THE RADIO EXPERIMENTER'S MAGAZINE

OFFICIAL ORGAN OF SHORT WAVE LEAGUE

July 1932

SHORT WAVE CRAFT

Edited by HUGO GERNSBACK

NOW 25¢

BUILD THIS POCKET *Short Wave* RECEIVER

See Page 144

IN THIS ISSUE

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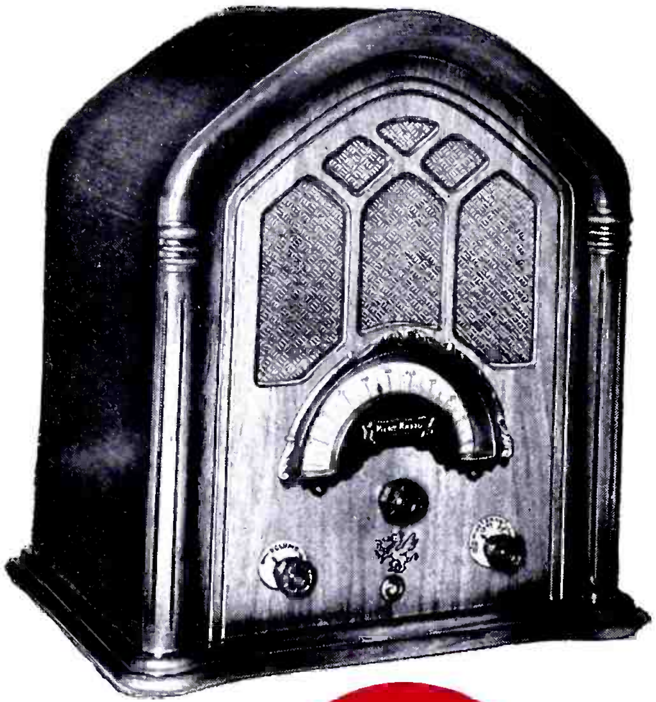

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PILOT DRAGON

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●

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●

S.W. TYPE 224-A TUBES. The PILOT 224-A tube is especially designed to reduce noises in S. W. receivers. It will improve your results.

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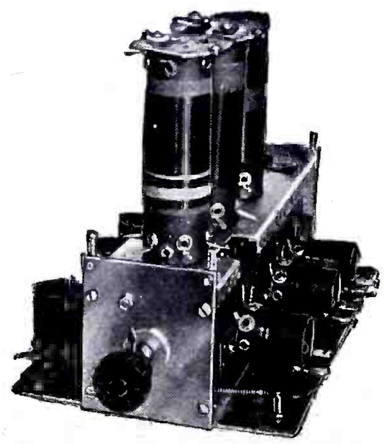
The DRAGON Catacomb and Band-selector Switch are a marvel of mechanical and electrical precision. The switch which eliminates all dead-end losses from the 9-coil circuit has 46 contacts and 125 silver points. On life tests, these switches have been rotated over 28,000 times without showing the slightest signs of wear.



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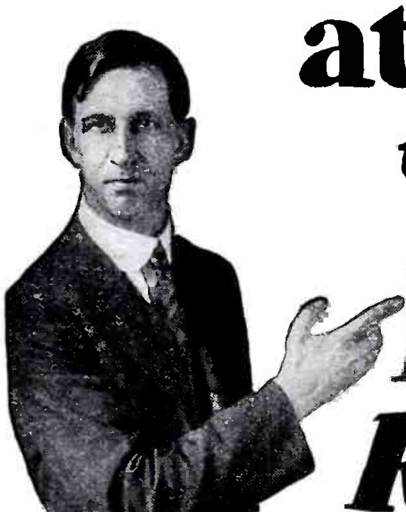

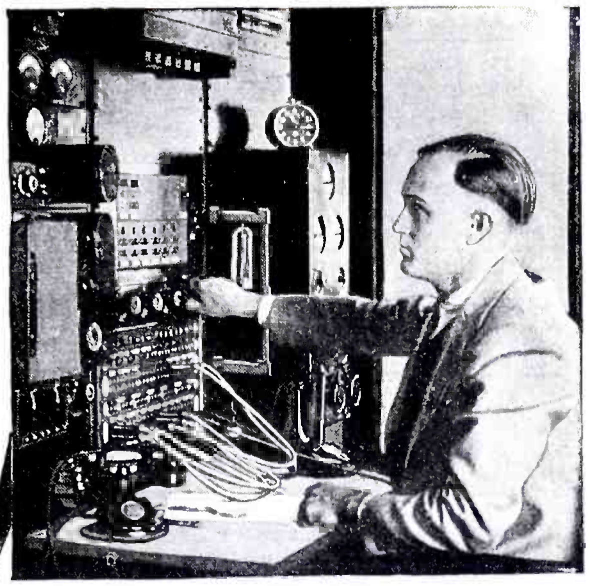

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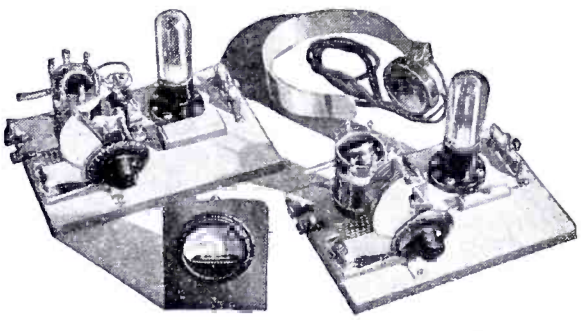

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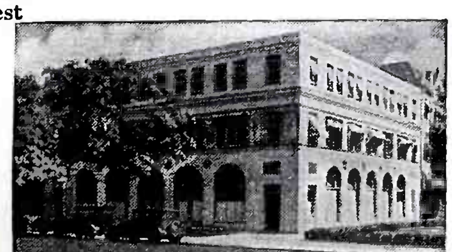

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VOL. III **SHORT WAVE CRAFT** NO. 3

HUGO GERNSBACK, Editor

H. WINFIELD SECOR, Managing Editor

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This new Readrite precision instrument embodies features which have always been desired in any instrument built for service work: (1) low cost; (2) simplicity of design; (3) accuracy of measurements; (4) ruggedness of the complete unit. It is needless to add that the kit is capable of testing anything from old battery models to the latest screen-grid, pentode, and multi-mu receivers.

EIGHT METER SCALES AVAILABLE

The "Model 700" is an extremely compact device. The outside dimensions of the carrying case are only 10¾ by 7¾ by 3¾ inches. The analyzer contains a D.C. voltmeter, an A.C. voltmeter and a milliammeter. The D.C. voltmeter has three ranges: 0 to 60; 0 to 200; and 0 to 600 volts. The A.C. voltmeter has also three ranges: 0 to 10; 0 to 140; and 0 to 700 volts. The milliammeter has two ranges; one for 20-mill. reading and the other for 100-mill. **This variety of ranges makes it possible to test every conceivable radio circuit**; high voltage secondaries of power transformers, current drain of all radio tubes, including the high power 250 and 210 tubes, etc.

CONVENIENT SELECTOR SWITCH

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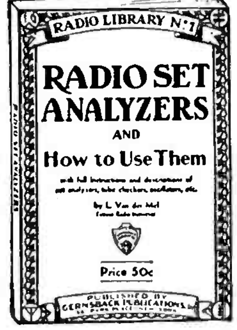
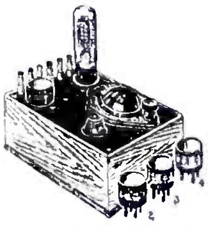


The Analyzer **is furnished** complete with test leads, connecting cables, Burgess 4½ volt battery, several battery leads, UY to UX adapter, '80 rectifier adapter and resistance and capacity charts. Shipping weight, 8 lbs.

Model 700 Analyzer. List Price $35.00. YOUR PRICE $14.70

WORLD-WIDE SHORT-WAVE SET



Range 18 to 200 meters. Employs low current drain 230 tube. Requires but 1/45 volt "B" battery, 2 No. 6 drycells and earphones to operate.

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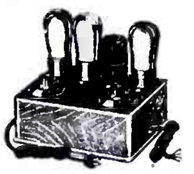
A.C. SHORT WAVE CONVERTER KIT



Contains all parts and instructions to build a three-tube S. W. converter. Range 10 to 200 meters. Includes filament transformer for 110 volts, 60 cycles, A.C. Complete with set of 3 plug-in coils. Ship. wt. 8 lbs.

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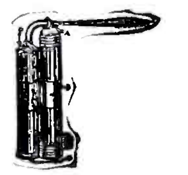

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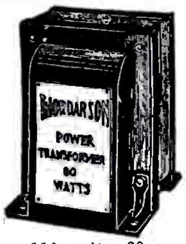

For 110 volts 60 cycle A.C. operation, 5 v. @ 2 a., 2½ v. @ 3 a. Ct., 2½ v. at 10½ a., 2½ v. at 3a. Ct., 340 V-340 V Ct.

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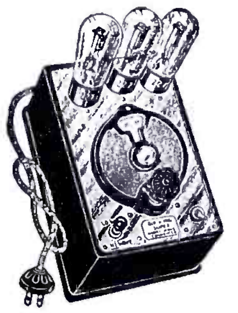

Converts any broadcast receiver into a full-fledged superhet S.W. Receiver. Range 20 to 115 meters. Requires no plug-in coils. Has built-in filament transformer for 110 volts 60 cycles A.C. Employs 3 227 tubes. Single dial control. Instructions included. Shipping wt. 8 lbs.

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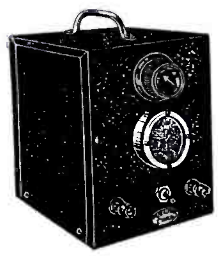

Excellently suited for P. A. work, inter-communication systems, etc. Comprises sensitive single-button microphone, microphone coupling transformer and battery, cut-off switch, gain control and output terminals. Put up in neat black crackle - finished metal case, equipped with convenient carrying handle. Measures 5"x6½"x6¾". Will correctly match the input impedance of practically all type amplifiers. Easily connected to the broadcast receiver for home recording. Ship. wt. 10 lbs.

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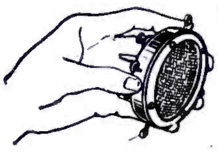

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No. 1655—Mike. Your Price $2.25

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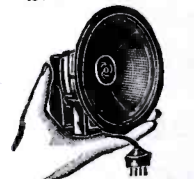

A real dynamic speaker with surprising volume and tone. 6¼" overall, 4½" diaphragm. Standard 2500 ohm field coil. Output transformer to match all type output tubes. Wt. 5 lbs.

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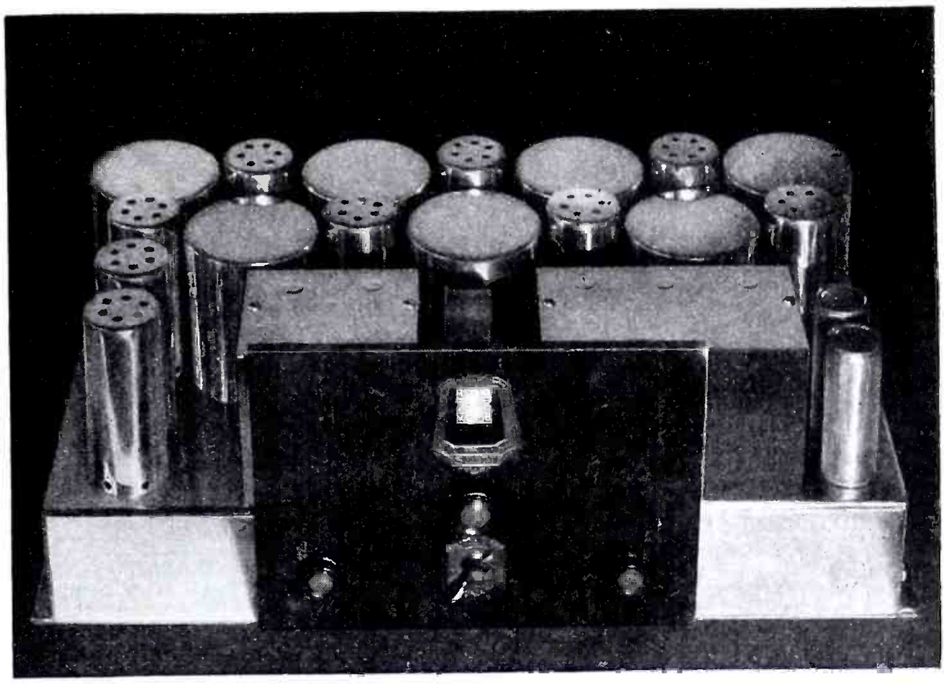
15-550 METERS

no plug in coils

SINGLE DIAL

no trimmers



Proved **by independent laboratory tests and by practical use to be the greatest radio achievement of all time!**

Such a receiver as the *de luxe* Scott All-Wave is still generally considered *impossible.* Yet, here it is! A 15-550 meter receiver *without* plug-in coils that tunes the whole range with absolute precision, on One dial—*without* the help of trimmers. But that's not all. The *de luxe* Scott All-Wave incorporates far greater *sensitivity,* and obviously better *selectivity* than have ever been considered possible of attainment. And with it all, a tonal output that is guaranteed to be as perfect as the tonal input at the station!

Here IS Sensitivity - - -

*12/1000ths of a microvolt per meter at 1400 K. C. and 6/10ths of a microvolt at 600 K. C. This is an average of several thousand times more sensitivity than engineers have ever considered practical. And this sensitivity would not be practical even in the *de luxe* Scott All-Wave were it not for the unique means by which this receiver lowers the natural noise level of reception. But it IS practical in the *de luxe* Scott All-Wave, and the 12/1000ths to 6/10ths microvolt per meter sensitivity brings in stations, *at most any distance,* with local volume. Stations that no other receiver could ever hope to get, come in on the *de luxe* Scott All-Wave, with enough volume to be heard a block away!

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WHAT ARE YOU DOING IN RADIO

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SHORT WAVE CRAFT

July, 1932 Vol. III, No. 3

H. GERNSBACK, *Editor*
H. WINFIELD SECOR, *Managing Editor*

Experimenting in Short Waves

By HUGO GERNSBACK

IT is a curious fact that history tends to repeat itself in practically everything. Short waves are not immune from this seeming law. During the period of 1922-1925, the well-known radio boom at that time was in full swing. Everyone from bootblack to banker became infected with the radio bug and started to build his own radio set. This activity went on for a number of years undiminished, and the amount of radio materials that was consumed during those days has never been equalled since.

With short waves we now have a case parallel to the radio boom of that time. Last fall a certain amount of activity started in short waves, and the movement has gathered impetus, and the radio industry hopes that by this fall and winter, it will reach sizable proportions.

It should be noted that radio has always run in cycles. When I first became identified with radio in 1903, immediately after Marconi made his important experiments, there was then a great activity in "wireless." Later on, this was repeated when the amateur activity began to assume proportions in 1908 and still later, when the sinking of the S.S. "Republic" created another small boom, as "wireless" was the direct cause of saving hundreds of passengers' lives.

Ever since that time, radio has had its "ups and downs." The reason for this is found in the fact that a new crop of radio experimenters come along, work at it for two or three years, and then drop it for something else. It generally takes an entirely new activity in radio to get the public interested and bring along a new and greater crop. This happened in 1922 when broadcasting first came along. It has happened now when short waves are taking the world by storm, and when you cannot pick up a newspaper without finding some new and marvelous exploit of the short waves in it. Short waves seem to be everywhere these days, and there is seemingly no activity where they do not enter and stay. Naturally with all the present existing short wave transmitters, and the new ones being added every day, space is becoming well saturated with short waves, and there is hardly a minute during the twenty-four hours that one cannot find something to interest him in this spectrum.

The old itch for distance has now come back with a vengeance. The radio experimenter of the vintage of 1923 loudly heralded the feat of getting a station 500 miles away on his earphones. The short wave experimenter of today is not satisfied unless he logs at least half a dozen different countries during the twenty-four hours, and then goes out to log the Antipodes.

The radio thrills of 1923 are naught compared to those of 1932. The thrill of hearing a station 10,000 miles away is never to be forgotten. Then, too, from an educational and instructional point, that is, by listening to the foreign stations and announcements, is a feature that should not be overlooked.

In the meanwhile, it would seem that all forces in radio are contriving to bring into life the most marvelous radio paradise that radio experimenters ever dared to hope for. New circuits, new radio components, a horde of new radio tubes, all make for a combination of an unexplored radio empire that must send thrills of anticipation up and down the spine of even the most hardened radio man.

New circuit combinations in connection with the new tubes will be tried out by the hundred thousand before the year is out, and the end is not as yet in sight. New tubes are being announced almost weekly, and the tube manufacturers are vying with themselves to produce more sensitive, as well as more efficient, tubes for short wave purposes.

The time is coming when it will be possible to receive the Antipodes with a one-tube set on the loud-speaker — something that every radio experimenter worth his salt is itching for.

And most important is the fact that radio experimenting in short waves today is extraordinarily economical. Almost everyone can afford the luxury of a short wave set, because its total cost is ridiculously low for a simple outfit. In this, too, history is repeating itself with the boom days of 1922 and 1925. Radio experimenters of that day were making one-tube "bloopers," but even then, radio experimenting was far more expensive than it is nowadays. We remember that at one time a single tube cost $12.00, while nowadays you can buy a complete one-tube short wave set for a fraction of the cost of a single tube at that time!

Radio manufacturers everywhere are reporting increased sales on radio components used chiefly for short wave purposes. It is a most healthy sign, and one that augurs well for the art in the very near future.

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

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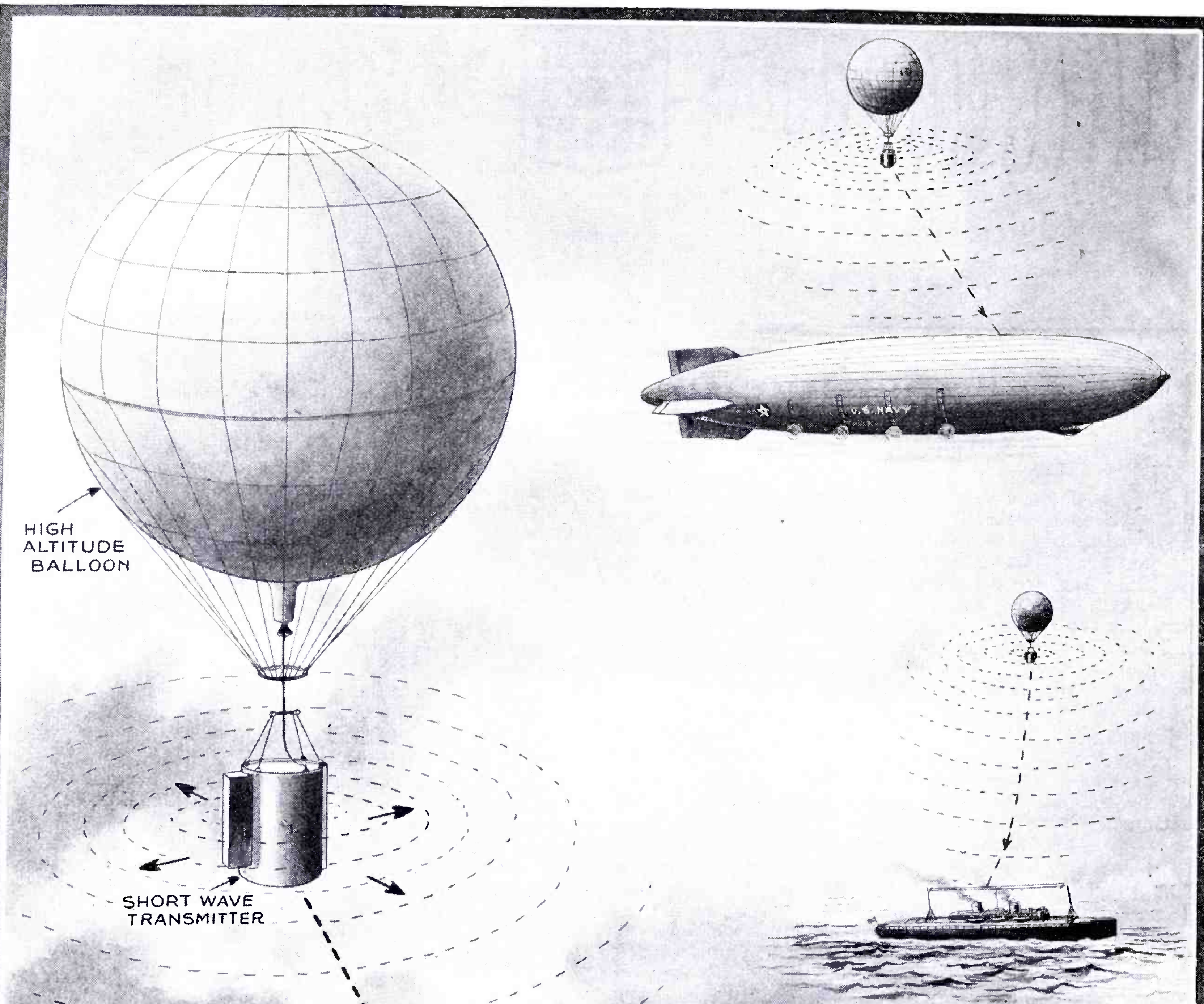
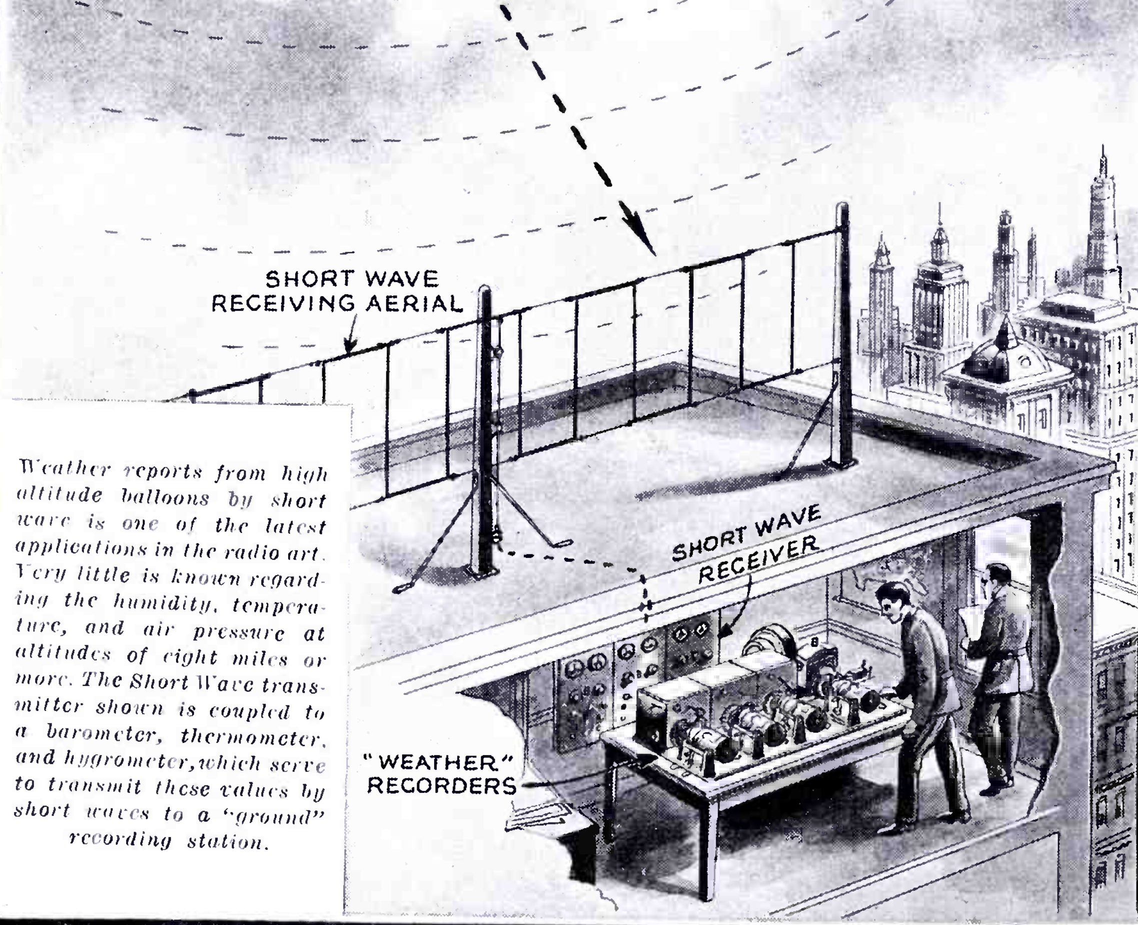
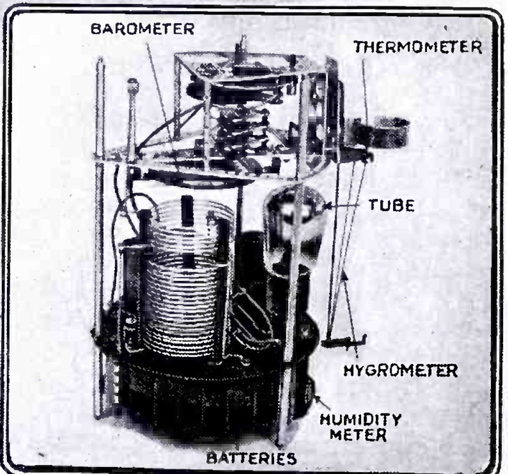
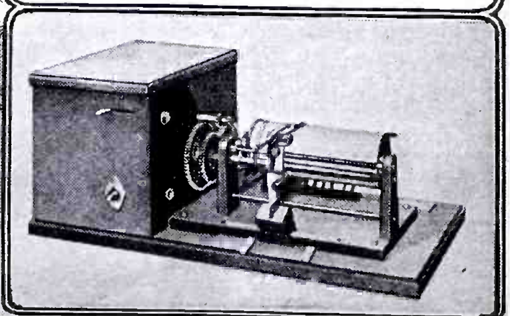




Weather reports from high altitude balloons by short wave is one of the latest applications in the radio art. Very little is known regarding the humidity, temperature, and air pressure at altitudes of eight miles or more. The Short Wave transmitter shown is coupled to a barometer, thermometer, and hygrometer, which serve to transmit these values by short waves to a "ground" recording station.



Above—Automatic weather transmitter which attaches to balloon. Below—Typical recorder used at ground station.



