- 46.73 meters PUERTO PLATA, DOM. REP. 11:40 a.m.-1:40 p.m., 5:40-7:40, 9:40-11:40 p.m.

6410 kc. TIPG
-B- 46.8 meters APARTADO 225, SAN JOSE, COSTA RICA "LA VOZ DE LA VICTOR" 12 n.-2 p.m., 6-11:30 p.m.

6380 kc. HI3U
-B- 47.02 meters SANTIAGO de los CABALLEROS, DOM. REP. Irregular in evening

6375 kc. YV4RC
-B- 47.06 meters CARACAS VENEZUELA 6:45-9:30 p.m.

6316 kc. HIZ
-B- 47.5 meters CIUDAD TRUJILLO DOMINICAN REPUBLIC Daily except Sat. and Sun. 4:40-5:40 p. m.; Sat., 9:40-11:40 p. m.; Sun., 11:40 a. m.-1:40 p. m.

6300 kc. YV12RM
-B- 47.62 meters MARACAY, VENEZUELA 8-10:30 p.m.

6230 kc. OAX4G
-B- 48 meters Apartado 1242 LIMA, PERU Daily 7-10:30 p.m. Wed. 6-10:30 p.m.

6185 kc. HI1A
-B- 48.5 meters P. O. BOX 423, SANTIAGO, DOMINICAN REP. 11:40 a. m.-1:40 p. m. 7:40-9:40 p. m.

6180 kc. XEXA
-B- 48.54 meters DEPT. OF EDUCATION MEXICO CITY, MEX. 8-11:30 a.m.

6175 kc. HJ2ABA
-B- 48.58 meters TUNJA, COLOMBIA 1-2; 7:30-9:30 p.m.

6170 kc. HJ3ABF
-B- 48.62 meters BOGOTA, COLOMBIA 7-11:15 p. m.

6160 kc. ★YV3RC
-B- 48.7 meters CARACAS, VENEZUELA 11 a.m.-2 p.m., 4-10:30 p.m.

6155 kc. COKG
-B- 48.74 meters BOX 137, SANTIAGO, CUBA 9-10 a.m., 11:30 a.m.-1:30 p.m., 3-4:30 p.m., 10-11 p.m., 12 m.-2 a.m.

6150 kc. CSL
-B- 48.78 meters LISBON, PORTUGAL 7-8:30 a.m., 2-7 p.m.

6150 kc. ★CJRO
-B- 48.78 meters WINNIPEG, MAN., CANADA 8 p. m.-12 m. Sun. 3-10:30 p. m.

6150 kc. HJ5ABC
-B- 48.78 meters CALI, COLOMBIA Daily 11 a.m.-12 n., Sun. 12 n.-2 pm., Daily except Sat. and Sun. 7-10 p.m.

6140 kc. ★W8XK
-B- 48.86 meters WESTINGHOUSE ELECTRIC & MFG. CO. PITTSBURGH, PA. Relays KDKA 9 p.m.-1 a.m.

6135 kc. HI5N
-B- 48.9 meters SANTIAGO, D.R. 6:40-9:10 p.m.

6130 kc. TGXA
-B- 48.94 meters GIORNAL LIBERAL PROGRESSISTA, GAUTEMALA CITY, GUAT. Heard in the evening.

6130 kc. COCD
-B- 48.92 meters "La Voz del Aire" CALLE G y 25, VEDADO, HAVANA, CUBA Relays CMCD 11 a.m.-12 n., 7-10 pm., Sun. 12 n.-4 p.m.

6130 kc. ZGE
-B- 48.92 meters KUALA LUMPUR, FED. MALAY STATES Sun., Tue., and Fri., 6:40-8:40 a. m.

6120 kc. ★W2XE
-B- 49.02 meters ATLANTIC BROADCASTING CORP. 485 MADISON AVE., N. Y. C. Relays WABC, 10-11 p.m.

6120 kc. XEFT
-B- 49.02 meters AV. INDEPDENCIA 28, VERA CRUZ, MEX. 11 a.m.-4 p.m., 7:30 p.m.-12 m. Sat. also 6:30-7:30 p.m. Sun. 11 a.m.-4 p.m., 9 p.m.-12 m. Relays XETF

6115 kc. HJ1ABE
-B- 49.05 meters CARTAGENA, COL. P. O. Box 31 Mon. 10 p.m.-12 m. Daily 7:30-9 p.m.

(All Schedules Eastern Standard Time)

6110 kc. ★CHNX
-B- 49.1 meters
P.O. BOX 998
HALIFAX, N.S., CANADA
Daily 9 a.m.-12:30 p.m., 4-10 p.m.
Relays CHNS

6110 kc. GSL
-B- 49.10 meters
DAVENTRY,
B.B.C., BROADCASTING HOUSE, LONDON, ENGLAND

6110 kc. VUC
-B- 49.1 meters
CALCUTTA, INDIA
Daily except Sat., 3-5:30 a. m., 9:30 a. m.-noon; Sat., 11:45 a. m.-3 p. m.

6105 kc. HJ4ABB
-B- 49.14 meters
MANIZALES, COL., S. A.
P. O. Box 175
Mon. to Fri. 12:15-1 p. m.; Tues. & Fri. 7:30-10 p. m.; Sun. 2:30-5 p. m.

6100 kc. ★W3XAL
-B- 49.18 meters
NATIONAL BROADCASTING CO.
BOUND BROOK, N. J.
Relays WJZ
Monday, Wednesday, Saturday, 5-6 p.m., Sun. 12 m-1 a.m.

6100 kc. ★W9XF
-B- 49.18 meters
NATL. BROAD. CO.
Relays WENR, Chicago
Sun., Tues., Thur., Fri. 9 p.m.-2 a.m.; M., W., Sat., 1-2 a.m.

6097 kc. ZTJ
-B- 49.2 meters
AFRICAN BROADCASTING CO.
JOHANNESBURG, SOUTH AFRICA.
Sun.-Fri. 11:45 p.m. 12:30 a.m. (next day)
Mon.-Sat. 3:30-7 a.m. 9 a.m.-4 p.m.
Sun. 8-10:15 a.m.; 12:30-3 p.m.

6090 kc. ★CRCX
-B- 49.26 meters
TORONTO, CANADA
Daily 5:30-11:30 p.m.
Sun. 11:45 a.m.-11:45 p.m.

6090 kc. VE9BJ
-B- 49.26 meters
SAINT JOHN, N. B., CAN.
7-8:30 p. m.

6085 kc. 2RO
-B- 49.3 meters
E.I.A.R.
ROME, ITALY

6083 kc. VQ7LO
-B- 49.31 meters
NAIROBI, KENYA, AFRICA
Mon.-Fri. 5:45-6:15 a.m., 11:30 a.m.-2:30 p.m. Also 8:30-9:30 a.m. on Tues. and Thurs.; Sat. 11:30 a.m.-3:30 p.m.; Sun. 11 a.m.-2 p.m.

6080 kc. CP5
-B- 49.34 meters
LAPAZ, BOLIVIA
7-10:30 p. m.

6080 kc. HP5F
-B- 49.34 meters
Carlton Hotel
COLON, PANAMA
11:45 a.m.-1:15 pm., 7:45-10 p.m.

6080 kc. W9XAA
-B- 49.34 meters
CHICAGO FEDERATION OF LABOR
CHICAGO, ILL.
Relays WCFL
Sunday 11:30 a. m.-9 p. m. and Tues., Thurs., Sat., 4 p. m.-12 m.

6079 kc. DJM
-B.X- 49-34 meters
BROADCASTING HOUSE, BERLIN, GERMANY
3-5 p.m.

6072 kc. OER2
-B- 49.41 meters
VIENNA, AUSTRIA
9 a.m.-5 p.m.

6070 kc. HJ4ABC
-B- 49.42 meters
PERIERA, COL.
9:30-11:30 a.m., 7-8 or 9 p.m.

6070 kc. VE9CS
-B- 49.42 meters
VANCOUVER, B. C., CANADA
Sun. 1:45-9 p. m., 10:30 p. m.-1 a. m.; Tues. 6-7:30 p. m., 11:30 p. m.-1:30 a. m. Daily 6-7:30 p. m.

6065 kc. HJ4ABL
-B- 49.46 meters
MANIZALES, COL.
Daily 11 a.m.-12 n., 5:30-7:30 p.m. Sat. 5:30-10:30 p.m.

6060 kc. ★W8XAL
-B- 49.50 meters
CROSLEY RADIO CORP.
CINCINNATI, OHIO
6:30 a.m.-8 p.m.; 11 p.m.-1 a.m.
Relays WLW

6060 kc. W3XAU
-B- 49.50 meters
NEWTOWN SQUARE, PA.
Relays WCAU, Philadelphia
8 p.m.-11 p.m.

6060 kc. OXY
-B- 49.50 meters
SKAMLEBOAEK, DENMARK
1-6:30 p.m.

6050 kc. HJ3ABD
-B- 49.59 meters
BOX 509, BOGOTA, Col.
COLOMBIA BROADCASTING
12 n.-2 p.m., 7-11 p.m. Sun. 5-9 p.m.

6050 kc. HI9B
-B- 49.59 meters
SANTIAGO
DOM. REP.
Irregular 6 p.m.-11 p.m.

6050 kc. GSA
-B- 49.59 meters
DAVENTRY,
B.B.C., BROADCASTING HOUSE, LONDON, ENGLAND

6042 kc. HJ1ABG
-B- 49.65 meters
EMISORA ATLANTICO
BARRANQUILLA, COLO.
12 n.-1 p.m., 6-10:30 p.m. Sun. 1-8 p.m.

6040 kc. W4XB
-B- 49.67 meters
MIAMI BEACH, FLA.
Relays WIOD 12 n.-2 p.m., 5:30 p.m.-12 m.

6040 kc. PRA8
-B- 49.67 meters
RADIO CLUB OF PERNAMBUCO
PERNAMBUCO, BRAZIL
1-3 p.m., 4-7:30 p.m. daily

6040 kc. ★W1XAL
-B- 49.67 meters
BOSTON, MASS.
Tues., Thurs. 7:15-9:15 p.m. Sun 5-7 p.m.

6040 kc. YDA
-B- 49.67 meters
N.I.R.O.M.
TANDJONGPRIOK, JAVA
5:45-6:45 p.m., 10:30 p.m.-1:30 a.m.

6030 kc. ★HP5B
-B- 49.75 meters
P. O. BOX 910
PANAMA CITY, PAN.
12 n.- 1p.m., 7-10:30 p.m.

6030 kc. VE9CA
-B- 49.75 meters
CALGARY, ALBERTA, CAN.
Thurs. 9 a.m.-2 a.m. (Fri.); Sun. 12 n.-12 m. Irregularly on other days from 9 a.m.-12 m.

6020 kc. CQN
-B- 49.83 meters
MACAO, CHINA
Mon. and Fri. 3-5 a.m.

6020 kc. ★DJC
-B- 49.83 meters
BROADCASTING HOUSE, BERLIN
11:35 a.m.-4:25 p.m., 4:55-10:45 p.m.

6020 kc. XEUW
-B- 49.82 meters
AV. INDEPENDENCIA, 98.
VERA CRUZ, MEX.
8 p.m.-12:30 a.m.

6018 kc. ZHI
-B- 49.9 meters
RADIO SERVICE CO.,
20 ORCHARD RD.,
SINGAPORE, MALAYA
Mon., Wed. and Thurs 5:40-8:10 a.m. Sat. 10:40 p.m.-1:10 a.m. (Sun.) Every other Sunday 5:10-6:40 a.m.

6012 kc. HJ3ABH
-B- 49.91 meters
BOGOTA, COLO.
APARTADO 565
6-11 p.m.
Sun. 12 n.-2 p.m., 4-11 p.m.

6010 kc. ★COCO
-B- 49.92 meters
P.O. BOX 98
HAVANA, CUBA
Daily 9:30 a.m.-1 p.m., 4-7 p.m., Sun. 8-10 p.m.
Sat. also 11 p.m.-12 m.

6005 kc. HJ1ABJ
-B- 49.96 meters
SANTA MARTA, COLO.
6-11 p.m. except Wed.

6005 kc. VE9DN
-B- 49.96 meters
CANADIAN MARCONI CO.,
MONTREAL, QUE., CANADA
Saturdays at 11:30 p.m.

6000 kc. HJ1ABC
-B- 50 meters
QUIBDO, COLOMBIA
5-6 p.m., Sun. 9-11 p.m.

6000 kc. TGWA
-B- 50 meters
GUATEMALA CITY, GUAT.
12 n-1 p.m., 6:30-7:30 p.m. 10-11 p.m. Sat. also from 12 m.-6 a.m. (Sun.)

6000 kc. RV59
-B- 50 meters
MOSCOW, U. S. S. R.
Daily 12:30-6 p.m.

5990 kc. ★XEBT
-B- 50.08 meters
MEXICO CITY, MEX.
P. O. Box 79.44
8 a.m.-1 a.m.

5985 kc. HJ2ABC
-B- 50:13 meters
CUCUTA, COLOMBIA
6-9:30 p.m.

5980 kc. HJ2ABD
-B- 50.17 meters
BUCARAMANGA, COL.
6.10 p.m.

5980 kc. XEVI
-B- 50.17 meters
MEXICO CITY, MEX.
Mon., Wed., Fri., 3-4 p.m. Tues., Fri. 7:30-8:45, 10 p.m.-12 m.; Sat. 9-10 p.m.; Sun.1-2:15 p. m.

5980 kc. HIX
-B- 50.17 meters
CIUDAD TRUJILLO, DOMINICAN REP.
Sun. 7:40-10:10. Daily 11:40 a. m.-12:40 p.m., 4:40-5:40 p.m.; Tues. and Fri. 8:10-10:10 p.m.

5970 kc. HJN
-B- 50.26 meters
BOGOTA, COL.
6-11 p.m.

5968 kc. HVJ
-B- 50.27 meters
VATICAN CITY (ROME)
2-2:15 p. m., daily. Sun., 5-5:30 a. m.

5950 kc. HJ4ABE
-B- 50.42 meters
MEDELLIN, COLO.
Daily 11 a.m.-12 n., 6-10:30 p.m.

5940 kc. TG2X
-B- 50.5 meters
GUATEMALA CITY, GUAT.
4-6, 9-11 p.m.

5910 kc. HRN
-B- 50.76 meters
TEGUCIGALPA, HONDURAS
12:30-2 p.m., 6-7:30, 8-9:30 p. m.; Sun. 3-5 p.m., 8 p.m.-12 m.

5900 kc. HH2S
-B- 50.85 meters
PORT-au-PRINCE, HAITI
7:30-10:30 p.m.

5885 kc. HCK
-B- 50.98 meters
QUITO, ECUADOR, S. A.
8-11 p.m.

5880 kc. YV8RB
-B- 51.02 meters
"LA VOZ de LARA"
BARQUISIMETO, VENEZUELA
6-10 p.m.

5860 kc. HI1J
-B- 51.19 meters
SAN PEDRO de MACORIS, DOM. REP.
6:30-9 p.m.

5853 kc. WOB
-C- 51.26 meters
LAWRENCEVILLE, N. J.
Calls Bermuda, nights

5850 kc.★YV5RMO
-B- 51.28 meters
CALLE REGISTRO, LAS DELICIAS APARTADO de CORRES 214
MARACAIBO, VENEZUELA
11 a.m.-12:30 p.m., 5-9:30 p.m.

5825 kc. TIGPH
-B- 51.5 meters
SAN JOSE, COSTA RICA
7-10 p.m.

5800 kc. ★YV2RC
-B- 51.72 meters
RADIO CARACAS
CARACAS, VENEZUELA
Sun. 8:30 a.m.-10:30 p.m.
Daily 11 a.m.-1:30 p.m., 4-9:30 p.m.

5790 kc. JVU
-C- 51.81 meters
NAZAKI, JAPAN

5780 kc. OAX4D
-B- 51.9 meters
P.O. Box 853
LIMA, PERU
Mon., Wed. & Sat. 9-11:30 p.m.

5720 kc. YV10RSC
-B- 52.45 meters
"LA VOZ de TACHIRA,"
SAN CRISTOBAL, VENEZUELA
6-11:30 p.m.

5713 kc. TGS
-B- 52.51 meters
GAUTEMALA CITY, GUAT.
Wed., Thurs. and Sun. 6-9 p.m.

5500 kc. TI5HH
-B- 54.55 meters
SAN RAMON, COSTA RICA
Irregularly 3:30-4, 8-11:30 p.m.

5077 kc. WCN
-C- 59.08 meters
LAWRENCEVILLE, N. J.
Phones England irregularly

5025 kc. ZFA
-C- 59.7 meters
HAMILTON, BERMUDA
Calls U.S.A., nights

5000 kc. TFL
-C- 60 meters
REYKJAVIK, ICELAND
Calls London at night. Also broadcasts irregularly

4975 kc. GBC
-C- 60.30 meters
RUGBY, ENGLAND
Calls Ships, late at night

4820 kc. GDW
-C- 62.24 meters
RUGBY, ENGLAND
Calls N.Y.C., late at night

4752 kc. WOO
-C- 63.1 meters
OCEAN GATE, N. J.
Calls ships irregularly

4600 kc. HC2ET
-B- 65.22 meters
Apartado 249
GUAYAQUIL, ECUADOR
Wed., Sat., 9:15-11 p.m.

4320 kc. GDB
-C- 69.44 meters
RUGBY, ENGLAND
Tests, 8-11 p. m.

4273 kc. RV15
-B- 70.20 meters
KHABAROVSK, SIBERIA, U. S. S. R.
Daily, 3-9 a.m.

4272 kc. WOO
-C- 70.22 meters
OCEAN GATE, N. J.
Calls ships irregularly

4098 kc. WND
-C- 73.21 meters
HIALEAH, FLORIDA
Calls Bahama Isles

4002 kc. CT2AJ
-B- 74.95 meters
PONTA DELGADA,
SAO MIGUEL, AZORES
Wed. and Sat. 5-7 p. m.

3040 kc. YDA
-B- 98.68 meters
N.I.R.O.M.
TANDJONGPRIOK, JAVA
5:30-11 a.m.

(All Schedules Eastern Standard Time)

When to Listen In

By M. Harvey Gernsback

All Schedules Eastern Standard Time

ENGLAND

● DAVENTRY operates approximately as follows in April. Trans. 1—12:15-2:15 a.m. on GSN (11.82 mc.) and GSB (9.51 mc); Trans. 2—6-8:45 a.m. on GSJ (21.53 mc.) and GSG (17.79 mc.) A third transmitter may be used on GSF.; Trans. 3—9-10:15 a.m. on GSG and GSF (15.14 mc.), 10:15 a.m.-12 n. on GSF and either GSG or GSE (11.86 mc.); Trans. 4—12:15-2:15 p.m. on GSI (15.26 mc.), GSD (11.75 mc.) and GSB, 2:15-4 p.m. on GSD, GSB and either GSL (6.11 mc.) or GSC (9.58 mc.), 4-5:45 p.m. on GSB, GSD and either GSC or GSO (15.18 mc.); Trans. 5—6-8 p.m. on GSD, GSC and either GSB or a 19 meter wavelength (GSF, GSO or GSP, (15.31 mc.); Trans. 6—10-11 p.m. on GSD and GSC.

GERMANY

The latest schedule available on the German short wave stations follows: Stations marked (*) are experimental. For South Asia DJN 12:30-3 a.m., 3:50-11 a.m., DJR* 1:30-3:30 a.m., DJB 3:50-11 a.m., DJL* 6:30-8 a.m. For East Asia DJA 12:30-3:50, 8:05-11 a.m., DJQ 12:30-3, DJE 8:05-11 a.m. For Africa 11:35 a.m.-4:25 p.m. on DJD and DJC., on DJP* 12 N-2 p.m.; DJO* 3-4:55 p.m. For S. America, DJA 4:55-10:45 p.m. For Central America DJN, 4:55-10:45 p.m. For N. America DJD and DJC 4:55-10:45 p.m., DJM* 7:30-9:30 p.m.

CZECHOSLOVAKIA

According to a letter received from the directors, the new 34 kw. short wave broadcaster being erected near Prague by the government, should be ready for tests by May of this year. It has wavelengths in all the s-w broadcast bands except the 16 and 11 meter bands.

ITALY

The schedule of the Italian 2RO has not been changed at the time of writing but it is expected that the afternoon transmission will be shifted to 11.81 mc. shortly. 2RO has 2.19 meter waves (15.23 and 15.29 mc.), one 16 meter wave (17.77 mc.), one 13 meter wave (21.51 mc.) and one 11 meter wave (25.65 mc.). These will probably be employed during the coming summer, especially during the morning transmissions.

(Continued on page 43)

Here's Your Button

The illustration herewith shows the beautiful design of the "Official" Short Wave League button, which is available to everyone who becomes a member of the Short Wave League.

The requirements for joining the League are explained in a booklet, copies of which will be mailed upon request. The button measures ¾ inch in diameter and is inlaid in enamel—3 colors—red, white, and blue.

Please note that you can order your button AT ONCE—SHORT WAVE LEAGUE supplies it at cost, the price, including the mailing, being 35 cents. A solid gold button is furnished for $2.00 prepaid. Address all communications to SHORT WAVE LEAGUE, 99-101 Hudson St., New York.

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

SHORT WAVE SCOUT NEWS

Brecksville, Ohio, O.L.P. Short Wave "Log"

KKP—16030 kc., Hawaii, very loud.
HH3W—9595 kc., Haiti, very loud, clear and steady.
VK2ME—9590 kc., Australia, fair, rather choppy; calling W2XAF.
HRN—5875 kc., Honduras, very good.
DJC—6020 kc., Germany, very loud and clear.
HRN—5875 kc., Honduras, very loud.
HC2RL—6660 kc., Ecuador, very good.
KEE—7715 kc., U.S., very loud.
GSC—9580 kc., England, very good, steady.
DJC—6020 kc., Germany, very loud.
GSL—6110 kc., England, loud but QRM.
KEE—7715 kc., U.S., very loud.
TIEP—6710 kc., Costa Rica, loud, but QRM.
HH3W is a new station located in Port Au Prince, Haiti. P.O. Box A117.
Xmitter 42-46-46s Mod. Grid A. 30 watts output. Schedule—1 to 2 P.M., and 7 to 8:30 P.M., E.S.T.
C. Ricardo Widmaier, Opr.

The above is from a veri received from HH3W. HH3W is the call used for broadcasting, while HH2W is the amateur call. (Eastern Standard Time.)

EDWARD M. HEISER,
Route 2, Box 124
Brecksville, Ohio.

Official Listening Post Report from Hiram Muxo, 765 Trinity Ave., Bronx, New York.