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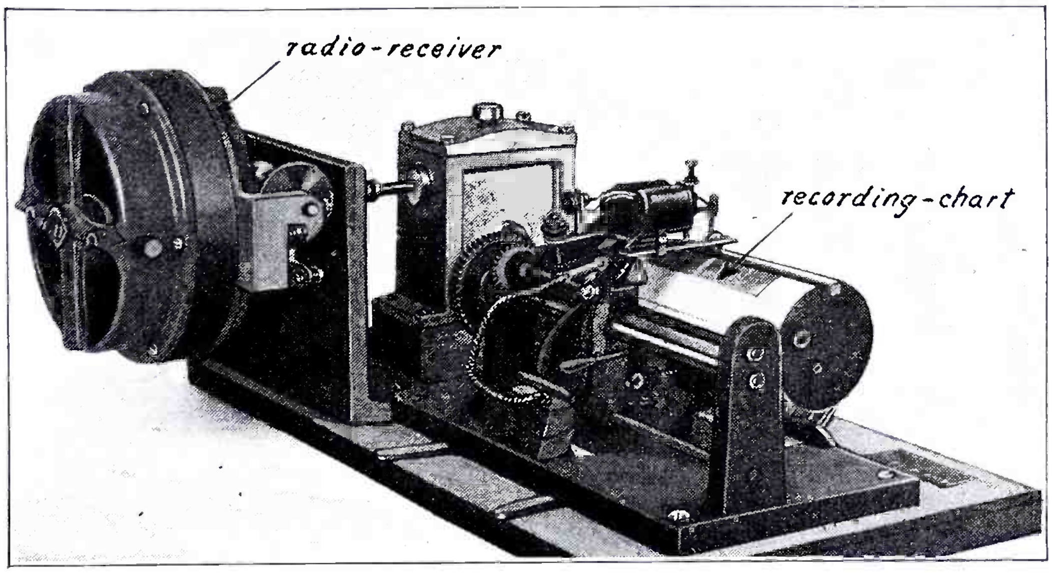
Balloon Radioes Weather by Short Waves

Automatically Without Aid of a Crew

By RENE LEONHARDT (Berlin)

WHAT are the air conditions at a height of 45,000 feet or more? Daily records of the temperature, humidity and air pressure will shortly have to be known by weather recording stations for the benefit of aircraft pilots. Today the average plane flies at a height of 10,000 to 20,000 feet, but due to the decreased air resistance encountered at higher altitudes, airplanes fitted with super-charged motors will tomorrow fly at heights of 40,000 to 60,000 feet. Even now it is very desirable for both the scientists and also for the air traffic experts to know and study the daily changes in temperature, humidity and air pressure of the upper atmosphere. The illustration on the opposite page, together with the one showing a typical ground station recorder, illustrate the latest high-altitude, automatic, radio transmitting apparatus devised by Professor Moltshanoff, the Russian scientist, for use with the North Pole expedition on the ship "Malygin." This apparatus, without human assistance, and when secured to a balloon filled with hydrogen or helium gas, gives continuously and progressively reports on the air pressure, degree of moisture, and temperature of the air, which conditions are recorded graphically by automatic radio receivers and pen recorders located at the ground station. The recording instrument on the ground may be installed in the regular weather bureau laboratory or they may be portable such as for use with a polar expedition. The automatic transmitter and air condition detectors carried by the balloon are fitted with suitable indicators, which operate switches in the radio transmitter periodically. The radio weather signals received from the balloon at the receiving station on the ground are translated into mechanical motions and corresponding marks made on the revolving paper charts.



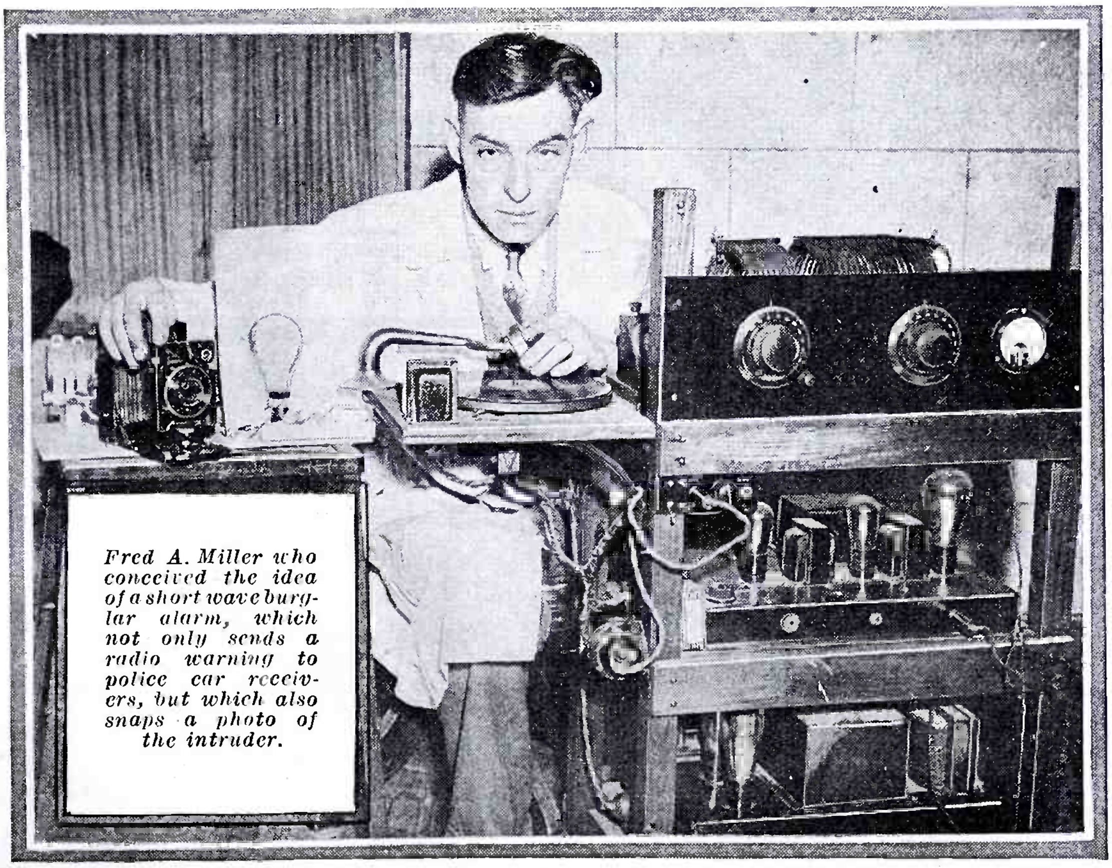
One form of radio receiver and motor-driven weather recorder used on ground.

The height of the balloon can be deduced from a table giving the various altitudes corresponding to different air pressures. If it is desired to determine the direction in which the balloon lies, although it may not be visible even with binoculars, this factor can be obtained by means of a radio loop receiver, fitted with angle measuring scales of the type described by Captain James A. Code, Jr., of the U. S. Signal Corps, in an article which appeared on page 248 of the December '31-January '32 issue of this magazine.

In the radio balloon set described by Capt. Code, in the issue of SHORT WAVE CRAFT referred to, the length of the waves radioed from the balloon was 125 meters and the signals were heard eleven miles.

Burglar Alarm Notifies Police and Photographs Intruder

AN automatic device that broadcasts a burglar alarm code to police car receivers and which also snaps a photo of the burglar, has recently been perfected by Mr. Fred A. Miller of St. Louis, Missouri. The apparatus here shown was recently given a practical city-wide test in conjunction with the St. Louis Police Department and the apparatus was found to work perfectly in the demonstration. Reports state that it has received the unqualified approval of numerous police officials. This ingenious device perfected by Mr. Miller, utilizes a short wave radio transmitter, as shown at the right of the photo, connected with a special code transmitting circuit, which causes a suitable message to be sent over the air to police cars and headquarters at any time when a break in the alarm circuit occurs. When desired, direct wires may lead from the set to police and fire headquarters. The code message is inscribed on a phonograph disc record, which can be seen in the center of the photo just in front of Mr. Miller. If an intruder should set the device in action, the record turntable starts revolving; the transmitter is energized and simultaneously a camera and flashlight snaps a picture of the person.



Fred A. Miller who conceived the idea of a short wave burglar alarm, which not only sends a radio warning to police car receivers, but which also snaps a photo of the intruder.

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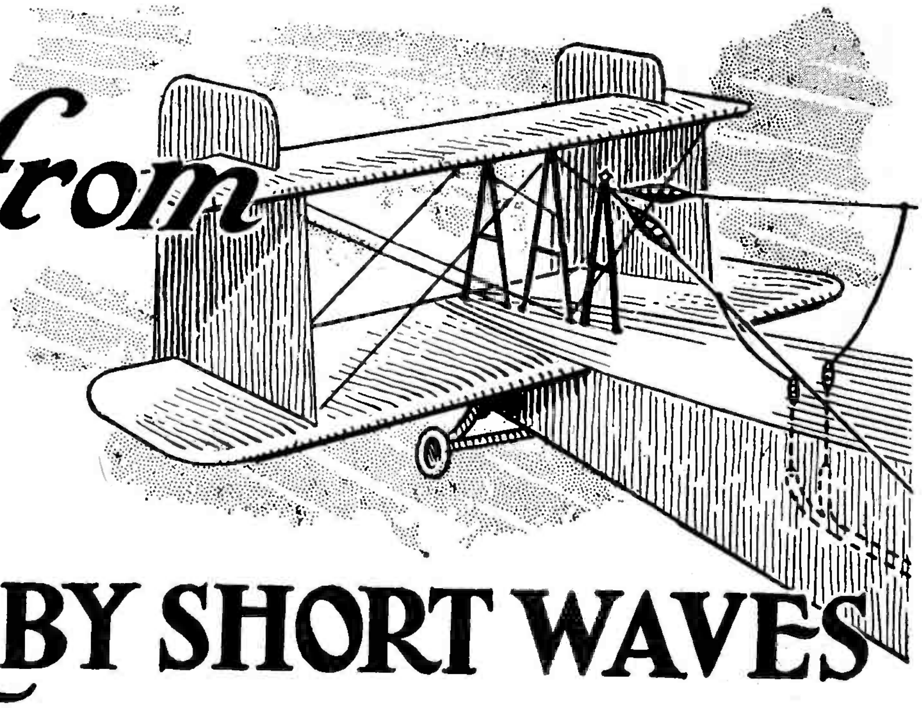
MUSIC from THE AIR BY SHORT WAVES



A NOVELTY in aviation broadcasts was accomplished on May 2, when Sandra Phillips and Peggy Keenan, red-headed two-piano team, presented their "Piano Pictures" program over WABC and the entire Columbia coast-to-coast network from an airplane hovering above New York at an altitude of 10,000 feet. As well as the music of their two pianos, a two-way conversation between the plane and a ground point was included as part of the broadcast, which marked another achievement in unusual short-wave broadcasts for Columbia.

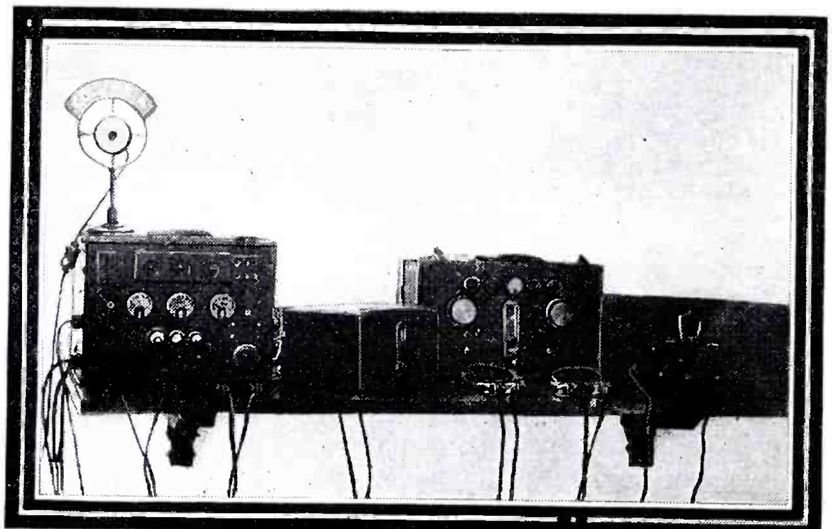
It will no doubt be of interest to readers to know how this was accomplished, and a technical description and engineering diagrams disclosing the methods employed follow.

Two things were essential; first, to equip the plane with a miniature broadcasting station and studio; and, second, to equip a suitable ground point for the reception of the airplane transmission and the location of the "cueing" station.

The airplane, which was piloted by the highly capable A. P. Kerr, Assistant Operations Manager of the Eastern Air Transport, was a giant 18-passenger *E. A. T. Curtiss Condor*, powered by two 625-horsepower Conqueror motors. This alone offered a problem from the standpoint of motor-noise interference. The plane was equipped with a portable 50-watt phone transmitter, W2XDZ, especially modified to pass all frequencies within the musical range. The power supply for the transmitter was furnished from a 1250-volt dynamotor which was driven by a 12-volt bank of storage batteries. Inasmuch as the drain on the batteries was quite heavy, it was necessary to float them across a 50-ampere generator.

A quarter - wave trailing transmitting antenna, 94 feet long and weighted at the end, was dropped through the floor of the cabin. The frequency used was 2,478 kilocycles. Before landing, the antenna was reeled in.

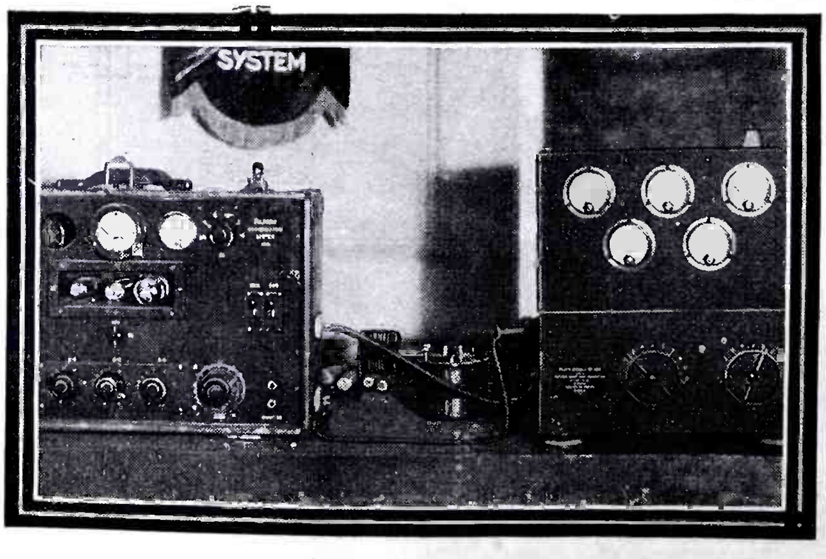
All of this equipment, in addition to the short-wave and long-wave receiving sets, was located in the forward of the plane's three compartments, directly behind the nose of the plane, where the two pilots were located. This left the center compartment between the control room and the studio for the carrying of invited guests and for use as a "buffer"



Speech input and three short wave receiving sets at "ground" station.

Sandra Phillips and Peggy Keenan, whose piano duet was broadcast by short waves from a plane in flight.

One of the greatest short wave broadcasting stunts ever staged was recently accomplished successfully over the "Columbia" network, when a giant eighteen-passenger Curtiss Condor plane flew over New York City carrying entertainers, whose concert performed aboard the plane was picked up by short waves. The broadcast was then amplified by the ground station and fed to the network.



Short wave "cueing" transmitter for talking to plane.

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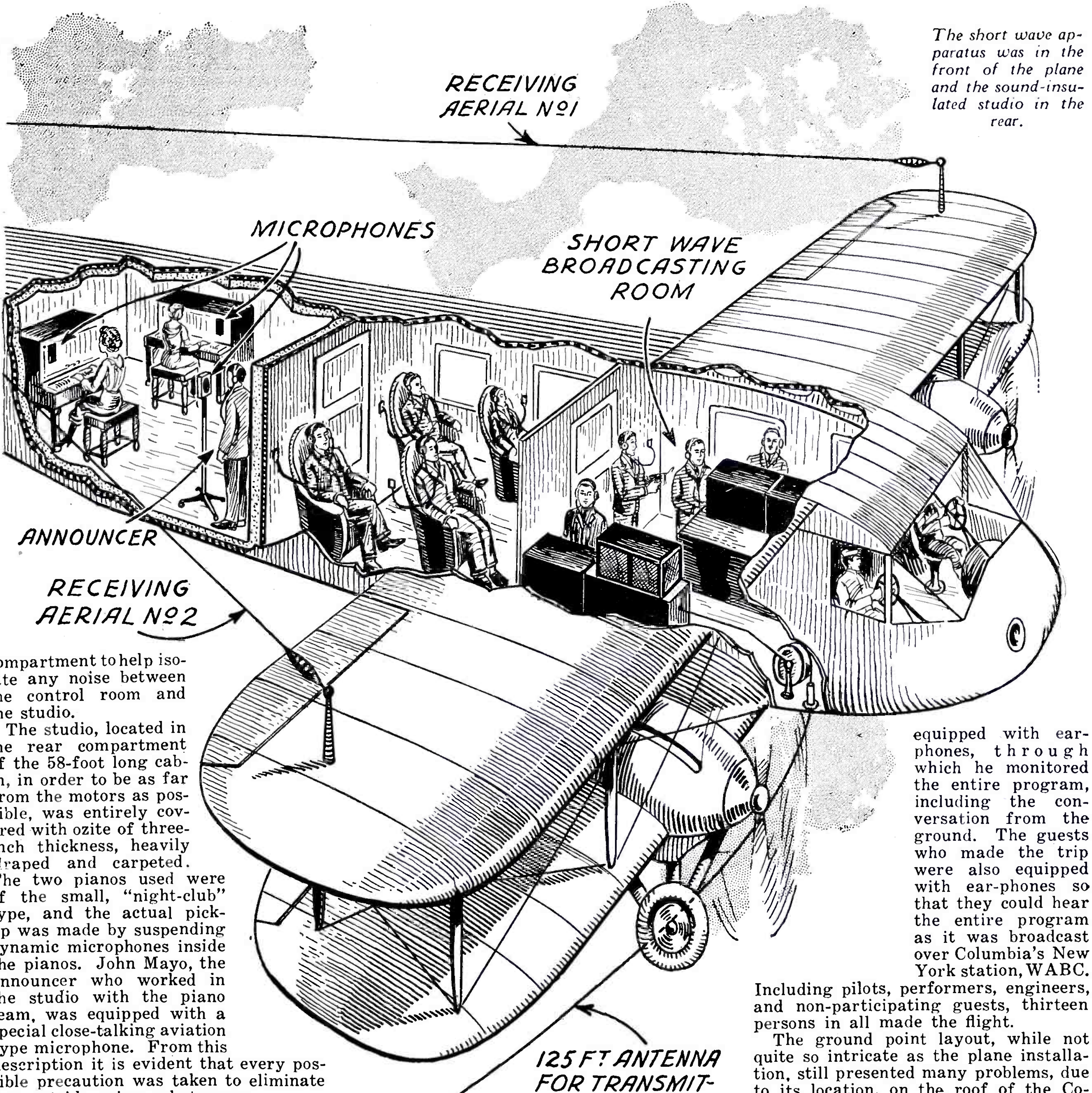


The short wave apparatus was in the front of the plane and the sound-insulated studio in the rear.

compartment to help isolate any noise between the control room and the studio.

The studio, located in the rear compartment of the 58-foot long cabin, in order to be as far from the motors as possible, was entirely covered with ozite of three-inch thickness, heavily draped and carpeted. The two pianos used were of the small, "night-club" type, and the actual pick-up was made by suspending dynamic microphones inside the pianos. John Mayo, the announcer who worked in the studio with the piano team, was equipped with a special close-talking aviation type microphone. From this description it is evident that every possible precaution was taken to eliminate any outside noises whatsoever.

In order to accomplish the two-way conversation which was carried on during the program between Mayo on the plane and Paul Douglas at the Columbia Building in New York, Mayo was equipped with ear-phones, through which he monitored the entire program, including the conversation from the ground. The guests who made the trip were also equipped with ear-phones so that they could hear the entire program as it was broadcast over Columbia's New York station, WABC.

Including pilots, performers, engineers, and non-participating guests, thirteen persons in all made the flight.

The ground point layout, while not quite so intricate as the plane installation, still presented many problems, due to its location, on the roof of the Co-

(*Continued on page* 174)

Actual photo of the plane in flight, showing transmitting antenna.

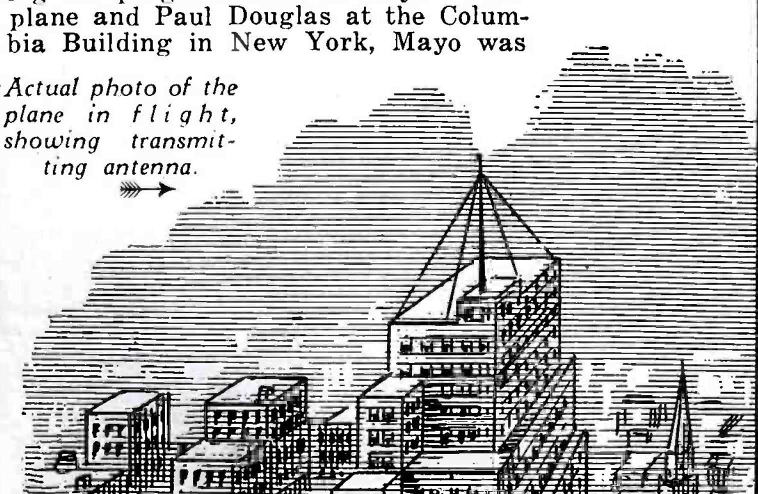


Fig. F—Fred A. Parsons, the builder and owner, seated at his short-wave station card file of 8,000 short wave stations!

A de Luxe *Station* A TINY

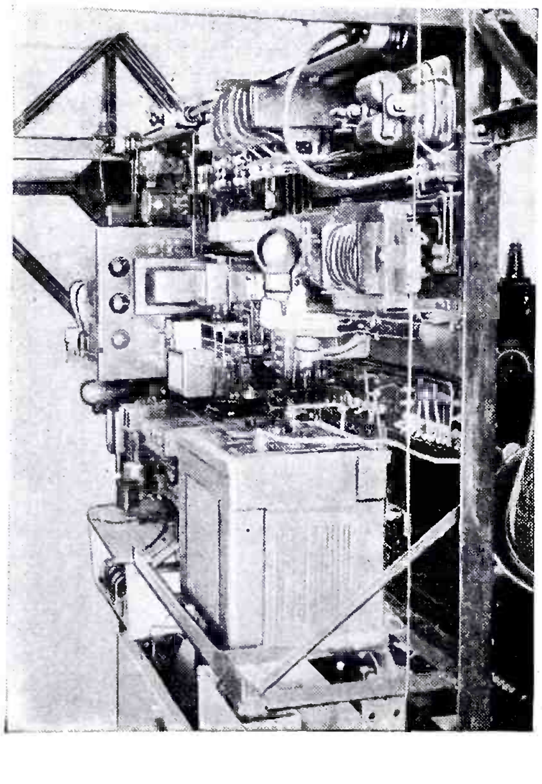
By ROBERT

One of the most elaborate "ham" stations in the eastern part of the United States, is that owned and operated by Fred A. Parsons, who has designed and built a really "first-class" transmitter and receiver.

THE idea seems to be prevalent that amateur short wave stations consist of piles of junk in the cellar or the attic, with disorder and confusion belying the remarkable efficiency with which "ham" short-wave apparatus is credited. Undoubtedly this reputation is deserved by some installations, but a great many amateurs who pride themselves on their workmanship as well as their technical ability have constructed stations that rival or even exceed expensive commercial stations on the points of efficiency, flexibility, convenience, compactness and appearance. An example in point is the fine outfit of Fred A. Parsons, who has successfully overcome the limitations of a New York City apartment and has created a radio station that excites envy and admiration in every visitor who sees it.

The accompanying illustrations speak volumes for the patience and ingenuity of the builder, who has been a radio amateur since the days when station owners selected their own call letters and wavelengths and kept their neighborhoods in an uproar with their thundering "open spark-gaps." In a twelve-foot square bedroom (which, incidentally, still serves as a bedroom during those brief hours when he is NOT playing with his apparatus), Parsons has constructed a commercial-appearing panel and table that is the last word in operating convenience and flexibility. See Fig. A.

Above: Fig. E—The compact "workshop" of Mr. Parsons, which is merely a converted clothes-closet.



Left: Fig. B—Back view of the instrument racks, showing the angle-iron construction and the compact grouping of the parts. Everything is open and accessible in spite of the apparent crowding.

A framework of angle-iron members supports three rows of bakelite panels, which are 5 feet, 2½ inches wide over-all and stand 6 feet off the floor. All receiver parts and associated control devices are mounted behind these panels, the floor being clear except for a dynamic speaker, which is too big to put anywhere else, and a closed "B" battery box. The compact manner in which the parts are supported is clearly shown in Fig. B, which was taken with the camera right up against the wall. The panels are spaced about three feet in front of the latter, so that the owner can walk around and work on the apparatus comfortably.

The center of the operating table is dropped in the center, to accommodate a typewriter. At the left is a steel filing cabinet containing what is probably the most remarkable short-wave log used by any amateur. It holds more than *8,000 separate cards*, one for every short-wave station in the world, amateurs excepted. This will be described in greater detail. To the right of the table is a 50-watt transmitter which is just undergoing completion. This is shown better in the close-ups of Figs. C and D. The loop visible in Fig. A is used experimentally for broadcast and 700-meter commercial reception.

The first vertical panel (to the left) consists of five individual panels. From top to bottom they serve as follows: (1) low voltage A.C. supply for tube filaments, pilot lights, etc., A.C. voltmeter and ammeter; (2) storage battery charging panel (note rectifier tube in Fig. B), D.C. voltmeter and ammeter; (3) fuses for all filament and plate circuits; (4) storage battery load meter; (5) main short-wave receiver. The latter is a ruggedly built set using one T.R.F. antenna stage, one untuned R.F. intermediate stage, regenerative detector and two-stage, transformer-coupled audio amplifier. It tunes from 15 to 550 meters and uses interchangeable plug-in coils. It may sound very inconvenient to walk around to the back of the panel to change coils, but actually this is a very minor matter, since the same set of coils is kept in place for an hour or more while really serious listening is being done.