● GLAD to be of service to *Short Wave Craft.* My report: These new stations have not verified.
HRP1—El Eco de Honduras, 6360 kc., R7.
TGS—Radiotransmisora de la Casa Presidencial, 5713 kc., R8.
TI8WS—Ecos del Pacifico, Punta Arenas, Costa Rica, 7550 kc., bad fading.
YV8RB—From Barquisimeto, Venezuela, 5880 kc., R9 at times.
YV5RMO—Ecos del Caribe, Maracaibo, Venezuela, 5850 kc., R9 plus. I heard this station on Feb. 18, about 9:30 P.M., E.S.T.
The following stations have verified:
DJE, DJA, DJB—Germany. These stations come in R9.
EAQ—Spain, 9860 kc., 22:30 to 02:30, G.M.T.; 17:00 to 19:00 G.M.T., Sat.
2RO—Italy, 6:00 to 7:30 P.M., Mon.. Wed., Fri., 6085kc.; 2:30 to 5 P.M., every day on 9780 kc.
HJ4ABE—La Voz de Antioquia, 50.6 meters, near 5950 kc. Daily 11 A.M., 12 noon; 6 to 10:30 P.M.
HJ4ABB—Manizales, Columbia. Mon., to Fri., 12:15 to 1 P.M.
T1PG—La Voz de la Victor, frq. 6410 kc., 1000 watts.
COCD—La Voz del Aire, 6130 kc.
COCO—6010 kc., Havana, Cuba.
CJRX, 11720 kc.; W8XK, 21.50 mc., 1521 mc.; W9XF, 6100 kc., 10 k.w.; W1XAL, 11790 kc.; W2XAF, 9530 kc.; CJRO, 6150 kc.; W2XAD, 15330 kc.; W3XAL, 17780 kc.

HIRAM MUXO.

Report from F. W. Hartmann, South Amboy, N.J.

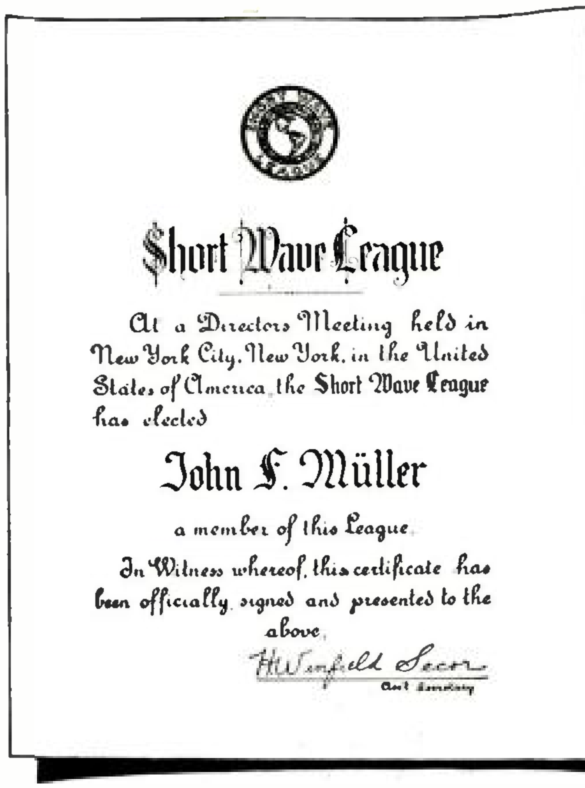
● OVER 100 stations were heard in the past month.

W1XK in Boston and W8XK in Pittsburgh do not *verify* reports any more. YV1ORSC mentioned in last month's report is in San Cristobal, Venezuela and not Colombia, as was stated.

Among stations heard the past month were:
HP5F—6080 kc., 10:05 P.M., Colon, Panama, fair to good.
HJ4ABA appears to have raised its frequency slightly.
HRN—5875 kc., Honduras, very good, best heard Sundays 9-10 P.M.
YV12RM—6300 kc., 6:45 P.M., Maracay, Venezuela, fair.
CEC—10670 kc., 8:30 P.M., Chile, heard best around 9 P.M.
HI1S—Dominican Republic, 6420 kc., heard 8 to 10:30 P.M., calls U.S. amateurs at times.
DJM—6079 kc., 4:17 P.M., Berlin, Germany, on 12 noon to 4:30 P.M., best heard around 4 to 4:30 P.M.
CO9GC—6155 kc., 6:28 P.M., Santiago, Cuba, very good.
TIRCC—6550 kc., 7:48 P.M., San Jose, Costa Rico, fair to good.
DZB—10042 kc., 2:50 P.M., Berlin, Germany. broadcasts 2 to 4 P.M.
JVM—10746 kc., Japan, strong code interference on its Monday and Thursday broadcasts, signal strength fair to good.
DZA—9675 kc., 5:05 P.M., Germany, good.
W9XAA—11830 kc., Chicago, Ill., heard 8 to 10 A.M.
VK3ME—9518 kc., Melbourne, Australia, is poor to fair.
VK3LR—9580 kc., Melbourne, Australia, heard best 7 to 7:30 A. M.
VE9DN—6005 kc., Montreal, Canada, very good, heard 11:40 A.M. to noon on Saturdays.
VK2ME—9590 kc., Sydney, Australia, heard good on Sundays, 7 to 8 A.M.
PMN—10260 kc., 7:25 A.M., Bandoeng, Java, very poor.
HJ3ABD—6050 kc., 10:38 P.M., Bogota, Colombia, very good; HJ3ABD Colombia Broadcasting moved to 6050 kc. from 7400 kc., its old frequency.
HC2JSB—Guayaquil, Ecuador, heard at different times.
HJN—5970 kc., 10:08 P.M., Bogota, Colombia, very good.
JVN—10660 kc., Tokio, Japan, was heard 7:53 to 9:05 A.M.

Verifications received from HAS3, TPA2 for 15 meg. 11890 kc., 11715 kc., DZB, W4XB, W1XAL, 6.04 meg. and W1XAL, 11 meg.

FLETCHER W. HARTMAN,
365 John Street, South Amboy, N.J.


Short Wave League

At a Directors Meeting held in New York City, New York, in the United States of America the Short Wave League has elected

John F. Müller

a member of this League

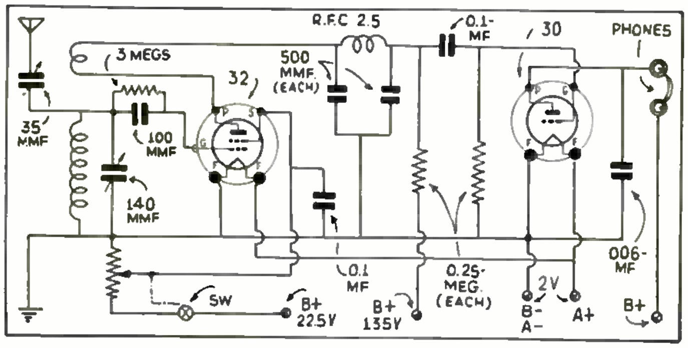
In Witness whereof, this certificate has been officially signed and presented to the above

H. Winfield Secor
Asst. Secretary

This is the handsome certificate that is presented FREE to all members of the SHORT WAVE LEAGUE. The full size is 7¼" x 9½".

See page 58 how to obtain certificate.

• • • Short Wave



2-tube battery-operated receiver.

REGENERATIVE BATTERY SET

Robert Jones, Westerpoint, Md.

(Q) I would like to build a battery set using a type 32 as a regenerative detector, resistance-coupled to a type 30 audio frequency amplifier. Regeneration should be controlled with a potentiometer and the coils should have two windings.

(A) For a battery-operated receiver this one should be the most efficient of the simpler sets. Coil

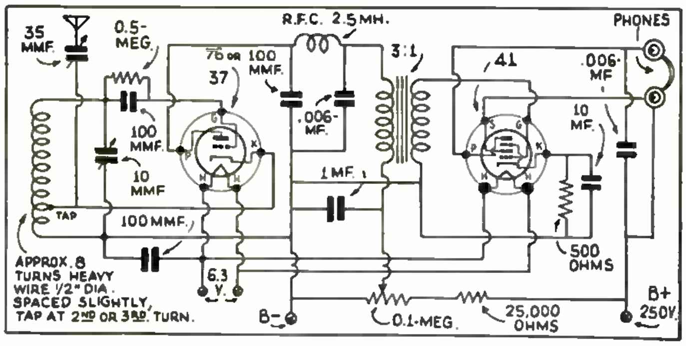
(A) We see no reason why either the 2-tube set or the Oscillodyne should cause interference in a broadcast receiver providing the smaller sets were tuned to wavelengths below 200 meters.

5 METER RECEIVER

Michael DeFonce, White Plains, N.Y.

(Q) Would you be kind enough to print a diagram of a 5 meter receiver which uses a 37 and a 41.

(A) The 5 meter receiver here



5-meter receiver using 6.3 volt tubes.

data can be obtained from the January 1936 *Question Box.*

2-TUBE DIAGRAM

C. Doane, Jr., Marshfield, Ore.

(Q) Please print a diagram of a reiceiver using a 57 and 56 with no R.F. stage.

(A) You will find such a diagram reprinted herewith.

(Q) Will this receiver cause interference in a regular broadcast receiver, when the short wave set is tuned below 200 meters. Also would a 1-tube super-regenerator, such as the 1-tube Oscillodyne, cause interference under similar conditions?

printed is of the self-quenching type and should give excellent results. It is practically the same as the famous 2-tube receiver originated in the November, 1934 issue of *Short Wave Craft* and which is used by nearly 50% of the 5-meter "bugs."

AMPLIFIER FOR BAT. SET

S. Platkin, Brooklyn, N.Y.

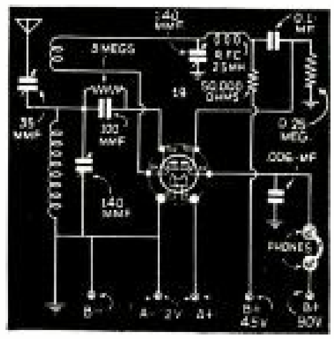
(Q) I have built the "Prof. Doerle" and have had excellent results with it. Now I would like to add an amplifier to it, in order that I may obtain full loud-speaker volume. Would you kindly print the diagram and indicate a suitable tube.

(A) Undoubtedly the best suited tube is the type 33 pentode. This will provide plenty of volume for the speaker. The input connections as shown in the diagram should be connected to the present phone posts of your receiver.

PHONE-JACK FOR ALL-STAR JUNIOR

M. J. Schaffer, Vallejo, Calif.

(Q) Would you please tell me how I may connect a pair of earphones to the All-Star Junior 5-tube Super? If possible I would like to use a jack which would cut out the speaker, while the phones were being used.



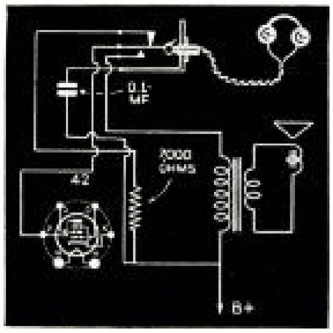
"Two-in-one" receiver using a type 19 tube.

2 IN 1 RECEIVER

Harry W. Lewis, Quakertown, Pa.

(Q) Please show a diagram in the *Question Box* of a 1-tube battery operated receiver using a type 19 tube, one section for the regenerative detector and the other as a resistance-coupled audio amplifier.

(A) This 1-tube receiver which actually performs the same as a 2-tube set, was originally the "*Twinplex*" which took short-wave "Fandom" by storm several years ago. Excellent results can be expected and it is an ideal beginner's set.



Phone jack for "All-Star" receiver.

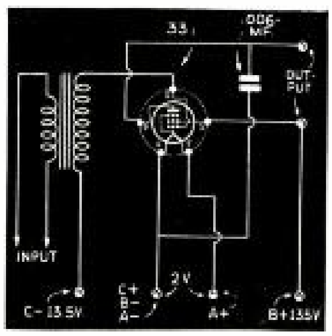
(A) We have shown in the diagram a method by which you may connect phones to the 42 amplifier and disconnect the speaker at the same time. The 7000 ohm resistor is brought into the circuit when the primary of the output transformer is disconnected in order to provide a suitable load for the pentode. The jack has three plates, forming a single-pole double-throw switch and also the output connections for the earphones.

NEED LICENSE FOR FIVE METERS?

Harry Retales, Ipswich, Mass.

(Q) Please give me complete details and information regarding the use of the five meter band. For experimental purposes is a license necessary?

(A) Absolutely! A license is necessary, regardless of what wavelength you are operating on. Many experimenters are under the impression that for the very short waves, no license is needed. This of course is *not* true.



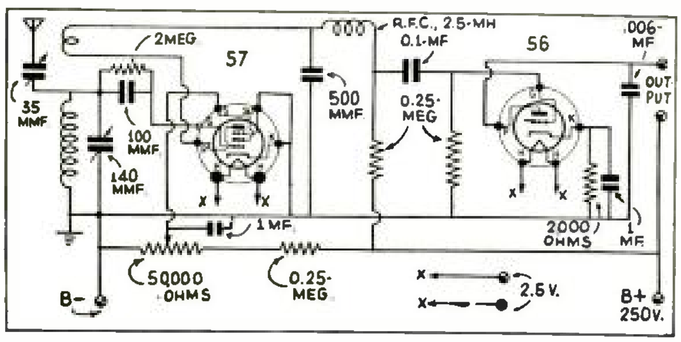
Pentode amplifier for any battery set.

3-TUBE A.C., T.R.F. RECEIVER

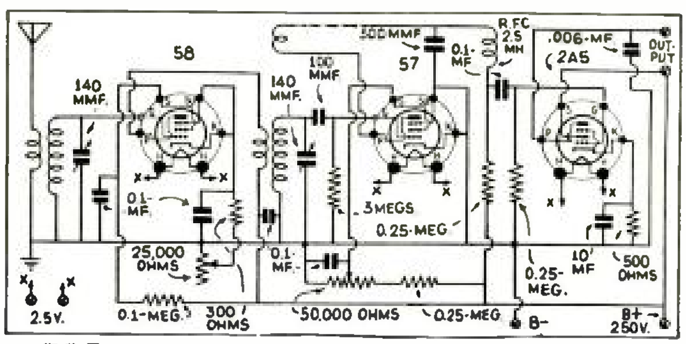
William Danson, Sussex, Can.

(Q) Would you please publish a diagram of a short-wave receiver using a 58 tuned R.F. amplifier, a 57 regenerative detector and a 2A5 audio amplifier? Could another 2A5 be added to this at a later date?

(A) The diagram you requested will be found on this page and it should make an excellent short-wave receiver. However, we do not recommend that you add another pentode to the line-up already shown. Better results will be obtained by adding a 56 between the 57 and the 2A5. This will give additional audio volume.



The old "standby"; 57 detector and 56 A.F. amplifier.



T.R.F. regenerative receiver with pentode A.F. amplifier.

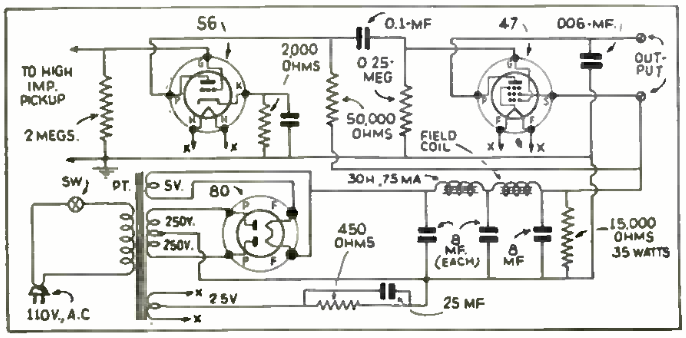
QUESTION BOX

EDITED BY GEORGE W. SHUART, W2AMN

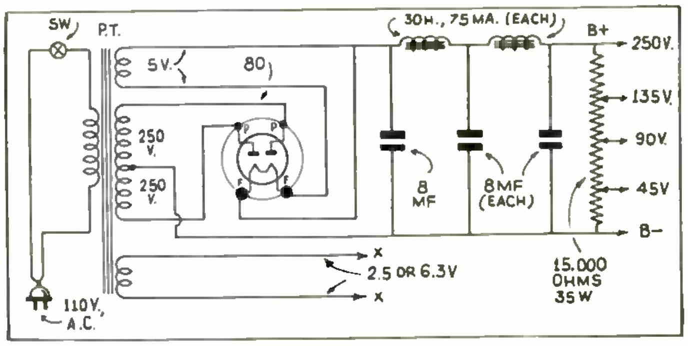
● Because the amount of work involved in the drawing of diagrams and the compilation of data, we are forced to charge 25c each for letters that are answered directly through the mail. This fee includes only hand-drawn schematic drawings. We cannot furnish "picture-layouts" or "full-sized" working drawings. Letters not accompanied by 25c will be answered in turn on this page. The 25c remittance may be made in the form of stamps, coin or money order.

Special problems involving considerable research will be quoted upon request. We cannot offer opinions as to the relative merits of commercial instruments.

Correspondents are requested to write or print their names and addresses clearly. Hundreds of letters remain unanswered because of incomplete or illegible addresses.



Amplifier for phonograph pick-up.



Power-supply for any A.C. operated receiver.

AMPLIFIER FOR PHONOGRAPH PICK-UP

Stuart G. Patterson, Phila., Pa.

(Q) I intend to build an amplifier for an electric phonograph using a 56 and a 47 together with an 80 rectifier. Would you please print the necessary diagram and state the impedance of the pick-up head. Also what field-coil resistance should be used in the power-supply.

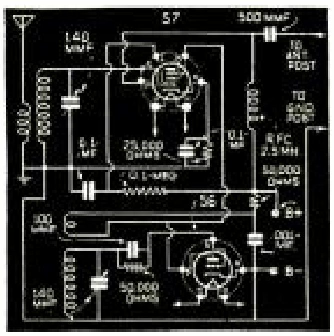
(A) The complete diagram is shown and we recommend that a high impedance pick-up be used and coupled directly to the grid circuit. For the field coil we suggest something around 1500 to 2000 ohms. This should be used in place of one of the filter chokes as shown in the diagram.

3-TUBE E.C. RECEIVER

Arthur Woolf, Johannesburg, S. Africa.

(Q) Would you please be so kind as to publish in one of your coming *Question Boxes* a circuit diagram showing the connections of an electron-coupled 3-tube receiver. I would like to use a 57 transformer, coupled to a 56 and another transformer coupled to a 2A5. Also furnish the coil data.

(A) We are printing the diagram you request but are not showing transformer coupling. The 57 does not work well through a transformer and we believe better stability and results would be obtained by using resistance coupling. The antenna should be coupled through a 35 mmf. variable condenser. The coil data for this receiver may be found in the January *Question Box.*



2-tube converter.

2-TUBE CONVERTER

Edward Cole, Cape Girardeau, Mo.

(Q) I have an RCA superheterodyne receiver which does not cover the short-wave bands and I would like to construct some sort of converter which would give me satisfactory results. Would you be kind enough to print a diagram in your *Question Box?*

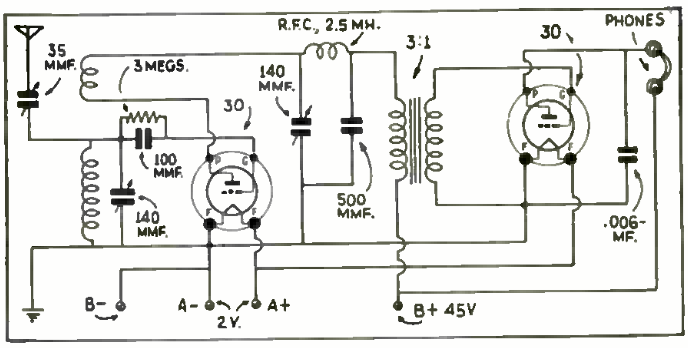
(A) We are pleased to print the diagram of a converter using a 56 and a 57. Standard four prong coils are used, data for which may be found in the January *Question Box.* This should give satisfactory results in conjunction with your receiver. If your set happens to use 6.3 volt tubes, then you will, of course, substitute a 6C6 and a 76 in place of those shown in the diagram.

DIAGRAM OF TWO TYPE 30's

L. Edwards Jr., Shelbyville, Tenn.

(Q) Would you be so kind as to publish a diagram of a battery-operated receiver using two type 30 tubes? This should have a regenerative detector with a regeneration condenser and one stage of transformer-coupled audio amplification. The plate supply should consist of 45 volts from a "B" battery.

(A) This combination provides a very sensitive and economical receiver and is ideally suited to the needs of the new-comer to the ranks of short waves.



Battery set using two type 30's.

POWER SUPPLY DIAGRAM

H. V. Calkins, Toledo, Ohio.

(Q) I would like to construct a power supply which will deliver the following voltages: 3 volts, 45, 90, and 145 volts.

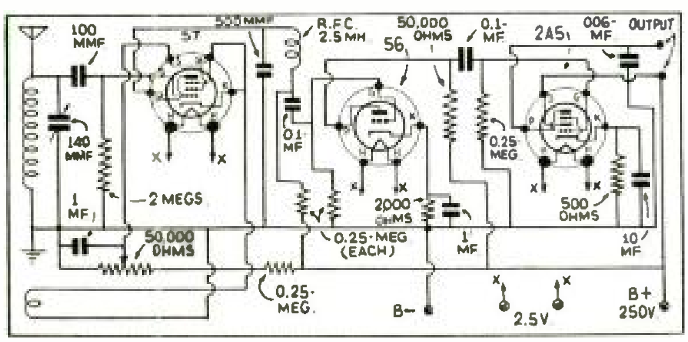
(A) The power supply diagram shown will deliver the necessary voltages. However, we do not know why you specify 3 volts, unless this were for the filament supply. Transformers usually have 2.5 or 6.3 volt filament windings.

2-TUBE A.C.-D.C. SET

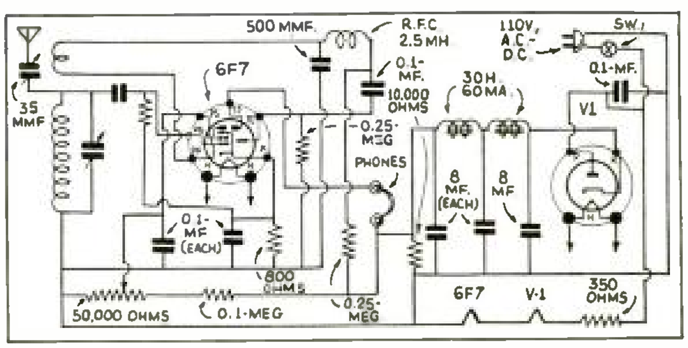
Bob Feik, Sioux City, Iowa.

(Q) Would you please print a diagram in your next *Question Box.* of an A.C.-D.C. receiver.

(A) The 6F7 is used as the detector and audio amplifier; the pentode section as the detector and the triode section as the audio stage. The heaters are operated directly from the 110 volt line through a voltage-dropping resistor.