There are four panels in the center rack, as follows: (1) special resistance-coupled A.F. amplifier for television work; (2) push-pull '45 amplifier for

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Amateur *Built In* SPACE

HERTZBERG

Mr. Parsons, whose station is here portrayed, has 8,000 short wave stations card-indexed! With two receivers, Mr. Parsons can listen simultaneously to both sides of a conversation on a single loud-speaker.

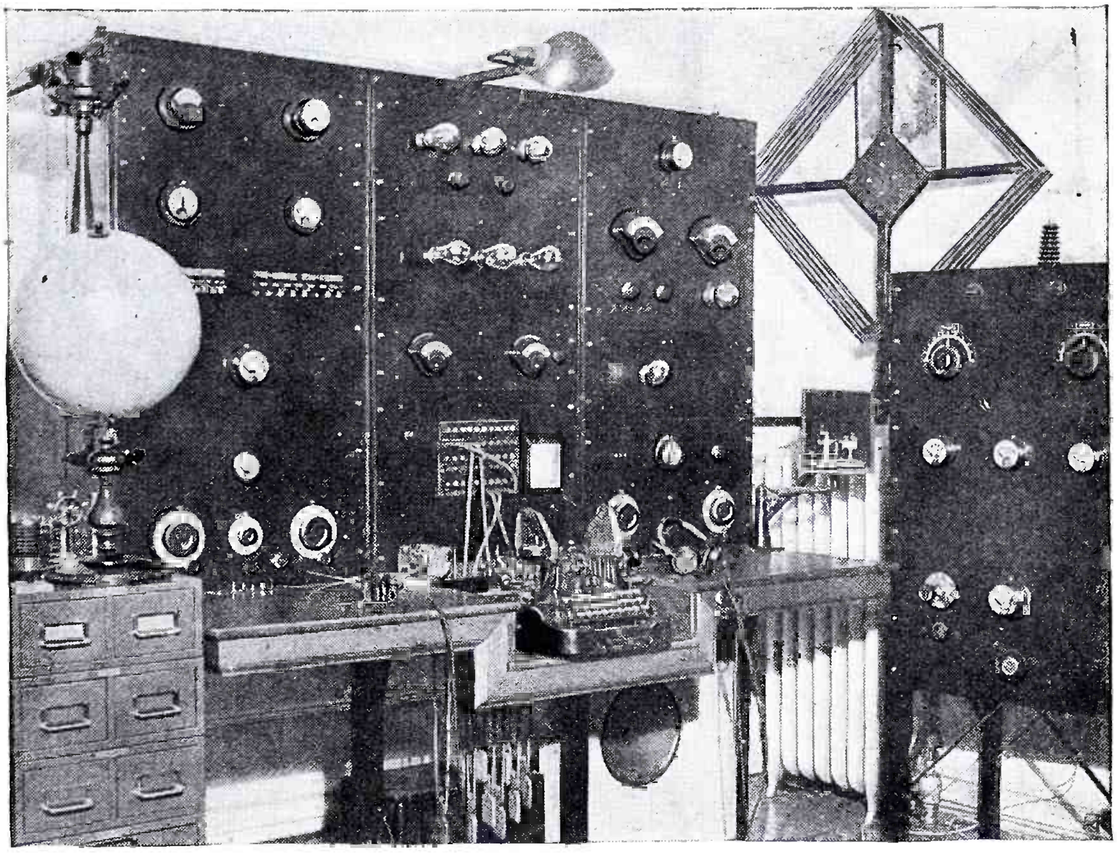


Fig. A—General view of Mr. Parsons' station. At the extreme left is the card filing cabinet, in the center the operating table and instrument racks, and at the extreme right the short wave transmitter.

operation of the big dynamic speaker—the third tube is a '80 rectifier; (3) plate voltage and plate current meters, in "B" battery circuit to short-wave receivers; (4) control panel consisting of ten plugs and 30 jacks. This is a very tricky arrangement, and makes for extreme flexibility. It allows "juggling" of loud speakers, amplifiers and receivers in interesting combinations. Needless to say, the wiring is a bit complicated, and took considerable time and effort.

The third and last rack holds four more panels. From top to bottom they function as follows: (1) relay circuit with D.C. milliammeter, to feed amplifier output to telegraph sounder or tape recorder; (2) high voltage supply for amplifiers and various experimental applications; (3) separate amplifier for sounder or recorder, used with very weak signals; (4) auxiliary short-wave receiver, a duplicate of the one on the left.

The use of two short-wave receivers, properly "mixed" through the switchboard into a single loud speaker, permits a very desirable operating feature: the reproduction of BOTH sides of a telephone or telegraph conversation without the frantic dial twisting necessary when only a single receiver is available. This greatly increases the fun and enjoyment obtainable from the short waves. After hearing this system in operation you will never be satisfied with only ONE set!

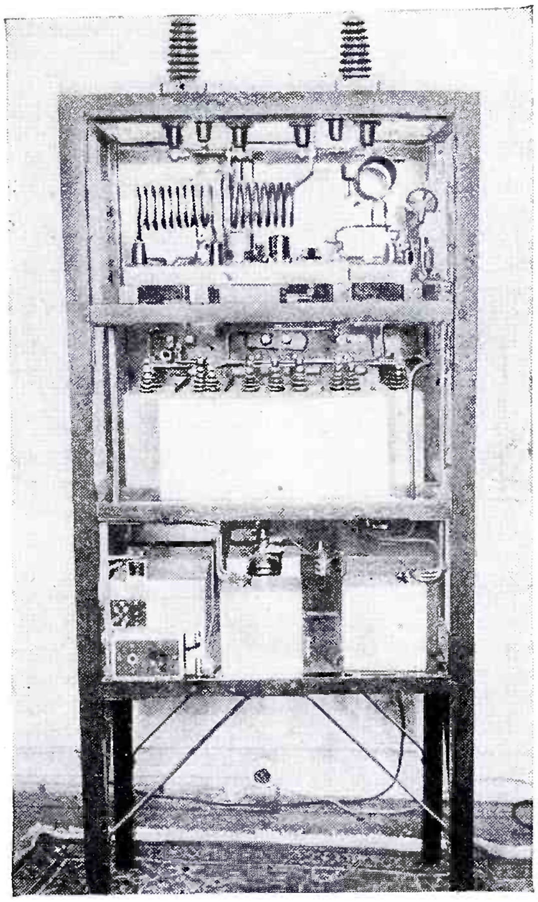
The short-wave transmitter, illustrated in Figs. C and D, was built on a separate frame-work to prevent trouble due to R.F. pickup by the receiver units. It is 5 feet high, 2 feet wide and 1½ feet deep, and consists of three sections: top, transmitter proper; center, filter system; bottom, power units. The transmitter circuit is of the standard master-oscillator-power-amplifier type, and employs a 210 oscillator feeding into a 50-watt amplifier. The oscillator is tuned in the so-called 80-meter band, and the amplifier may be operated either here or in the 40-meter band, the second harmonic of the oscillator being utilized. The transmitting antenna is a single wire voltage-fed Hertz. This is the simplest of transmitting antennas, and is very practical for apartment dwellers who have landlords and fussy neighbors to contend with.

At the time this article was written Mr. Parsons had not yet received his license and call letters. Many old-timers may remember him as 2ABM.

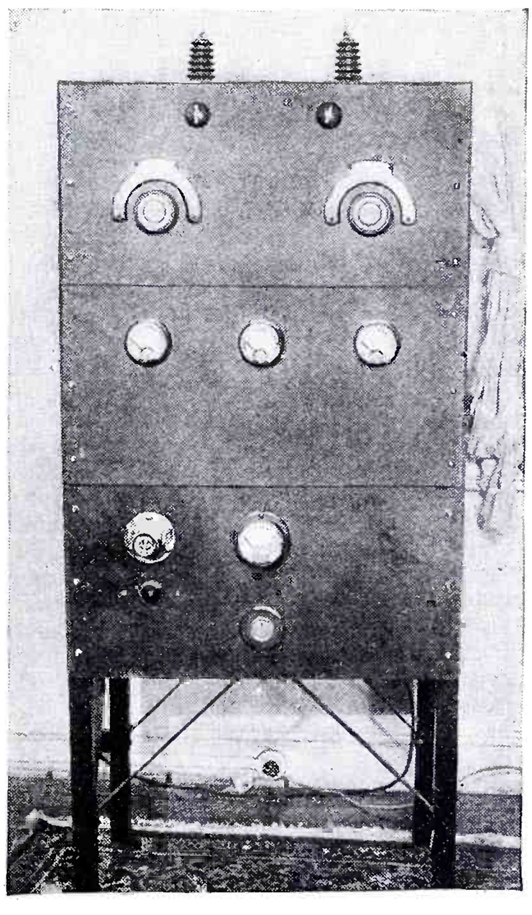
If the reader has gotten the idea that Mr. Parsons had a complete machine available for the construction of his spectacular station, let him take a look at Fig. E. This shows all the tools and equipment Mr. Parsons used, and incidentally it shows how the limited space of a clothes-closet may be employed to the greatest advantage. The assorted hand tools are kept in straps on the inside of the closet door, where they are within easy reach of the radio table. The closet itself is lined with shelves that hold the usual conglomeration of loose parts and supplies owned by every radio experimenter.

The card file of short-wave stations, previously referred to, is Mr. Parsons' special pride and joy, and is without equal in the amateur field. Amateur sta-

(Continued on page 184)



Above: Fig. D—Back view of the transmitter. Notice the logical arrangement of the parts and the neatness of the wiring.



At Right: Fig. C—Front view of the 50-watt transmitter. The panels are of bakelite, the framework of wood and iron.

All Photos by the Author

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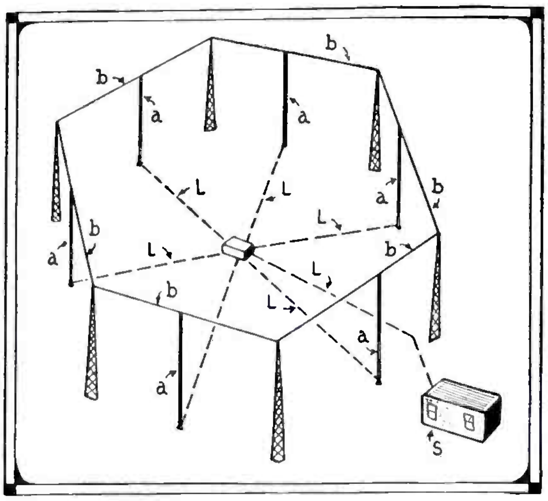
No Fading *With* These Aerials

By DR. FRITZ NOACK,
Berlin

As is well known, fading plays a very unpleasant rôle in radio reception. For a long time specialists have been striving to eliminate it.

Fading might well have its origin in the fact that at rather great distances



The new transmitting antenna which German engineers intend to erect at Munich. Here the central transmitter at S energizes the circle of antennas as shown, with the result that with the reception of the different waves from the respective antennas, a mean average strength of signal will be picked up by the receiver.

from the transmitter, the waves no longer reach the receiver by gliding over the surface of the earth, but through the air. In general there reaches the receiver not a single wave, but several of them, whose paths are of different lengths. If the lengths of the paths are in a certain relation to the wave length, it can happen that two waves entirely efface each other at the place of reception, so that the broadcast entirely disappears at the loud-speaker.

In receiving short waves coming from far-distant stations, it has been observed that in a circuit about a place of reception, the fading does not occur at the same time. Consequently in the great German receiving station of Beelitz, several locally separated receiving antennas have been installed, which in the case of difficult reception conditions all receive the same station (but have fading periods at different times) and deliver the signals received to a common amplifier. If enough of these receiving antennas are present, then the individual telephonic currents coming from the individual receiving antennas are superimposed on one another, and result finally in a fairly uniform telephonic current, so that in the head phones or loud-speaker at the place of reception, the fading is scarcely noticeable at all.

The former German radio station at Munich is now to be strengthened in a very short time. A new antenna is to be built, since the previous masts were buckled by a storm a few months ago. The authorities are considering whether an antenna shall not be built at Munich which will more or less completely eliminate the fading at every point of reception, or at least make it endurable.

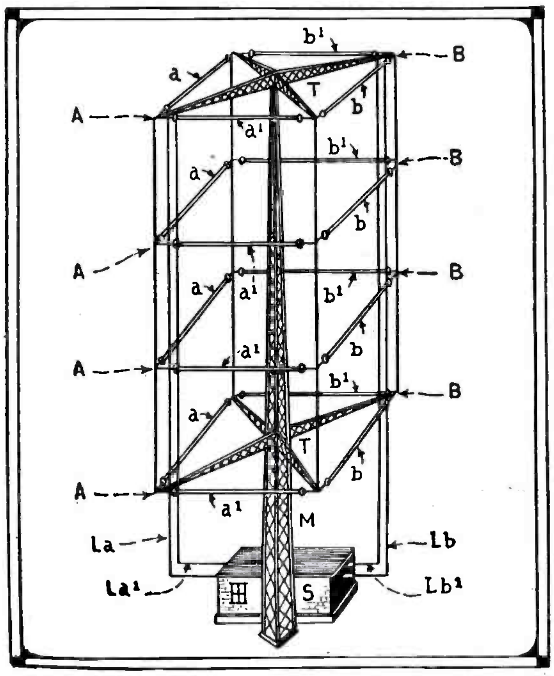
Such a "fading-proof" antenna assumes the following proportions: As with a fading-free reception system it will also be a matter of simultaneously operating several transmitting antennas of the same kind, spatially separated, with one and the same oscillation of the centrally located transmitter; then the most varied waves go out at the same time from the individual transmitting antennas. At the point of reception one will then not only pick up the waves from a single antenna, which may be subject to fading, but also the waves from the other transmitting antennas, for which, because of their spatial separation, the fading will presumably be perceptible at different times at the point of reception. Vertical single-wire antennas will be used, their length being in a definite proportion to the

Not only in short wave transmission but in long wave as well, fading is one of the problems which has baffled radio engineers. Two new antenna systems designed to reduce or practically eliminate fading have been developed by German engineers and are here described by Dr. Noack. One of the new antennas is to be erected at Munich and the other at Zeesen.

wavelength sent out. Theoretical calculations show that such an antenna can in fact have as a consequence a considerable reduction of the fading phenomena. Whether this antenna will be established in Munich is not yet certain, but it is of interest that such a new antenna design has at least been considered.

On this occasion I should like to describe another novel antenna form, which also comes into consideration for transmitting purposes, which, for definite reasons, is suitable only for *short waves.*

In Zeesen, near Königswusterhausen, stands the German short wave station which rebroadcasts overseas on a wave length of 31.38 meters most of the German long wave broadcasts. This transmitter is demonstrating the phenomenon of being received well only at great distances, while in the vicinity of the station it is heard relatively poorly. On the other hand, however, the short wave transmitter is supposed to cover all Europe, of course, and to be easily audible in all Europe. The reasons for the peculiar reception conditions of a short wave station at nearby distances lie in the fact that the waves, right at the point of transmission, rise steeply into the air and describe on the way to the point of



The new "vertical cage" transmitting antenna designed for the famous Zeesen station. With this antenna arrangement a signal eight times more powerful than that ordinarily picked up at a given distance from the transmitter is made possible. Using this antenna the signals are radiated in all directions equally; in consequence at any given instance, the receiving station will pick up a signal free from fading.

reception the above mentioned great arcs through the atmosphere, thus becoming easily perceptible at a great distance from the transmitting station, but "skipping" or jumping over a so-called "dead zone" between the station and the distant point of reception. If it were possible so to influence the radiation of the waves from the transmitting antenna, that they would be propagated predominantly parallel to the surface of the earth, to be sure, in any desired direction from the station in the same way, then it would be possible to provide sufficient reception energy, even for relatively nearby points of reception everywhere around the station.

Antenna a Cage-like Affair

The Telefunken company, which also built the Zeesen short wave transmitter, has now instituted experiments in this regard. While formerly a direct vertical wire was used at Zeesen as an antenna, a brand new antenna system will soon be put in operation, whose plan is here shown. As shown, the new antenna is a sort of cage affair. On a wooden mast M are attached at the top and at the height of about 25 meters (82 feet) beams T.

(*Continued on page* 180)

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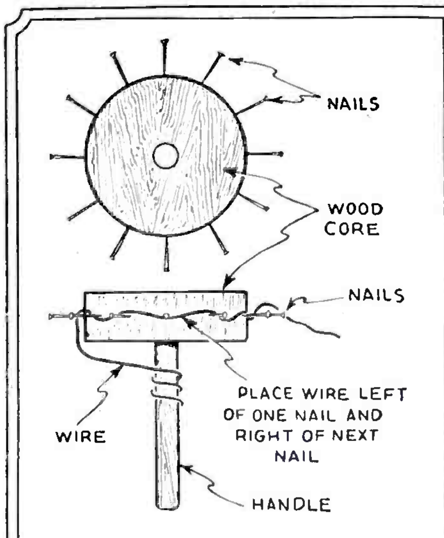


FIG 1 SIMPLE COIL WINDING DETAILS

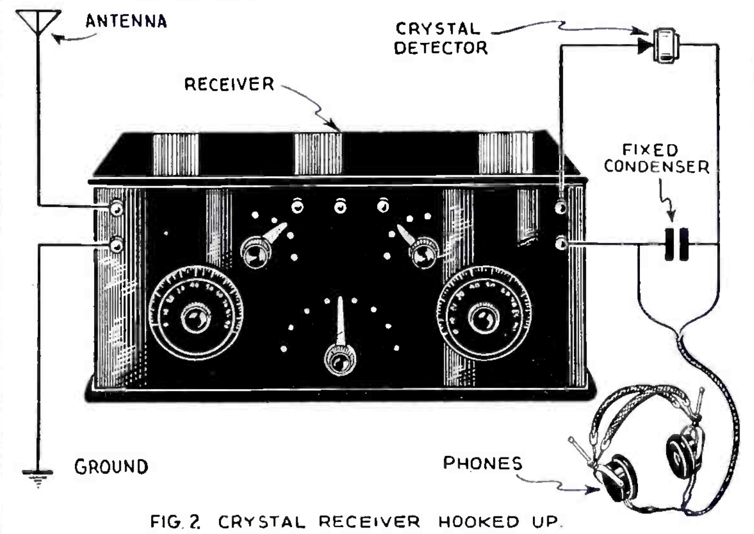


FIG. 2 CRYSTAL RECEIVER HOOKED UP

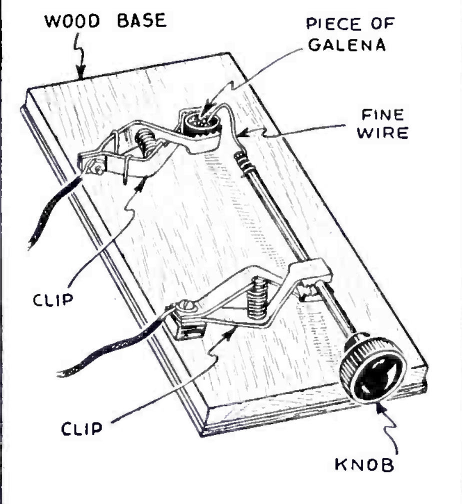


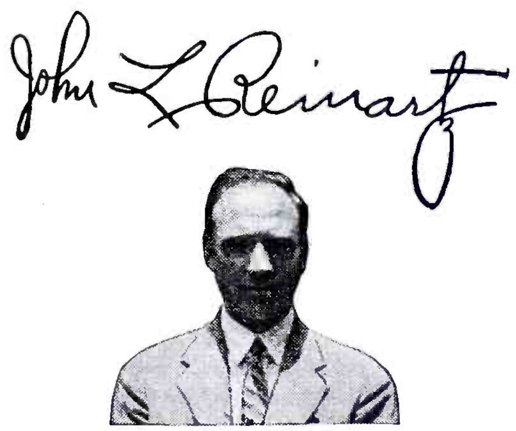
FIG. 3 SIMPLE CRYSTAL DETECTOR

How To Become a RADIO AMATEUR

No. 1 of a Series—Specially Prepared by John L. Reinartz

IN this series of articles on "How To Become An Amateur," an attempt will be made to so arrange the designs that all parts can be used over again in one way or another. This will conserve both material and money, as you will have use for them later when you will want to build more expensive sets.

The most simple and yet really practical receiving set is the crystal detector outfit. This type of receiver will receive only signals that are modulated at some audio frequency and as this is what we want to receive we will build one. Such a receiver has in its simplest form a coil which can be tuned, an antenna, a ground connection, a crystal detector and a pair of ear phones. To make sure that our crystal detector is working properly, we add a small buzzer, a dry cell, and a button which we push to set the buzzer going while testing the crystal. The whole will be mounted on a panel and enclosed in a box. When completed it will be something for the beginner to be proud of.



John L. Reinartz—one of the shining lights in the world of amateur radio and short waves. It might easily be said that the name of Reinartz and short waves are synonymous. Mr. Reinartz made his first bid for fame in the realm of short waves and amateur radio by designing the famous receiving circuit which is known all over the world as the "Reinartz" circuit. Mr. Reinartz is at present an electrical engineering consultant. He has contributed many articles to the radio press and devised many valuable and interesting circuits and devices covering short wave transmitters and receivers.

Making the Coil

To make the coil we are first going to build a form upon which to wind the wire. This form is a wooden disc two and one-half inches in diameter and one inch in thickness. See Fig. 1. Through a hole in the center we mount a handle by which it can be held in the left hand while wire is being wound on it with the right hand. Around the outer diameter of the disc we drill nine equally spaced holes to take nine ten-penny nails, which will just fit tightly but which can be pulled out with a pair of pliers. We are now ready to wind our coil, using No. 24 double cotton covered wire. We start by winding a couple of turns around the handle and then around the first nail to the second nail, then to the third nail, and so on around the form, going from the left side of one nail to the right side of the next nail in basket weave form. When we have wound on fifteen turns we take off a loop and wind fifteen more turns, make another loop and wind fifteen turns more. This time, instead of making a loop, we cut the wire, leaving about a six-inch lead. Then, starting with the next nail, we again wind on turns as follows: Two turns, a loop, two turns, a loop, two turns, a loop, two turns, a loop, two turns, a loop, two turns, a loop, two turns a loop, and two turns, a loop, and then fifteen turns, a loop, and then ten turns, a loop, and then ten turns, which finishes the coil. Before taking the nails out we first boil some paraffin in a dish and dip the coil into it. After it cools down and the paraffin has hardened we carefully pull out each nail. Do this without disturbing the coil in any way. Slide it off the form and then with a needle and some coarse thread sew through the places that the nails fitted through, going from one place to the next around the coil twice and tie the ends as they meet. There will now be no danger of the coil falling apart. We lay the coil aside and take up the matter of the panel on which our parts are to be mounted.

The Panel

The panel should be not smaller than 7 x 12 inches, and 7 x 14 will not be too large. On it are mounted two condensers, seven binding posts and three switch levers so located that they will look nice and symmetrical. We lay them out as shown in Fig. 2. The two condensers are regular variable condensers as used for receivers, being of .00035 mf. capacity. Two of the switch levers are to have four contact points and the other to have nine contact points. The binding posts are mounted two in each upper corner and three equally spaced in the top center. They are an inch apart and three-quarters of an inch from the edge of the panel. When marking the points, do so on the rear of the panel and keep the (Cont. on p. 179)

JOHN L. REINARTZ, whose name is known to every radio amateur or "ham," no matter whether it is in New York City, Java or South Africa, has agreed to prepare a series of twelve articles for SHORT WAVE CRAFT. *The editors have received so many requests from readers who are interested in learning the "stepping stones" in the career of a full-fledged licensed radio amateur, that they asked Mr. Reinartz to prepare this series, number one of which appears herewith. The titles of the eleven monthly articles which are to follow are:*

2—The vacuum tube, plotting a curve; 3—Adding the vacuum tube to your receiver; 4—Amplification, different ways to obtain it; 5—Learning the code; 6—Obtaining a license; 7—Transmitting circuits—building a transmitter; 8—Choosing the right transmitting antenna for your location; 9—Wavemeters—building one; 10—"Going on the air"; 11—Modulation—classes A, B and C; 12—Making it a phone station.

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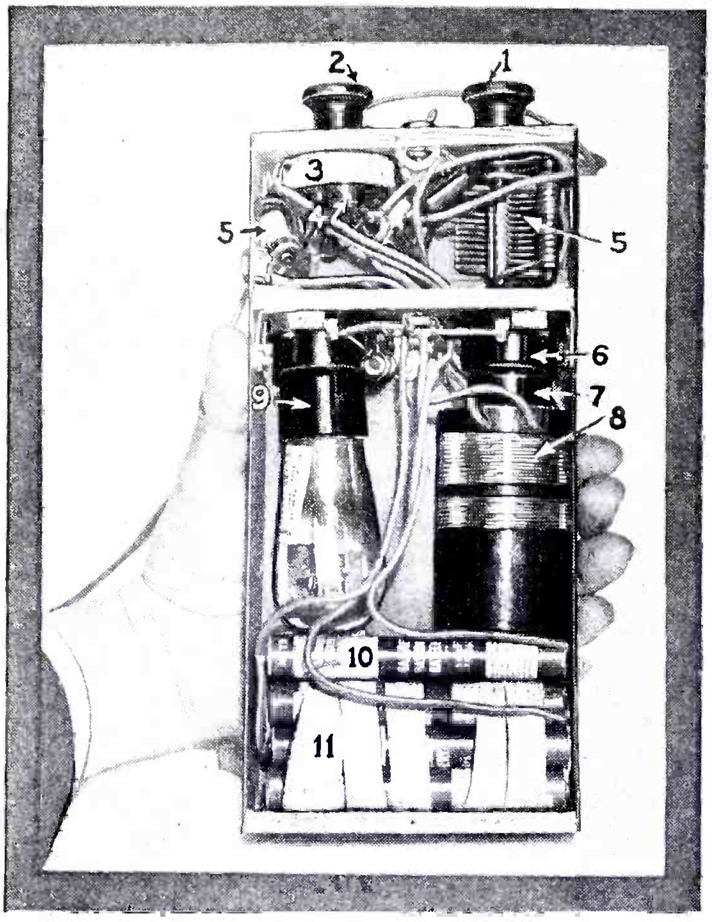
Build This Pocket

WHO among us has not wished at one time or another for a good pocket receiving set on which we could, perchance, listen to music and speech from the broadcast stations in the 200 to 550 meter band, and when desired, switch over and listen to the fascinating mysteries of the short waves, be it *police calls—foreign broadcasts*—or *radio amateurs* "chewing the rag"?