Regenerative detector and two A.F. amplifiers.



A.C.-D.C. receiver with a 6F7 and a V1.

Some Little-Known Facts About Short and All-Wave Aerials — By Arthur H. Lynch

With a special discussion of the best location for an antenna; "long distance" reception in noisy locations.

Long-Distance Reception

● LONG-DISTANCE radio reception depends upon several important factors. The power used at the transmitter is very important. No less important is the transmitting antenna. Such eminent authorities as Paul F. Godley, have been able to increase the service areas of many of our broadcasting stations by making no changes in power, but simply by improving the design of the antenna systems. We have been attempting to cover long distances by radio for a long time, but it has only been during the past couple of years that the *importance of the antenna system* has been recognized.

Another important factor to be considered in our long distance work is the *location of the receiver itself!* Then, too, the design of the receiver and its overall sensitivity, selectivity, and so forth, must be considered.

We are then in just about the position of the person who has a new receiver and wants to install it in a manner which will bring about the most satisfactory reception. There is one drawback to long distance radio reception which is greater than all others—and that is *man-made static!* It makes itself evident to us by producing raucous groans and hisses along with the speech and music we desire. It is much more prevalent in some localities that others, and there are a very few locations where this nuisance does not seem to exist at all. It is this noise, produced by the radiations from the circuits in which electrical machinery is incorporated, therefore, from which we must free ourselves, if we are to get the best possible performance from our receivers.

Installing a Modern Radio Receiver

Radio receivers, as they are being manufactured today, are very satisfactory devices and they are, as a general thing, sensitive enough to cover very long distances for us, if we only give them *half a chance!* It must be remembered from the very start, that we can only use the full sensitivity which the manufacturer has provided in our receiver, if its use does not bring in a lot of noise to "hash up" our desired programs. Most receivers are so sensitive that they will actually bring in stations a thousand miles or more away when attached to a wire just a few feet long, in a location *which is free from noise.* Therefore, the first thing to do in placing a receiver in operation is to set it up in the most convenient part of the house and attach ordinary pieces of wire to the antenna and ground posts. If the volume control can be run up to the limit, without having the loudspeaker imitate the "battle of the Marne," you may consider yourself very lucky and you need concern yourself but little with the antenna and noise problem which is very much the concern of us less fortunate folk.

If a small amount of noise is observed, it may be eliminated in a great many instances by the very simple expedient of moving the receiver to another part of the same room, or by increasing the length of the antenna wire. The increase in length results in a better signal pickup and has the apparent effect of cutting down the interference. Moving the receiver is a remedy which is frequently effective but is little tried.

If you are, like most of us, still bothered by an undesirable din from your loudspeaker, it may be that a good line filter inserted between your electric light outlet and the receiver will do the trick for you. It will be observed that what we are attempting to do is provide satisfactory reception with the least possible effort and expense. This desirable result is not always possible but it is worth striving for.

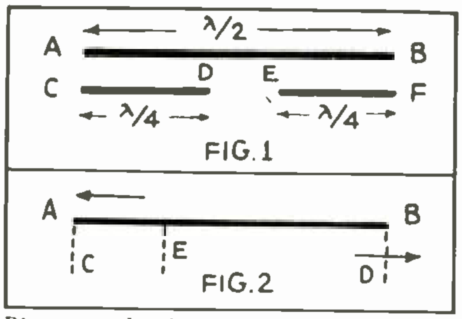
There is a definite relation between the energy picked up by our receiver from the station we desire to hear and the energy it picks up from those circuits which radiate parasitic electrical impulses which create noise. This relationship is known as the *signal-to-noise* ratio. For satisfactory reception we must have a ratio which is in favor of the signal.

Contrary to general belief, there is not much inherent noise in the radio receiver itself. This may be proved very easily by simply disconnecting the antenna and turning the volume control up to the limit. There is a lot of "loose conversation" going on at present about *tube noise.* Such noise is of no practical consequence in the ordinary receiver and, therefore, need have no consideration here at all.

The ideal situation is one where we may have complete freedom from noise and an antenna of reasonable length, let us say from forty up to a hundred or more feet from the antenna post on the receiver to the far end of the antenna. The length, for ordinary reception is not very important.

Fortunately, the noise which most interferes with our reception is confined to an area of a few feet around the wiring which carries it into our location. Interference from a neighbor's vacuum cleaner or oil-burner may be carried along the electric light or the telephone wires and radiated in our house and may then be picked up by our antenna.

Therefore, when we happen to be in a location where interference of the "man-made" variety prevails, it is necessary for us to set up our antenna in a manner which will enable us to pick up the *greatest amount* of energy from the desired stations and the *least possible energy* from radiators of interference. We must, in other words, improve the *signal-to-noise* ratio.



Diagrams showing relation of ¼ and ½ wave-length aerials; also impedance—match diagram.

What we need is a means of placing our antenna far enough away from the sources of interference to prevent it being affected by them, and then a means of getting the energy picked up by the antenna to our receiver, without being contaminated by the local parasitic radiations.

Solving the "Noise Pick-up" Problem

The whole matter is not very complicated and may be thoroughly understood by reference to the accompanying figures. Suppose we go over them in rotation, considering each problem and its solution as we go. In Fig. 1 we have represented two different types of antennas. The upper line, between A and B, may be considered to represent the portion of any antenna which is the "flat-top" and which is generally in a horizontal or semi-horizontal plane. We have represented the length as being $\lambda/2$, (λ = wavelength) or approximately one-half the wavelength to which it will respond most readily. The relation of wavelength to the antenna length is an important consideration for either transmitting or receiving, when the service is to be maintained upon a single wavelength. It loses its significance when we attempt to use the antenna to cover a broad band of wavelengths or frequencies, as is the case when we are using a modern, multi-band or all-wave receiver.

An antenna of similar length is represented in the lower portion of the figure by C-D and E-F, though it is broken in the center, and each section is half as long as A-B, or one-quarter wavelength, for some particular frequency. While there has been a great deal said and written about the importance of the length of the antenna and the manner in which it should be erected, it is not generally understood that most of the information which has been published has been based upon the performance of antennas for *specific*, rather than *general* purposes.

For instance, much has been made of the *directional properties* of various forms of antennas. While the *directional properties* may be demonstrated on certain wavelengths with a particular antenna, we can not assume that the same characteristics will be found to exist when the antenna is used on other wavelengths. It should be remembered that we are much more concerned with *reducing noise* than we are with the increasing of signal strength, because *the average, modern receiver,* as we have mentioned, *does not require very much of an antenna to produce plenty of signal from the desired station, if we are able to keep the noise down to a reasonable level.*

Let us assume, then, that either of the forms we have illustrated will do the job, as far as "pick-up" is concerned. Would there be any advantage in selecting one over the other? Progressing to Fig. 2, we have shown three possible connections from A-B, by the dotted lines C, D and E, which represent the ordinary lead-in which is used to connect the antenna to the receiver. If the lead C is employed we may consider that the antenna will receive best from the direction to the left, while the reverse will be true, if the lead-in is taken off in the position indicated by D. However, this statement may be taken with a "grain of salt" in connection with the *average* person's receiving antenna. It is true that antennas having their leads taken off from one end will receive best in the direction opposite the free end, but it is only true to any marked degree, when the horizontal portion of the antenna is several times as long as the wavelength we desire to receive. To have any noticeable *directional properties*, in the regular broadcast band, therefore, the antenna would have to be *several blocks* long! If the connection is made at E, no noticeable directional effects will be observed but another point is raised which has come in for its share of misconception.

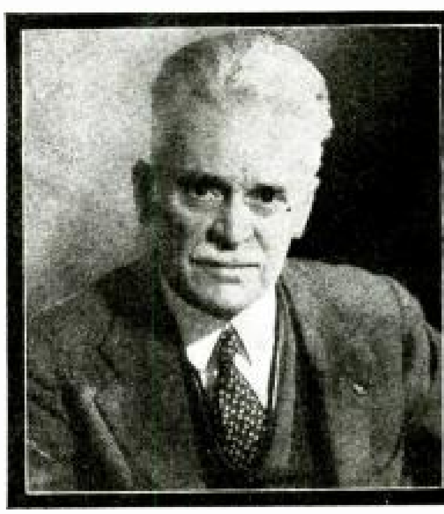
If the point at which E is connected is carefully chosen with relation to the total length of the antenna—that is the horizontal portion, A-B—we provide ourselves with what is termed a single-wire, *matched-impedance* lead-in. That is, we will accomplish such a result if we consider that the antenna will respond to a particular frequency or wavelength, rather than a whole group of wave lengths, which is more in line with what we require. Therefore, for the purpose of general reception, we may just as well forget about all the ballyhoo with which such lines have been adorned. We may just as well forget about *impedance matching*, for the moment.

(To be concluded)

HIRAM PERCY MAXIM

● SHORT-WAVE "Hams" throughout the country mourn the passing of Hiram Percy Maxim who passed away on February 17 at La Junta, Colorado. His home was in Hartford, Connecticut, from which point his far reaching activities in short-wave Hamdom emanated. Mr. Maxim was well-known throughout the world, particularly as the inventor of the Maxim silencer and numerous implements of warfare. Mr. Maxim was the president and founder of the American Radio Relay League with headquarters at Hartford, and he was responsible for the rapid growth of the League and its membership, which numbers thousands of short-wave "hams" throughout the country.

Hiram Percy Maxim was the son of Sir Hiram Stevens Maxim, inventor of the Maxim automatic gun, and he was a nephew of Hudson Maxim, inventor of smokeless powder.



For many years, Mr. Maxim was president of the Amateur Cinema League and he was also president of the International Radio Union. Mr. Maxim was born in Brooklyn, New York, September 2, 1869, and in 1886 he graduated from the School of Mechanic Arts of the Massachusetts Institute of Technology. He also held an honorary degree of Doctor of Science from Colgate University. At the start of his career, Mr. Maxim was an electrical engineer with the Fort Wayne (Indiana) Jenny Electrical Company. He was also associated at one time with the Thomson Electric Welding Company of Lynn, Massachusetts. Later he was associated with the American Projectile Company of Lynn, and still later he was chief engineer for the Electric Vehicle Company of Hartford, Connecticut. He was a member of numerous scientific societies and held a commission as Lieut. Commander in the United States Naval Reserve Corps. In 1933, he published a book entitled—"Life's Place in the Cosmos."

How 5-Megacycle Waves Bridged Hurricane Break

(*Continued from page 6*)

masts for the antennas, and erecting two shacks, each about eight by twelve feet, for the radio transmitters and receivers. The second day after work started in the field, radio contact was established on a temporary basis. In the meantime the linemen were bringing in connections from the open-wire circuit to Key West, and on September 21 the first circuit was formally turned over for service.

12 Volt Storage Batteries Supplied Power

In the preliminary conferences held to decide the type of apparatus to be employed, it was recognized that a considerable amount of electric power would be required for the operation of the radio apparatus. Since no commercial power was available anywhere near the sites of the radio terminals, it was desirable to use the most efficient and the lowest-power radio equipment available. This led to the decision to use some of the low-power equipment developed for airplane and ship-to-shore communication. To meet these requirements the five-watt 19A transmitter and a 12-type receiver were finally selected. Both of these units have very moderate power requirements, and *12-volt storage batteries could be used as a primary source of power.* Complete radio equipment for four channels, two in each direction, including batteries and dynamotors, was shipped from New York to Miami, where it was taken by truck to the site of the eastern terminal just outside of Tavernier. Here half of it was unloaded and the rest put on a fishing boat for the fifty-five-mile water trip to Big Pine Key.

The equipment and arrangement at the two terminals are practically identical. The two radio shacks and antenna poles at Big Pine Key are shown in the photograph at the head of this article. The shacks are about 300 feet apart and each has its antenna poles located adjacent to it and as near the water as practicable. The transmitter antennas are single-wire verticals approximately a quarter-wavelength long. One antenna is fed by a concentric transmission line and the other runs directly to the radio transmitter. Vertical wires were also used for the receiving antennas.

Simplicity and Small Size of Apparatus Outstanding

The simplicity and small size of the apparatus within the shacks are evident from the photographs. In the transmitter shack the two 19A transmitters are mounted on a shelf and the two dynamotors, supplying 500 volts for the plate, are on another shelf directly beneath them. On the floor are the storage batteries supplying power for the filaments and the dynamotors. Sufficient B-battery capacity is also available for emergencies. The box on the wall above the transmitters terminates the lead cable running underground to the receiver shack. The arrangement of the receiver shack is similar. On the upper shelf are the two 12-type receivers, while beneath them are the dynamotors and batteries. A 3000-cycle cut-off filter is connected in the output of each receiver to eliminate carrier hiss and other extraneous high-frequency noises.

To conserve power, the receivers and transmitters at both ends were provided with a remote control on-off circuit, the Big Pine Key terminal being controlled from Key West, and the Tavernier terminal, from Miami. This enabled the testboard men at Key West and Miami to shut down the radio apparatus whenever there is no traffic and thus to save considerable power. Such an arrangement is particularly desirable at Big Pine Key where the batteries have to be carried all the way to Key West for recharging. The batteries for Tavernier were hauled to Homestead for charging.

Every precaution was taken during the installation to prevent cross-talk or any form of interaction between the various circuits at each terminal. Frequencies of about *five megacycles* were employed for transmitting from west to east and of about *four megacycles*, from east to west. This gave a separation of approximately a million cycles between transmitter and receiver frequencies at either terminal, and combined with the 300-foot separation between transmitters and receivers, greatly helped to eliminate interference. In addition all speech wires near the radio receivers, and the composite coils in the connecting telephone lines, were carefully shielded and grounded. The use of underground lead cable to connect the two shacks was another precaution against such interference. With these precautions, and the inherently high quality of the radio apparatus employed, transmission is exceptionally good considering the small amount of power used. During the day a user talking from New York to Havana would not be aware that a radio link was included in the circuit. Sometimes bad static conditions are encountered at night. More than 80 per cent of the calls normally originate during the daytime, however, and the circuit during the first few weeks, was kept in operation only during daylight hours.

Not only was the installation completed in a remarkably short time, but it was carried out under adverse conditions. The sites were covered with a dense mangrove jungle, with mosquitoes and sand flies in droves. Some conception of the appearance of the country may be obtained from the illustration which shows one of the sites during an early stage in the construction. Smudges were kept going continuously in a more or less vain effort to beat back the mosquitoes. Although the shacks were screened, so that the installation inside the shack could proceed without too much annoyance from mosquitoes, the screening proved of little value in barring the sand flies, which readily passed through its meshes. In addition, there were the transportation difficulties caused by the remoteness of the radio terminal sites and the disruption of normal transportation services. In spite of all obstacles, however, the work proceeded rapidly, and the second channel was turned over on September 28. For the first time a radio link had been used in this way as an emergency means of restoring service in an important telephone line.—*Courtesy Bell Laboratories Record.*

The LAMB "Noise Silencer"

(*Continued from page* 16)

of this operation can be maintained. This adjustment can be so set that the signal will maintain itself at any pre-determined level. Thus when the noise increases above the signal-level, the "gain" of the receiver is cut down, permitting the noise to be cancelled out.

It will thus be seen that the noise can never rise to a greater amplitude than the signal. The diagram given is for an adapter unit which may be applied to any superhet receiver having two I.F. stages. Experience and actual tests have proven that those who try this very ingenious idea will be well rewarded for their efforts.

WAKE UP! FELLOWS!
$20.00 Prize Monthly for Best Set

● **THE editors are looking for "new" receiving circuits—from 1 to 5 tubes preferably. A $20.00 monthly prize will be awarded to the best short-wave receiver submitted. The closing date for each contest is 75 days preceding date of issue (April 15 for the July issue, etc.). In the event of a tie, an equal prize will be given to each contestant so tieing. Address all entries to: Editor, SHORT WAVE CRAFT, 99 Hudson St., New York City.**

5-Meter Super-Regenerator

(*Continued from page 16*)

ing grid-leak and condenser and plate return by-pass to cathode, are chosen so that blocking action is attained, thus causing super-regeneration. The circuit as shown functions as a usual oscillator, in which the grid-leak is too high to allow the grid electrons to leak off at a rate which would give a constant value of grid voltage. As a result, there is a variation of average bias which stops oscillation because the plate current is decreased and the mutual conductance of the tube drops.

The circuit constants (values of grid-leak and condenser and circuit decrement) determine the cycles per second this occurs; in this instance, an inaudible rate. Evidently, the plate circuit must constitute a comparatively low impedance path to cathode at such an inaudible frequency, since the plate by-pass must be not lower than .006 mf.

Resistive coupling is used to the first audio (6C5) tube. The plate-to-cathode return by-pass condenser must be quite large to permit super-regeneration. This condenser has no effect on the radio frequency, since it is on the low R.F. voltage side of the R.F. choke.

The super-regenerative circuit is extremely desirable for stand-by operation when receiving modulated oscillator transmitters, due to the fact that it tunes quite broadly. This is due to the fact that the detector circuit oscillates periodically over a band of frequencies often from 50 to 195 k.c. in width. As the plate or grid voltage of the super-regenerative detector is varied over wide limits, it goes in and out of oscillation at extremely high frequency, thus varying its oscillation period and resulting in the desired broad tuning.

Through the use of two stages of audio amplification sufficient volume is obtained to assure satisfactory reception under practically all conditions. The circuit shown will give excellent results even in locations where local interference is abnormally high. For earphone reception, the 6C5 tube in the output stage is very satisfactory. For loud speaker operation, a 6F6 tube is recommended. In changing from the former to the latter, cathode bias remains the same and it is simply necessary to connect the screen-grid terminal of the 6F6 tube to "B" plus.

For power supply, a six volt storage battery may be used with standard "B" batteries or for A.C. operation, the filaments may be supplied directly from a six volt transformer and the "B" supply from a "B" eliminator. Of course, a standard power supply may be constructed for this set using an 80 type rectifier. In this case, especially, care should be taken to have sufficient filtering.

The circuit above described is suitable either for five or ten meter reception. Coil constants are given with the diagram. An important feature of this receiver is the use of metal tubes throughout. These tubes, due to their inherent qualities produce superior results even in ordinary short wave sets. On ultra-short waves, the improvement over the glass tubes is still greater.

Construction Details

The set is constructed on a metal chassis 5¾" x 6" x 2" high. An aluminum panel 5¾" x 6" high is used.

The small variable condenser is mounted on a thin bakelite strip 2⅜" above the chassis deck. This is held in place by a small right angle bracket. The coils L1 and L2 are mounted on a thin bakelite coil shelf which is held about 1¼" from the chassis deck by means of two pieces of bakelite tubing. The variable condenser is set back about 3" from the panel, being connected to the tuning knob or vernier dial by means of a bakelite rod. If the set is to be used interchangeably for five and ten meter reception, lugs should be soldered to the ends of coils L1 and L2 so that the desired coils can be fastened to three binding posts by means of locking nuts.

Having mounted the four tube sockets on the chassis and fastened the panel to the chassis, the volume control is mounted on the front chassis wall, halfway from either side. The variable condenser and coils are mounted next. The other parts are mounted beneath the chassis. Most of them can be soldered in place while the wiring is being completed. A Fahnstock clip should be attached to the top of the chassis to provide a ground connection.

The wiring can be completed in a very short time. If unaccustomed to the new metal tubes, work from a socket diagram to avoid any chance for mistakes. Naturally, all leads should be made as short and direct as possible. Use spaghetti to avoid possibility of short circuits. Be sure to mount coil L3 at least an inch from the bottom side of the chassis deck. A resistor mounting strip may be used for this purpose.

Complete List of Parts

C1—Hammarlund Antenna Trimmer Condenser. type IBT-70 (70 mmf.)
C2—.1 mfd. Cornell-Dubilier Cartridge Condenser.
C3—Hammarlund Trimmer Condenser, type MICS-70. (70 mmf.)
C4—Hammarlund Midget Variable Condenser, type SM-15. (15 mmf.)
C5—.00025 mfd. Cornell-Dubilier Fixed Mica Condenser.
C6—.006 to .1 Cornell-Dubilier Cartridge Condenser.
C7—.01 mfd. Cornell-Dubilier Cartridge Condenser.
C8—.1 mfd. Cornell-Dubilier Cartridge Condenser.
C9—.01 mf. Cornell-Dubilier Cartridge Condenser.
C10—.1 mf. Cornell-Dubilier Cartridge Condenser.
R1—600 ohm 10 watt Electrad Vitreous Enameled Resistor.
R2—1 meg. ½ watt I.R.C. Metallized Resistor.
R3—170,000 ohm, ½ watt, I.R.C. Metallized Resistor.
R4—75,000 ohm Electrad Potentiometer with Switch, type 202.
R5—1 meg., ½ watt I.R.C. Metallized Resistor.
R6—1000 ohm, ½ watt I.R.C. Metallized Resistor.
R7—170,000 ohm, ½ watt I.R.C. Metallized Resistor.
R8—1 meg., ½ watt, I.R.C. Metallized Resistor.
R9—1000 ohm, 10 watt Electrad Vitreous Enamelled Resistor.
RFC—1 Hammarlund Midget R.F. Choke, type CH-X. (2.1 mh.)
RFC—2 Hammarlund Midget R.F. Choke, type CH-X.
L1—See Winding Directions.
L2—See Winding Directions.
L3—Hammarlund Midget R.F. Choke, type CH-X.
J1 and J2—Earphone Jacks.
BP1—Ground Post.
V1—Tube, type 6K7 R.C.A. Radiotron.
V2—Tube, type 6J7, R.C.A. Radiotron.
V3—Tube, type 6C5, R.C.A. Radiotron.
V4—Tube, type 6C5 or 6F6 R.C.A. Radiotron.
1—Calibrated Dial, I.C.A.
1—Bakelite Pointer Knob, I.C.A.
1—Small Knob for Volume Control.
1—Metal Chassis, Blan, 5¾" x 6" x 2" high.
1—Blan Aluminum Panel, 5¾" by 6" high.
1—Bakelite Strip, ⅛" thick, 3½" x ¾" for mounting L1, L2.
1—Bakelite Strip, ⅛" thick, 2¾" x ¾" for mounting variable condenser.
1—Bakelite Rod Shaft Extension.
2—Pieces of Bakelite Tubing, 1¼" high for coil shelf.
2—Metal Tube type Screen Grid Clips.

Girl Operators, Attention!

Listen "YL's" and "XYL's"!! Why not send the Editor a good photo of your "Rig"—and don't forget yourself. A separate photo of yourself will do, with a "clear" photo of that station! $5.00 for best "YL" photo.—Editor. See page 649 March issue for details.