Pocket-size receiving sets have been the goal of short wave experimenters the world over, but thus far we have not seen a pocket receiver as small as the one here described, which would give the signal strength in the phones that this receiver does. In fact, the signals are sufficiently strong to operate a sensitive loud-speaker unit, where some form of horn of the folded or telescopic type is to be used. Coil data are given for reception on wavelengths from 20 to 550 meters. This receiver contains batteries, tubes and all tuning apparatus.



An interesting close-up of the "pocket receiver" held in the hand and with one side of case removed. 1—knob for tuning condenser 5; 2—knob for adjusting regeneration control 3 and switch 4; 5—"A" battery resistor; 6—socket for tube 7, which is inside the tuning coil 8; 9—second-tube; 10—"A" battery; 11—"B" battery.

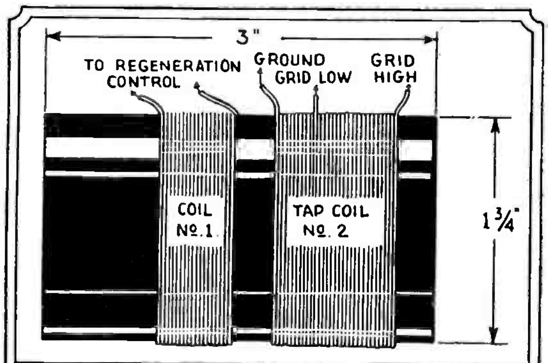
spring clips soldered to their free ends, one of which you can connect to any grounded metal pipe or other system, while the "aerial" clip may be attached to any one of a dozen temporary or improvised aerials. For example, in some of the tests made by the authors, the ground clip was attached to a steam radiator, while the aerial wire was clipped on to the chain from a lamp socket, and good reception was at once obtained. You will be astonished at the many novel "aerials" and "grounds" you will be able to use to receive signals on—including metal bedsteads, metal filing cabinets, boilers, wire fences, telephone lines, etc. One stunt is to connect the ground wire to any pipe system and the aerial lead to a *pie-plate* or a piece of circular metal on which a desk telephone is placed, reception being afforded by the capacity-effect between the felt-covered metal base of the phone and the tin pie-plate.

A complete radio set which can be carried around in your coat pocket! Here it is, and a mighty interesting gadget to intrigue the mechanical ingenuity of the reader. For size it is 9 inches long, 4 inches wide and a little over 1½ inches deep. Thus this set will fit into the average top-coat pocket with no trouble at all.

The Circuit

The electrical circuit of the set is simple enough, consisting of but two tubes. The first tube is a detector, which is resistance-coupled to the first audio stage. Regeneration is controlled by the 50,000-ohm potentiometer. As the number of turns on the feed-back coil is larger than normal, the action of the feed-back circuit is unusually good.

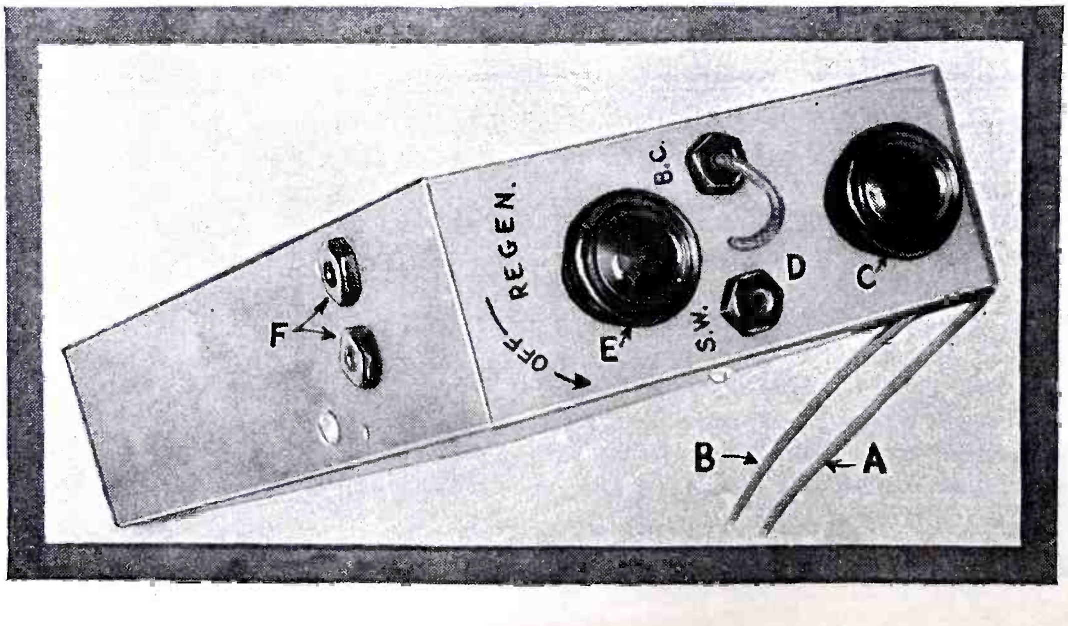
An interesting point should be noted in the electrical circuit and that is



WAVE BANDS IN METERS	COIL No. 1	COIL No. 2	TAP AT	WIRE SIZE
(550-240 / 240-125) LONG TAP / SHORT TAP	72 TURNS	119 TURNS	31 TURNS	No. 34 ENAM.
(100-50 / 50-20) LONG TAP / SHORT TAP	15 TURNS	24 TURNS	12 TURNS	No. 18 ENAM.

Coil winding data is given above for both short and broadcast waves.

The authors conceived and built the coat pocket receiver here illustrated and described and had a world of fun with it. We'll bet if you once build one of these pocket receivers that you will never again be without one, as you will be surprised how natural and convenient it is to grab up a receiver of this type and slip it into your pocket, portfolio or overnight bag. NO EXTERNAL BATTERIES TO FUSS WITH—and simply a pair of flexible wires, with



At left—Appearance of the complete "pocket receiver" for short and broadcast waves. A and B, aerial and ground wires; C, tuning knob; D, cord tip and jacks for switching from short to BC waves; E is the regeneration control knob, and F, phone cord jacks.

the use of an auto-transformer connection to increase the sensitivity of the entire receiver. The gain over the ordinary method of connection of simple detector tuning coils, as

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SHORT WAVE RECEIVER

By HUGO GERNSBACK and C. E. DENTON

indicated by the results obtained, led the author to build coils to cover various bands. By the limits of the switch connections here employed, no more than two bands can be covered. Therefore, it is necessary to determine just which bands are to be covered and to wind the coils with the proper number of turns as indicated in the chart. If the constructor wishes, he can take small radio-frequency choke coils and remove turns until the required band is covered.

To duplicate the tuning arrangement as shown in the drawings, it will be necessary to use three chokes, one for the short waves, one for the long waves and one for the feed-back or regeneration circuit.

total current consumption of the set is .12 ampere, plus the plate current of the two tubes. Three of the small *fountain-pen* style flashlight batteries (3 volts each) are used to light the filament. These three batteries are connected in parallel. The plate supply consists of a number of the same units connected in series. This provides sufficient energy as far as the "B" supply is concerned to run the set for hours at a time. The batteries used as the "A" supply should not be used continuously, but should be allowed to recuperate after being in use for more than two hours. If this is done the life of the batteries used in the "A" supply unit will last a long time. These batteries were secured from the 5 and 10c stores.

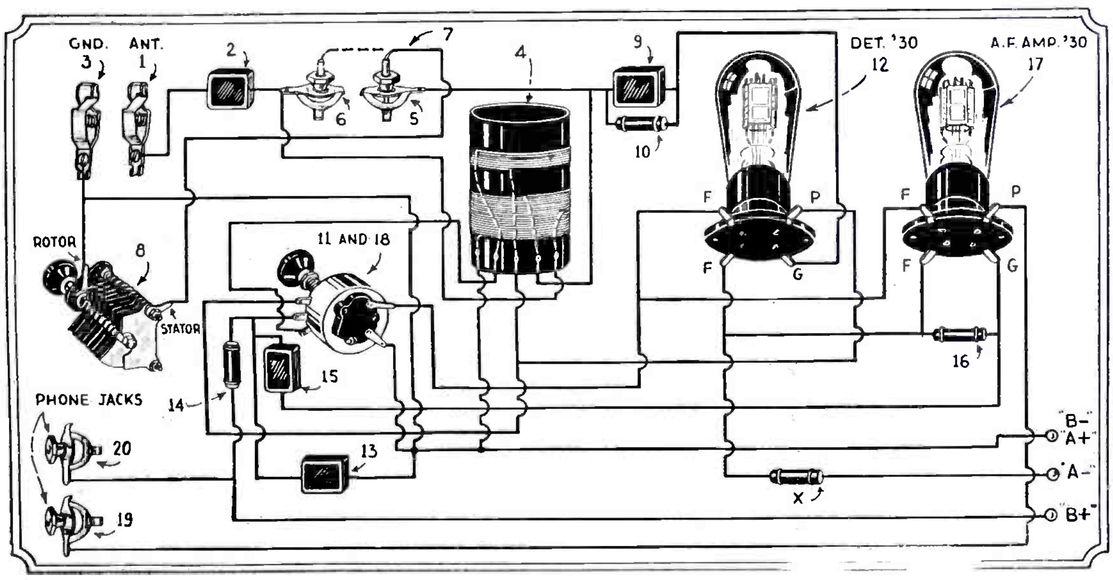
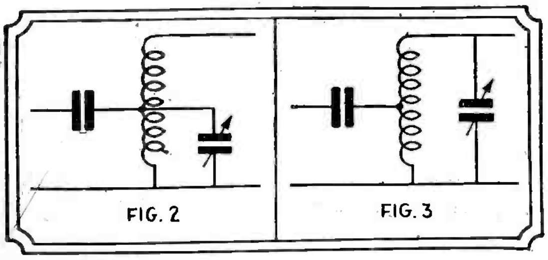


Figure 6 shows picture diagram which anyone can easily follow in building the 2-tube, battery-operated, "pocket receiver" here described.

Max D. Pearlman tuning in a station on the "pocket receiver." The choice of short or broadcast waves is provided, and with a good pair of phones some very excellent results have been obtained.

The mechanical construction of the box must be left more or less to the builder. It seems that it is not always easy to obtain fibre of the required size. Many of our readers who are good carpenters can make a neat box of 2 or 3 ply veneer. Do not use metal, as the proximity of the coil to the case will upset the inductance values of the coils and increase their losses. The coils as specified in the cir-

(*Continued on page 174*)

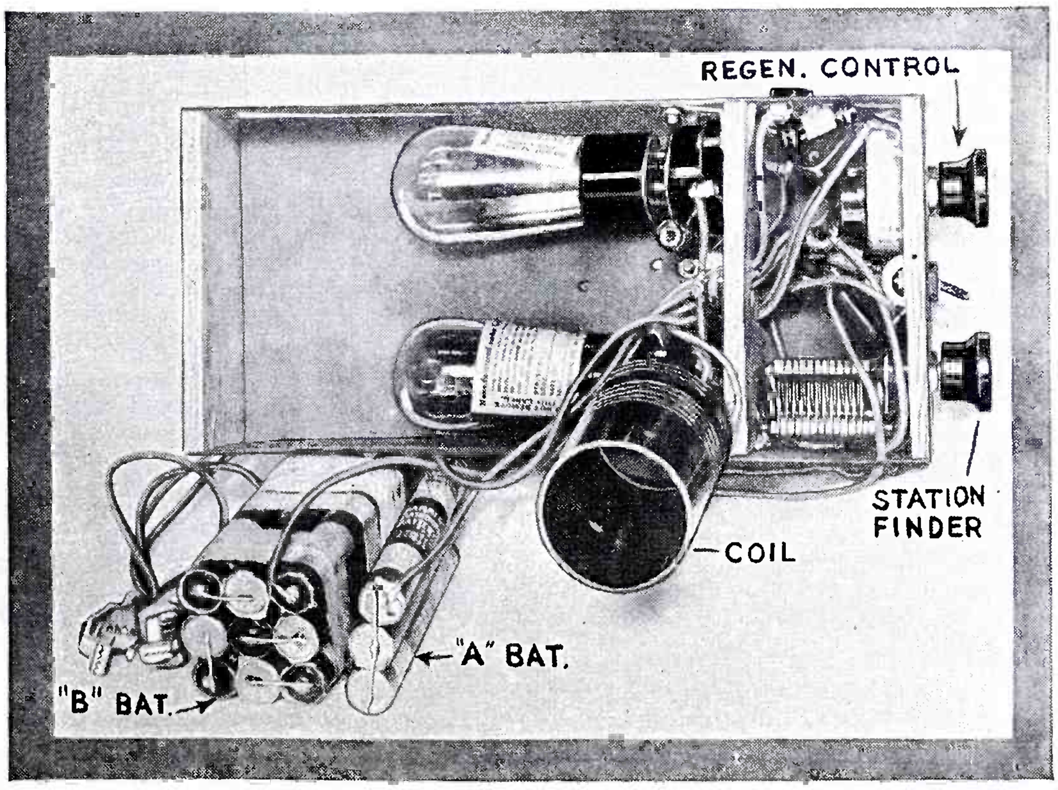


The two diagrams above show the interesting auto-transformer connections employed in the design of this "pocket" short and broadcast wave receiver.

At right—Another view of the "pocket receiver" showing tuning inductance removed from its position over one of the vacuum tubes, together with "A" and "B" batteries, which are composed of a number of fountain-pen flashlight, three-volt units. An ideal job could be made with a fibre case covered with leather

Power Supply

The power supply is as simple as can be. As the filaments of the two tubes are rated at 60 milliamperes each, the



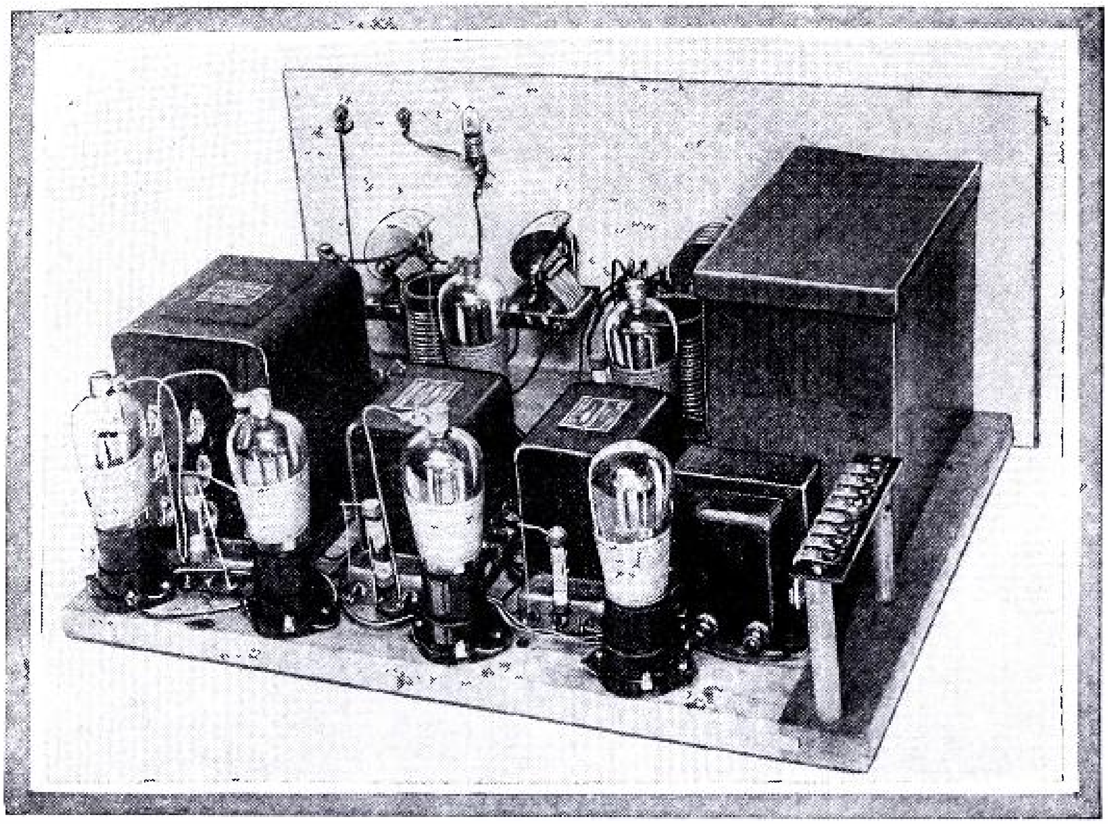
A Low-Power PHONE TRANSMITTER

of the *Portable Type*

Designed and Built by

JOHN B. BRENNAN, JR.

W2DJU



Rear view of portable phone transmitter designed and built by John Brennan, Jr., W2DJU. National "Class B" amplifier transformers are used.

WHY a portable transmitter? Probably there are as many answers to that question as there are persons who build one. But perhaps no stranger reason can be given than the one that, in his browsing around the pile of accumulated junk which finds itself in the possession of most experimenters, the builder comes across a discarded cabinet and wonders what he can build to fit in it. More often than not he is wont to say to himself, "Hm, an old cabinet. Just the thing for a portable transmitter." The cabinet being father to the idea, he (the father) is promptly relegated to the background in the ensuing events and all attention is centered on the desirability and shortcomings of circuits, the choice of tubes, and so on, ad infinitum.

While always having wanted to build for himself a portable transmitter, the author never quite got around to the job until he happened to come upon an old DeForest cabinet which in former days housed the now forgotten reflex receiver. You know the kind—a lid on top; double doors in front, and a compartment in the bottom for "B" batteries.

In an effort to choose the best of circuits many past issues of radio magazines were religiously studied and, as it was thought at the time, a really serviceable circuit arrangement was chosen. It is shown diagrammatically in Fig. 1 and consists of an isolated oscillator and single pentode R.F. amplifier for the radio-frequency portion of the transmitter and a pair of pentodes in parallel for the modulator.

Class "B" Modulation System Used

In a subsequent chat with genial Joe Heller, chief engineer of the Wireless Egert Engineering Company, this design was discussed and finally discarded for

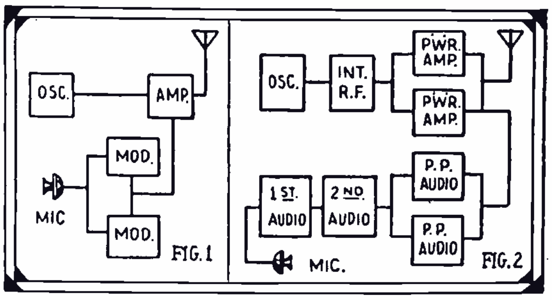


Fig. 1 above shows simple phone transmitter line-up; Fig. 2, new circuit arrangement of phone transmitter here described and illustrated.

one which, while doubling the number of tubes originally planned upon, would more than justify their use in the quadrupled power output obtained with their use. This was made possible by the use of the now popular Class B type of modulation in preference to the former type A Heising modulation system.

Briefly, the new circuit arrangement consists of an isolated oscillator, followed by an intermediate R.F. amplifier using a pentode, which, in turn, feeds a pair of pentodes arranged in push-pull to form the final or power amplifier R.F. stage. The audio system consists of a first audio stage followed by a second using a pentode, which, in turn, feeds a pair of pentodes arranged in "push-pull." It will be seen that, diagrammatically, the radio and audio portions of this transmitter are similar. The diagram is shown in Fig. 2.

Now, without going into the actual construction of such a transmitter, let us examine for a moment the prime requisites of a *portable.*

First, it should be compact and not too heavy.

Second, tubes should be selected which will require a minimum plate supply voltage and six volts filament supply.

Third, it should employ a circuit which will give maximum dependable coverage, per tube used; the circuit should not be an "expensive" one.

Just how well these requirements are met in the transmitter whose construction is to be described here is illustrated as follows:

First, a most compact arrangement of the parts employed in construction is obtained, as is shown by the accompanying illustrations. Second, tubes have been selected which require no more than 135 volts plate supply and six volts (storage battery) filament supply. Third, a most efficient R.F. circuit is employed and with the class B modulation system referred to and shown in the diagrams, essentially 100 per cent modulation is obtained. Considering performance in output watts, the transmitter is a most economical one.

Tubes

Most ideally suited to use in a portable radiophone transmitter are the new six-volt automobile tubes, which are now generally available. These tubes, or more correctly the Triad T-237's and

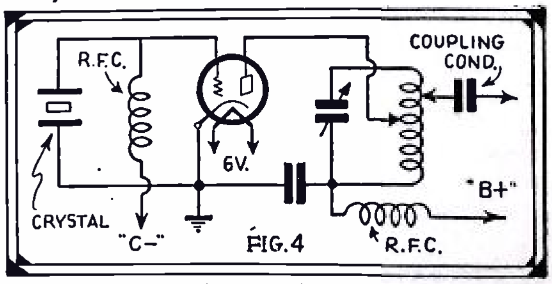


Fig. 4—Crystal control circuit which may be employed, at the option of the builder.

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This very desirable and economical phone transmitter can easily be carried in the car and can be worked on batteries, either dry or storage. This transmitter uses eight tubes of the 6.3 volt auto type and incorporates the new "Class B" system of modulation. Extremely simple in design and construction, the transmitter here described by Mr. Brennan is ideal for the amateur whose pocketbook is limited. Data are given for 80 and 160 meter operation.

T-238's, are similar in construction to their older brothers, the A.C. type tubes, in that electron emission is obtained by means of a coated cathode which is heated by a filament. The filament is a heavy, rugged affair and has been designed particularly to withstand the jars and shocks incident to their use in moving automobiles.

Since they require no more than six volts for filament supply, the regular car battery can be used for this purpose when the transmitter is carried by car to some remote point. Also, maximum efficiency is obtained when their plates are supplied with 135 volts "B" battery, another point in their favor, since weight is a considerable factor in the operation of a short-wave portable. The use of other types of tubes might require a great deal more plate supply with no commensurate increase in efficiency.

It is only fair to mention that the desire for a transmitter as efficient as possible, within the limits imposed by the requirements outlined previously, had by this time become uppermost in the mind of the author, while the original idea of attempting to build a transmitter into a given cabinet was discarded entirely, with the result that the cabinet was put back with the other junk, from whence it came, to gather the dust of a few more years.

Suit Yourself with Layout

It is probably true to state that the circuit arrangement of a given transmitter, as printed on paper, will suggest a certain type of *breadboard layout* to the experimenter and from this point on it becomes a matter of condensing and making more compact the physical arrangement of the required parts, so as to arrive at a desirable and neat appearing type of construction. For this reason the author does not advance the particular type of construction which he has employed as the only one which will be suitable. Much latitude in layout exists and it is with the idea in mind of presenting to the reader only one of many satisfactory types of layout that the following constructional hints are given. The individual experimenter can indulge in any number of variations, just so long as sensible reasoning is included in the scheme of things.

COIL TABLE

COIL	80 METERS	160 METERS
L1	35 TURNS	60 TURNS
L2	35 TURNS	60 TURNS
L3	35 TURNS	60 TURNS
L4	10 TURNS	15 TURNS
WIRE	Nº. 20	Nº. 24

BOTH SPACE WOUND
L3, L4 WOUND ON SAME COIL FORM. L4 WOUND ON TUBE LOCATED INSIDE L4
FIG. 5

Fig. 5—Coil data table for 80 and 160 meter inductances.

The Transmitter Circuit in Detail

In Fig. 3 is shown the entire transmitter circuit. It will be seen that the oscillator V1 employs the conventional Hartley system and consists of a single T-237 tube. The circuit is made to oscillate over a band of frequencies determined by the condenser-coil combination L1-C1. By means of a plug-in coil L1 the frequency band can be changed so that operation may be had in all of the government-licensed phone bands. Of course, crystal control could be added, if the experimenter's pocketbook will stand the additional expense. In that case, the oscillator circuit is altered to that shown in Fig. 4. This change, if it can be afforded, is highly recommended, since the stability of the emitted wave is immeasurably improved and there is less tendency toward frequency modulation of the generated oscillations, a condition which sometimes exists due to vibration of the plates of the variable condensers, improperly shielded oscillators, poor power-supply regulation, etc.

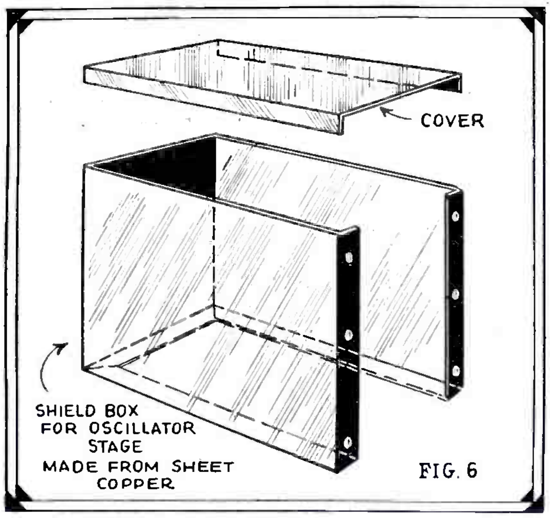
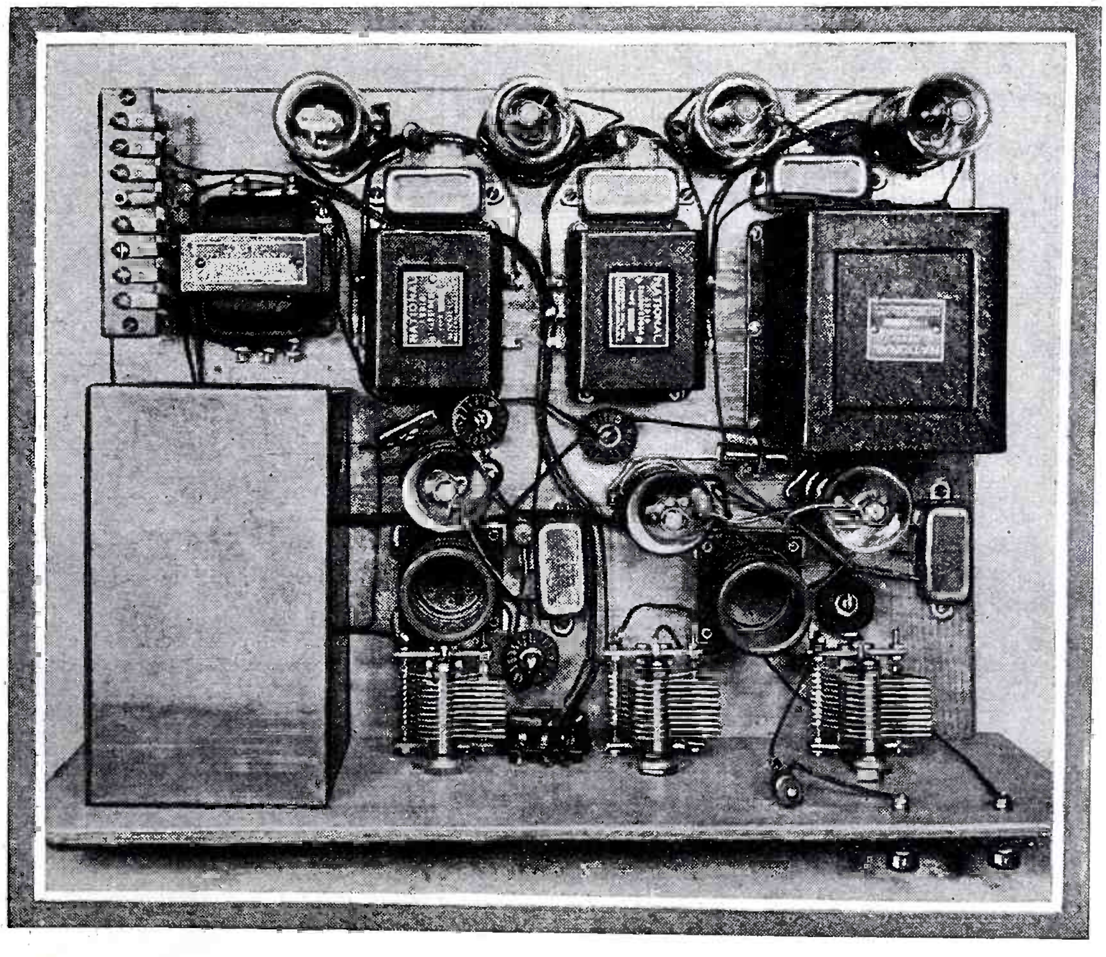


Fig. 6—Details of oscillator shield box and cover.