A Modern 5-Meter Transmitter

(Continued from page 15)

Coils

The R. F. unit is as simple as possible. The oscillator grid coil is wound on an isolantite form, with a clip for changing the cathode tap. The grid condenser and leak are mounted on the top of the coil form. The coils between the 89 oscillator and 89 buffers are mounted on 1" feed through insulators, with the plate coil on the outside. The tuning condenser for the plate coil is directly under it, beneath the chassis.

The coils for the plates of the 89 buffers and the 801 grids are under the chassis and are mounted on a victron strip for efficient insulation. The buffer plate tuning condenser is at the rear of the chassis. It is made by cutting the rear bearing and one rotor and stator plate from a standard 35 mmf. double spaced unit. It would probably be better to move it forward about an inch or more, thus shortening the leads, and there would be no need to cut it up.

The 801 tank condenser is a double-spaced, split-stator unit and is mounted directly under its respective coil. A strip of Victron was placed under it since some of the screws came very near to the steel chassis wall. All the condensers are coupled by Insulex flexible couplings and ¼" bakelite rods to the knobs. These turn very easily and there is no hand capacity whatsoever.

Neutralizing and By-pass Condensers

The neutralizing condensers are 35 mmf. double spaced Star units. Since this capacity was rather high, they are cut down to 4 stator and 3 rotor plates and are both mounted on a 6" x1" Victron strip supported on bushings. The neutralizing connections to the 801 sockets are all made above the chassis.

All by-pass condensers in the set are mounted as close to their respective elements as possible, and the ground ends fastened to a piece of No. 12 wire which runs all the way across the chassis in the rear. All other ground connections are, of course, made to the same wire.

When ready to put the outfit into operation, the power supply should first be checked for correct voltages, then all heater and filament circuits should be tested. Set the C bias voltage divider at about the values mentioned previously and check to see that the voltage arrives intact at the grid terminals. It is a good plan to remove the filter imput condenser when first trying out the set, as this drops the voltage somewhat.

Tuning Up!

Since the procedure of tuning is exactly the same as in other M.O.P.A. jobs, it will be necessary to go into it but briefly. The oscillator grid condenser should be set about mid scale and the cathode tap at about the 4th turn from the bottom. Then rotate the plate condenser until a large dip occurs in the oscillator plate current. Next tune the buffer plate condenser till the buffer plate current drops sharply. The plate voltage to the 801's should not be connected for this preliminary tuning. Next comes neutralization, which, contrary to expectations, proved to be exceptionally easy. A one-turn loop of insulated wire with a flashlight bulb across it is placed in inductive relation to the plate tank of the 801's and the two neutralizing condensers turned until no setting of the plate tank condenser or of the buffer plate condenser will cause a glow. This point should occur when the neutralizing condensers are about 2/3 open. The plate voltage to the P. A. may now be put on and its plate condenser, and also the other 2 plate condensers tuned for maximum grid current and minimum plate current. Next the antenna should be clipped on and the set tuned to resonance with the plate current on the final amplifier standing at about 100 to 130 ma. For those who want a rough check of currents, the following are approximately correct for 550V. on the P. A., 500 on the 89's and no load; oscillator plate, 35 ma.; buffer plates, 60 ma.; P. A. plate 50 ma.; and P. A. grid, 10 ma. This holds true for bias voltages as given. On load, the final amp. plate current will rise to about 100 to 130 ma.

Results!

Now for results. About 50 contacts have been made since the outfit was completed. Invariably, the more distant stations gave better reports than with the old transmitter. The signals are more steady, sharper, and there is virtually no drift. Also, the tone quality is almost always commented upon as being improved. The best DX to date is W1AVV and W1EER, who are about 40 miles away and who give reports up to R7 and 8 depending upon conditions.

So here you have a strictly modern transmitter, fitted to work in our increasingly crowded 5 meter bands. Why not build one and give yourself and the "5 meter gang" a real break?

List of Parts

3—Hammarlund 6 prong isolantite sockets
2—Hammarlund 4 prong isolantite sockets
1—Hammarlund 5 prong isolantite socket
1—Hammarlund 5 prong isolantite coil form
1—Hammarlund double spaced split stator condenser
1—Hammarlund 50 mmf. midget condenser
2—Hammarlund 25 mmf. double spaced midget condenser
2—Hammarlund "Star" double spaced midget condenser (35 mmf.)
1—300 Ma. meter*
1—150 Ma. meter
1—100 Ma. meter
1—25 Ma. meter
2—R.C.A. 801's
3—R.C.A. 89's
1—R.C.A. 523
1—R.C.A. 80
6—Pilot lamps with sockets
12—I.C.A. name plates
4—I.C.A. 2" dials with knobs
4—I.C.A. insulex flexible couplings
2—I.C.A. 5 post terminal strips
1—I.C.A. 7 prong plug and socket
1—4-pole double throw switch
1—I.C.A. SPST switch
1—I.C.A. DPDT switch
3—I.C.A. grid clips
2—I.C.A. 4-prong sockets
10—I.C.A. 1" feed through insulators
3—strips Victron 1" x 6" x ⅛"
3—Aerovox 2 mf. 1000 V. condensers
10—Aerovox .0001 mf. 1000 V. mica condensers
4—Aerovox .001 mf. 400 V. mica condensers
1—Aerovox dual 8 mf. electrolytic (wire leads)
1—Aerovox 50,000 ohm 75 W. wire resistor
1—Aerovox 5000 ohm 50 W. wire resistor
2—Aerovox 50,000 ohm 10 W. wire resistor
1—Aerovox 75,000 ohm 1 W. carbon resistor
2 feet 7 wire cable
1—Power transformer, Thordarson
1—250 ma. choke, Thordarson
1—midget transformer, Thordarson (200 V., D.C.)
1—midget choke, Thordarson (30H.)
1—120 ma. 30H. choke, Thordarson
2—8" x 12" steel chassis
1—rack
Wire, hardware, etc. (*Triplett meters specified.)

When To Listen In

(*Continued from page* 32)

MOSCOW

The short wave programmes from Russia now take place exclusively on 25 meters. From March 1 50 meters was closed for the summer. The schedule is as follows. Daily (and Sun.) 12:30-1:30 and 3-6 p.m. Also 6-7 a.m. on Wednesdays and 6-9, 10-11 a.m. and 9-10 p.m. on Sundays. RNE is being heard fairly well from 4-6 p.m. and on Sunday from 9-10 p.m. Broadcasts in English occur on Sundays, Mondays, Wednesdays and Fridays from 4-5 p.m. Also on Wednesdays from 6-7 a.m. and on Sundays from 10-11 a.m.

CHINA

XGO at Nanking now broadcasts news, etc., daily at 12 noon on 7.53 mc. CQN at Macao, Portuguese China, formerly of the 49 meter band is now on 9.525 mc. (31.49 m.) on Mondays and Fridays from 7-8:30 a.m.

"Police Call" list, greatly enlarged, will appear in the June number.

High Frequency Superhet

(Continued from page 9)

in greater simplicity, ease of construction and lower cost. NOTE: (The base on the model receiver is drilled to accommodate a separate high frequency oscillator and 2,000 kc. I.F. transformers when they are available.)

The second detector uses a 6F6 pentode with the grid and screen tied together, causing the tube to function as a hi mu triode. The absence of a cathode resistor in this circuit causes the tube to draw grid current through the grid resistor network when a signal is received. This rectified grid current is fed to the grids of the I.F. amplifier through the filter network shown. This prevents overloading of the second detector and provides automatic volume control.

The output stage is a 6F6 connected as a pentode and coupled to the speaker through the socket provided in the receiver base. The speaker is a 6-inch dynamic with a 2,500-ohm field, the field being a part of the filter system. The speaker should be mounted on a baffle board two or three feet square for good fidelity.

Directions for Building Receiver

Drill the chassis and mount all tube sockets, transformers, resistors and condensers as shown in the picture.

Connect the high voltage leads of the power transformer, one to each plate of the 80 tube socket; the plate connections being the contacts in which the smaller pins of the tube fit.

To the two larger terminals of this socket connect the 5-volt winding of the power transformer.

One end of the 6.3 volt winding connects to terminal 2 of each of the other tubes; the other end of the winding connecting terminal 7 of all of the other tubes. These connections should be made with twisted insulated wire.

Attach 110 volt cord with switch, which is a part of the volume control, in series. From the center tap of the high voltage winding connect a lead to the chassis at the nearest point.

From one side of the 5-volt winding a wire is run to the choke coil and the other end of this choke coil connects to the field winding of the loud speaker. The other side of the field winding supplies all of the high voltage to the receiver and will be referred to hereafter as point X.

The red lead of one of the 8 mfd. electrolytic condensers is attached to the wire which connects the choke coil with the filament wire or the lead which connects to the 5-volt winding of the power transformer. The other end of choke coil connects to one terminal of the loud speaker field coil and to the red lead of another electrolytic condenser. The other lead from this field coil being connected to the red lead of the third electrolytic condenser and is terminated on a small insulator designated as point X.

Both black leads of the electrolytic condensers are attached to the chassis.

Coils L-1 and L-2 are mounted, one on each of the C-1 (variable) condensers. The end of coil L-1 which connects to the stator plates of front C-1 connects to the grid cap on top of the 6K7 tube which is mounted toward the front of the chassis.

The other end of this coil is mounted to the chassis.

From terminal 8 of this first tube, connect one end of a 400-ohm resistor; the other end of this resistor connects with one end of a 350-ohm resistor and also is attached to terminal 8 of the other two 6K7 tube sockets. The other end of this 350-ohm resistor is attached to the chassis as is one end of a .01 condenser; the other wire from this condenser going to terminal 8 of this first 6K7 tube.

The number 4 terminals of all of the 6K7 tubes are connected together and attached to the high voltage lead of the speaker field, or point X, through a 15,000-ohm resistor and a 20,000-ohm is connected from terminal 4 to ground.

Terminals 5 of the 6K7 tubes are connected to the number 8 terminals of their respective tube sockets.

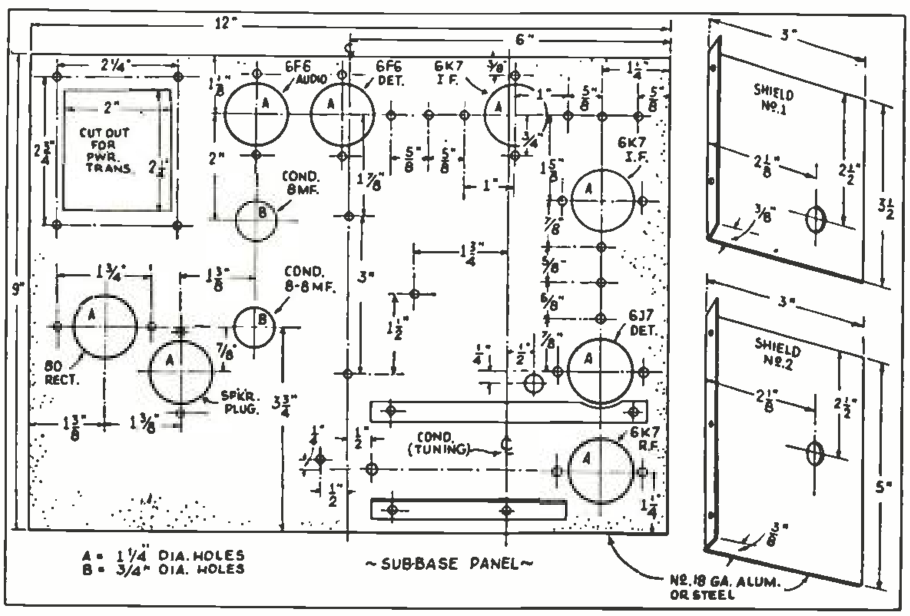
From terminal number 3 of the first 6K7 socket attach R.F. C-1 and C-2. The other end of R.F. C-1 connects to point X. The other terminal of C-2 is attached to the tap on L-2. The end of L-2 which is attached to the stator connection of the rear C-1 goes to one end of a .25 megohm resistor and to one terminal of C-3.

The other end of this resistor and the other terminal of this condenser is attached to the grid connection on top of the 6J7 tube.

The end of L-2 which is connected with the rotor plates of rear C-1 is grounded to the chassis and runs to R.F. C-2; the other end of R.F. C-2 being connected to terminal 8 of the 6J7 tube.

Terminal 4 of the 6J7 tube is connected to the middle terminal of the 50,000-ohm potentiometer and also has a .1 mf. condenser connected between it and ground; the ground in all cases being the chassis.

From terminal 3 of the 6J7 tube, connect one end of one 100,000-ohm resistor



Details of Superhet Chassis

and one terminal of .0001 mf. condenser. From the other end of the 100,000-ohm resistor a .5 mf. condenser is attached to ground and also one end of a 10,000-ohm resistor, the other end of which connects with point X. The other end of this condenser connects to the grid cap on top of the second 6K7 tube and also to one end of a 250,000-ohm resistor. The other end of this resistor connects to another 250,-000-ohm resistor and these in turn connect to a third 250,000-ohm resistor. The points where each of these three resistors connect with each other are also attached to the bottom end of the respective 250,-000-ohm grid resistors.

From terminal 3 of the second 6K7 socket connect one end of a 50,000-ohm resistor and also one terminal of a .0001 mf. condenser; the other end of this resistor going to point X.

The grid connection on top of the third 6K7 tube connects with the other terminals of this .0001 mf. condenser and one end of a 250,000-ohm resistor.

From terminal 3 of the third 6K7 tube, connect one end of another 50,000-ohm resistor and one terminal of another .0001 mf. condenser; the other end of this resistor being connected to point X.

From the other end of this .0001 mf. condenser, run a wire to terminals 4 and 5 of the first 6F6 tube.

One end of a 250,000-ohm resistor is connected to terminal 3 of the 6F6 tube and one end of a .01 mf. condenser. The other end of this 250,000-ohm resistor goes to point X.

The other terminal on the .01 mf. condenser is connected with the outside terminal on the 500,000-ohm volume control; the center terminal of this volume control is connected with terminal 5 on the second 6F6 tube socket; the remaining connection on the volume control going to ground.

From terminal 3 of the last 6F6 tube a lead is run to one terminal on the transformer which is mounted on the loud-speaker; the other terminal of this transformer being connected to terminal 4 of the last 6F6 tube and point X, connections being made by means of the tube socket provided for loud-speaker plug.

Connect a 500-ohm resistor between terminal 8 on the last 6F6 socket and ground. Attach the red wire from a 10 mf. electrolytic condenser to terminal 8 of the last 6F6 socket; the black wire being connected to ground.

One end of the 50,000-ohm potentiometer referred to earlier, connects to ground; the other terminal having a 100-000-ohm resistor in series with it and point X. Terminal No. 1 on each of the tube sockets is attached to ground (chassis) at the nearest point.

Directions for Building the 10-Meter Converter..

(Continued from page 8)

of the other 8 mf. electrolytic condensers. The black wires on both of these condensers are attached to the chassis.

Coil L-1 which consists of six turns of No. 10 copper wire wound to occupy a space of one inch is three-quarters of an inch in diameter. It is mounted upon the small standoff insulators on top the chassis as shown. From the end of the coil nearest the front of the chassis, a wire one and three-quarter inches in length is connected to the rotor plates of the front section of the tuning condenser (C-1). The other end of this coil is connected by means of a wire one and one-quarter inches in length to the stator plates of this same condenser and also to the grid cap on top of the 6L7 tube which is mounted to the left of this coil. Also from this same end of the coil the wire is attached to one terminal of a 35 mmf. adjustable condenser. The other terminal of this condenser being connected to the antenna terminal. Also from the end of

(Continued on page 47)

RADIO INSTRUCTION

Radio Amateur Course

(Continued from page 27)

previously, employing receiving type tubes, this method would be entirely too complicated and the advantages would probably be slight. It is only in the last *buffer* or between the last *buffer* and the *final amplifier* stages where this method is really a distinct advantage.

In Fig. 9 we have the same circuit except that we use two tubes in *push-pull*. In this case, one link coil is coupled to the B plus end of the driver tube, and the other coupled to the center of the grid tuned circuit, while in Fig. 8, both coupling coils were coupled to the low potential end of the tuned circuits. The push-pull circuit, of course, is not suited for *frequency doubling* although it is recommended for *tripling*. However, *frequency tripling* is *not* commonly used in the amateur bands.

We can also obtain frequency multiplication with a single tube in another manner as shown in Fig. 10. This is the twin triode type tube, such as the 53 and 6A6, where one section is used as a plate-tuned *crystal oscillator* and the other triode section capacitively coupled to it, is used as a *harmonic amplifier*. Choosing the proper method of neutralizing amplifiers is another problem which very often confronts the amateur. Either *grid neutralization*, as shown in Fig. 11, or *plate neutralization* (Hazeltine) may be used. There is really no difference in the two circuits where adequate driving power is employed. However, in some instances the plate neutralization method may be slightly superior. In both of these circuits we have used a center-tapped coil, with the tuning capacity shunted across the entire inductance. Another method of accomplishing this is shown in Fig. 12A, where the tuning condenser is only shunted across the plate section of the coil. If the plate coils are well constructed and tapped in the *exact electrical center*, the method shown in Figs. 11 and 12 are more convenient, because coils may be changed without requiring a *resetting* of the neutralizing condenser. Neutralization voltage may be also obtained as shown in Fig. 13; that is, directly from the driver-stage tank coil.

If push-pull circuits are to be used for frequency doubling, then the connections, as shown in Fig. 14, must be employed. In this case, the grids are connected in the usual push-pull manner, while the plates are connected in parallel. This is a very efficient *frequency doubler* although it employs two tubes instead of one, and unless the increased power obtained in this manner is really necessary, the complication does not warrant the use of this type of multiplier. The most versatile and efficient oscillator and multiplier circuits where low-powered exciters with an out-put of around 10 or 15 watts is required, are shown in Fig. 15 and 16. In 15 we have the pentode *Tritet "oscillator buffer"* or *multiplier*, which in turn drives another screen-grid tube. This arrangement will provide 10 to 15 watts out-put, when the amplifier tube is operating as a straight amplifier and not a multiplier, and around 5 to 10 watts when *doubling* takes place in the plate circuit of the amplifier.

In Fig. 16 we have used the combination oscillator and multiplier with the 53 tube, using a two-point switch for operation either at the crystal frequencies or the second harmonic of it, and a 210 or type 45 tube is used as an amplifier. The output of this will vary widely, depending upon the excitation. A full 15 watts may be obtained when the triode operates as a straight neutralized amplifier, and in the so-called neutralized doubler arrangement, approximately 10 watts could be obtained. In the diagrams, Figs. 15 and 16, the values of these parts are given and can be used in constructing either of these exciter units.

10 Meter Converter

(Continued from page 45)

the coil which connects with the rotor plates of the condenser, a wire is also run down through the chassis and soldered to a point beside the tube on the chassis. Terminal 3 of the 6L7 socket is connected to one end of the L-3 winding. The other end of this winding being connected to point X and also to one terminal of a .01 mf. condenser. The other terminal of this condenser being connected to ground or chassis. An 80 mmf. adjustable condenser is connected across this L-3 winding. One terminal of a 20,000-ohm resistor and one terminal of a 15,000-ohm resistor are connected together and a wire is run from this point to terminal 4 of the 6L7 socket which also has one lead from a .01 mf. condenser connected to it. The other end of this condenser goes to ground. Terminal 5 of this same socket is connected to terminal 5 of the 6C5 socket. Terminal 8 of the 6L7 socket is connected to one end of a 350-ohm resistor and also to one connection of a .01 mf. condenser. The other end of the resistor and condenser are connected to ground. Terminal 1 of this socket is also connected to ground as is terminal 1 of the 6C5 socket. A 100,000-ohm and a 20,000 resistor are connected together and from this point a wire is run to terminal 3 of the 6C5 socket. Also from this terminal one end of a .01 mf. condenser is connected. The other end of this condenser goes to ground. Terminal 5 has a connection to one terminal of a .00025 mf. mica condenser and also one end to a 50,000-ohm resistor, the other end of this resistor connects with ground. The other end of this mica condenser is attached to the stator plate connection on the rear of the tuning condenser C-2 and also to one end of the coil L-2. The other end of this L-2 coil is connected with the rotor plates of this same tuning condenser and ground. The tap on L-2 is connected to terminal 8 of the 6C5 socket.

All connections to the L-2 coil must be as short as possible. The remaining connections on the 20,000-ohm resistor and the 100,000-ohm resistor are connected to ground and the remaining connections on the 15,000 and 20,000-ohm resistors are connected with terminal X. The end of the winding L-4 nearest the end of the winding which is connected with terminal 3 of the 6L7 socket is attached to the binding post to the rear of the chassis marked antenna. The other end of the L-4 winding is brought to the binding post marked ground and to chassis. Coil L-2 is wound upon a piece of insulating material one and seven-eighth inches long and three-quarter inches in diameter. It has five turns of No. 22D.C.C. wire and the winding is spaced to occupy eleven-sixteenths of an inch. The tap is made at a point one-half turn from the end of the winding which connects to ground. The shield can encloses this coil. This winding specification is very critical and must be adhered to in all details.

Coil L-3 is wound upon a one-inch diameter tube which is one and three-quarter inches in length. The winding of this coil consists of No. 28 enamelled wire with turns closely wound to occupy a space of one and three-eighths inches. Over this winding a thin piece of paper is placed and L-4, which consists of 25 turns of the same wire closely wound, is placed near the end of L-3 which connects to point X.

After all connections have been checked, turn the switch on and attach the antenna to the antenna binding post on top of the chassis and ground on the ground post. From the binding post on the rear of the chassis marked antenna, attach a lead to the antenna connection on the broadcast receiver. Likewise from the ground binding post, attach a wire to the ground connection on the broadcast receiver. Tune the broadcast receiver to a point somewhere between 1,400 and 1,500 kilocycles. Adjust condenser C-3 with an insulated screw driver until maximum noise is heard in the receiver. Also adjust C-4 until greatest noise is obtained, then slowly tune condenser until a station is heard.

Parts for 10-Meter Converter

1 adjustable 30 mmf. condenser
1 adjustable 80 mmf. condenser
1 two-gang tuning condenser, Midget type—having a maximum capacity of 35 mmf.
4 .01 mf. fixed condensers
2 electrolytic 8 mf. condensers
2 20,000-ohm, 1-watt resistors
1 15,000-ohm, 1-watt resistor
1 50,000-ohm, 1-watt resistor
1 100,000-ohm resistor
1 350-ohm, 1-watt resistor
2 8-contact tube sockets for metal tubes
1 30 Henry 50-m.a. choke coil
1 4-contact tube socket for 80 type rectifier tube
1 power transformer having 250-volt high voltage winding
1 5-volt winding
1 6.3-volt winding
1 dial for tuning condenser
3 small Standoff insulators
1 piece ¾-inch diameter insulating material, 1¾ inches in length
1 shield can, 2½ inches in diameter
2 binding posts
1 mounting strip with two terminals for antenna and ground.
1 piece ¾-inch tubing 1⅞ inches long
1 6L7 tube
1 80 tube
1 .00025 mf. fixed mica condenser
1 110-volt switch
1 110-volt cord and plug
Small spool of No. 36 enameled covered wire
10 feet Pushback wire
1 grid cap for metal tube

Champion Radio "Op" Advises You

● IF you as a "Ham" had to put your finger on the weakest spot in the average radio operator's makeup, you would probably wind up by specifying his "style" of sending the code signals. Not only does the average "Ham" or commercial operator frequently become careless and clip off his dots and dashes, or the time-space between them, so that they no longer resemble the theoretically correct time spacing for the length of each signal and the space between them, but a number of other idiosyncrasies creep in.