Below—Top view of 8-tube phone transmitter, using 6.3 volt auto tubes; the plug-in inductances may be seen just behind the tuning condensers.

Energy from the oscillator is picked off its plate through a coupling condenser C8 and thence fed to the grid of the succeeding tube V2, a T-238 pentode. This tube and its associated apparatus comprises an intermediate stage of radio-frequency amplification, the circuit being tuned by means of the variable condenser C3, which shunts the inductance L2; here too the coil is of the plug-in type. There follows a final or power amplifier stage of radio-frequency amplification, consisting of a pair of T-238 pentodes, V3 and V4, arranged in push-pull. These tubes are coupled to the previous stage by means of a coupling condenser C9. The antenna is inductively coupled to the plate circuit of the power amplifier stage by means of L4 and is tuned to resonance with that circuit by means of the variable series condenser C5, shown. A six-volt flashlight P completes the antenna circuit, being used to indicate maximum



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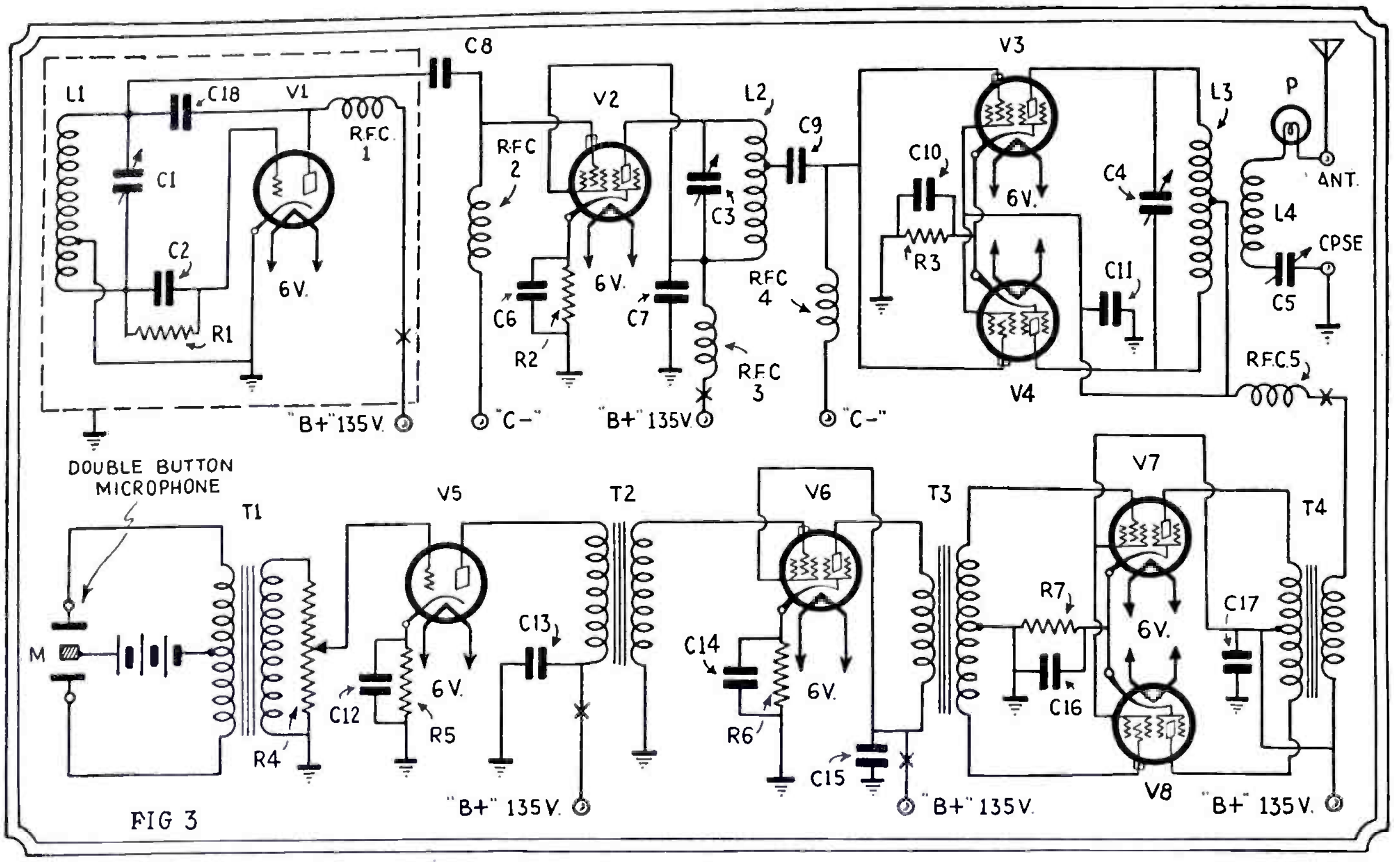


Fig. 3—Schematic circuit for the 8-tube phone transmitter here described, which can be operated from dry or storage batteries, so as to be carri d in the car if desired.

flow of current in the antenna when the variable condenser tunes the antenna circuit to resonance with the amplifier.

The Class "B" Modulator

The modulation system uses four tubes in all, the first of which V5 is a T-237, fed by the microphone M and microphone transformer T1. It outputs to a standard interstage audio transformer T2 which is used as a coupling medium between it and the succeeding T-238 pentode stage V6. The final audio stage, which is more correctly termed the modulator stage, consists of a pair of T-238 pentodes, V7 and V8, arranged in "push-pull." These push-pull tubes are coupled to the previous stage and to the R.F. power amplifier by means of special coupling transformers, T3 and T4, especially intended and designed for use in class B modulation systems. Actually, the transformers used here were originally designed to work with type 210 tubes, but the plate impedance of these tubes was found to be so nearly like those of the -38's that the use of these class B transformers with the -38's is quite possible. It should be borne in mind, however, that this is purely a convenient arrangement. Naturally, it would be more satisfactory if transformers especially designed for use with the -38's were available.

Practically all of the information necessary to the duplication in construction of the transmitter described here is contained in the various illustrations.

It might be noted that the construction centers around a panel base, the tuning condensers, microphone control, etc., being mounted on the panel, while the plug-in coils and their mounts and the tubes and their sockets, audio transformers, resistors, by-pass condensers, R.F. chokes and the like being mounted on the base, as shown.

As a matter of fact, all the illustrations should be carefully studied before any attempt at actual construction is made. In this way the placement of each part and the manner in which it is mounted, in respect to other adjacent parts, will be clearly understood.

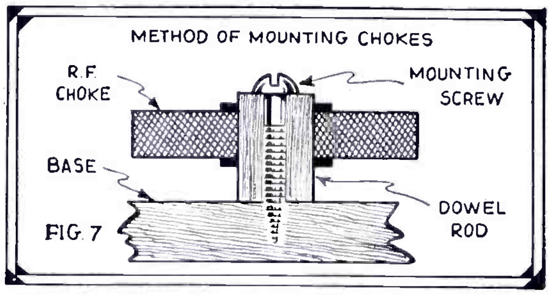


Fig. 7—Showing one method of mounting the choke coils.

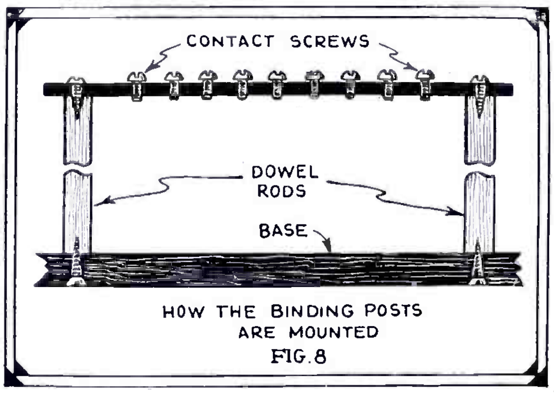
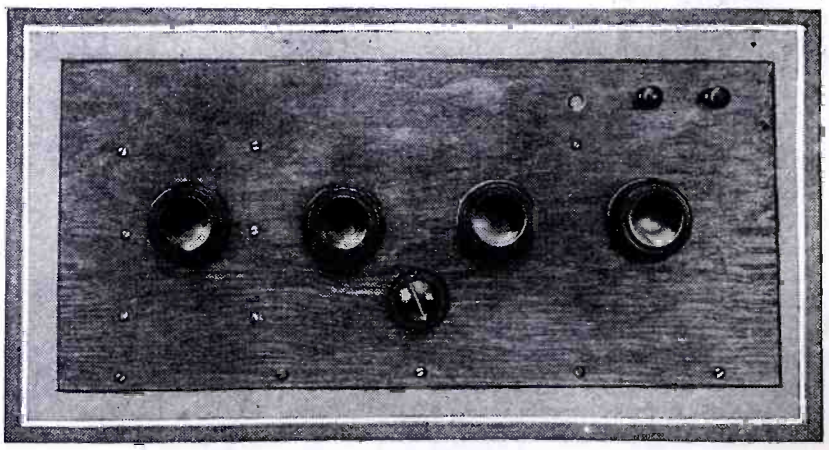


Fig. 8—Author's arrangement of terminal strip.



Front view of portable phone transmitter, showing tuning controls.

Adjusting the Circuit

If it is desired, a 0-50 milliammeter may be mounted permanently on the panel and connected to a plug. Then, at the points marked "X" in the circuit diagram, Fig. 3, single, closed-circuit jacks may be included, so that this milliammeter may be plugged in at these various points to read the current in the plate circuits.

If, however, the meter is not permanently included in the layout, then, in the preliminary tests which must be made to place the transmitter in operation, the meter must be temporarily connected in the circuits successively at these points.

Assuming that the construction has been completed and that the various circuits have been checked with the diagram, to locate any incorrect connections, the coupling condenser, C8, should be temporarily disconnected from the plate of the oscillator tube. Then, with a frequency meter, tune the oscillator to a point *within* the amateur phone band. (If you have an unlimited radiophone amateur license, you are permitted to operate your station in the so-called "80-meter band." If you have only a regular amateur license, then it is compulsory to operate a phone transmitted in the so-called "160-meter band.") By placing one side of a neon bulb in contact with the plate circuit of the oscillator tube, you may determine that the tube is oscillating at this frequency adjustment. Now proceed to the next R.F. circuit, V2. Apply the "C" bias voltage, increasing the value until the plate current reading on the milliammeter, previously plugged into the plate circuit of V2, is reduced to zero. Then note the value of grid bias voltage which accomplished this condition. The correct value of grid bias voltage which should be applied for satisfactory operation is twice this value. In other words, the proper C bias voltage is twice that value which is found necessary to reduce the plate current to zero when the excitation, through the coupling condenser, C8, is removed.

Reconnect the coupling condenser C8 and tune the circuit C3-L2 until, by plac-

(*Continued on page* 189)

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$500.00 Short Wave Builder's Contest—$100 in Monthly Prizes for Best Models

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

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

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

SHORT WAVE SET **SHORT WAVE ADAPTER**
SHORT WAVE CONVERTER

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

Rules for $500.00 Short Wave Builder's Contest

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

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

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

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

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

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

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

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

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

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

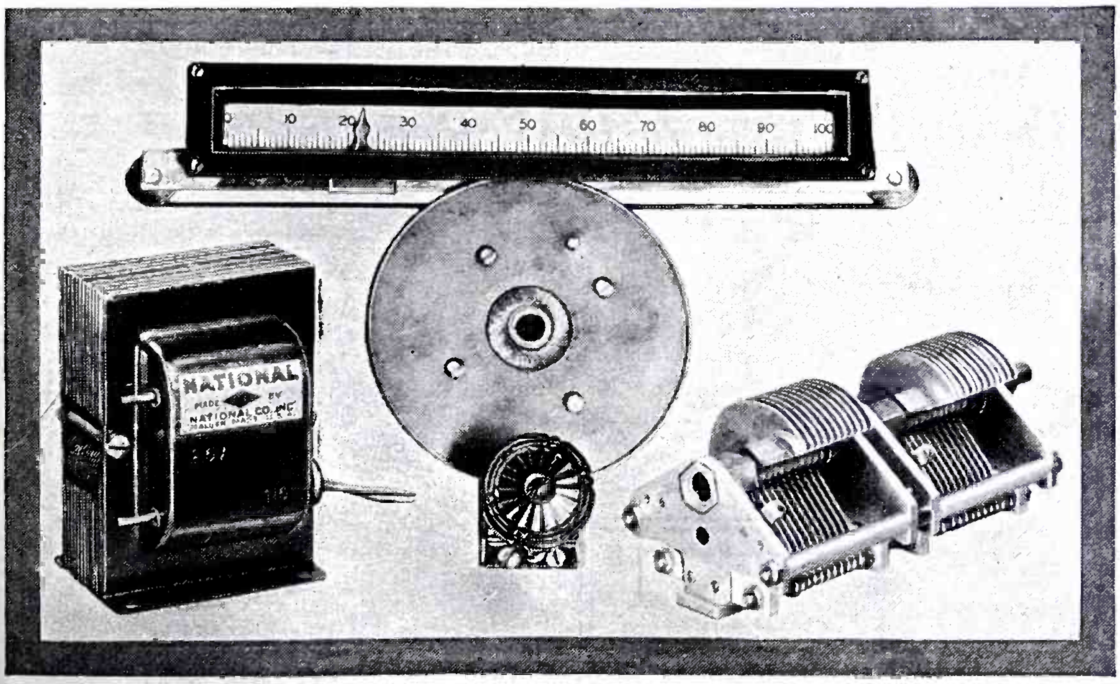
8.—All sets must be shipped in strong wooden boxes, NEVER in cardboard boxes. All sets must be sent "prepaid"! Sets sent "charges collect" will be refused. SHORT WAVE CRAFT Magazine cannot be held responsible for breakage in transit due to improper packing of sets. Before packing the set, be sure to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

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

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

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

New Linear Dial Scale and Other New Apparatus



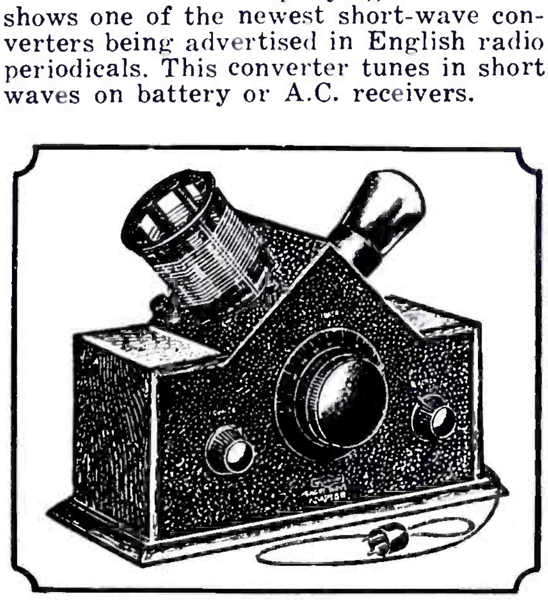
Left—New heater transformer. Center—Full-vision linear scale. Right—New H.F. condenser with isolated rotors.

SEVERAL new pieces of apparatus of interest to short wave "fans" are illustrated above. At the left of the picture we see a new heater transformer, capable of delivering up to 10 amperes at a potential of 2.5 volts, with greatly improved regulation characteristics. The full-vision linear scale shown in the center of the photo provides easy tuning and the action of the scale and dial movements is very smooth, especial attention having been paid to this feature by the designing engineers of the National Company, who are responsible for the three new items illustrated above.

Finally at the right of the photo we have a new style high frequency variable condenser which has isolated rotors. It is of the 270 degree, straight-line-frequency type, with aluminum plates and frame, the insulation being of the new low-loss isolantite. The isolated rotors eliminate the common coupling caused by the grounded frames in ordinary condensers. These condensers are available in various capacities.

NOVEL ENGLISH CONVERTER

OUR English radio friends have many novel and interesting ideas when it comes to short-wave receivers and converters. The accompanying illustration shows one of the newest short-wave converters being advertised in English radio periodicals. This converter tunes in short waves on battery or A.C. receivers.



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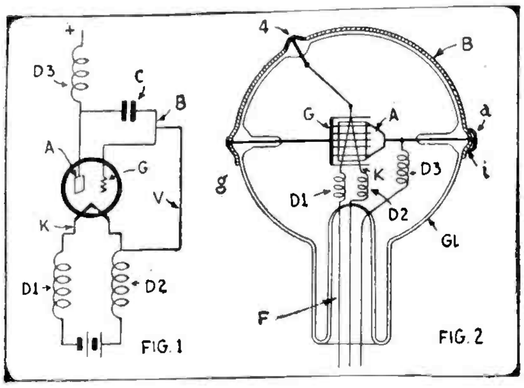
Short Wave Patents of Interest



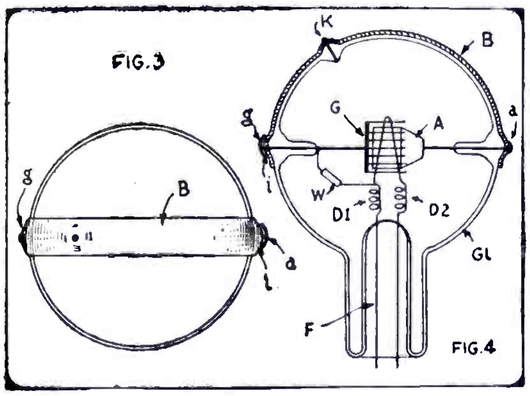
Short wave generator.

Short-Wave Tube Arrangement

(*German Patent* 519,999)

The short-wave generator consists simply of one tube, in which the oscillating circuit forming the connection between the grid and plate (Fig. 1) consists of a metal coating B, which is put on the outer glass wall of the tube. (Figs. 2 and 3.)

Grid and plate of the tube are held by leads or supports, which are passed



All chokes, etc., are placed inside the tube.

through the glass wall and the coating. The metal coating can be applied by gilding or in a similar way. Besides that, all the elements needed for operating the generator, such as choke coils (D1, D2) and resistances (W), are placed inside the tube. (Figs. 2 and 4.)

Short-Wave Transmitter

(*French Patent* 696,137)

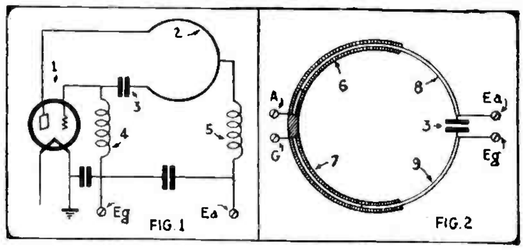
Fig. 1 (right) shows a short-wave transmitter with a loop-shaped inductance coil 2, in the plate circuit of tube 1. The grid potential Eg is separated from the plate potential Ea (which is conducted through choke coils 4 and 5) by the blocking condenser, which lies at a point in the oscillation circuit, where the high-frequency potential is zero; otherwise it is not possible, even by using choke coils, to keep the high frequency away from the direct-current wires.

To be able to effect the placing of the blocking condenser at the right place, without detuning the oscillating circuit 2, the loop-shaped inductance is made in circular form from metal pipes, which can be drawn out like a slide trombone (Fig. 2). The two circular arcs 6 and 7 are separated by an insulating piece at A and G, where the grid and plate of the tube are connected. The two circular arcs 8 and 9, which are mounted in one unit with the blocking condenser, run in arcs 6 and 7. On both sides of the condenser 3, are connected the grid and plate potentials Eg and Ea. It is apparent that in this way, condenser 3 may be moved within wide limits, without any change in the self-induction of the circuit.

Short-Wave Generator With Lecher System

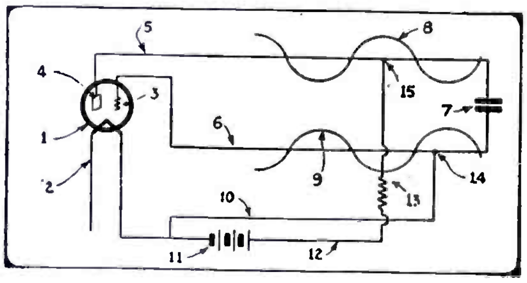
(*German Patent* 525,748)

In short-wave generators with parallel



An interesting short wave transmitter patent.

Lecher wires as an oscillatory circuit, lying between grid and plate, it is requisite that between the points (14 and 15 in the diagram) at which the feed wires for grid and plate potential are connected, no differences in high-frequency potential shall be present. To attain this, the feed points were so placed that they coincided with the low-voltage points (nodes) on the Lecher wires. But, even with this precaution, alternating potentials can occur between the feed points and the cathode, leading to disturbances. For this reason the feed points 14 and 15 on the Lecher system are so placed that one wire, 10, lies exactly as far to the right of a node, as the other wire, 12, lies to the left of the corresponding node on the other Lecher wire.—*Funk-Bastler.*



Lecher wire system for use with short wave generator.

Limiting the Tuning Range of S-W Receivers

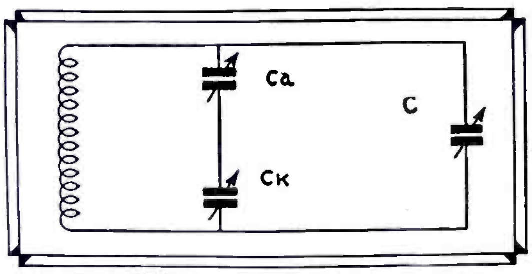
By R. N. NEUROTH

TUNING sensitive short wave receivers requires in the wave ranges below 30 meters in spite of short wave condensers and fine adjustments as a rule considerable practice and is not always easy to manage. An arrangement indicated by Dr. Fehse of Hamburg, in the case of which the tuning of such short wave sets after once adjusting to a selected ground wave, can be limited at will to narrow bands of only a few meters breadth, is but little known.

There is used an ordinary regenerative detector, the simplest and most efficient set for short wave reception; the hookup is standard.

The illustration shows the grid oscillation circuit of a short wave detector. It is seen that besides the tuning condenser Ca, there are also present two other capacities, C and Ck. The arrangement is such that Ca and Ck lie in series and their combination in parallel to C. The condensers Ca and C each have a capacity of 100 mmf. while Ck is a small neutralization or correction condenser of maximum 20 to 30 mmf. The resulting capacity of Ca and Ck, which can be calculated from the formula:

$$C_{RESULT} = \frac{C_a \times C_K}{C_a + C_K}$$



Arrangement of capacities in grid circuit as analyzed here by Mr. Neuroth.

represents the band condenser of the receiver. Now for example if condenser Ck is set at 5 mmf. as is well known the resulting capacity of the condensers Ca and Ck lying in series is less than 5 mmf. But thereby the possibility of changing the tuning by means of Ca is also very much limited, for by a full variation of Ca between 0 and 100 degrees, there would result only trifling changes of the capacity resulting from Ca and Ck. The wave band covered by Ca becomes the smaller, the less the capacity of Ck and the consequently resulting capacity is chosen.

Operation offers no greater difficulty than in ordinary radio apparatus, since after once adjusting both capacities C and Ck along with the regeneration regulator, only Ca needs to be operated.

Now it may be claimed that this minimal capacity change of C, as is attained by parallel connection of Ca and Ck, can more simply be attained by parallel connection of a very small condenser to C. On further consideration it is easily seen that such a fine adjustment condenser, no matter how small a capacity, would not lead to the goal. Assume that condenser Ck is set for 20 mmf. and then by changing Ca between say 10 mmf. and

(*Continued on page* 178)

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The Short Wave Beginner

By C. W. PALMER

No. 1 of a Series—Getting Started in Short Waves

C. W. Palmer, the author of this new series, "The Short Wave Beginner," has been writing on popular radio subjects for leading radio magazines and in the opinion of the editors he is one of the best qualified writers to prepare so difficult a subject. Mr. Palmer combines the happy faculties of writing in a smooth interesting style, and keeping his treatment of the subject "down to earth," so that the layman can understand what he is talking about. Mr. Palmer was radio editor of SCIENCE AND INVENTION for several years and also a member of the editorial staff of RADIO NEWS.

THE man who is interested in building short-wave receivers and listening to the local and distant broadcasts has been at a distinct disadvantage up to the present, as there has been no direct source of information to instruct him on how to get started. Even for the fan who is fairly well versed in radio from the usual broadcast angle, it is still a difficult task to become familiar with the peculiarities of the short waves.