You may not believe it, but Ted R. McElroy, who holds the imposing title of "Official Champion Radio Telegraph Operator of the World," recently had the following to say regarding the code and how to learn it properly:

"My own experiences in learning to telegraph were about the same as those of any embryo "Ham." Believing that I could develop speed and technique by practice, I did a lot of sending and receiving. After many months of this tiresome routine, I became very much discouraged and, in fact, utterly disgusted. I was hopelessly *stuck* and despite long hours of practice, I could not raise my speed beyond a certain point.

"The operators in the office where I worked as a messenger recommended various methods. I tried them all, but without results, and I was just about to give it up as a bad job when one day "Chick" Stiles, one of the speediest operators in the office, told me about his favorite system of training for skill and speed and the splendid results he, himself, had received from it. Within a few days after I had decided to try this system, my first lessons came, with a personal instruction letter advising me just what to do and what *not* to do. I remember particularly well the caution against *too much practice*, and he outlined certain daily practice procedure which, surprisingly enough, required only 30 minutes to one hour!"

As Mr. McElroy states:

"This was so vastly different from the four to six hours practice I had been indulging in previously, that I was both amazed and skeptical. But I determined to follow the instructions for at least a week or two, and if results were not forthcoming I would stop. I adhered to his advice by studying and practicing as directed, and to my great surprise and delight, I found that the system really worked."

This article has been prepared from data supplied by courtesy of the Candler System Co.

The A-B-C of Frequency Modulation

(*Continued from page 13*)

mitter not only impulses of *varying length and equal power* need to be sent, but the signals must also be transmitted with *dynamic variations*. Described in other words—"Since music consists very often of a succession of *one and the same tone* but reproduced with *varying power*—the signals to be transmitted have to be sent out with *varied volume—or 'amplitude'* as the technicians call it."

Amplitude Modulation = Amplitude Variations

Therefore, when music is to be transmitted it is necessary to apply the so-called *amplitude modulation*. Fig. 3 shows how this is done. The water beam is not only cut off into parts each *of different length*, as in the case of code transmission (compare Fig. 2), but the single "water cuts" are sent out with *varying heights* of the water level, or as the radio engineer would call it—"*with varying amplitude*." This effect is easy to obtain through the use of proper fitting valves of special design. The re-creation of these water amplitudes into sound of different tone volume can easily be obtained by means of a drum as demonstrated by Fig. 5. The principle of this transmission system, expressed in a few words, is as follows: *At all occasions where a particular audio frequency has to be transmitted with greater volume, the amplitude (the water level) must be increased and vice versa.*

If we compare Fig. 3 which shows music transmission with varying amplitude of the water-level, with the curve presented in Fig. 4, which shows the two *side-bands* of an "amplitude modulated" radio transmitter, we shall easily recognize that our water transmitter actually produces *amplitude modulation.*

Frequency Modulation = Frequency Variation

Many amateurs become frightened if they merely hear the name *frequency modulation*. This attitude towards the latest progress in radio communication is not reasonable; if we understand *amplitude modulation* there is no reason why we should not understand *frequency modulation*. That this opinion is correct will be demonstrated by means of another water transmitter analog of slightly different design.

Instead of *one water* pipe (used in Fig. 1 as the signal carrier), *a great many are employed* in the system shown by Fig. 5. Each of these several pipes is furnished with a valve operated by "remote control" to cut off the water beam or jet into parts *of varying length* but there is one great difference between the system shown in Fig. 1 and Fig. 5.

Series of pipelines for each particular amplitude: In the system shown in Fig. 1 the various "water cut-offs" are transmitted over *one and the same pipe*, regardless of whether they have a small or large amplitude. In the transmission system of Fig. 5, signals with a *small amplitude* are transmitted over *pipeline No. 1*, but signals of *medium amplitude* require 3 or 4 pipelines, and consequently signals of *large amplitude* require *all the pipelines*.

How the signals of various amplitude which are to be received, are transformed into sounds of equivalent volume, is easy to understand from Fig. 5, showing a drum placed below the various pipe openings.

Broken line does not interrupt transmission: This kind of transmission has of course the disadvantage that considerably more space is needed to install the many pipelines. However, it has the marked advantage that in case one pipe has become defective during reconstruction work (for example excavation in a city street) the transmission will not be affected to a great extent, since the broken pipe is used only *during a part of the entire transmission time*. During the period of use it is employed to transmit only a *particular volume* of the tone to be transmitted, or as the technicians say—*a particular amplitude*.

One transmitter radiates a great many frequencies: In radio transmission by means of *frequency modulation* the same condition exists as in multiplex water pipeline transmission. The principles of radio communication are shown by Fig. 6. We see that the transmitter at the left radiates *not only a single* frequency band, (as in the case when "amplitude modulation" is used), but *a great many* different frequency bands.

In case a tone *of small volume* is to be transmitted it will be sent over *channel No. 1*, for example. For a tone of *medium volume, channels No. 2, 3 and 4* will be employed, and if a tone of *very great volume* is to be transmitted, then *all six channels* will be used.

Atmospheric Interference Does Not Affect Transmission

That atmospheric interference cannot disturb a *frequency modulated* transmission is explained by Fig. 6. We know from experiments that atmospheric electricity has a frequency band which is rather broad, and which moreover actually covers a considerable part *of all radio frequencies* in use at present. And we also know that a few of these many frequencies contained in atmospheric electricity *are especially powerful.*

When atmospheric electricity disturbs our reception it is mostly due to such a powerful frequency. The disturbance which we meet is due to the fact that such a powerful interference has *collided* with the frequency of the station we wish to receive.

Only One Channel May Be Disturbed

As long as only *one channel* is available (as in amplitude modulation), and this channel is disturbed, the *entire communication* is cut off, or at least, considerably disturbed—in other words, we hear plenty of "static!" However, if we have *many channels*, as in the case *frequency modulation*, we obtain an effect similar to the one demonstrated in Fig. 5.

The system presented in Fig. 5 shows that though *one pipe or even two* may be put out of order, *all the other ones will remain unaffected!* About the same thing will happen in radio communication, if many frequency channels (as in the case of *frequency modulation)* are used. One particular channel may be affected, but since this particular channel is used only *for a part* of the entire transmission time, the disturbance will have no considerable effect; sometimes it will not be recognizable at all.

How Frequency Modulation Is Produced

After we have studied the principal facts about *frequency modulation*, and its advantages in effecting radio communication —"without interference"—there remains only to explain how this new kind of modulation may be obtained. This is also quite easy to understand and will be demonstrated by the aid of Fig. 7, which shows the principal diagram of a transmitter. Parallel to the condenser of the tuning circuit, an additional small condenser (in the form of a condenser microphone) has been connected. This condenser microphone acts in about the same manner as a "trimmer" or band-spread condenser; an auxiliary of radio reception which is often applied in receivers of modern design.

We know from the operation of our receivers that in case we vary the additional small condenser, the *frequency tuning* of our receiver changes. Exactly the same variation of frequency tuning is obtained when the announcer shown in Fig. 7 speaks into the condenser microphone. The sound waves hit the plates of the condenser microphone, and make them vibrate, or, described in other words—"the distance between the plates of the condenser microphone changes." We know that by changing the distance between the condenser plates, the capacity value of a condenser changes. Therefore it is easy to understand that the vibrating plates of the condenser microphone must affect the *frequency radiated* by the transmitter.

As long as the announcer speaks *softly* the frequency fluctuations of the transmitter *will be small.* But in case he *raises his voice* very much, the plates of the condenser microphone *will vibrate to a larger extent,* and consequently the frequency of the transmitter *will vary greatly;* or, more technically expressed—the frequency of the transmitter "swings out" to a larger extent.

Something About the "Frequency Swing"

The expression "swings out" describes much better what actually happens when *frequency modulation* is applied, than the expression we have used until now: "the frequency varies!" In reality the transmitter varies its frequency not only in *one direction* (as demonstrated by the simplified diagram of Fig. 6) but the frequency swings *to both sides* of the "carrier frequency" (marked O in Fig. 9). This "swing effect" is easy to understand if we keep in mind that the condenser microphone is not always compressed by the sound impulses, but also *expands*—in a *reversed* direction—and in the same degree as it was compressed.

That means, as Fig. 9 indicates, the "carrier frequency" not only increases in its frequency value, but also decreases.

The "Band-Width" Necessary

As Fig. 9 shows, the frequency marked as No. 0 (carrier frequency) swings for example not only to channel 40 in a specific case, but also back to channel 40' etc. In practice, the width of the swing is considerably larger as it is possible to recognize from Fig. 9. Major Armstrong, for example, who uses the two kilowatt transmitter located atop the Empire State Building, in New York City, operates this ultra short-wave transmitter on a frequency of 41 mc. (Megacycles). The carrier frequency of 41 mc. swings to both sides to such an extent that the entire band-width of the transmitter covers a frequency range of 150 kc.

Percentage "Band-Width" Quite Small

The required frequency range of 150 kc. for a single transmitter appears, at first glance, quite large, but we have to keep in mind that a transmitter operating with such a band-width in the ultra short-wave range (between 1 and 10 meters) occupies (by percentage) much less space than a transmitter operating with the usual band-width of 10 kc. in the "broadcast" band.

The wave range between 5 and 10 meters appears, at first, quite small. However, if we express the width of this wave range in frequencies or cycles, we find that it actually involves a frequency band of 30,000 kc. (30,000,000 cycles).

If we figure out how much this band-width is expressed in frequencies of all short wave channels above 10 meters; together with all broadcasting and long wave channels, we will ascertain that this tremendous wave range involves not more than 30,000 kc. Again, if we try to find the percentage of space required by a single transmitter, figured on the frequency basis in relation to the meter basis, we will find that a single transmitter operating with 10 kc. band-width in the broadcast band, requires 2 per cent of the entire space of the broadcast band. A *frequency-modulated* transmitter with a band-width of 150 kc. operated in the ultra short-wave range requires (figured on a similar basis) 0.5 per cent only.

The modulation system actually employed: Before closing this description it seems necessary to remark that the modulation system shown in Fig. 7 and 8 are the more simple methods of *frequency modulation.* Since the microphone must be mobile, to give the broadcast studios the necessary freedom to move it (far way from the transmitter) to any place desired, Major Armstrong has developed a similar modulation system, but of different design.

Short Wave Scouts

(*Continued from page 18*)

system running in the direction north and south.

Mr. Scrimsher states that more recently he has erected a Zeppelin antenna which has increased his volume some 30 per cent. This new antenna, however, is running in an east and westerly direction and is 50 feet above the ground.

Congratulations, Mr. Scrimsher!

We would like to point out to the many readers interested in this contest that recently we have received a number of entries in which there is great evidence of forgery. On many of these the dates on the veri cards were changed so that they came within the 30-day period selected in order to bring up the grand total. This is quite a serious offense, inasmuch as an affidavit is taken that the stations were all received within a certain period.

Needless to say, if there are any signs of changing dates the entry is immediately disqualified regardless of its total.

In one or two cases the entrant has lost the trophy merely because he was dishonest in submitting his list.

TIPG—6410 kc.—"La Voz de Victor." San Jose, Costa Rica.
HP5J—9590 kc.—"La Voz de La Panama." Panama City, Panama.
HP5B—6030 kc.—"Radiodifusora de La Miramar." Panama City, Panama.
TG2X—5940 kc.—"La Voz de La Policia." Guatemala, C.A.
HIH—6814 kc.—"La Voz Del Higuamo." San Pedro de Macoris, Dominican Republic.
HC2RL—6658 kc.—"Quinta Piedad." Quayquil, Ecuador.
PRADO—6620 kc.—"El Prado." Riobamba, Ecuador.
YVQ—6672 kc.—"Estacion Nacional de Radio." Maracay, Venezuela.
YV2RC—5800 kc.—"Broadcasting Caracas." Caracas, Venezuela.
YV3RC—6160 kc.—"Radiodifusora Venezuela." Caracas, Venezuela.
YV6RV—6520 kc.—"La Voz de Carabobo." Valencia, Venezuela.
YVIORSC—5720 kc.—"La Voz del Tachira." San Christobal, Venezuela.
HJ3ABH—6012 kc.—"La Voz de La Victor." Bogota, Colombia.
HJ4ABA—11710 kc.—"Ecos de La Montana." Medellin, Colombia.
CEC—10670 kc.—"Compania Internacional de Radio S.A." Santiago, Chile.
EAQ—9860 kc.—"Radiodifusion Ibero-Americana." Madrid, Spain.
2RO—9635 kc.—Radio E.I.A.R. Rome, Italy.
2RO—11810 kc.—Same as above.
HVJ—15120 kc.—Vatican City. Rome, Italy.
PHI—11730 kc.—The PHOHI. station. Hilversum, Holland.
PCJ—15220 kc.—Philips Radio Laboratories. Eindhoven, Holland.
HAT4—9125 kc.—Radio Labor. Budapest, Hungary.
HAS3—15370 kc.—Same as above.
HBL—9595 kc.—Societe des Nations. Geneva, Switzerland.
DJA—9560 kc.—Der Deutsche Kurzwellensender. Zeesen, Germany.
DJB—15200 kc.—Der Deutsche Kurzwellensender. Zeesen, Germany.
DJC—6020 kc.—Der Deutsche Kurzwellensender. Zeesen, Germany.
DJD—11770 kc.—Der Deutsche Kurzwellensender. Zeesen, Germany.
DJE—17760 kc.—Der Deutsche Kurzwellensender. Zeesen, Germany.
DJN—9540 kc.—Der Deutsche Kurzwellensender. Zeesen, Germany.
DJQ—15280 kc.—Der Deutsche Kurzwellensender. Zeesen, Germany.
11715 kc.—Radio Colonial. Paris, France.
11890 kc.—Radio Colonial. Paris, France.
15245 kc.—Radio Colonial. Paris, France.
RNE—12000 kc.—Radio Center. Moscow. U.S.S.R.
CT1AA—9600 kc.—Estacao Radio. "Radio Colonial." Lisbon, Portugual.
PMA—19345 kc.—Java Wireless Stations. Bandoeng, Java.
PLP—11000 kc.—Java Wireless Stations. Bandoeng, Java.
VK2ME—9590 kc.—"The Voice of Australia." Sidney, Australia.
VK3ME—9518 kc.—Melbourne, Australia.
VK3LR—9580 kc.—National Broadcasting Service. Lyndhurst, Australia.

World-Wide 10-Meter Converter

(Continued from page 12)

selectivity decreases. When once adjusted though, *regeneration* is constant over the entire ten meter band! There we have the reason for the unusual performance of the converter. When operated with a superhet tuned to approximately 2000 kc. the ten meter sensitivity is many times greater than the sensitivity of the super at 2000 kc. That is of course for a given setting of the volume control of the super. We mention this because the noise-level is higher on ten than on 2000 kc. The super on 2000 kc. can be run "wide open," whereas the gain control can be run only halfway open with the converter operating on ten. Part of the "background" is of course due to tube noise especially encouraged by regeneration.

The tubes used are a 6A8 as the detector and a 6C5 as the oscillator. The 6A8 seems to be the best tube for the detector, because we tried the 6L7, which is no doubt a good tube, but there were no signs of regeneration and believe us when we say this converter was not at all adequate without the regenerative feature. And for this reason we recommend that those who build it should duplicate it—part for part in value and make. Also the various voltages indicated should be employed.

Tuning Condensers—How Built

The tuning condensers for the two circuits are constructed from a National SE90, 270 degree condenser. All plates were removed and the stator reassembled in two sections, with a single plate in each. The spacing between these two is slightly over one-half inch. Two rotor plates are also used, making two 2-plate tuning capacities operated by a single shaft. No shielding was used between these two stators, but let no one assume that the coupling thus permitted accounts for the regeneration. This split-stator condenser was put in nearly a month after the converter was first placed into operation; the original one was too large (too high capacity). With the two UM25. 25 mmf. National condensers used for band-setting and the coil specifications given, the ten meter band is spread over nearly the entire dial and even this is none too great a spread. Getting the two circuits to track, even with these very small condensers, required that the plates of the split-stator condenser be bent and spaced in a manner to allow perfect "tracking."

Coupling Converter to Receiver

Coupling the converter to the receiver is another very important part of the job. For this purpose we have used an old or discarded I.F. transformer. The can was removed and the windings removed from the wood dowell. Then we used some of the wire removed and wound a single layer of it three-quarters of an inch long. This is close wound and given a coat of coil lacquer. One of the padding condensers (C4) of the old transformer is used to tune the coil and the other (C5) condenser is used to couple the converter output circuit to the antenna post of the superhet receiver. This condenser (C5) is used only when the converter is used with a receiver employing a capacitive input circuit. If your receiver uses an antenna coupling coil, then you will need a small coil (L4) having a similar number of turns and coupled to L3 as shown in the drawing.

Some experimenting may be necessary with this winding in order to obtain the greatest amount of effective coupling. Using an I.F. transformer for this part of the converter provides the necessary mounting; the tuning condensers and the whole unit is also well shielded.

The coupling leads to the receiver should also be shielded to minimize "pickup" on the frequency to which the superhet is tuned. The frequency of the super is not critical, but should be higher than 2000 kc. in order to prevent "images" from appearing in the ten meter band. Although with the selectivity provided in the first detector, there was no trouble with images. The main trouble seemed to be the picking up of harmonics of 20 meter stations and commercial stations operating close to that band.

Well, there's the story fellows, and we hope that those who read this article will give the "rig" a try and see how *efficient* it *really* is and also help to *populate* the ten meter band.

Parts List for 10-Meter Converter

3—50,000 ohm resistors (insulated) ½ watt, I.R.C.
1—50,000 ohm resistor (insulated) 1 watt, I.R.C.
1—100,000 ohm resistor (insulated) 1 watt, I.R.C.
5—.0001 mf. mica condensers, Cornell-Dubilier.
2—25 mmf. UM-25 National Var. condensers.
1—Remodeled National SE-90 condenser, (see text).
2—National Octal sockets.
1—Double tuned I.F. transformer, remodeled as per text. (C4, C5, are approximately 70 mmf.) Padders.
1—3 inch National Dial.
1—30 mmf. padding condenser (C3) National M30.
1—6A8 metal tube, RCA Radiotron.
1—6C5 metal tube, RCA Radiotron.

COIL DATA:

Detector coil has 9 turns of No. 12 tinned copper wire, with an inside diameter of ¾ inch, spaced to a length of 1¼".
The "oscillator" coil has 7 turns of the same size wire, wound to the same diameter, and spaced to an over-all length of 1⅛ inches.

"Ham" Applications of the Cathode-Ray Oscillograph

(Continued from page 7)

graph amplifiers, *until the maximum vertical deflection is equal to the maximum horizontal deflection.*

Now if the stage has *good fidelity* a 45 degree diagonal straight line pattern will be formed. If the line bends toward the horizontal (see Fig. 2) at the upper right end, it indicates that the apparatus is non-linear. Overloaded transformer (A) due to saturation, not enough bias on the second 56, too much grid signal input or insufficient plate voltage or a combination of these effects may be responsible. If the line bends up (see Fig. 3) look for audio regeneration (rather rare) or incorrect filtering of the signal voltage.

For any tendency toward bending in the lower section of the line, such as in Fig. 4A or B, look for inadequate grid filtering or poor ground connections and tendencies toward regeneration. For an effect like Fig. 4B, abnormal bias on the second tube will be the most probable offender. A straight line indicates linear relationship between the signal voltages in all parts of the circuit between the two test points. With a constant external sweep frequency applied to the grid of the saw-tooth oscillator, actual pictures of the voice currents may be obtained, but these are no good for distortion analysis as we cannot always detect distortion by the shape or form of a wave. Most waves are far too complicated for this.

The other stages can be tested in the same way, and finally the entire amplifier can be tested by connecting 1 to the right hand horizontal plate and the top vertical plate to point 3.

You must expect a little curvature of the line as in Fig. 4B, because of the characteristic of class B amplifiers. However, with the proper plate voltage and associated apparatus this can be minimized.

Testing Power Supply

Next we may test the power supply *ripple voltage*, either for exact voltage value or for relative value as compared to the D.C. available. Connect an A.C. source, say between 15 and 50 volts to both horizontal and vertical deflector plates, and adjust the straight line resulting to a

45 degree angle (estimated) on the screen. Now with the horizontal plates left connected and the input voltage known, the ripple at either side of the power choke may be connected to the vertical plates. Obviously, if the angle remains the same the ripple voltage is equal to the timing voltage. If the angle is more vertical, the ripple voltage is higher being equal to (E_o tan θ = E_r). This, of course, means that all phase differences between the two are eliminated without changing their values otherwise. Any phase difference between voltage applied to the horizontal and vertical plates will result in an ellipse or circular pattern. The exact angle will then be indeterminate. Instead of being from lower-left to upper-right as shown in the diagram, they may be from lower-right to upper-left where the phase is 180 degrees instead of zero degrees. Analysis can be made as easily in this case as otherwise. Voltage may also be read as a vertical deflection with any sweep frequency or no sweep voltage at all if calibrated for voltage readings.

Neutralization Tests

For a very accurate *neutralization adjustment*, connect the top vertical plate amplifier input to point 4 on the circuit of Fig. 1. Break the plate circuit of the 46 buffer stage and adjust for no vertical deflection. A high frequency sweep saw-tooth voltage on the horizontal plates is recommended here although not essential. By means of it, transients may be segregated from recurrent forms. At point 5 there should be no R.F. even with the by-pass condenser C-1 disconnected. Some negative D.C. may form here, but this is normal due to excitation of the grid and rectification.

At points 6 and 7, the same considerations may be tested for the *power stage.* The effectiveness of the R.F. choke in the power output plates may be ascertained by touching the top vertical plate to point 8, being sure to use a range appropriate for the high voltage at this point.

Determining Per Cent of Modulation

Now for 100% modulation, the voltage at point 8 of Fig. 1 will vary from zero to double that at 450 volts (or 900 volts). With a constant audio input provided by a simple audio oscillator (preferably around 400 cycles) and point 9 or 10 of the audio amplifier fed to the saw-tooth wave generator so as to "lock-in" to this frequency or a multiple of it, connect the top vertical plate to 11. A hazy pattern of the *voice envelope* should appear, from which the modulation percentage may be determined by inspection. Adjustment of R-1 and the output plate voltage may be made for maximum percentage modulation. If this cannot be attained in your particular set-up, changes in design will be necessary.

Another method of measuring *modulation percentage* with the Cathode Ray Oscillograph is by means of the *triangle* pattern. Place the audio wave on the horizontal plates in such a manner that increased amplitude will deflect the beam to the right. Bias the beam in the center of the target, and attach the vertical plate to 11 or the modulated R.F. output. Now as an audio signal is fed in the input of the A.F. system a triangle will be formed. If the audio voltage sweeps the spot to the left in a straight line any distance after it converges into a point, it is an indication that the *modulation is over 100%!* On the other hand, if the pattern does not converge into a point, due to R.F. still remaining at the minimum part of the audio cycle to the left, the modulation is less than 100%. Since there is negligible audio loss across the R.F. choke, the two free plates may be placed across it at points 8 and 11, with 11 vertical and 8 horizontal.

Analyzing "Transients"

Almost without question, the greatest value of this instrument is in the analysis and study of transients. Alteration of the circuit for eliminating these non-recurrent *disturbing factors* may be made while the Cathode Ray test equipment is connected

(*Continued on page 63*)

A Sensitive 4-Tube "Regen." Superhet.

(*Continued from page 22*)

was designed for use with headphones, so only one A.-F. stage is used—a 6C5 all-metal tube, resistance-capacity coupled to the output of the second detector. The grid resistor of the 6C5 output stage is a 250,000 ohm potentiometer connected in the conventional volume control circuit. An A.-F. volume control is desirable since it allows the volume to be regulated to any desired degree without disturbing the setting of the regeneration control in any way.

Coil Positions

Proceeding with our description, the *detector coils* are at the left of the tuning condenser; the *oscillator coils* are at the right. In each circuit the highest frequency coil is placed *above* the chassis and close enough to the wave-band switches to insure short direct wiring between them: the lower frequency coils are mounted underneath the chassis and are placed at right angles to each other to prevent the intercoupling mentioned above. The socket for the 6J7 tube is at the left of the tuning condenser; that of the 6C5 is at the right. The 6F7 socket is at the center of the chassis just behind the tuning condenser. The socket at the rear and center of the chassis is for the 6C5 audio output tube. The iron-core I-F. transformers are mounted at the rear corners close enough to the 6J7 and 6F7 sockets to keep the plate and grid leads fairly short. The antenna and ground connections are at the left rear of the chassis; the two tip jacks connect the headphones or speaker into the plate circuit of the 6C5 audio stage.

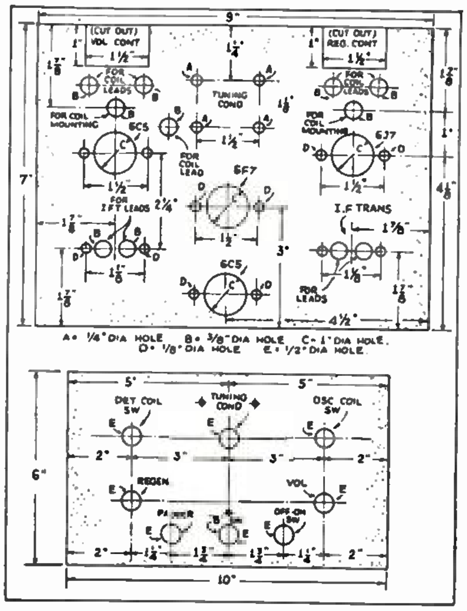
This layout is the result of considerable experimental work with this particular circuit and should not be changed if our results are to be duplicated. The various by-pass and fixed condensers, resistors, etc., that are placed underneath the chassis are supported by the wiring and are merely mounted in the position that gives the shortest leads.

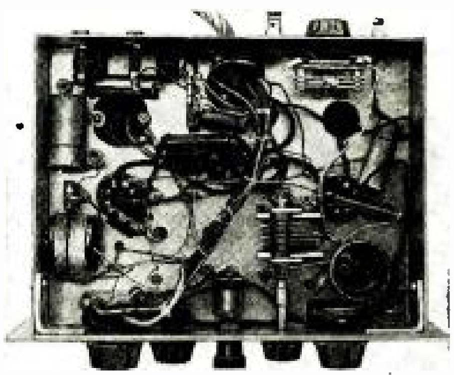
Lining Up the Set

Tune in a *weak station,* preferably a broadcasting station, back down the regeneration control until the voice or music clears up and readjust the padding condenser for maximum volume. If the signal becomes very loud, tune to a weaker station or reduce the input by turning out the antenna-series condenser. *Do not reduce the volume by turning down the A.F. volume control!* Now with an insulated screw driver or neutralizing tool, turn the trimmer of the grid section of the output I.F. transformer until the signal is loudest. Repeat the process with each trimmer in turn, working away from the second detector. If the signal becomes loud it will be necessary to reduce the input again as I.F. circuits cannot be sharply peaked with strong signals from either an oscillator or broadcast stations. It is best to leave the trimmer across the primary of the input transformer alone as it is extremely critical and if it is changed, all of the trimmers, including the "padder," will have to be readjusted. Adjust the antenna-series condenser until there are no "dead-spots" in the tuning scale and set the regeneration control for best reception in exactly the same manner as in the ordinary regenerative receiver.

If the detector and oscillator circuits do not track properly, i.e., produce the correct I.F., remove or add turns to either the detector or oscillator grid coils until the difference between their tuned circuits is equal to the I.F. or 456 kc. The oscillator must operate on a frequency 456 kc. *higher* than that to which the detector is tuned. In case either the first detector or the oscillator does not oscillate normally this may be due to insufficient turns in the tickler circuit or the intercoupling mentioned above. Keep the "hot" R.F. leads as far apart as possible and, if the trouble still persists, these leads may be *shielded* with the usual braided copper sleeving which is then grounded to the chassis. If the lack of oscillation is due to insufficient tickler turns, simply move the cathode tap up one or two turns toward the grid end of the coil until satisfactory oscillation is obtained.

This particular model uses only two sets of coils and tunes from about 15 to 65 meters in two positions of the coil switches. This arrangement effectively covers most of the frequencies used in present-day short-wave activities, excluding the 80 and 160 meter "amateur" bands. It is possible to add a third set of coils which will include the 80 meter amateur band on position "three" of the switches. However, great care must be used to prevent absorption losses and intercoupling. The author does not recommend the use of more than three sets of coils; if a greater range is desired, use plug-in coils instead of those shown here. The four coils in this receiver are wound on the 1½ inch bases taken from discarded tubes of the 201a type.





Chassis Data and Bottom View

Loud Speaker Worked on Strong "Sigs"

As mentioned above, this receiver was not designed for loud-speaker operation. However, we have used a sensitive speaker at times when conditions are very good. Several *foreign* stations have been brought in at good *loud-speaker* volume with the 6C5 stage alone. If regular use of a loud-speaker is desired, it is advisable to add an *output* stage to the circuit shown in Fig. 1. A 6.3 volt pentode such as the 38 will give plenty of volume and the darin on the "B" batteries is quite small. Speakers can be obtained with windings of the proper impedance to match this or any other output tube, no output transformer being required.

If the above instructions have been carefully followed, it is not likely that any serious trouble will be encountered. It must be remembered that this circuit is new to most experimenters and the author asks that the constructor be patient if he does not get results at once. A careful adjustment of the padding condenser or a trimmer may make a great deal of difference in the signal strength or selectivity. If any difficulty is experienced, however, the author will be glad to give further advice or information if a self-addressed and stamped envelope is enclosed for reply. Letters should be sent in care of *Short Wave Craft.*

Awards in the $50.00 Prize Letter Contest which closed March 31, will be published in the July number.

List of Parts

CONDENSERS

C1 Tuning condenser, 2 gang, 140 mmf. per section.—Hammarlund.
C2 Midget tuning condensers, 50 mmf. Hammarlund.
C3 Midget tuning condenser, 35 mmf. Hammarlund.
C4, C5, C11 Paper cartridge condensers, 0.1 mf. 400 volts. Cornell-Dubilier.
C6 Paper cartridge condenser, 0.25 mf. 400 volts. Cornell-Dubilier.
C7 Mica fixed condenser, .00025 mf. Cornell-Dubilier.
C8 Mica fixed condenser, .003 mf. Cornell-Dubilier.
C9, C10 Paper cartridge condensers, 0.05 mf. 400 volts. Cornell-Dubilier.
C12 Mica fixed condenser, .0001 to .00025 mf. Cornell-Dubilier.
C13 Mica fixed condenser, .001 mf. Cornell-Dubilier.
C14 Paper cartridge condenser, .01 mf. 400 volts. Cornell-Dubilier.
C15 Paper or Mica fixed condenser, .01 mf. (see text). Cornell-Dubilier
C16 Electrolytic condenser, 25 mf. 25 volts. Cornell-Dubilier.

RESISTORS

R1 Metallized resistor, ¼ watt. 15000 ohms. I.R.C.
R2 Metallized resistor, ½ watt, 1000 ohms. I.R.C.
R3 Metallized resistor, ¼ watt, 25,000 ohms. I.R.C.
R4 Potentiometer, wire wound, 50,000 ohms. I.R.C.
R5 Metallized resistor, 1 watt, 35,000 ohms. I.R.C.
R6 Metallized resistor, 2 watts, 300 ohms. I.R.C.
R7 Metallized resistor, 10,000 ohms, ¼ watt. I.R.C.
R8 Metallized resistor, 1 watt, 1000 ohms. I.R.C.
R9 Metallized resistor, ¼ watt, 500,000 ohms. I.R.C.
R10 Metallized resistor, 1 watt, 100,000 ohms. I.R.C.
R11 Potentiometer, carbon type, 250,000 ohms.
R12 Metallized resistor, 2 watts, 1000 ohms. I.R.C.

COILS

L1, L2, L3, L4, L5, L6 Detector, oscillator and antenna coils (see coil table below).
I.F.T. Iron-core I.F. transformer. One input and one output. Miller. (456 kc. pre-tuned.)
RFC1 R.F. choke, 2½ millihenry. Hammarlund.
RFC2 R.F. choke, 10 or 12 millihenry. Hammarlund.

OTHER PARTS

1 Electralloy chassis, 7x9x2 inches in size. I.C.A.
1 Aluminum or electralloy panel, 6x10½ inches. I.C.A.
2 Wave-band switches, 3 pole, 3 position (SW1, SW2).
2 Off-on switches (SW3, SW4).
3 "Octal" sockets for metal tubes. Isolantite.
1 7 prong socket for 6F7 tube (small).
1 tube shield.
Miscellaneous knobs, jacks, binding posts, dial, etc.

COIL TABLE

Range in Meters	Grid Turns	Tap at (Turns)	Antenna Turns	Size Wire (D.C.C.)
15-35	7¼	3	2½	No. 24
35-65	12	5	4¾	No. 24
65-150	30	9	7	No. 28

All coils are close wound on 1½ inch forms: antenna coils are coupled to the grid end of the coils.

A Neon Tube Oscilloscope

(Continued from page 15)

next fellow to share the air in true Amateur fashion. That many Amateurs offend is a matter of common knowledge and yet the offences committed in 98% of the cases are unintentional. They are due to either lack of suitable measuring devices, or insufficient knowledge. Discounting the latter instances, how many phones on the air today are noticeably imperfect in some respect. "Pretty good quality, but a broad signal," you say. In defense it might be said that this particular station is equipped with a few excellent meters. Of course meters are of great value, and we could not get along without them, but meters do not always tell the true story, particularly on registering voice frequencies. Thermocouple meters are often sluggish, and always sluggish enough not to read the peaks dwelt momentarily upon by the vast and complicated range of the human voice. The oscilloscope is perhaps the most accurate means of recording these instantaneous peaks, that, out of control, constitute the major offense committed by phone transmitters. Much campaigning has been done on the matter of *over-modulation*, and while the results have been noticeable, lack of equipment has been the chief reason for not clearing up the situation. The oscilloscope data here furnished is the layout used in the one constructed and put into operation by W1COL.

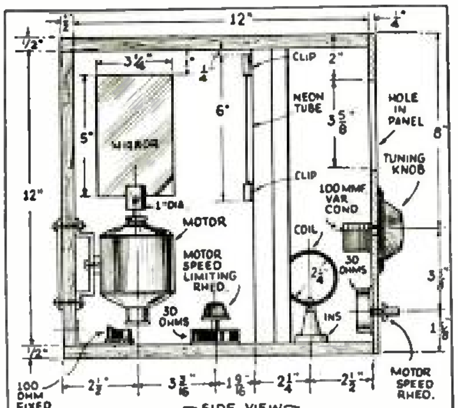


FIG. 2

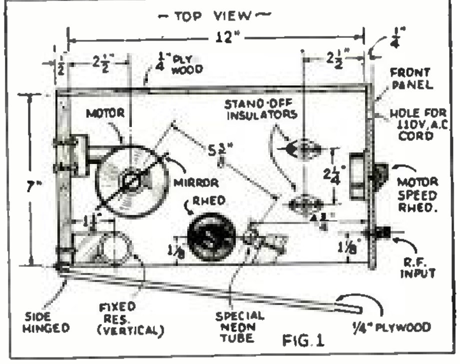


FIG. 1

Side and Top Views of Oscilloscope.

The wiring diagram is simple and self-explanatory as portrayed in Fig. 3. Figure 3 also shows the front panel on which are mounted the Hammarlund Star .0001 midget variable condenser, the motor speed rheostat, and the binding posts to which the radio frequency input is connected. Fig. 1 is a view looking down on the floor of the instrument. The inside cabinet dimensions are height 12 inches; depth 12 inches; width 7 inches. The top, back, and bottom are of ½ inch stock for rigid construction to withstand motor vibration. The sides and front panel are of ¼ inch plywood, and the left side is hinged so as to get to the parts without disturbing wiring, etc., and to be able to shift coils (L1 Fig. 3) for various bands. The cabinet is painted flat black—inside to reduce the ef-

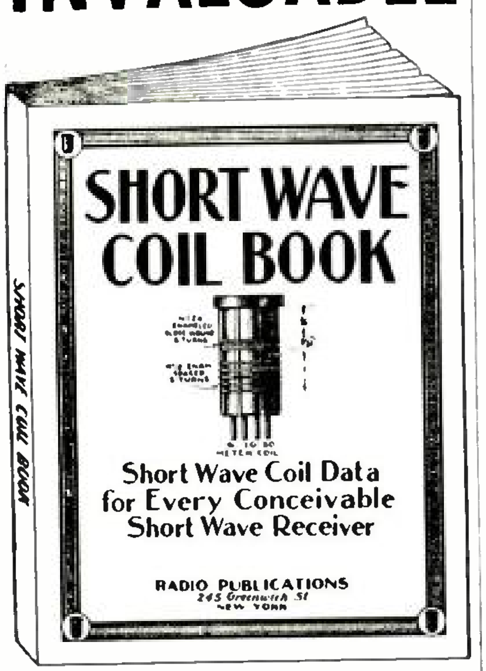
fect of reflected light rays. The motor—in this case a sewing machine motor—is mounted vertically and to the back of the cabinet so that its shaft is 2½ inches from the inside rear, and centrally with relation to either side. Other types of motors will, of necessity, be mounted as best adapts them. Two 30 ohm filament type rheostats and a hundred ohm, 100 watt fixed resistance, are connected in series with the motor in the 110 volt line. The motor should be of universal type, having a commutator, with ability to run on both A.C. and D.C. One of the rheostats is shown on the panel and controls the motor speed manually.

Too great a motor speed will bend the mirror due to centrifugal force as most inexpensive motors are apt to be slightly out of true or wobbly in the bearings. Once the mirror is bent it will be difficult to flatten it out perfectly again, and the picture will not be true. Do not put the mirror on the motor until you have it sufficiently slowed down or you will probably ruin it! A good practice is to set R2 (Fig. 3) so that with all of R1 in the circuit, the motor runs at its slowest speed without stalling. Slow speeds are most desirable, but the motor must run smoothly and evenly. As stated before, the fixed resistor R3 will of course vary depending on the current drawn by your particular make of motor but it will not be difficult to determine the correct value. Resistors capable of carrying the motor current without heating should be used, *otherwise the motor speed will pick up as the resistors heat.* The neon tube is now mounted on the vertical brace which is of ¾ inch stock and which is set at an angle, so the neon tube faces the center of the mirror. The tube is mounted at a height so that it is opposite the mirror.

If a metal cabinet is used, it may be necessary to mount the tube more than the stipulated 1⅛th inches from the side to eliminate the effect of the metal on the neon tube. The coil L1 Fig. 3, should have about the same number of turns as the tank coil of the transmitter's amplifier tank. The coils in this case have plugs and plug into stand-off insulators to make "band-changing" easy. The coupling coil L2 is 2 turns of rubber insulated wire wound over L1 and terminated with small clips which clip to the rear of the rf binding posts. Figs. 1, 2 and 3 give complete layout and wiring.

In using the oscilloscope for audio (voice current) viewing, it may be necessary to step up the last audio stage through a small "step-up" audio transformer, if the output voltage of the audio amplifier is not great enough to light the tube. Of course, when using the scope for audio work, coil L1 and condenser have no part in the process.

To put the oscilloscope into operation (radio frequency) and assuming that the correct coil L1 is in place, attach a pair of twisted wires to the binding posts on the panel (connected internally to L2) and connect the other end of the twisted cord to a 1 or 2 turn coil (L3) which coil should be very loosely coupled to the tank of the final stage of the transmitter. The transmitter should be under load, or on the air when making tests. Now rotate the tuning condenser of the scope over the band. If the coil L1 is in band the tube will glow as the condenser is tuned to resonance. Now adjust the coupling of L3 to the transmitter tank so that the neon tube, which glows from the center toward either end, glows for a distance of ¾ of an inch on each electrode. (Total length of glow 1½ inches).



Checking Modulation

Now start the motor and through the viewing hole there should be a steady even ribbon 1½ inches wide on the mirror. (So far only the unmodulated rf is used). Vary the motor speed, and if any series of lumps appear on both sides of the ribbon at any motor speed, there is ac present which is modulating the rf carrier. (Of course this should be located and eliminated). The next step is to turn on the speech and modulator stages and speak into the microphone. The ribbon should vary in width from zero to twice its unmodulated amplitude IF YOU ARE MODULATING 100%. Over-modulation will show a greater amplitude than under-modulation. No peaks should exceed the 100% amplitude limit! Adjust your transmitter accordingly. Distortion will show a higher cycle peak on one side of the ribbon than the other. Under-modulation will be evident because the peaks will not reach the 100% line. The speed of the motor should be varied for best results. A pure sinusoidal signal—one of unvarying frequency—applied through the modulator should appear in the scope as a symetrical pattern. Voice frequencies, of course, being a complication of many frequencies will show as numerous peaks and valleys on both edges of the ribbon.

The kit mentioned above is supplied by the Sundt Engineering Co.

Two New Tubes

(Continued on page 25)

D.C. Plate Current—150 max. Milliamperes.
D.C. Grid Current—30 max. Milliamperes.
Plate Input—150 max. Watts.
Plate Dissipation—60 max. Watts.

Typical Operation:
Filament Voltage (A.C.)—10—10—10 Volts.
D.C. Plate Voltage—600—800—1000 Volts.
D.C. Grid Voltage (Approx.) —95— —105— —110 Volts.
Peak R.F. Grid Voltage (Approx.)—235—245 —250 Volts.
D.C. Plate Current—140—140—140—Milliamperes.
D.C. Grid Current (Approx.)—30—30—30 Milliamperes.
Driving Power (Approx.)—7—7—7 Watts.
Power Output (Approx.)—45—70—90 Watts.

FREQUENCY	15	30	60	MEGACYCLES
Percentage of Max. Rated Plate Voltage and Plate Input	100 max.	75 max.	50 max.	Per Cent

834 TENTATIVE CHARACTERISTICS

Filament Voltage (A.C. or D.C.)—7.5 Volts.
Filament Current—3.25 Amperes.
Amplification Factor—10.5.
Direct Interlectrode Capacitances (Approx.):
Grid-plate—2.6 mmf.
Grid-filament—2.2 mmf.
Plate-filament—0.6 mmf.
Bulb—S-21.
Base—Medium 4-pin, Bayonet.

MAXIMUM RATINGS AND TYPICAL OPERATING CONDITIONS

As R.F. Power Amplifier—Class B Telephony
Carrier conditions per tube for use with a max. modulation fact. of 1.0

D.C. Plate Voltage—1250 max. Volts.
D.C. Plate Current—100 max. Milliamperes.
Plate Input—75 max. Watts.
Plate Dissipation—50 max. Watts.

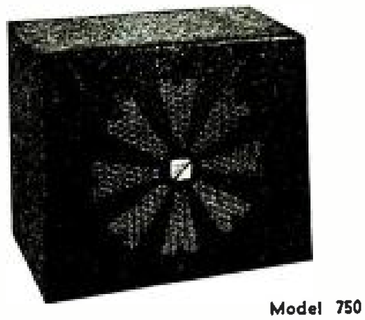
Typical Operation:
Filament Voltage (A.C.)—7.5—7.5—7.5 Vols.
D.C. Plate Voltage—750—1000—1250 Volts.
D.C. Grid Voltage (Approx.)— —70— —90— —115 Volts.
Peak R.F. Grid Voltage (Approx.)—90—100—115 Volts.
D.C. Plate Current—50—50—50 Milliamperes.
D.C. Grid Current (Approx.)—1—0.5—0 Milliamperes.
Driving Power (Approx.)—3.3—3.1—3 Watts.
Power Output (Approx.)—11—16—20 Watts.

As Plate-Modulated R.F. Power Amplifier—Class C Telephony
Carrier conditions per tube for use with a max. modulation fact. of 1.0

D.C. Plate Voltage—1000 max. Volts.
D.C. Plate Current—100 max Milliamperes.
D.C. Grid Current—20 max. Milliamperes.
Plate Input 100 max. Watts.
Plate Dissipation—35 max. Watts.

Typical Operation:
Filament Voltage (A.C.)—7.5—7.5 Volts.

(Continued on page 63)



• • • SHORT WAVE ESSENTIALS
FOR MEMBERS OF THE SHORT WAVE LEAGUE • • •

Application for Membership SHORT WAVE LEAGUE

SHORT WAVE LEAGUE 5-36
99-101 Hudson Street, New York, N. Y.

I, the undersigned, herewith desire to apply for membership in the SHORT WAVE LEAGUE. In joining the LEAGUE I understand that I am not assessed for membership and that there are no dues and no fees of any kind. I pledge myself to abide by all the rules and regulations of the SHORT WAVE LEAGUE, which rules you are to send to me on receipt of this application.