It is the purpose of this series of articles to help this class of radio enthusiasts. For the benefit of those who have a very limited knowledge of radio, we will assume that the reader is entirely unfamiliar with the subject. Therefore, we beg those more fortunate readers with some past experience to be patient if we spend undue time in explaining every technical word and expression.

To understand how radio signals are received, it is necessary to have a knowledge of electricity—the basis of radio. Suppose, then, we start by considering the subject from the very beginning.

Electrons

Matter is any substance having weight and volume. The air we breathe, the water we drink and the earth on which we live are all forms of matter. Matter of all kinds is composed of tiny specks which have been called *atoms.* These atoms, in turn, are made up of a number of still smaller particles of two kinds, and in order to start out with the right foot, we will give these particles their correct names—*electrons* and *protons.* The electrons are tiny charges of negative electricity and the protons are charges of positive electricity. Do not make the mistake made by some people when thinking about electrons and protons. They do not carry the electricity; they *are* the electric charges. If a negative charge of electricity were divided into many small charges, eventually a minute charge would be reached that could no longer be divided. This final division would be an electron. So much for the electron and proton.

(*Continued on page* 176)

THE "beginner" in the short wave field is frequently the one who is apt to be neglected in an array of articles presented in any radio magazine. SHORT WAVE CRAFT *has always endeavored to keep the beginner in mind and the editors always select as wide a variety of short wave articles as possible. Beginning with this issue, we present a new series of especially written articles entitled, "The Short Wave Beginner," by Mr. C. W. Palmer, well-known radio writer. The following articles will appear in the next eleven issues:*

2—The Beginner's Short Wave Receiver; 3—Building the Beginner's Short Wave Set; 4—Aerials for Short Wave Reception; 5—Tuning the Short Wave Receiver; 6—Expanding the Beginner's S. W. Set; 7—Further Improvements for the Beginner's S. W. Set; 8—Electrifying the Beginner's Set; 9—The Final Step in the Construction of the Beginner's 4-Tube S. W. Set; 10—A Battery-Operated Beginner's 4-Tube Set; 11—A "Plug-less" Beginner's Set; 12—Theory of Radio Wave Propagation.

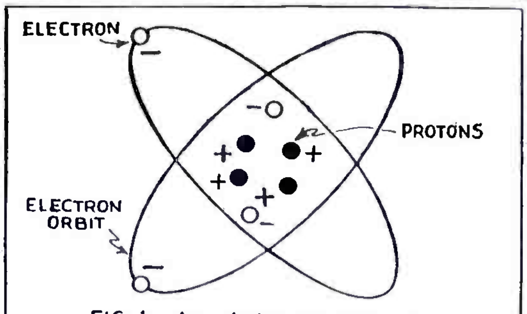

FIG. 1 AN ATOM OF HELIUM.

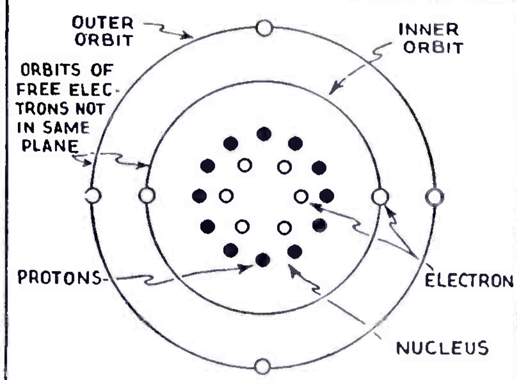

FIG. 2 AN ATOM OF CARBON.

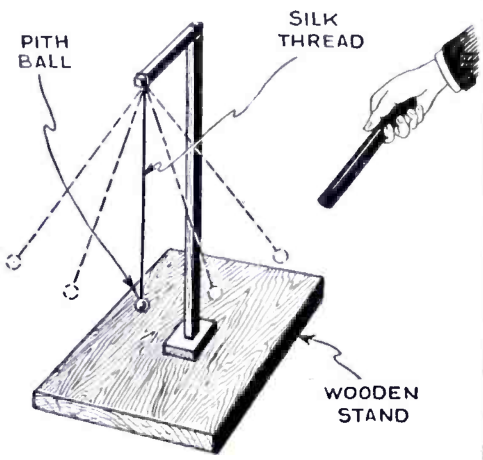

FIG. 3 A STATIC EXPERIMENT.

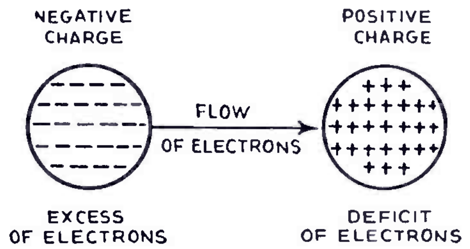

FIG. 4 TRANSFER OF SURPLUS ELECTRONS.

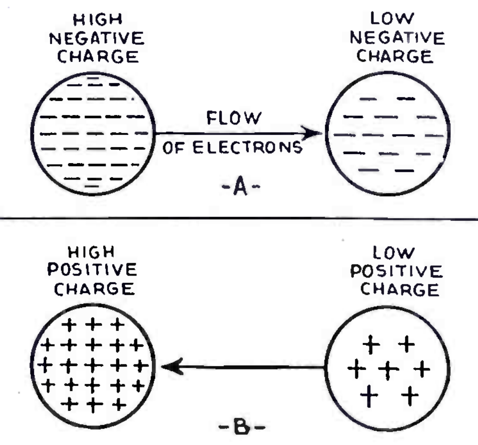

FIG. 5 EXAMPLES OF ELECTRON FLOW.

The diagrams above illustrate the basic electrical conditions occurring in the structure of certain atoms; also electron flow.

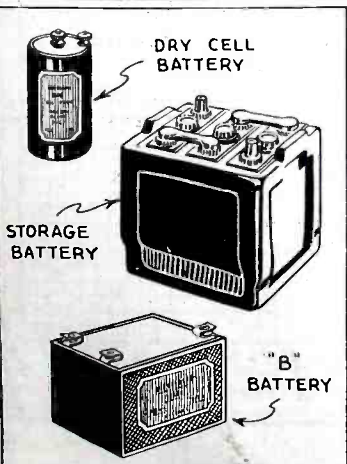

FIG. 6 TYPES OF BATTERIES.

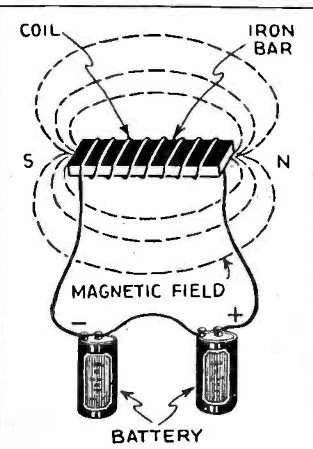

FIG. 7 ELECTRO-MAGNET

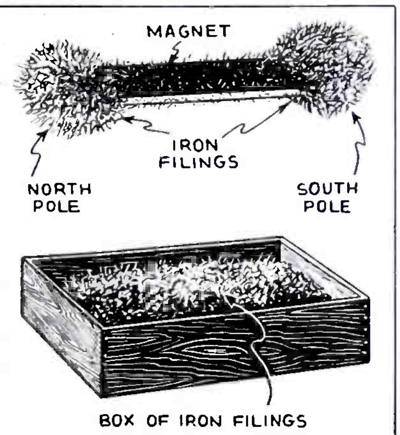

FIG. 8 DEMONSTRATING POLES OF A MAGNET.

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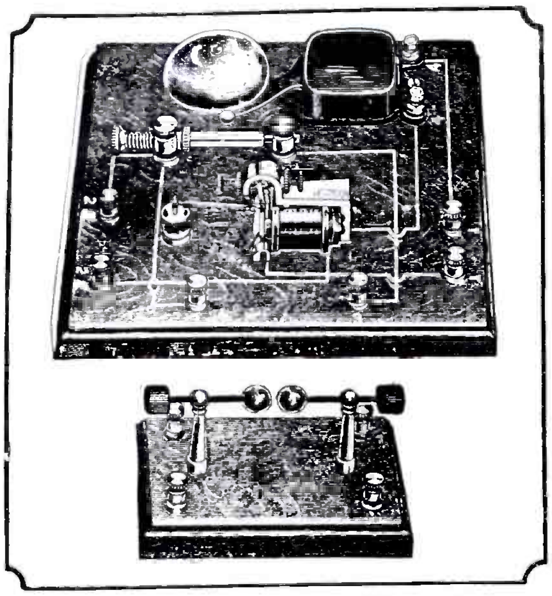


Shades of Edouard Branly! Yep—Back to the good old "coherer" and "spark-gap" days! Showing the "lecture room" radio demonstration apparatus in vogue before the advent of short waves and vacuum tubes.

Demonstrating

Every student and radio club director is interested in practical methods for physically demonstrating the action of short waves. Mr Barr, who has designed many short wave demonstration instruments for one of the leading scientific apparatus companies, here describes how such apparatus can be built and operated.

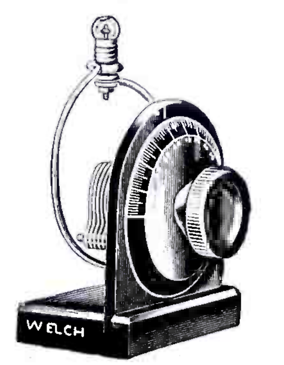
THE following description gives an explanation of a piece of apparatus designed to be used by schools in teaching the principles of radio. For the past several years there has not been available any adequate apparatus which would teach the principles of radio transmission with the same effectiveness that other physical principles are taught by means of laboratory apparatus.

Spark Gaps and Coherers

The apparatus formerly used consisted of a *spark gap* energized by a high voltage induction coil or a transformer and to which was attached two square plates for a radiating device; this comprised the transmitter. The receiver consisted of a *coherer* (metal filings in a glass tube) which actuated a relay which in turn connected to an electric bell circuit. The bell would ring when radio waves impinged on an antenna device similar to that of the transmitter. As one can readily see, the application of such an apparatus is exceedingly limited and the apparatus in no way exemplifies modern radio equipment.

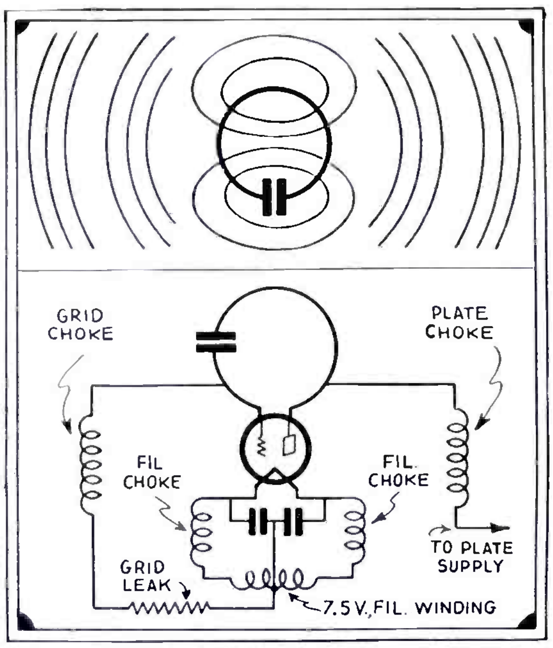
Perhaps the development of modern radio equipment to be used for teaching purposes was retarded due to the fact that the dimensions of the aerial system were so large, but with the development of short waves, this is no longer a disadvantage and the short wave equipment described in this article was designed to meet the demand for radio apparatus which would show all the effects of radio waves within the confines of the laboratory.

The heart of the apparatus is the oscillator, which will produce by means of the vacuum tube such high frequency alternating currents that the field set up during each oscillation will not have time to collapse within the loop of inductance and will escape in the form of radio waves.



A simple wavemeter comprising a variable condenser, a loop of wire and a flashlight bulb.

The choice of a suitable oscillator circuit required some deliberation, since several requirements were to be met due to the range of experiments that it was desired to perform. These requirements were: 1. That the oscillator should be capable of generating frequencies ranging from 100,000,000 cycles per second to 2,000,000 cycles per second. 2. That the different frequencies should be obtained by merely plugging in various values of inductance coils, with a minimum amount of plug-in contacts.



Top—Illustrating the action of a wire loop excited by an oscillator and how the radio waves are whipped off or radiated from the loop.

Below — Diagram showing ultra-audion transmitter circuit described in the text.

Ultra-Audion Oscillator Used

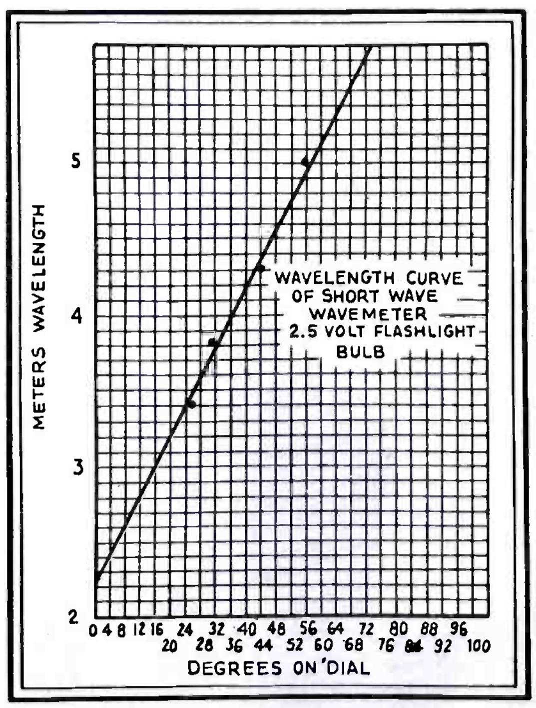
To meet these requirements it seemed that only one circuit would be suitable, namely—the *ultra-audion*. This circuit oscillates well at almost any frequency and requires only two connections for changing inductance coils. The choke coils used must be properly designed or there will be certain frequencies at which it will refuse to oscillate. In this oscillator it was found that entirely satisfactory operation was obtained with various inductances which produced wave lengths of around 3, 4, 5, 7, 9, and 13 meters, thus showing that it is capable of continuous oscillation from 3 to 15 meters. Other coils are furnished to operate on the assigned amateur bands of 20, 40, 80, and 160 meters. This enables the user of the apparatus to experiment on the low waves from 3 to 15 meters to demonstrate the various phenomena of radio waves, as well as to use the higher wave lengths as a standard amateur transmitter if desired.

The following is a description of the experiments that can be performed with the apparatus in the ultra short wave region:

The "Demonstration" Receiver

1. A receiving circuit consisting of a loop or inductance, a small variable condenser, and a flashlight bulb, all connected in series, is used to receive the waves and to illustrate tuning or resonance. The above combination is recognized to be the standard *wavemeter* circuit working on the absorption principle. When the variable condenser is adjusted so that its reactance matches the reactance of the inductance for a given frequency, the wavemeter *is in resonance* and sufficient current will be flowing in it *to light the flashlight bulb.*

This experiment shows that the oscillator is producing waves which are received in the tuned circuit with sufficient energy to light the bulb. Care should be taken to hold the tuned circuit at a distance great enough so that the bulb will not be burned out and to prevent too broad an indication of resonance on the dial of the condenser. If precise readings are desired it would be well



Typical calibration curve for simple wavemeter here described, for measuring waves but a few meters in length.

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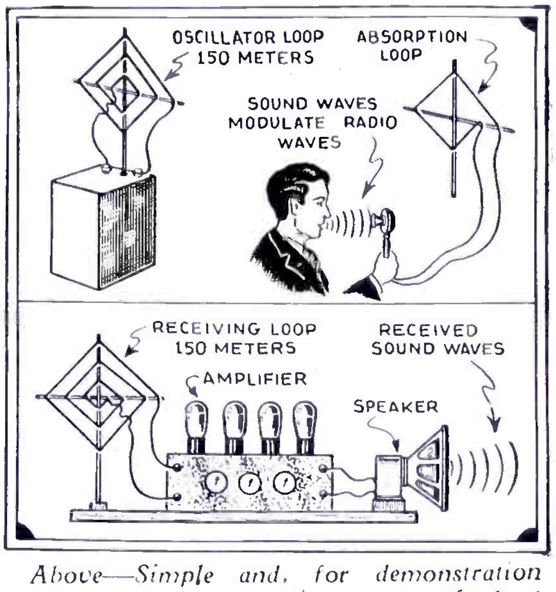
SHORT WAVES

By D. L. BARR

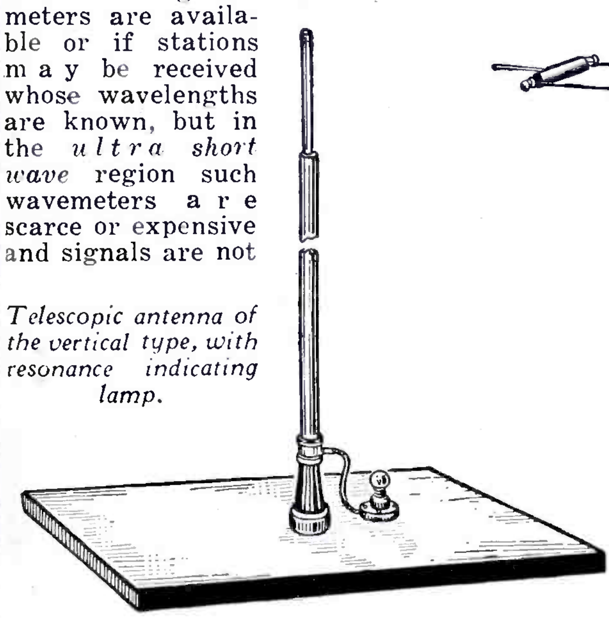


Above—Simple and, for demonstration purposes, very attractive set-up of short wave radiophone apparatus, the transmitted wave being modulated by a microphone connected to an absorption loop.

to select a flashlight bulb with as low resistance filament as possible, since the resonance point will then be more sharp. If a graph is made of dial readings against wavelengths, this variable tuned circuit may be used as a wavemeter to determine the wavelength which the oscillator is emitting with any given inductance coil. The method of calibrating this wavemeter will be described.

Demonstrating Wavelength with Lecher Wires

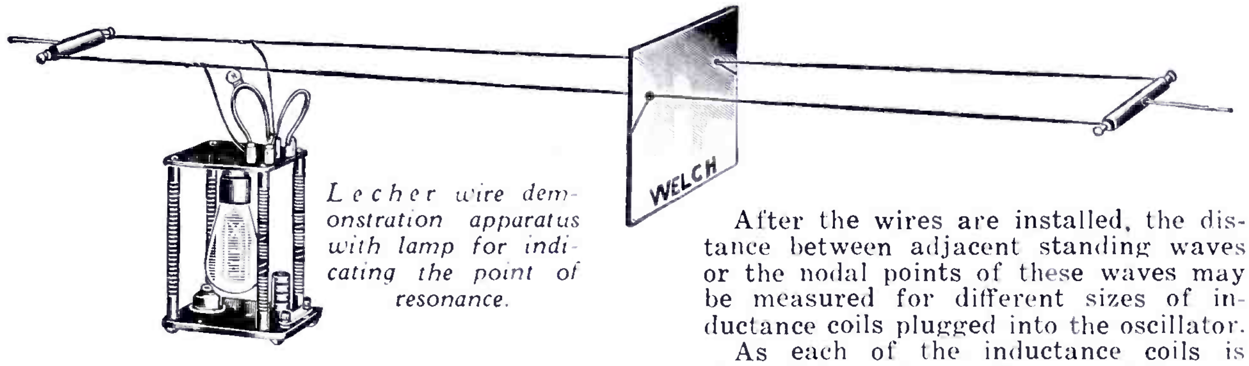
Various methods may be used to determine wavelengths if other standard wavemeters are available or if stations may be received whose wavelengths are known, but in the *ultra short wave* region such wavemeters are scarce or expensive and signals are not



Telescopic antenna of the vertical type, with resonance indicating lamp.

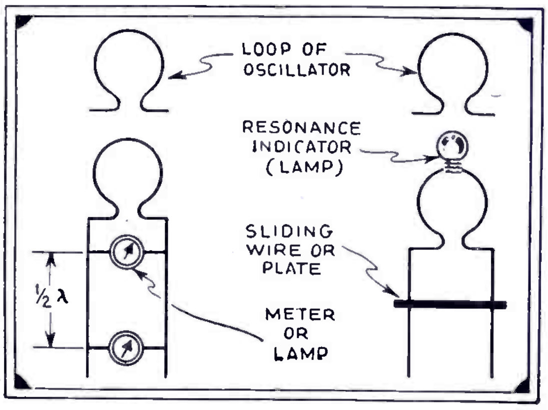
available to calibrate from. In this case, wavelengths are measured directly, using a meter stick to determine the actual linear measurement of the waves. This is accomplished by means of two parallel wires called *Lecher wires.* These wires are coupled inductively to the transmitter and are strung out parallel to a length equal to one-half the maximum wave length you wish to measure. When these wires are set up in the manner shown clearly in the illustration, standing waves are set up on them, and when their position is located, the distance between them is measured with a meter stick (1 meter equals 39.37 inches). This distance multiplied by two expresses the wavelength in meters.

There are several different methods of locating the nodal points of these standing waves which exist at distances of each half wavelength. One method is to slide a hot wire or thermo-ammeter or flashlamp indicator along the wires and the points of maximum current in the meter or bulb will indicate the nodal points. Another method is to slide a neon bulb along the wires and the points at which it lights indicate the nodes. It is perhaps more convenient to place the indicator at the end of the wires which is coupled to the oscillator, so that it may be permanently connected in series with the wires. The nodal points may then be located by sliding a shorting plate along the wires and when the nodal points are reached, maximum current will be indicated in the meter or bulb at the transmitter end of the line. This is the method used in the *Lecher wires* furnished with the radio demonstration outfit described in this article. If accuracy is desired the experimenter should employ a low-resistance thermo-ammeter in place of a flashlight bulb, and should construct the wires rigidly with an accurate measuring scale. Still another method for obtaining the nodal points uses no indicating instrument in the *Lecher wires* themselves at all but locates



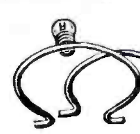
Lecher wire demonstration apparatus with lamp for indicating the point of resonance.

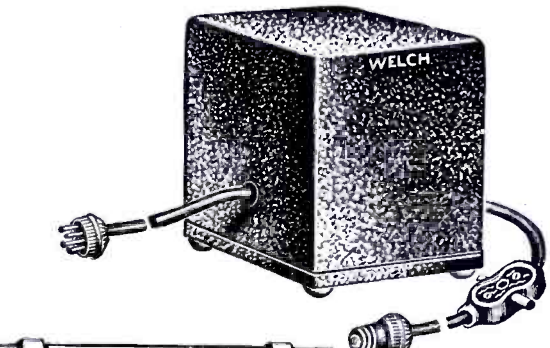
the points by noticing the rather sudden change in the plate current milliammeter reading when the shorting plate is slid onto the nodal point.

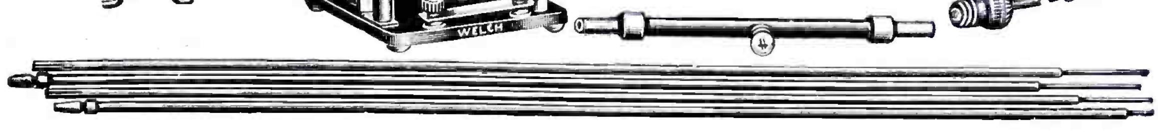


Above: Two ways of using Lecher wires for indicating resonance points and determining the length of short waves.

Ultra short wave oscillator, with radiation loops and transformer to excite oscillator tube, together with telescopic antenna rods for adjusting to different wavelengths.—Courtesy Welch Scientific Co.







After the wires are installed, the distance between adjacent standing waves or the nodal points of these waves may be measured for different sizes of inductance coils plugged into the oscillator.

As each of the inductance coils is plugged into the oscillator and the resulting wavelength measured on the Lecher wires, the wavemeter is placed adjacent to the oscillator and the resonance point is located on the wavemeter dial. If a suitable scale is selected, the range of wavelength values may be laid out on the ordinate and the dial readings on the abscissa. Corresponding points are noted and a curve drawn for the wavemeter readings. (See sketch.) This curve may be mounted under celluloid and if the bulb is not changed in the wavemeter, any wavelength measurement within its range may be made without referring to the *Lecher wires.*

A Study of Different Antennae

Another study may be made by the apparatus with different types of antennae. The two general types of antennae are the Hertzian and the Marconi. In the Hertzian types we have merely two rods strung out to a length equal to one-half the wave length of the oscillator, while in the Marconi antenna, one side is grounded and a vertical wire one-quarter wave length high is used.

(*Continued on page* 178)

A de Luxe Screen-Grid 4

With Space-Charge Amplifier

By D. T. VAN DUSEN — W8CWE

THE receiver here described can well be called a de luxe type of set and will be the pride and joy of every short-wave enthusiast who builds it. The object was to build all the good points of various leading short-wave receivers into one de luxe job and the author sincerely believes that it has been successfully accomplished.

Expense and simplicity have been taken into consideration, but not to such an extent as would interfere with the desired results.

The set is equally sensitive on all wavelengths and has an extremely low signal-to-background noise ratio. The use of resistance coupling and the space charge amplification brings about a wonderful degree of tone quality with ample volume.

To start with, the receiver should be completely shielded. The difference in cost of a shielded job is very small in comparison with the difference in the results obtained. Best results were obtained by using sheet copper, although aluminum may be used very satisfactorily. If copper is used it can be colored beautifully by heating. If a bright finish is desired the copper may be cleaned with acid and a thin coat of clear lacquer applied. The cabinet should be 15 x 8 x 8 inches. The use of the choke coils and fixed condensers is very important and should not be neglected.

The antenna is coupled to the R.F. stage by a 15,000-ohm resistance, which was found to be more satisfactory than the usual choke coil. A positive bias is obtained on this tube by the use of a small flashlight cell.

The detector tube is resistance-coupled to the space charge amplifier and its grid is biased by a small flashlight cell placed in the grid leak circuit. Attention is called to the fact that the negative or case of the small cell is grounded in the R.F. stage, while in the detector stage the positive or center terminal is grounded. The use of these small dry cells has much to do with the absence of hum in this set.

The '35 tube works fine as a *space charge* amplifier and we will see this type of amplifier used more every day. It is well to mention that never should there be more than six volts applied to the grid of this tube. It will work very satisfactorily with but two volts.

The screen grid of the R.F. stage should receive a potential of 60 to 70 volts, while the detector screen grid works best with from 15 to 20 volts. Little trouble will be found in the resistance coupling.