I consider myself belonging to the following class (put an X in correct space): Short Wave Experimenter ☐ Short Wave Fan ☐ Radio Engineer ☐ Student ☐

I own the following radio equipment:

Transmitting ....

Call Letters ....

Receiving ....

Name ....

Address ....

City and State ....

Country ....

I enclose 10c for postage and handling for my Membership Certificate.

A FEW WORDS AS TO THE PURPOSE OF THE LEAGUE

The SHORT WAVE LEAGUE was founded in 1930. Honorary Directors are as follows:

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

The SHORT WAVE LEAGUE is a scientific membership organization for the promotion of the short wave art. There are no dues, no fees, no initiations, in connection with the LEAGUE. No one makes any money from it; no one derives any salary. The only income which the LEAGUE has is from its short wave essentials. A pamphlet setting forth the LEAGUE'S numerous aspirations and purposes will be sent to anyone on receipt of a 3c stamp to cover postage.

FREE MEMBERSHIP CERTIFICATE

As soon as you are enrolled as a member, a beautiful certificate with the LEAGUE'S seal will be sent to you, providing 10c in stamps or coin is sent for mailing charges.

Members are entitled to preferential discounts when buying radio merchandise from numerous firms who have agreed to allow lower prices to all SHORT WAVE LEAGUE members.

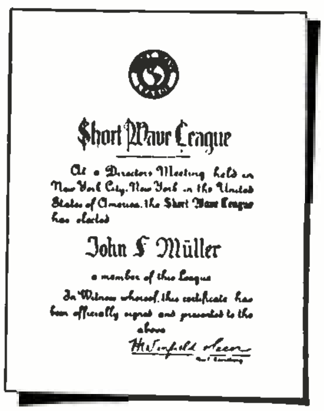


Illustration of engraved free membership certificate

SHORT WAVE ESSENTIALS LISTED HERE SOLD ONLY TO SHORT WAVE LEAGUE MEMBERS

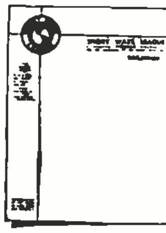
They cannot be bought by anyone unless he has already enrolled as one of the members of the SHORT WAVE LEAGUE or signs the blank on this page (which automatically enrolls him as a member, always provided that he is a short wave experimenter, a short wave fan, radio engineer, radio student, etc.).

Inasmuch as the LEAGUE is international, it makes no difference whether you are a citizen of the United States or any other country. The LEAGUE is open to all.

SHORT WAVE LEAGUE LETTERHEADS

A beautiful letterhead has been designed for members' correspondence. It is the official letterhead for all members. The letterhead is invaluable when it becomes necessary to deal with the radio industry, mail order houses, radio manufacturers, and the like; as many houses have offered to give members who write on the LEAGUE'S letterhead a preferential discount. The letterhead is also absolutely essential when writing for verification to radio stations either here or abroad. It automatically gives you a professional standing.

A—SHORT WAVE LEAGUE letterheads, per 100 .... **50c**



A—50c per 100

OFFICIAL SHORT WAVE LISTENER MAGAZINE

The finest magazine of its kind ever published—totally different in get-up and contents from any other. Contains the largest listing of short wave stations in the world, up-to-the-minute, including "Police," "Television" and short-wave stations, as well as a special list of the star short-wave stations with their frequencies and call letters. Also contains photos and descriptions of short-wave broadcasting stations in various parts of the world with photos of short wave studio artists—How to locate "weak" distance stations, and other hints for the "short-wave listener"—Question and Answer Department for the "listener"—Silver Cup Trophy for best photo of readers' listening "Posts," etc

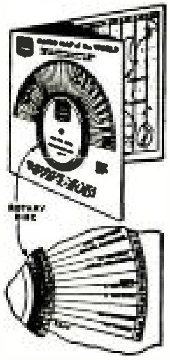
B—Official Short Wave Listener Magazine .... Prepaid **15c**

B—15c per copy

RADIO MAP OF THE WORLD AND STATION FINDER

The finest device of its kind published. The world's map on heavy board is divided into 23 sections, while the rotary disc shows you immediately the exact time in any foreign country. Invaluable in logging foreign stations. Also gives call letters assigned to all nations. Size 11"x22".

C—Radio Map of the World and Station Finder .... Prepaid **25c**



C—25c each

GLOBE OF THE WORLD

This highly important essential is an ornament for every den or study. It is a globe, 6 in. in diameter, printed in fifteen colors, glazed in such a way that it can be washed. This globe helps you to intelligently log your foreign stations. The base is of solid walnut, and the semi-meridian of a nickel-like metal. Entire device substantially made, and will give an attractive appearance to every station, emphasizing the long-distance work of the operator.

D—Globe of the World .... Prepaid **89c**

SHORT WAVE LEAGUE LAPEL BUTTON

This beautiful button is made in hard enamel in four colors, red, white, blue and gold. It measures three quarters of an inch in diameter. By wearing this button, other members will recognize you and it will give you a professional air. Made in bronze, gold filled, *not plated*. Must be seen to be appreciated.

E—SHORT WAVE LEAGUE lapel button .... Prepaid **35c**

EE—SHORT WAVE LEAGUE lapel button, like the one described above but in solid gold .... Prepaid **$2.00**

SHORT WAVE LEAGUE SEALS

These seals or stickers are executed in three colors and measure 1¼ in. in diameter, and are gummed on one side. They are used by members to affix to stationery, letterheads, envelopes, postal cards and the like. The seal signifies that you are a member of the SHORT WAVE LEAGUE. Sold in 25 lots or multiples only.

G—SHORT WAVE LEAGUE seals .... per 25, Prepaid **15c**

SHORT WAVE MAP OF THE WORLD

This beautiful map, measuring 18x26 in. and printed in 18 colors is indispensable when hung in sight or placed "under the glass" on the table or wall of the short wave enthusiast. It contains a wealth of information such as distances to all parts of the world, political nature of the country in which a broadcast station is located, etc., and from the manner in which the map is blocked off gives the time in different parts of the world at a glance.

F—SHORT WAVE Map of the World .... Prepaid **25c**

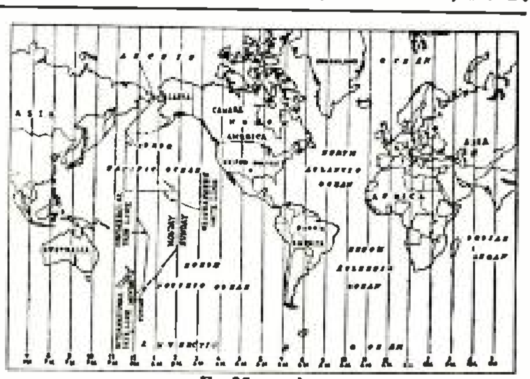
PLEASE NOTE THAT ABOVE ESSENTIALS ARE SOLD ONLY TO MEMBERS OF THE LEAGUE—NOT TO NON-MEMBERS WITH EXCEPTION OF ITEM B.

Send all orders for short wave essentials to SHORT WAVE LEAGUE, 99-101 Hudson Street, New York City.

If you do not wish to mutilate the magazine, you may copy either or both coupons on a sheet of paper.

SHORT WAVE LEAGUE 99-101 Hudson St., New York, N. Y.

G—15c for 25



F—25c each

D—89c each

E—35c each

SHORT WAVE LEAGUE, 99-101 Hudson Street, New York, N. Y.

Gentlemen:

I am already an enrolled member in the SHORT WAVE LEAGUE ☐
I am a new member and attach my application to this coupon ☐
Please send me the following short wave essentials as listed in this advertisement:

....

for which I enclose $.......... herewith.

(The LEAGUE accepts money order, cash or new U. S. Stamps in any denomination. Register cash and stamps.)

Name ....
Address ....
5-36 City and State ....
Country ....

A "Loop Aerial" S-W Receiver

(Continued from page 17)

Layout of Parts on Sub-Panel

Now turn your attention to some descriptive details for the arrangement of the parts on the subpanel. On the left are the two clips for connecting the filament-supply batteries. (Only two No. 6 dry cells in series will prove more than sufficient for a long-time operation of this receiver.) Then following across the panel is the detector tube, the 6:1 (5:1 is OK) audio transformer, the amplifier tube and finally on the extreme right are the three "B" voltage clips—one 45-volt tap, the other two serve as phone connections and one of these also as the 90-volt tap. The negative side of the "B" connects to the negative of the "A" battery.

Then back of the audio transformer is placed the grid-leak R2 and grid-condenser C2 and towering up for a distance of four feet is the house-lath and small cross-pieces which support the loop-coils L1 and L2.

When this completed support is fastened in place, a wire (with one end scraped) is slipped through the clip and held taut while passing to and over the top cross-piece and terminating its other scraped end in the second clip. This makes the loop coil L1, and since a small hole is drilled through the subpanel on the inner side of these two clips, a similar method is used to put the loop coil L2 into place. However, the ends of L2 are soldered to the proper wires underneath the subpanel.

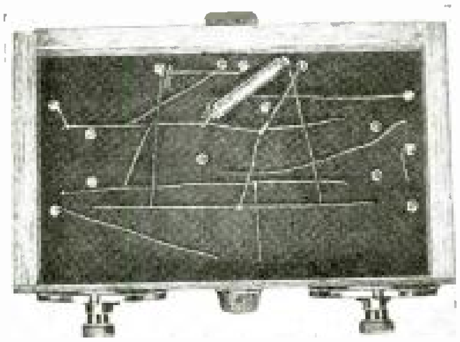
The other item of description is the radio frequency choke coil—labelled RFC. This choke coil is made on a 3" length of ¼" diameter wood dowel, with 1000 turns of No. 36 D.C.C. copper wire close-wound.

If you want to try a ground wire on this set, connect it to the A—, B— clip, but in my case, such a wire dampened the regeneration quite a lot.

If the constructor is a "fan" for a particular short-wave band, a little experimenting with various sizes of loops L1 and L2 (and condensers C1 and C3) will bring in the desired results.

Parts

2 .00035 mf. variable condensers
2 vernier dials
10-ohm rheostat and knob
2 UX sockets
5:1 audio transformer
5 megohm gridleak
1 .00025 mf. fixed grid-condenser.
1 top cross piece 4"x½"x⅜"
3 cross pieces 4¼"x½"x⅜"
1 RFC coil
17 feet of No. 18 D.C.C. copper wire for L1 and L2
2 type '30 tubes
2 No. 6 dry cells
1 90-volt "B" battery with 45-volt tap

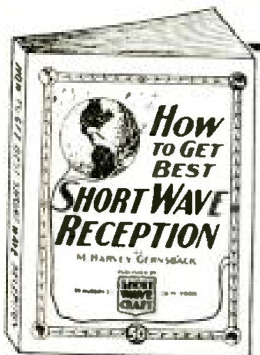


Bottom View

(The loop as constructed, when tuned by a 250 mmf. condenser, will cover the range approximately from 21 to 100 meters. If a 100 mmf. condenser is used, the range will be from approximately 19 to 35 meters. With the smaller condenser, of course, there will be less crowding of stations and tuning will be easier. Unless the wire on this loop is made very rigid, considerable difficulty will be experienced with frequency instability, the slightest vibration causing the set to be detuned quite severely. The best solution would be to use copper tubing instead of copper wire.—Editor)

Here are the Six BEST SHORT-WAVE RADIO BOOKS!

Without doubt you will have to go a long way to buy better books on short waves than you find on this page. Each book is written by a well-known authority on short waves . . . each book has been carefully illustrated with photographs and diagrams to make the study of this field of radio much simpler. The volumes on this page are the finest books on short-waves which are published anywhere today. Order one or more copies today . . . find out for yourself how fine they are. Prices are postpaid.



How to Get Best Short-Wave Reception

By M. HARVEY GERNSBACK

This book tells you everything you ever wanted to know about short-wave reception.

The author, a professional radio listener and radio fan for many years, gives you his long experience in radio reception and all that goes with it.

Why is one radio listener enabled to pull in stations from all over the globe, even small 100 watters, 10,000 miles away, and why is it that the next fellow, with a much better and more expensive equipment, can only pull in the powerful stations that any child can get without much ado?

The reason is intimate knowledge of short waves and how they behave. Here are the chapters of this new book.

1. What are Short Waves and what can the listener hear on a short-wave receiver or converter?
2. How to tune and when to listen in on the short waves.
3. How to identify short-wave stations.
4. Seasonal changes in short wave reception.
5. Types of receivers for short-wave reception.
6. Aerial systems for short-wave receivers.
7. Verifications from short-wave stations.

The book makes excellent reading matter. There are many tricks in short-wave reception that even some of the "old-timers" do not know. Be sure to get it.

40 Illustrations, 72 Pages. Stiff, flexible covers **50c**

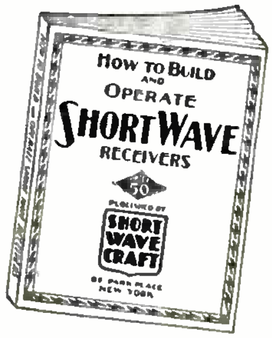
HOW TO BUILD AND OPERATE SHORT-WAVE RECEIVERS

THIS is the best and most up-to-date book on the subject. It is edited and prepared by the editors of SHORT WAVE CRAFT, and contains a wealth of material on the building and operation, not only of typical short-wave receivers, but short-wave converters as well. Dozens of short-waves sets are found in this book, which contains hundreds of illustrations; actual photographs of sets built, hookups and diagrams galore.

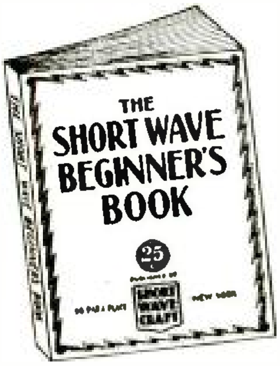
This book is sold only at a ridiculously low price because it is our aim to put this valuable work into the hands of every short-wave enthusiast.

We know that if you are at all interested in short waves you will not wish to do without this book. It is a most important and timely radio publication.

150 Illustrations, 72 Pages. Stiff, flexible covers **50c**



THE SHORT-WAVE BEGINNER'S BOOK



HERE is a book that solves your short wave problems—leading you in easy stages from the simplest fundamentals to the present stage of the art as it is known today. It is the only low-priced reference book on short waves for the beginner.

The book is profusely illustrated—it is not "technical." It has no mathematics and no technical jargon.

It also gives you a tremendous amount of important information, such as time conversion tables, all about aerials, noise elimination, all about radio tubes, data on coil winding and other subjects.

Partial List of Contents

Getting Started in Short Waves—the fundamentals of electricity. Symbols, the Short Hand of Radio—how to read schematic diagrams. Short Wave Coils—various types and kinds in making them.

Short Wave Aerials—the points that determine a good aerial from an inefficient one.

The Transposed Lead-in for reducing Static.

The Beginner's Short-Wave Receiver—a simple one tube set that anyone can build.

How to Tune the Short-Wave Set—telling the important points to get good results.

Audio Amplifiers for S-W Receivers.

Learning the Code—for greater enjoyment with the S-W set.

Wave length to Kilocycle Chart.

Wire Chart—to assist in the construction of coils.

25c **75 Illustrations, 40 Pages. Stiff, flexible covers**

101 SHORT-WAVE HOOKUPS

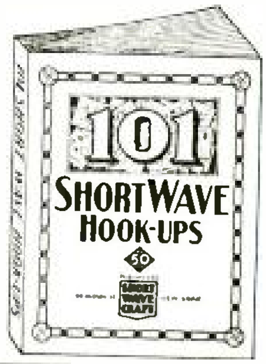
Compiled by the Editors of SHORT WAVE CRAFT

EACH and every hook-up and diagram illustrated is also accompanied by a thorough explanation of what this particular hook-up accomplishes, what parts are required, coil-winding information, values of resistors, etc., in fact, everything you want to know in order to build the set or to look up the data required.

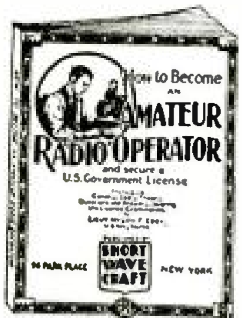
To be sure, all of the important sets which have appeared in print during the past five years are in this valuable book. Sets such as the Doerle, Dinsmore, the "19" Twinplex, Oscillodyne, Denton "Stand-by," Megadyne Triplex 2, "Globe-Trotter," 2-Tube Superhet, Minidyne, "Loop" Receiver, "Doerle" 2-tube Battery, "Doerle" 3 tube Battery, "Doerle" 2-tube A.C., "Doerle" 3-tube A.C. Doerle "Signal Gripper," Duo R.F. 4-tube Receiver, The Sargent 9-33 Tapped Coil Receiver, Globe-Girdler 7, The 2-Tube "Champ"—2 Tubes Equal 3, Ham Band "2-Tube Pee-Wee" Wyeth All-Way 6, Denton Economy 3, 2 Tube "Regenerative-Oscillodyne" will be found here, with full descriptions. In many cases, we have also included a picture hook-up for those who do not wish to follow the regular symbolic hook-up, but wish to have a regular wiring diagram.

This is a very handy volume, especially for those "fans" who wish to study the best sets in the short-wave art, from one tube up to ten tubes.

100 Illustrations, 72 Pages, Stiff, flexible covers **50c**



HOW TO BECOME AN AMATEUR RADIO OPERATOR



50c **150 Illustrations, 72 Pages, Stiff, flexible covers**

WE chose Lieut. Myron F. Eddy to write this book because his experience in the amateur field has made him pre-eminent in this line. For many years he was instructor of radio telegraphy at the R.C.A. Institute. He is a member of the I.R.E. (Institute of Radio Engineers), also the Veteran Wireless Operators' Association.

If you intend to become a licensed code operator, if you wish to take up phone work eventually—this is the book you must get.

Partial List of Contents

Ways of learning the code. A system of sending and receiving with necessary drill words is supplied so that you may work with approved methods. Concise authoritative definitions of radio terms, units and laws, brief descriptions of commonly used pieces of radio equipment. This chapter gives the working terminology of the radio operator. Graphic symbols are used to indicate the various parts of radio circuits. General radio theory particularly as it applies to the beginner. The electron theory is briefly given, then waves—their creation, propagation and reception. Fundamental laws of electric circuits, particularly those used in radio are explained next and typical basic circuits are analysed. Descriptions of modern receivers that are being used with success by amateurs. You are told how to build and operate these sets. Amateur transmitters. Diagrams with specifications are furnished so construction is made easy. Power equipment that may be used with transmitters and receivers, rectifiers, filters, batteries, etc. Regulations that apply to amateur operators. Appendix which contains the International "Q" signals, conversion tables for reference purposes, etc.

TEN MOST POPULAR SHORT-WAVE RECEIVERS

—HOW TO MAKE AND WORK THEM

THE editors of SHORT WAVE CRAFT have selected ten outstanding short-wave receivers and these are described in the new volume. Each receiver is fully illustrated with a complete layout, pictorial representation, photographs of the set complete, hookup and all worth-while specifications. Everything from the simplest one-tube set to a 5-tube T. R. F. receiver is presented. Complete lists of parts are given to make each set complete. You are shown how to operate the receiver to its maximum efficiency.

CONTENTS

The Doerle 2-Tube Receiver That Reaches the 12,500 Mile Mark, by Walter C. Doerle.

2-R.F. Pentode S-W Receiver having two stages of Tuned Radio Frequency, by Clifford E. Denton and H. W. Secor.

My de Luxe S-W Receiver, by Edward G. Ingram.

The Binneweg 2-Tube 12,000 Mile DX Receiver, by A. Binneweg, Jr.

Build a Short-Wave Receiver in your "Brief-Case," by Hugo Gernsback and Clifford E. Denton.

The Denton 2-Tube All-Wave Receiver, by Clifford E. Denton.

The Denton "Stand-By," by Clifford E. Denton.

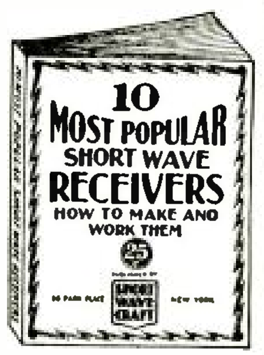
The "Stand-By" Electrified.

A COAT-POCKET Short-Wave Receiver, by Hugo Gernsback and Clifford E. Denton.

The S-W PENTODE-4, by H. G. Cisin, M. E.

Louis Martin's Idea of A GOOD S-W RECEIVER, by Louis Martin.

75 Illustrations, 40 Pages, Stiff, flexible covers **25c**



All the books shown on this page are published exclusively by

SHORT WAVE CRAFT

99-101 Hudson Street, New York, N. Y.

CLIP—MAIL

SHORT WAVE CRAFT, 99-101 Hudson Street, New York, N. Y. SW-5-36

Gentlemen: I enclose herewith my remittance for the amount of $............for which you are to send me, postpaid, the books checked below.

( ) How to Get Best Short-Wave Reception....................50c each
( ) 101 Short-Wave Hook-ups.....50c each
( ) How to Build and Operate Short-Wave Receiver....................50c each
( ) How to Become an Amateur Radio Operator....................50c each
( ) Ten Most Popular Short-Wave Receivers. How to Make and Work Them....................25c each
( ) The Short Wave Beginner's Book....................25c each

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

(Send remittance in form of check or money order. If letter contains cash or unused U. S. Postage Stamps, register it.)

OVERSEAS READERS!

These books can be obtained from the following houses:

GREAT BRITAIN
Gorringe's
9a, Green Street, Leicester Square
London, England

FRANCE
Editions Radio
42 Rue Jacob
Paris

AUSTRALIA
McGill's
183-195, 218 Elizabeth St.
Melbourne, C. 1

Oh! for a Ham "Shack" Like One of These

(Continued from page 21)

Lt. W. W. Johler

oscillator, a 841 buffer, and a 203A final, and a Collins impedance-matching network.

LIEUT. W. W. JOHLER,
Kemper Military School,
Boonville, Missouri.

W9NTP

(Continued from page 21)

input modulated by a pair of 46's in class "B." I use a Collins 7Y speech amp. which consists of a 53 and a 2A5, and a Turner type G crystal microphone on both of the above rigs. These outfits were built by W9NBZ. The receivers are a RME9D-S.S.S. pictured, and a National ACSW5 Thrill Box not shown. I have a 47 xtal osc. and a 45 final amp. with about 20 watts input on 40 and 80 meter CW on a 3630KC and 7260 KC.

BILLY BRENTLINGER, W9NTP,
(The Noisy Talking Politician)
1625 South 11th Street,
Terre Haute, Indiana.

Paul Bauerle

(Continued from page 21)

watts input. Rack and panel are made of steel, and all parts well insulated.