The '45 tube should have a grid bias of 45 volts with 250 volts on the plate. The high D.C. is kept out of the loudspeaker by the use of the 30-henry choke and the condenser.

The coils L1 and L2 are wound on Octocoil forms. The following table gives the correct number of turns and size of wire to be used; L1 is the tickler.

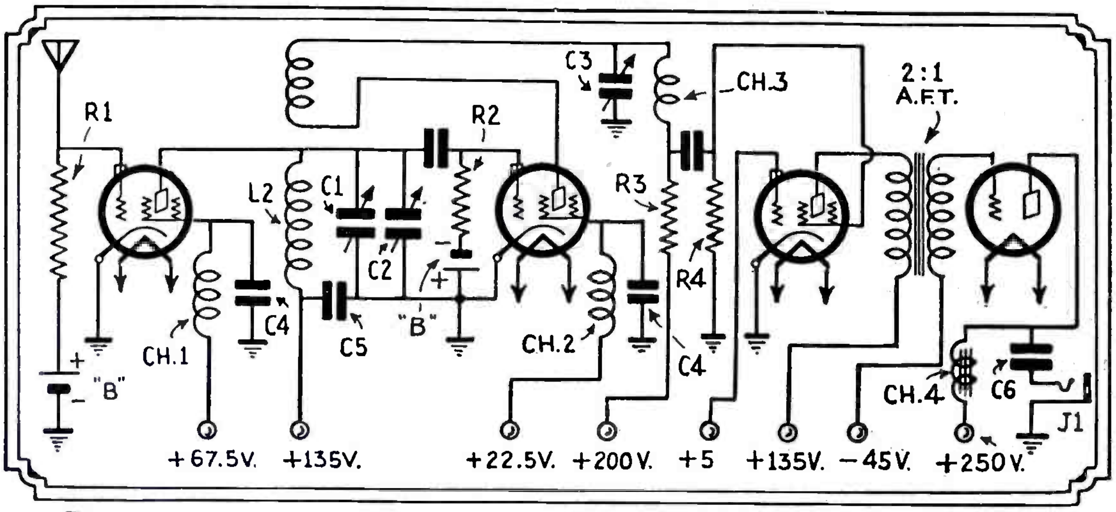
20 Meters
L1.....20 turns No. 26 Enamel
L2..... 6 turns No. 14 Enamel

40 Meters
L1.....12 turns No. 26 Enamel
L2.....12 turns No. 16 Enamel

80 Meters
L1.....15 turns No. 26 Enamel
L2.....26 turns No. 18 Enamel

150 Meters
L1.....25 turns No. 26 Enamel
L2.....48 turns No. 26 Enamel

To those who build this set with care, it will prove worthy of the high praise it will receive, for—after all—it's results that count and you get them in this *space charge* job.



The short wave receiver described by Mr. Van Dusen has several features to commend it, including a space-charge, first stage, A.F. amplifier and an efficiently coupled radio frequency stage, ahead of the regenerative detector. Coil and condenser data are given. The tickler coil is L1.

Values of Parts

R1—15,000 ohms.
R2—6 megohms.
R3—200,000 ohms.
R4—2 megohms.
C1—23-plate midget.
C2— 7-plate midget.
C3—13-plate midget.
C4—1 mf.
C5—.02 mf.
C6—2 mf.
Ch. 1, 2, 3—190 turns No. 30 wire.
Ch. 4—30-henry iron core choke.

In Our Next Issue

New Short Wave Altimeter—Which Indicates to the Pilot the Height of a Plane Above the Ground at Any Instant, by Dr. Irving J. Saxl, Consulting Physicist.

All About the New Transmitting Tubes for Short Waves, by Louis Martin, who has made a special study of the latest type vacuum tubes.

The Short Wave Megadyne—a remarkable combination crystal and vacuum tube receiver, by Hugo Gernsback.

A New Short Wave Converter, by M. H. Gernsback.

The Rotorit Crystal Detector Circuit for Short Waves, by R. William Tanner.

Several transmitter articles are in preparation and these will be published right along.

Second of the new series—"How To Become A Radio Amateur," by John L. Reinartz, famous short wave authority.

C. W. Palmer's second article of the series—"The Beginner's Short Wave Receiver."

A 7-Tube, Portable, Battery-Operated Superheterodyne, by Clifford E. Denton.

The Horizontal Diamond Shaped Antenna, by E. Bruce.

The Spread Side-Band System, by C. H. W. Nason.

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MICROPHONE VERSUS KEY

THE announced intention of the SHORT WAVE CRAFT to request removal of the code requirement for operators of ultra-short-wave phone transmitters has aroused widespread comment—some favorable, some unfavorable, as was to be expected. Many indignant correspondents thought we recommended the dropping of all code tests, whereas the article in the May issue very clearly stated that only the very highest frequency phone band was included.

We have absolutely no argument with people who claim that a knowledge of the code is very useful. The point we wish to emphasize is that the amateur "game" is undergoing a decided change, and most of the newcomers in it would much rather talk into a microphone in easy English than pound out their conversations laboriously on an unromantic telegraph key. The growth of broadcasting—for which the radio amateur is wholly responsible—has made the microphone the symbol of radio, and experimenters naturally gravitate toward this modern device rather than to the old-fashioned Morse key.

The foregoing mention of the amateur's rôle in broadcasting makes it particularly appropriate at this point to quote from a speech delivered recently before the Institute of Radio Engineers in Pittsburgh, Pa., by Dr. S. M. Kintner, vice-president of the Westinghouse Electric & Mfg. Co. In tracing the history of broadcasting from the time Professor Reginald A. Fessenden transmitted voice and music from Brant Rock, Mass., on Christmas Eve in the year 1906, Dr. Kintner led up to the broadcasting of the presidential election returns of 1920 by KDKA, and described some of the preliminary work that preceded this history-making event:

"All during the war one of the busiest of Westinghouse engineers was Dr. Frank Conrad. He was devising all kinds of equipment from hand grenades to radio sets. This interest in radio and the development of it for the government gave him special privileges, and he was permitted to operate various sending sets in the perfection of apparatus under development all during the period of government seizure of the radio stations."

Now comes the interesting part. The italics are ours:

"At the close of the war, when the necessity for radio development was no longer present, he continued as a result of his own interest. *He was a Morse operator, but not particularly speedy, and so concluded that the substitution of a microphone for the key would speed up his communications.* This was done, and he continued his experiments from his station, then located on the second floor of his garage at his home at East End and Penn Avenue, Pittsburgh. His listeners were amateurs, *but they gradually increased in number when they were no longer required to read the code to understand what was going on. From the vast number of amateur messages that I've read in log books and others, I never could see that anyone missed very much real information by such lack of code reading ability.* Finally these amateurs called up Conrad on the phone so frequently and at such inconvenient times that he established regular times when he would operate his station. This was generally Wednesday and Saturday nights. The information regarding these concerts of Conrad's was gradually passed by word of mouth until quite a number knew about it."

The rest is a matter of recorded history. Out of Dr. Conrad's amateur station and his understandable disinclination to "pound brass" grew pioneer station KDKA, and then the radio boom was on.

Fashions change, in radio as in any other interesting line of endeavor that is continually attracting new blood. The ultra-short-wave bands constitute the newest field of radio experimentation, opened by a new generation of "hams" who are not bound down by earlier traditions of roaring spark gaps and fancy key punching. Why restrict this new, eager talent with old regulations? Give them free rein on just one comparatively unimportant channel, and let them show what they can do!

GET 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 were explained in the May issue; copies of rules 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, 96-98 Park Place, New York.

Successful Club Meetings Without Speakers

It is surprising to see how much can be learned at an open club meeting, even without a featured speaker. Let each club member get up and mention the little problems or questions that have puzzled him during the past week, and then have the other members present offer possible explanations. They may have encountered exactly the same problems at one time or another, and may have already worked out solutions or answers.

If possible, delegate one member to bring down to each meeting some piece of apparatus that he has constructed or purchased. Nothing arouses interest like actual material that the "gang" can examine and criticize.

Since the subject of hook-ups will invariably come up at every meeting, one of the best investments a club can make is in a blackboard. Small boards of the kind used in nurseries can be bought for very little, or perhaps some member with a growing son or brother will contribute one. Merely talking about circuits is rather futile; you have to put them down in black and white so that everyone can see them.

Southbridge, Mass., Short Wave Amateur Club

Harry W. Persson, 4½ Twinehurst Place, Southbridge, Mass., informs us that he has organized the Southbridge Amateur Short Wave Club. The club has 24 members so far. It has one licensed operator and two transmitters and all the apparatus necessary to carry on short-wave experiments. Radio amateurs under thirty years of age in the vicinity of Southbridge will be welcomed to membership.

(*Continued on page* 186)

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New HIGH GAIN T. R. F. Receiver

By JAMES MILLEN *

This latest National short wave receiver employs the new tubes, which provide an efficiency equivalent to a "superhet."

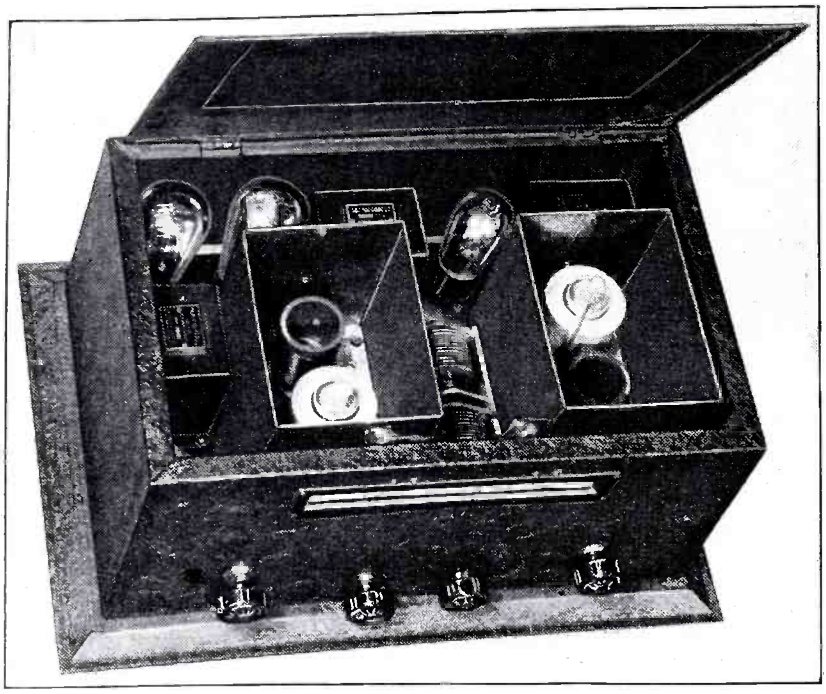

Fig. 4 (above)—Top view of the latest National Receiver—the SW-58, which employs the new '58 tubes.

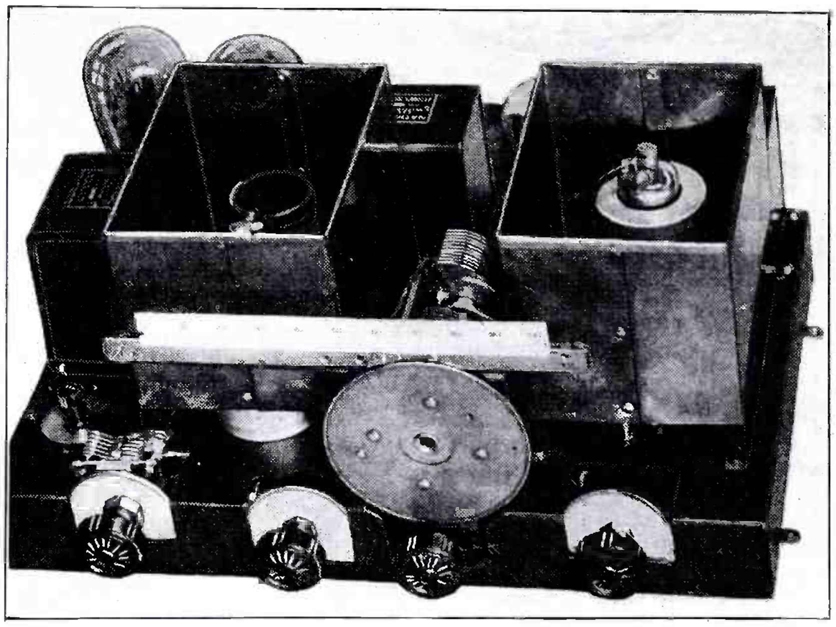

Fig. 2 (right)—Another view of the new National SW-58 Short Wave Receiver.

IN past years the scientific design of short-wave receivers has been retarded by the lack of laboratory equipment which would enable the short-wave engineer to predetermine and check performance with the technique and precision that has long been possible on the lower and conventional broadcast frequencies. It has been difficult to generate accurately known radio frequency potentials at frequencies above 6,000 kc., and sensitivity and gain measurements at wavelengths under fifty meters have necessarily been subject to an elastic interpretation, to say the least. However, the engineer now has a tool in his hands which enables him to produce controlled potentials at very high frequencies, and this apparatus has contributed greatly to the design of the T.R.F. short-wave receiver. The equipment functions on the principle of a balanced detector circuit generating high frequency harmonics, the voltages of which bear a close relationship to the strength of the plate current. Once this relationship has been established, it is only necessary to determine the plate current to ascertain the value of the R.F. potential.

* The National Company, Malden, Mass.

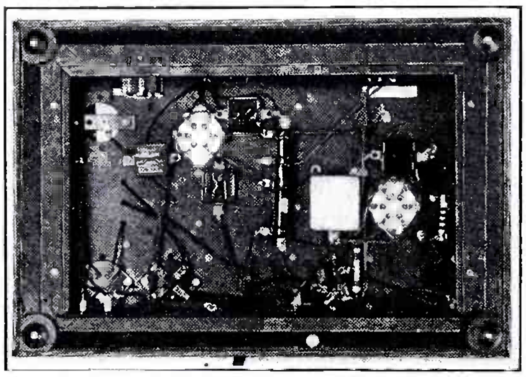

Fig. 3—Bottom view of the new SW-58 receiver.

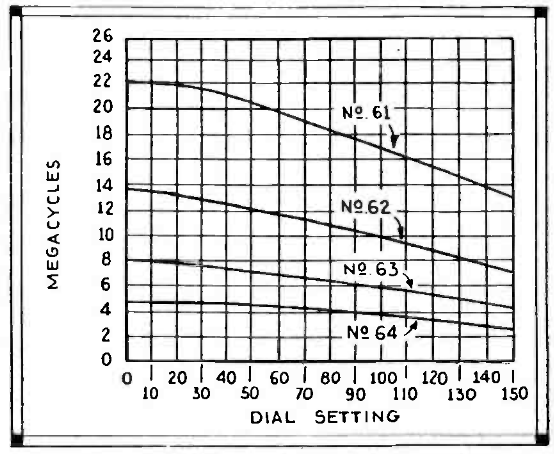

Fig. 5—Tuning curves showing the bands covered by each of the plug-in coils.

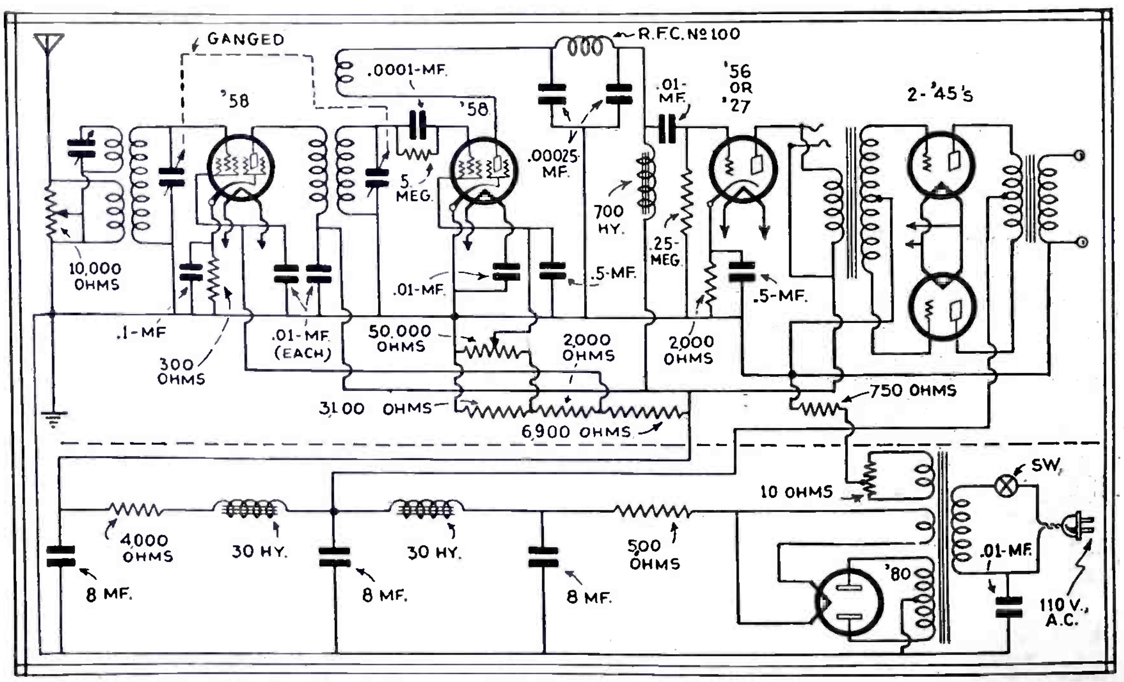

Fig. 1 shows diagram of the connections in the new National SW-58 T.R.F. receiver.

T.R.F. vs. The Short-Wave Super-het

It is the intelligent use of this recently developed laboratory equipment that has resulted in the high efficiency of the National SW-58 type of receiver which recommends its use, rather than the super-heterodyne, for amateur and experimental purposes on all frequencies lower than those of the ultra short waves. From a purely physical point of view, the super-heterodyne is a highly inefficient receiver due to the fact that only a small percentage of the tubes contribute to amplification. One of the detector tubes, the oscillator and the preselector tubes may be considered in this category of useless tubes, in so far as signal intensification is concerned. While it is true that the preselector tubes function as radio frequency amplifiers, such amplification rarely more than compensates the attenuation in the preselector circuit accompanying the attainment of image frequency rejection. However, all of these tubes contribute to tube hiss and

(*Continued on page* 185)

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How To Learn the CODE

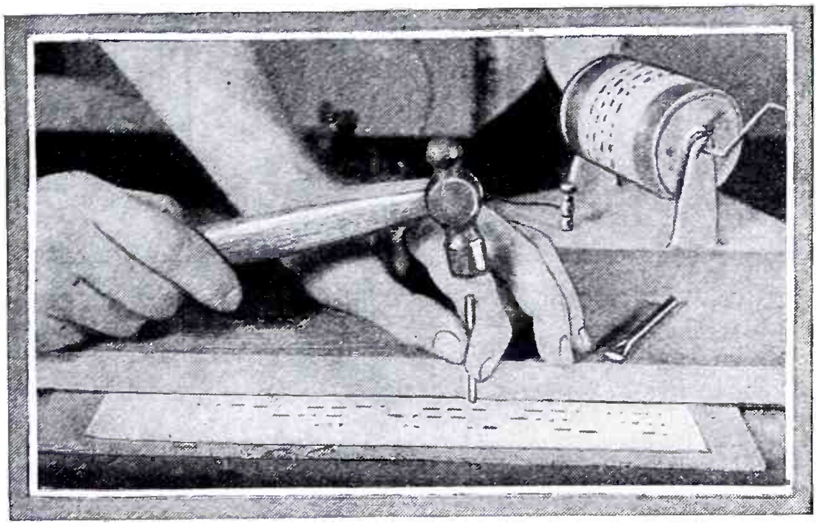
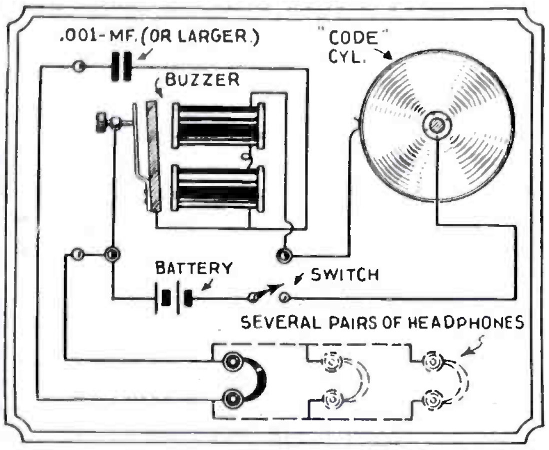


Photo above shows how the dots and dashes forming the code are punched in the paper belt, by means of a hammer and punch, as explained in the article.

By H. L. BLOXOM

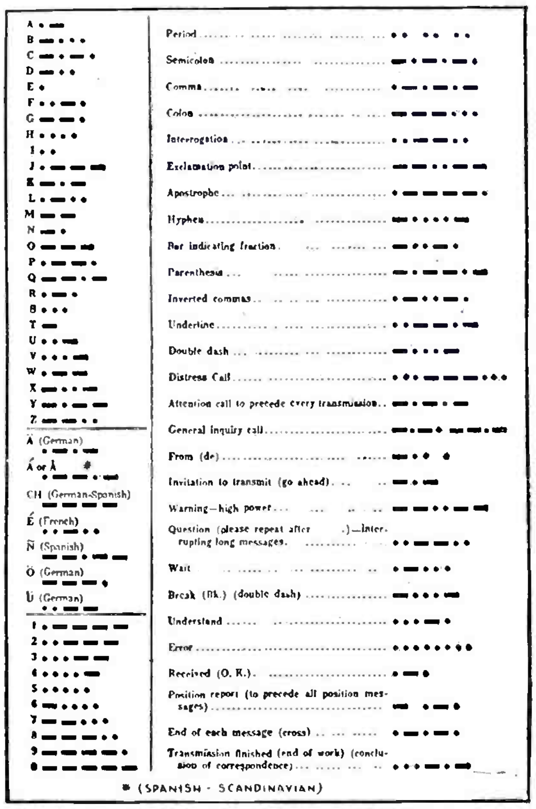
One of the best ways in which to learn the code is to provide some form of automatic transmitter such as that here described by Mr. Bloxom, and preferably the transmitter should be driven by a motor or clock work so that the student cannot outguess it.



One form of circuit for use where several pairs of phones are to be connected to the "code" drum and buzzer.

IT is a distressing fact that continued practice in sending the telegraph code has an almost negligible effect on one's ability to receive it. Unless the budding "ham" has a patient and practised partner, he usually finds it a slow, steep climb to where he can read the sign language of the ether in perfect relaxation. The characters must be sounded accurately and repeatedly for a long, long time before he learns to recognize them instantly and instinctively.

The need for this patient and practiced partner is largely fulfilled by some form of mechanical sender. Such a device was constructed without cost, by the writer, and is herein described for the benefit of those who may be in despair over the fact that the code they hear over their short-wave sets is a meaningless jumble of sounds.



Dots and dashes comprising the radio code.

How Contact-Making Drum Is Made

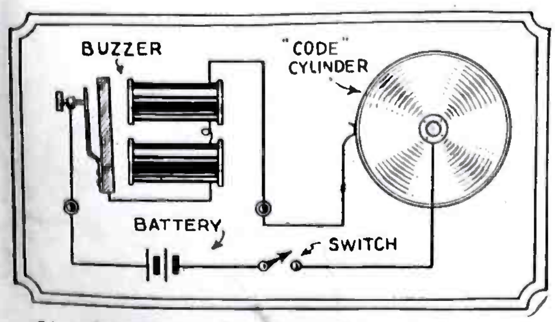
It consisted of a conducting drum arranged to be rotated on a suitable support, in such a way that a stationary contact intermittently closed a buzzer circuit through a perforated sheet of paper encircling the drum. To make it, a hole was bored accurately in the center of each end of a bright, empty condensed-milk can, and through these holes an iron wire was passed and secured by soldering with acid core solder. The wire had previously been cleaned with sandpaper and bent to form a crank at one end. Projecting from both ends of the can, it served as an axle. Metal supports having holes for the axle were screwed fast to a wooden base and spaced so as to prevent end-play, when the drum was in place, with a thick washer on the axle at each end. A binding post was fastened to one of these supports, as seen in the first illustration.

A hole was bored through the base in the position where the other binding post is seen in the illustration, and a screw was passed up from the bottom and made fast by a washer and nut. A binding post was set down upon the screw so as to clamp a wire against the nut. This wire had previously been shaped so as to make contact with the can at a point where there was made a sharp bend in the wire; the device was then ready to receive the perforated paper.

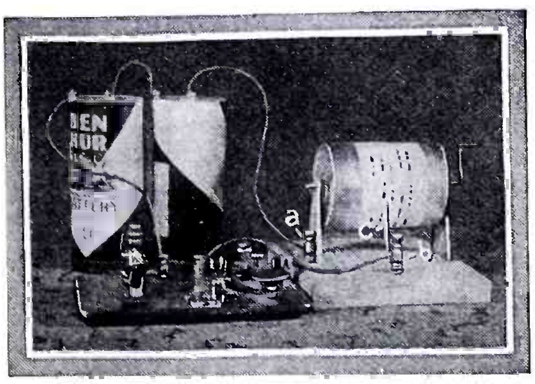
Perforating the Paper

To perforate the paper, two punches were required; one with a square punching end and the other with a rectangular end, as thick as the square, but three times as wide. The first was made from

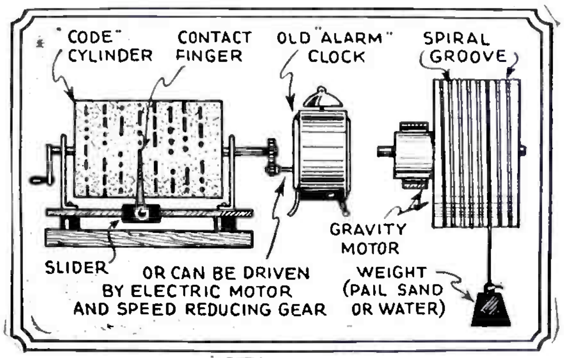
(*Continued on page* 184)



Simplest form of code teaching instrument, comprising a buzzer, battery, switch and "code" cylinder.



Completed code transmitting drum with perforated paper tape; (a) Binding post connected with drum support; (b) Binding post which clamps sliding contact "C."