The station is remote controlled by relays operated by push-buttons on desk.

PAUL BAUERLE, W8AHV,
Lansing, Mich.

VU2FY

(Continued from page 21)

so that either receiver may be used by the flick of a switch.

The aerial used is a half-wave Zepp, with 64-foot feeders, and it's non-directional. Efficiency is the keynote of the station which is classed as the finest in all Asia.

LIONEL F. STETSON,
1945 Argyle St.,
Chicago, Ill.

One Year's Subscription to
SHORT WAVE CRAFT
FREE
for the "Best" Station Photo

Closing date for each contest—75 days preceding date of issue: April 15 for July issue, etc. The editors will act as judges and their opinions will be final. In the event of a tie a subscription will be given to each contestant so tying.

New ACR-175 Amateur Communication Receiver

(Continued from page 23)

single-ended pointer simultaneously traverses a vernier scale of 100 divisions spaced equidistant around the entire circumference of the dial, this pointer making a complete revolution per vernier index division. Thus, any station can be logged accurately by noting in sequence the band letter, vernier index scale number and vernier scale number.

This article has been prepared from data supplied by courtesy of RCA Manufacturing Company.

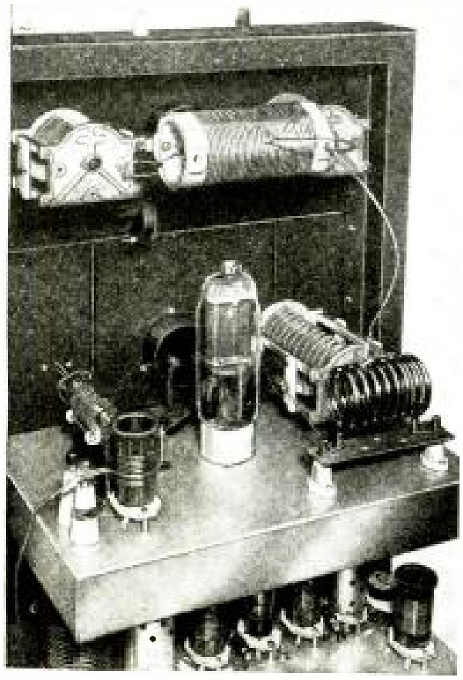
A Long-Lines Oscillator and Modulator

(Continued from page 28)

erage double-button carbon microphone. As a matter of convenience to the purchaser some antenna specifications are given, which will enable him to construct a fairly efficient radiating system for the Eagle Long Lines Transmitter. This article has been prepared from data supplied by courtesy of Eagle Radio Co.

W2AMN's All-Band Transmitter

(*Continued from page* 11)



This view clearly shows the antenna tuning "network," together with a complete pentode final amplifier. The plate tank coil and tuning condenser are on the right, and the grid tuning circuit is on the left.

voltage ratings, because a failure of a part due to breakdown can cause serious damage and no doubt, where high-power equipment is used, considerable expense.

The modulator is very simple and adequate for close-talking into a crystal microphone and of course for natural operation of a double-button carbon mike. Any fairly *high-gain* audio amplifier, delivering an output of from three to five watts, will serve.

Key-down meter readings of the transmitter as described will be as follows. Plate current maximum 160 ma. Screen current max. 50 ma. D.C. grid current max. 18 to 20 mills. Output 240 watts with 2,000 volts on the plate, 45 plus on the suppressor and 45 minus on the control grid. These are for "CW" operation.

For "phone"—plate current 75 ma., grid current 15 ma. 135 volts negative on the suppressor and 45 volts negative on the control grid. Screen-grid current 50 ma. carrier output, approximately 55 watts. The above is for the 803.

If the RK28 is used the readings will be approximately the same except that the suppressor negative voltage will only have to be around 45 to 50 for phone.

This transmitter was used in every band from 80 down to 10 meters. And the ten meter operation was quite surprising; good output was obtained on both phone and C.W. with the plate voltage reduced to around 1,500. The phone carrier appeared to be around 30 watts and over 130 on C.W. We worked Europe, Asia and Africa the first week on the air, with the transmitter in the 10 meter band. On other bands the DX was equally as gratifying.

Amplifier Plate Coil Data

80 m. band. 22 turns of No. 12 tinned copper wire on a Bud 3 in. dia. grooved ceramic form.

40 m. band. 16 turns of ¼ in. copper tubing 2⅜ in. inside diameter wound to a 5½ in. length.

20 m. band. 8 turns ¼ in. copper tubing 2 in. inside diameter, wound to a length of 3½ in.

10 m. band. 4 turns of 3/16 in. copper tubing 1 in. inside diameter, wound to a length of 3½ in.

Two sets of jacks are provided for these coils, one set spaced 5½ inches and another 3½ inches. They are Bud medium size (1¼ in.) jacks and plugs.

Amplifier Grid Coils

80 m. band. 38 turns No. 22 D.C.C. close wound.

40 m. band. 8 turns No. 22 D.C.C. close wound.

20 m. hand. 8 turns No. 22 D.C.C. spaced to length of 1⅛ in.

10 m. band. 3½ turns No. 22 D.C.C. spaced to length of ¾ in.

The grid coils are all wound on 4 prong XP-53 Hammarlund coil forms, 1½ in. diameter.

Antenna Loading Coil

34 turns of No. 12 tinned wire on a 3 in. Bud ceramic form with clip to short out unused turns for the higher frequency bands.

Link coupling consists of one turn each end of twisted pair of heavy wire.

Power Amplifier Unit

3—.001 mf. mica condensers (5,000 volt) Aerovox.
3—.001 mf. mica condensers (1,000 volt) Aerovox.
2—.002 mf. mica condensers (5,000 volt) Aerovox.
1—50 mmf. midget variable condenser, Hammarlund.
1—100 mmf. transmitting condenser (6,500 volt), Hammarlund.
2—200 mmf. transmitting condensers (2,000 volt), Hammarlund.
1—50,000 ohm 200-watt resistor with slider, I.R.C.
1—10,000 ohm 10-watt resistor, I.R.C.
1—0—200 ma. meter, Triplett.
1—0—2.5 amp. thermo-couple meter, Triplett.
2—3 in. grooved coil forms (ceramic), Bud.
1—5 prong large socket for 803, Bud.
4—4 prong XP—53 coil forms, Hammarlund.
1—Transmitting R.F. choke, Hammarlund.
1—19x10¾ in. panel, Wholesale, Radio.
1—2¼x11 in. chassis for above, Wholesale Radio.
2—4½ in. dials and flange-type knobs, I.C.A.
2—3½" dials and flange-type knobs, I.C.A.
1—803 tube, R.C.A.
Jacks, switches, etc.—Bud.

Power Supply Unit

2—2 mf. high-voltage filter condensers (3,000 volt) Sprague.
2—15 henry 250 ma. Filter chokes, Thordarson.
1—100,000 ohm 200-watt resistor, I.R.C.
1—2½-volt, 10 ampere, filament transformer, Thordarson.
1—high-voltage transformer, 2,300 volts each side of center-tap, with split primary, Thordarson.
1—10-volt filament transformer, Thordarson.
2—front-panel mounting sockets for 866's, Bud.
2—866 tubes, R.C.A. Radiotron.
1—19x10¾ in. panel, Wholesale Radio.

Modulator

1—300-volt power transformer, Thordarson.
2—30 henry "receiving type" chokes, Thordarson.
3—8 mf. electrolytic condensers, Cornell-Dubilier.
1—15,000 ohm 25-watt resistor, I.R.C.
1—suppressor-grid coupling transformer for pentode, Thordarson.
1—3 meg. ½-watt resistor. I.R.C.
1—3,500 ohm ½-watt resistor, I.R.C.
2—100,000 ohm ½-watt resistor, I.R.C.
2—¼ meg. ½-watt resistor, I.R.C.
1—500 ohm, 1-watt resistor, I.R.C.
The above small resistors are I.R.C. insulated type.
2—.1 mf. by-pass condenser, Cornell-Dubilier.
3—4 mf. by-pass condenser, Cornell-Dubilier.
1—20 mf. by-pass condenser, Cornell-Dubilier.
1—.006 mf. by-pass condenser, Cornell-Dubilier.
1—57 tube, R.C.A. Radiotron.
1—2A5 tube, R.C.A. Radiotron.
1—80 tube, R.C.A. Radiotron.
1—panel 19x8¾, Wholesale Radio.

General

4—"heavy-duty" layer-built 45-volt batteries, Eveready. (These also serve as bias for low-power stages.)
1—6 foot by 19 inches relay rack, Wholesale Radio.

Rack and panels are finished in black crackel enamel. The various insulators, jacks and switches used were Bud. The relays were constructed from material on hand. However any efficient commercial type relay may be used. The microphone shown in the photo is an Astatic crystal microphone.

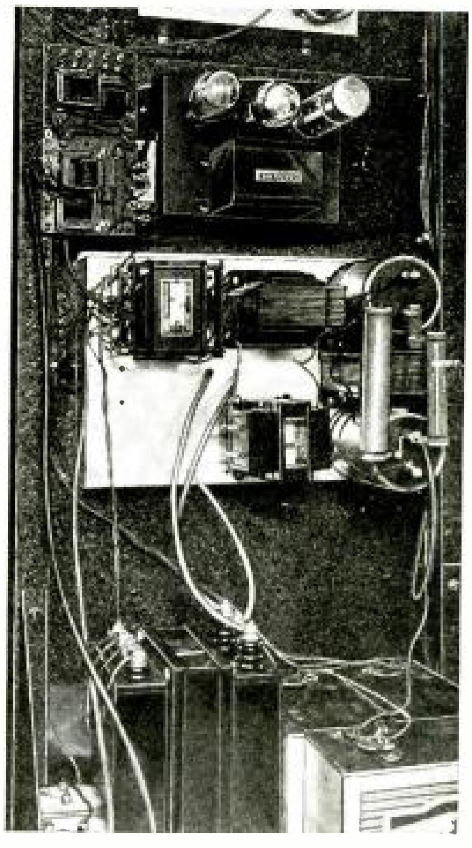
5 Meter "Long Lines"

(*Continued from page* 28)

without turning off the plate supply voltage. In this particular model, larger copper tubing is used than found in the average transmitter, and it can be expected that the efficiency will be somewhat increased because of this fact.

The design is such that the transmitter can be fastened to the wall or mounted on a table; rigidity is one of its outstanding features.

This article has been prepared from data supplied by courtesy of American Radio Hardware Co.



This view shows the high-voltage "power-supply" and the modulator, with the relay panel in the upper left-hand corner.

• Index to Advertisers •

(While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.)

Two New Tubes

(Continued from page 57)

D.C. Plate Voltage—750—1000 Volts.
D.C. Grid Voltage (Approx.)— —290— —310 Volts.
Peak R.F. Grid Voltage (Approx.)—415—435 Volts.
D.C. Plate Current—90—90 Milliamperes.
D.C. Grid Currrent (Approx.)—20—17.5 Milliamperes.
Driving Power (Approx.)—7.5—6.5 Watts.
Power Output (Approx.)—42—58 Watts.

As R.F. Power Amplifier and Oscillator—Class C Telegraphy

Key-down conditions per tube without modulation

D.C. Plate Voltage—1250 max. Volts.
D.C. Plate Current—100 max. Milliamperes.
D.C. Grid Current—20 max Milliamperes.
Plate Input—125 max. Watts.
Plate Dissipation—50 max. Watts.

Typical Operation:

Filament Voltage (A.C.)—7.5—7.5—7.5 Volts.
D.C. Plate Voltage—750—1000—1250 Volts.
D.C. Grid Voltage (Approx.)— —175— —200 —225 Volts.
Peak R.F. Grid Voltage (Approx.)—300—325—350 Volts.
D.C. Plate Current—90—90—90 Milliamperes.
D.C. Grid Voltage (Approx.)—20—17.5—15 Milliamperes.
Driving Power (Approx.)—5.5—5—4.5 Watts.
Power Output (Approx.)—42—58—75 Watts.

Cathode Ray Oscillograph

(Continued from page 53)

and a rapid "cut and try" procedure may be used.

A *transient* is usually a rapid intense change in voltage in a circuit, accompanied by a corresponding change in current, serving to temporarily unbalance all voltages, excite circuits by "impact," modulate voice, D.C. and high frequency components and cause general trouble.

While most other troubles of a periodic or recurrent nature can be identified, measured and controlled by ordinary means although tedious, the Cathode Ray Oscillograph is the only instrument yet developed that can deal *directly* with transients.

"Keying" Problems

If, for example, we attached the top vertical plate of the Cathode Ray Oscillograph to point 1 of Fig. 6A, and the lower one to point 2 while the horizontal ones were being supplied with the highest possible frequency saw-tooth wave (between 90 and 100 kc.) we might get a pattern somewhat like that in Fig. 6B, which would indicate serious key clicks in the transmitted wave as well as broadness of transmission. A condenser across the key might reduce as in Fig. 7B or even intensify this effect as in Fig. 7C, due to instantaneous charging. A resistor in series with the condenser to reduce its charging rate when the circuit is opened will be very helpful. If made variable, the resistor may be varied for minimum transient effects for both opening and closing of the key circuit. Good key operating characteristics are indicated in Fig. 8B with the circuit of Fig. 8A. The adaptability of chokes in various key circuits may also be given a decisive test in this way. *These problems are almost entirely a matter for the Cathode Ray Oscillograph,* as the "ham" has nothing else but his ear by which to make circuit corrections of this nature.

Degrees of coupling to prevent transient effects and the formation of *sub-harmonics* due to "tight coupling" may be discovered. The antenna may be adjusted to the best possible impedance match to the transmitter circuits by variation of factors controlling the impedance of each circuit until the best product of oscillograph amplitude and antenna current exists.

(This article was specially prepared for Short Wave Craft *by Mr. Sprayberry, President of the Sprayberry Academy of Radio.—Editor)*

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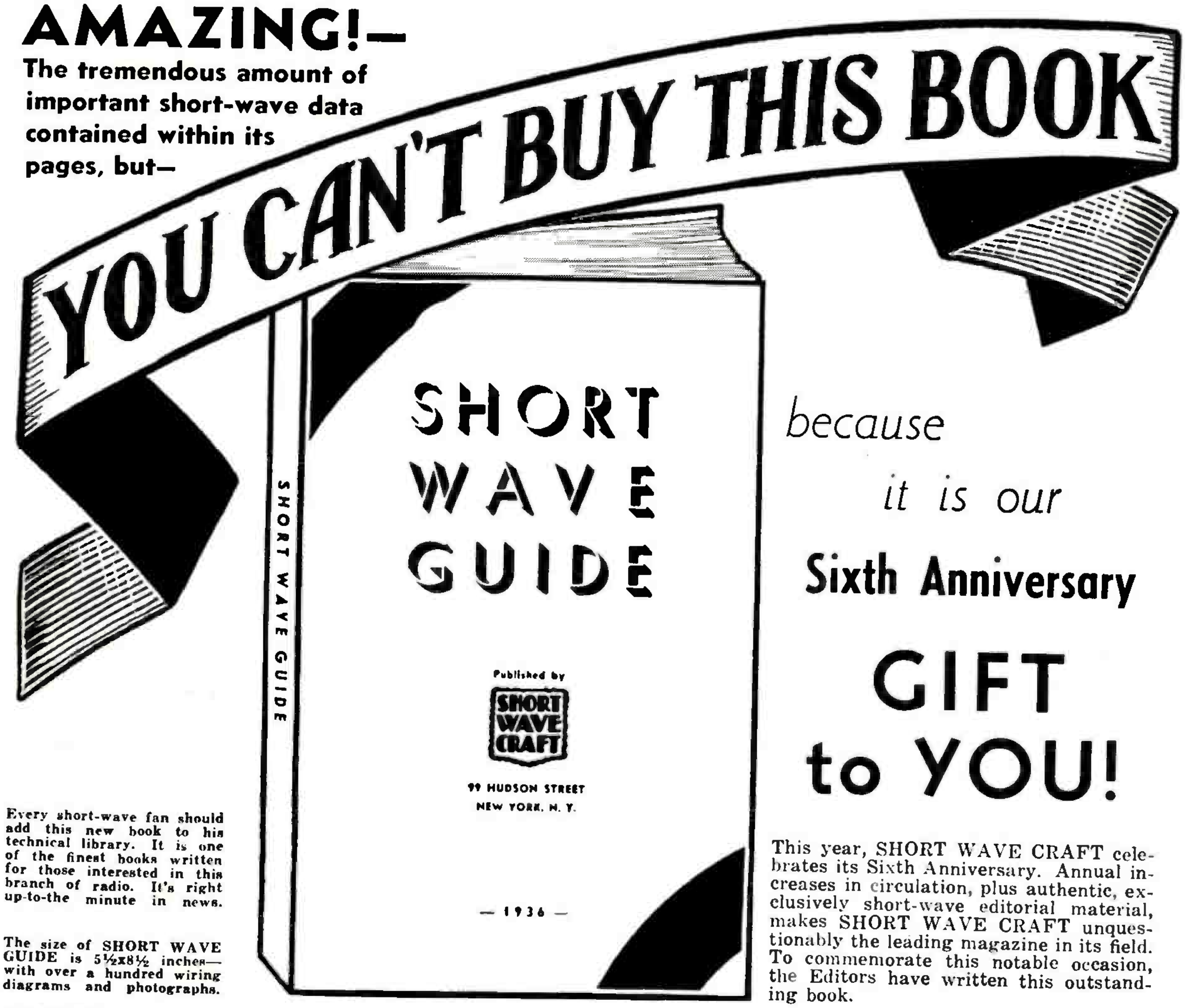
The tremendous amount of important short-wave data contained within its pages, but—



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This year, SHORT WAVE CRAFT celebrates its Sixth Anniversary. Annual increases in circulation, plus authentic, exclusively short-wave editorial material, makes SHORT WAVE CRAFT unquestionably the leading magazine in its field. To commemorate this notable occasion, the Editors have written this outstanding book.

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Partial Contents of Short Wave Guide

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Every short-wave fan is interested in learning some new kink or short-cut. Dozens of kinks, wrinkles, or "call them what you want" reach us every week—and in SHORT WAVE GUIDE you will find printed and carefully illustrated a variety of them. They will prove valuable to you in more ways than one.

Simple, Efficient Short-Wave Receivers Which Anyone Can Build

Complete constructional plans for building a number of one, two, and three-tube receivers, will also be found in SHORT WAVE GUIDE. Schematic diagrams, lists of parts—everything you need to know to build these sets and make them function properly is included.

Best Aerials for Short-Wave Reception

The many elaborate antenna systems suitable for short-wave receivers often present problems for set owners. SHORT WAVE GUIDE will give you information which will help you to decide which aerial is best adapted for your receiver. The many types of antenna will be illustrated.

Practical Hints on Short-Wave Tuning

There are thousands of short-wave stations broadcasting daily. Hundreds of these stations are heard by short-wave fans—and hundreds more could be heard distinctly if only you knew more about how to tune them in. Expert advice on proper short-wave tuning is included in SHORT WAVE GUIDE.

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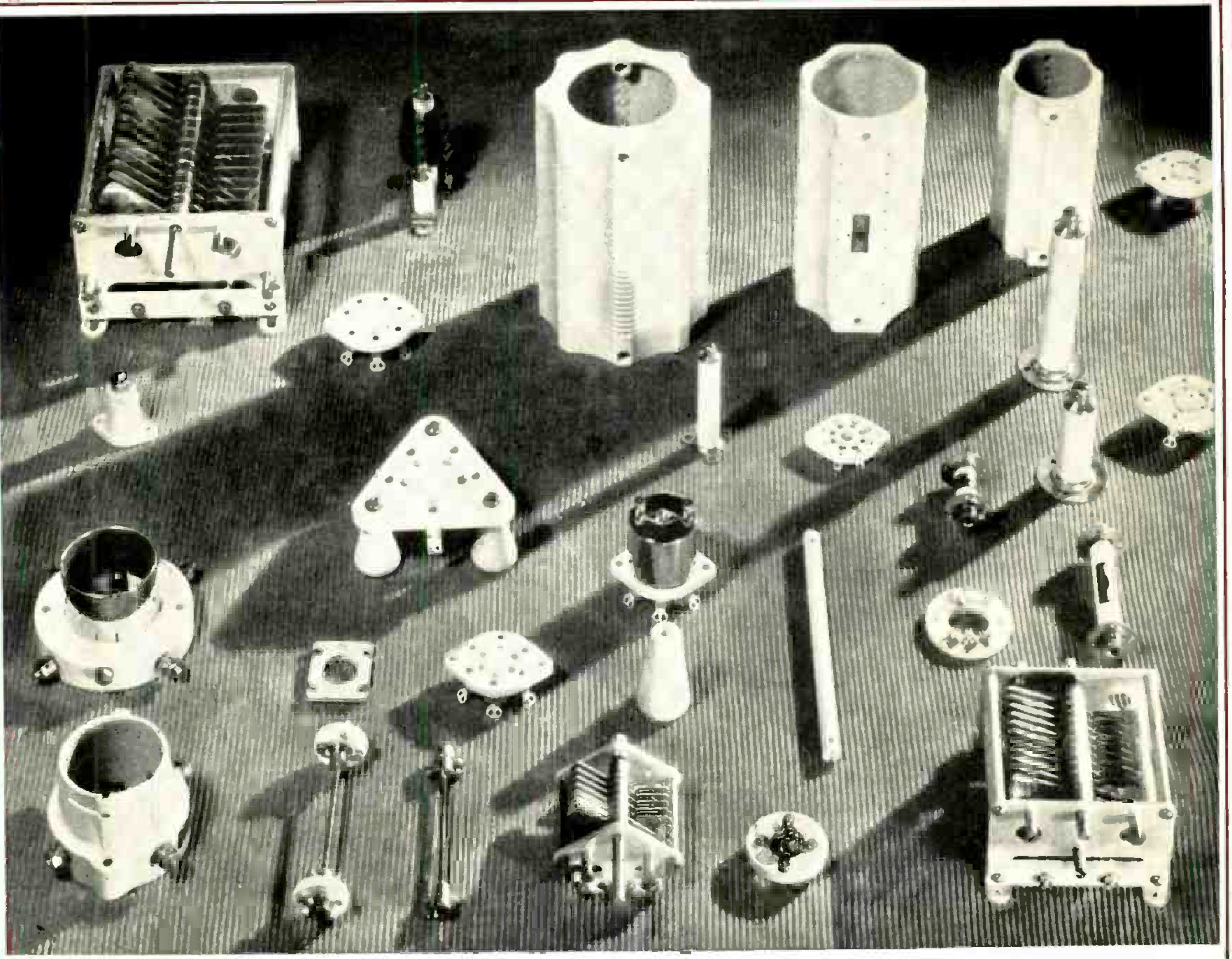

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