The "code" cylinder may be driven by an old clock or a gravity motor as shown, the contact finger being slid along to the desired position.

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Making and Using

The authors describe the latest methods of producing and measuring ultra short waves, having a length of one decimeter or approximately 3.9 inches. Data is given on several tubes and the wavelength produced by the Barkhausen method; a receiver for the decimeter waves is also described.

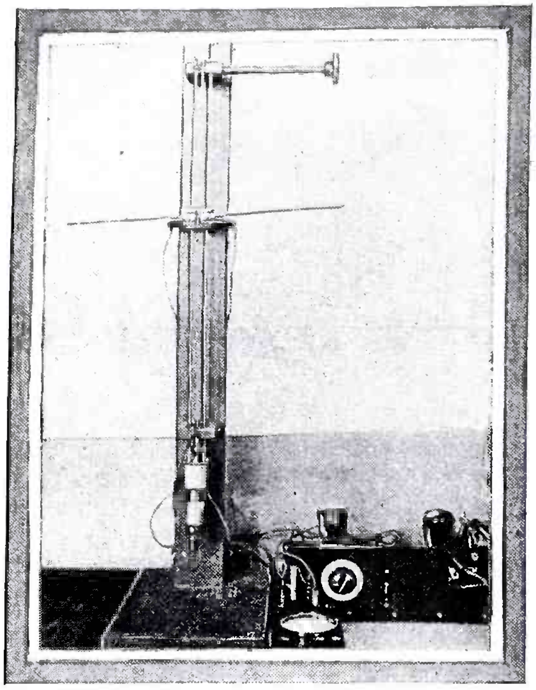

Fig. 4—Appearance of 1/10 meter transmitter.

THE tests conducted some time ago in which wireless telephony was carried on between Dover and Calais on a wave of only 18 cm. (7.2 inches) have directed the attention of even the less interested public to a short wave field which today, after intensive preliminary work by science, offers in an increasing degree, possibilities of practical use and also sets the amateur a number of new and highly attractive problems.

The jump to such short waves was only made possible by the discovery of methods of production fundamentally different from all those previously employed. There is a limit set to the production of shorter and shorter waves in a regenerative hook-up, namely, by the velocity of the electrons. Above a certain frequency the tube no longer acts as an inertia-free relay; that is, the electrons emitted follow the fluctuations in control voltage only with a perceptible shift of phase, so that plate current and plate potential can no longer go in counter-phase, as would be necessary for self-excitation.

It may easily be calculated for which frequency this case must occur. The electron motion from the cathode proceeds according to similar laws to those governing the free fall, and for the time of fall the following formula results:

$$T = \frac{r_a}{\sqrt{\frac{1}{2} E_a \frac{e}{m}}} \qquad (1)$$

In this r_a means the radius of the plate cylinder, e the charge of the electron, m its mass, and E_a the plate potential. By inserting the known numerical values of e and m, the formula reads:

$$T = \frac{3.4 \times 10^{-8} \times r_a \text{ cm}}{\sqrt{E_a \text{ Volt}}} \qquad (2)$$

For a plate radius r_a .5 cm. (.2 inch) and a plate potential E_a 500 volts, there results, for example, from formula 2 for the electrons a running time of T equal to .85 times 10^{-9} seconds. Now, since the duration of period for a 1 meter wave is 3.3 times 10^{-9} seconds, the delay in this case through the running time of the electrons makes itself already very unpleasantly perceptible. As a matter of fact, experience also shows that in the back-coupled (regenerative) hook-up, no waves below one meter in length can be stimulated or produced.

The widening of the range of undamped waves also to the field below one meter was made possible only through a principle found by a chance discovery and a systematic investigation following

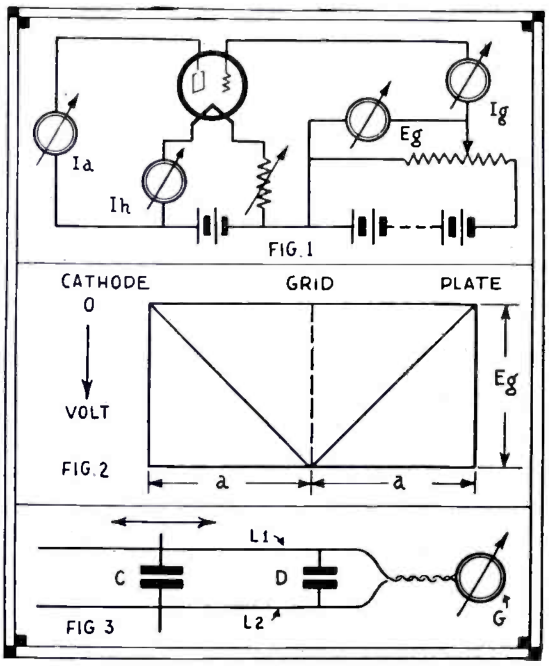

Fig. 1—Hook-up of a Barkhausen transmitter; Fig. 2 shows the course of potential in the tube; Fig. 3, the Lecher system for wave measurement.

upon that. In measuring the gas content of transmitting tubes, Barkhausen and Kurz observed in the year 1920 the occurrence of extremely short wave oscillations, whose origin is explained through the pendulum-like or oscillatory motion of the electrons.

The Occurrence of Electron Oscillations

The mechanism of electron oscillations becomes most evident if we take as a basis the simple hook-up of Fig. 1. The plate is connected through a milliammeter directly with the filament, while the grid has a potential of several hundred volts; the start and intensity of the oscillations one observes on the plate meter. For simplifying the theoretical consideration, we assume that the tube has plate-shaped electrodes and that the distance from cathode to grid is the same as from grid to plate. Then there results for the course of the potential in the tube the image of Fig. 2. Plate and cathode have the same potential, the grid being Eg, lower in potential, if we regard the motion of the electrons to the positive grid as a fall. Therefore the electrons fly from the cathode to the positive grid and reach their greatest speed at the grid itself. In case they do not chance to strike the grid wires, they fly through and continue toward the plate, while they now, however, must run counter to a braking potential. On arriving at the plate they have zero velocity, since they now are of course at the same height as at their start. At this moment they swing back again to the positive grid, through it again and back to the cathode, when the pendulum oscillation is repeated. Now the electrons oscillating back and forth in the period of this pendulum motion excite an electric oscillation of equal period, which accordingly cannot be determined in any way by an external oscillation circuit, but only by the internal structure of the tube—the distances between the electrodes—and by the voltages applied.

We had already seen that the running time (velocity) of an electron in the case of a distance from cathode to plate of .5 cm. (.2 inch) and a plate potential of 400 volts reaches the value of .85 times

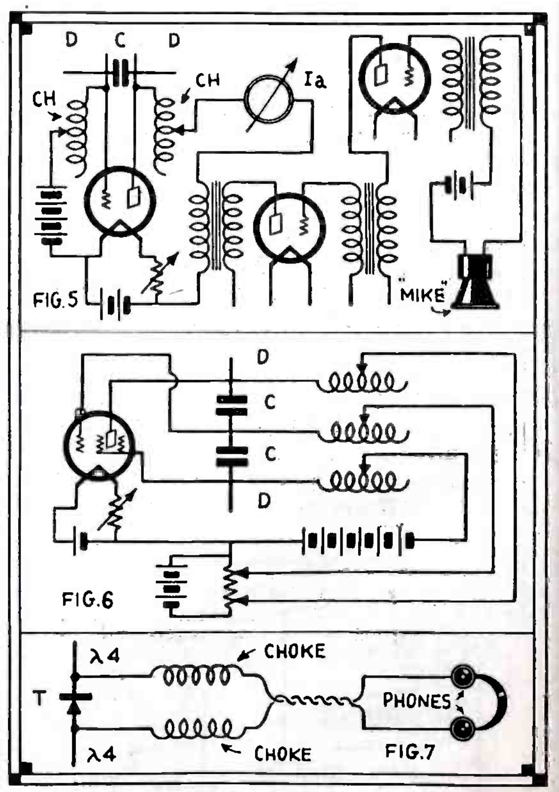

Fig. 5—Hook-up of the decimeter transmitter illustrated in Fig. 4; Fig. 6—Barkhausen transmitter with double grid (S. G.) tube; Fig. 7—detector receiver circuit for 1/10 meter waves.

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4 INCH WAVES

By H. RINDFLEISCH and L. ROHDE

10^{-9} seconds (about one-millionth of a second). Now, if we consider a tube in which the distances cathode-grid and grid-plate are each .5 cm. (.2 inch), and if we now apply the potential of 400 volts to the grid, then there results for the period of the electron pendulum swing four times the previously calculated running time, that is, 3.4 times 10^{-9} seconds. But this is almost exactly the period duration of a one-meter wave. From these considerations one finally obtains the approximation formula:

$$\lambda_{cm} = \frac{2000 \times r_a \text{ cm}}{\sqrt{E_g \text{ Volt}}} \qquad (3)$$

Therefore the smaller the distance between the electrodes and the higher the potential lying on the grid, the shorter the waves which one can excite. The results of numerous experiments agree well qualitatively with these two conclusions from the theory, and therewith give an indication for the construction of the tubes. In this way it is possible to get waves down to about 15 cm. (6 inches) in length.

Measuring Waves Below One Meter

Decimeter (one-tenth meter or 3.937 inches) waves cannot be measured with the normal methods of the resonance circuit of self-induction and capacity. For this purpose one uses a Lecher system (Fig. 3). This consists of two wires stretched out parallel a short distance apart, l_1 and l_2, which are bridged at one end by a detector D. Now if one pushes a condenser C along on the system of wires, one gets in regular succession in a galvanometer connected with the detector needle deflections, the distances apart of whose occurrences are equal to *half the wave length*. The coupling of this wave-meter with the transmitter is usually sufficient, if the Lecher wires are stretched out in the vicinity of the transmitter tube. For wave measurement one can also use the reflection of the wave on a metal surface. More will be said of this method, which is especially important for the very short waves, in the case of the discussion of the mirrors.

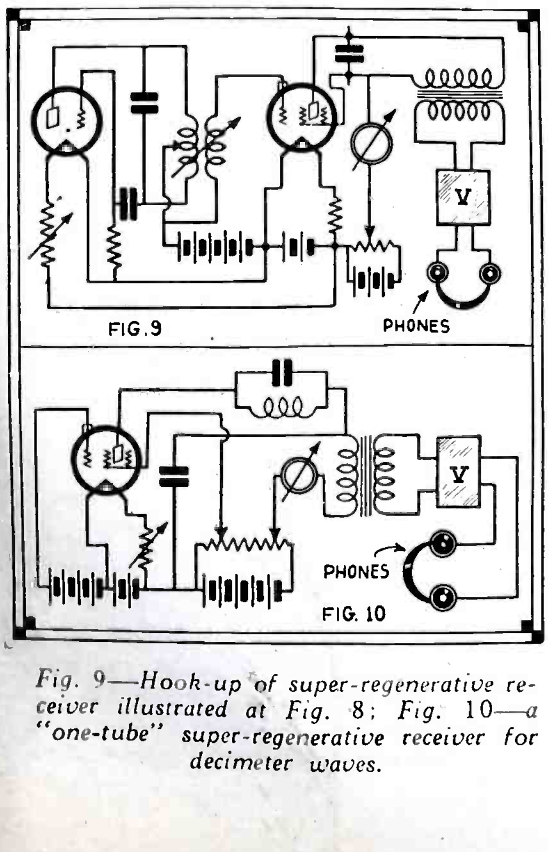

Fig. 9—Hook-up of super-regenerative receiver illustrated at Fig. 8; Fig. 10—a "one-tube" super-regenerative receiver for decimeter waves.

Construction of a Decimeter Transmitter

For the practical construction of a Barkhausen transmitter and for increasing the oscillation energy, one uses a Lecher system similar to that of the wave-meter, which for this purpose is directly connected to the grid and plate of the transmitter tube. The tuning to the wave produced by the tube again takes place by pushing a *capacity bridge* along the two wires, while one determines the maximum of oscillation energy in the plate instrument. Fig. 4 shows a transmitter ready for operation and Fig. 5 the corresponding diagram. The wires, about 50 cm. (20 inches) long, connected with grid and plate, carry the movable condenser C, which is fastened on a slide made of insulating material and provided with two contact springs. The conductors are connected to the ends of the Lecher wires through adjustable chokes Ch (about 20 turns of bare copper wire, wound on a diameter of about 1 cm. or .4 inch), the tap being so chosen that as little high frequency current as possible gets into the conductors. This point deserves especial attention, if it is a question of a raised position of the transmitter, since then one is obligated to too long wires.

The most important point in the transmitter is the choice of a suitable tube. Of the tubes available today, only a few, unfortunately, are suited for the production of *electron oscillations*, since for this as a rule, symmetrical cylindrical construction of the electrodes is necessary. Otherwise the velocities of the electrons from the cathode to the grid are different in each direction and cannot produce any oscillations at all. Cylindrical (symmetrical) tubes should absolutely be used in the Barkhausen hook-up.

Type of Tube	*Heating Current amperes*	*Wave Length cm.*	*Grid Volts*
210 or 250	1.25	120	100
		min. 20	500
226	1.05	same as above	...
226	1.05	190	200
280	2.0	208	158
224	1.75	45	180
199	0.06	120	120

The table gives the wavelengths which can be produced with the tubes in question at maximum energy and the smallest wave length. In the last column are given the appropriate grid voltages; if the same grid voltage is given in the case of the same tube for different wave lengths, then for producing the shorter wave a negative potential of the outer electrode is required.

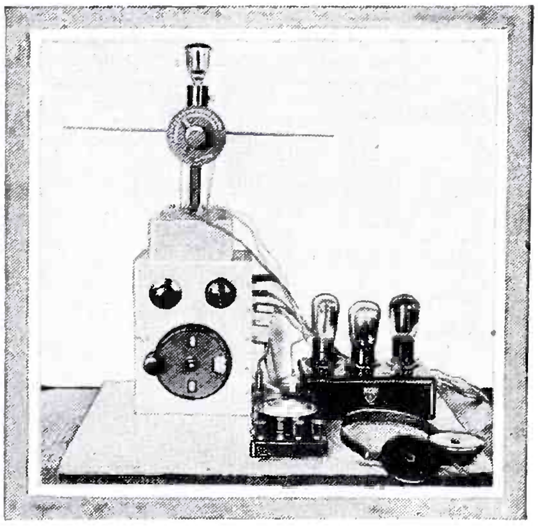
Fig. 8—Super-regenerative receiver for 1/10 meter waves.

One obtains the shortest waves with the small type of the French TMC tubes, which produce useful oscillations down to 16 cm. (6.4 inches). Oxide coated filament tubes are especially advisable for portable sets, on account of their small heating voltage. In the pentode the positive potential is put on the space charge grid, while control grid and plate together take over the rôle of the plate in an ordinary three electrode tube. If one applies to the plate or control grid also small positive or negative potentials, then by suitable regulation of all the operation data, a maximum of oscillation energy can be attained (see Fig. 6). The energy of the Barkhausen transmitter is very small, a disadvantage which however in great measure can be neutralized, for the most important fields of use of this wave range, by the possibility of concentrating the total energy into a sharp pencil or ray. One attains an increase in energy considerably greater by using a push-pull arrangement of two tubes, which operate on the same Lecher system. Nevertheless, of course with such an arrangement there is an increase in the difficulties of correct tuning, already present in the case of one tube, so that thus far push-pull transmitters have seldom been used in practice. The greatest energy which one can produce with a one-meter (3.28 feet) Barkhausen transmitter is about .3 of a watt! With shorter waves the attainable energy drops considerably.

The radiation of the energy takes place, as ordinarily, with ultra-short waves, by means of a dipole. There are connected to the bridge condenser of the Lecher system two straight wires D, D, one on each side, each one-quarter wave length long (see Figs. 4, 5, 6).

The *modulation* of the transmitter is best accomplished by a transformer in the plate lead (see Fig. 5), the primary winding being connected with the microphone through an ordinary amplifier. Since the frequency of the electron oscillations depends on the external potentials, one will expect in this type of modulation predominantly frequency modulation. However, the Lecher system used for increasing the energy *stabilizes the wave*, so that a powerful amplitude modulation is possible.

In discussing the *reception* methods it

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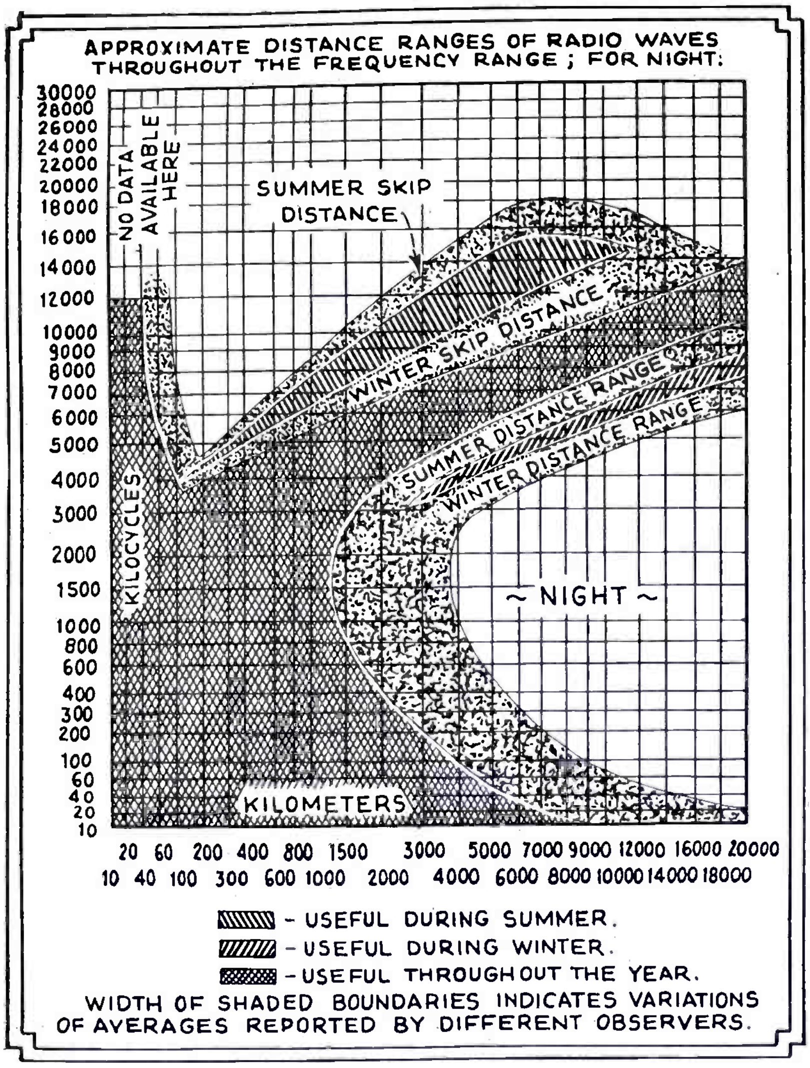

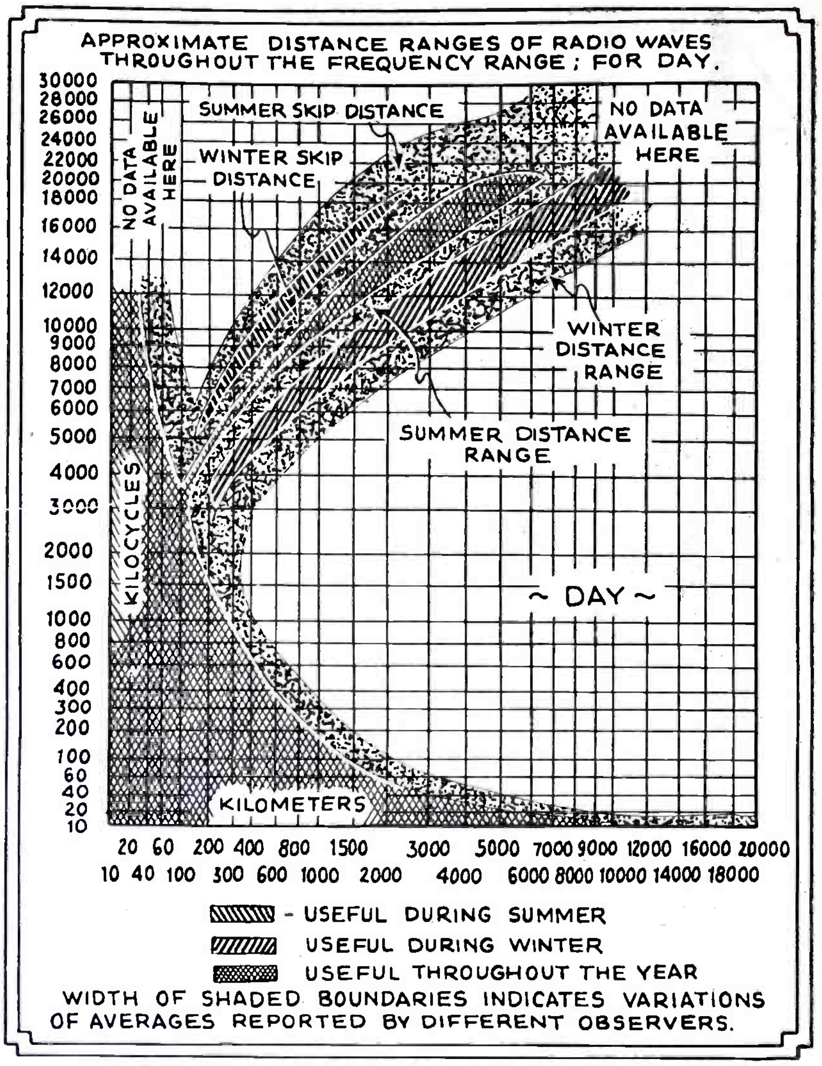

HOW FAR ON WHAT K-C?

The accompanying charts which were prepared by the U. S. Bureau of Standards, Washington, D. C., show the variation in range or distance covered at different seasons with various wavelengths or frequencies.

RADIO wave transmission takes place by the propagation of a "ground wave" along the ground, or a "sky wave" reflected or refracted from the Kennelly-Heaviside layer, or by both means. The waves are subject to absorption, both in the ground and in the ionized upper atmosphere. The ground-wave absorption in general increases with frequency and is reasonably constant with time over a given path at a given frequency; it varies for earth of different conductivities and dielectric constants. The sky-wave absorption is not a constant with time, frequency, or path; it appears to be a maximum in the broadcast band (550-1500 kc.), decreasing with change of frequency in either direction. In the daytime this absorption of the sky wave is so great that there is practically no sky wave, from frequencies somewhat below to somewhat above the broadcast band, the specific limits varying with season. Hence sky-wave propagation in the daytime is only appreciable in the lower and higher frequency ranges. During the night, however, sky-wave propagation takes place on all except extremely high frequencies. Sky-wave propagation is subject to material variations, dependent upon conditions and changes in the ionization of the Kennelly-Heaviside layer. Besides daily variation of daylight and darkness, factors such as latitude, season, magnetic storms, and solar disturbances, have been found to have effects upon this ionization. These changes in ionization result in wide variations in the transmission of sky waves from hour to hour, day to day, and year to year. At the higher frequencies, received field intensities for a given season and frequency may vary as much as 1 to 10 from one year to another.

Important Rôle of the "Sky Wave"

At the higher frequencies, reception at great distances is due entirely to the sky wave. Above a certain frequency, however, which may be as low as 4000 kc. (see attached graphs), no appreciable portion of the sky-wave radiation is reflected back to earth from the Kennelly-Heaviside layer in a certain zone surrounding the transmitter. In the area bounded by the inner edge of this skipped zone, the received wave may be composed of both ground wave and sky wave (the sky wave being appreciable on frequencies up to about 6000 kc. in the summer and 12,000 kc. in the winter); the sky wave intensity in this area is ordinarily much less at night than in the day. The outer boundary of the skipped zone is often called the skip distance. The skip distance increases with frequency, and varies diurnally and seasonally. Beyond the skip distance, the sky-wave radiation is received with useful intensity.

With present knowledge of propagation conditions, it is impossible to postulate any formulas or make any tables or charts which could be used to determine distance range over any given path accurately. The attached graphs give average distance ranges as observed by a number of experimenters* to occur most frequently over a number of transmission paths. Through certain frequency ranges, available data were so incomplete as to require extrapolation which may be considerably in error. Wide variations of distance range and skip distance must be accepted as normal.

The scales of abscissas and ordinates are cubical, (*i. e.*, numbers shown are proportional to cube of distance along scale, or, distance along scale is proportional to cube root of numbers). This was chosen because it spaces the data satisfactorily. A linear scale would crowd the low values too much and a logarithmic scale would crowd the high values too much.

Graphs Show Practical Range

The graphs show the limits of distance over which practical communication is possible. They are based on the lowest field intensity which permits practical reception in the presence of actual background noise. For the broadcasting fre-

*See references listed at end.

(*Continued on page* 183)

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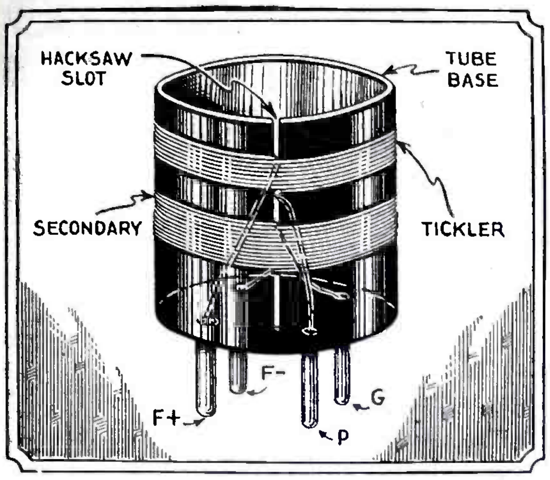
$5.00 PRIZE
Coil Winding Wrinkle

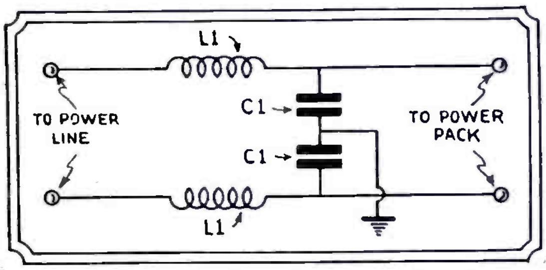


A saw slot serves to lead coil wires to pins.

Herewith is a short wave coil winding wrinkle which I find very useful and practical. Instead of drilling holes in a tube base or other coil form to take the leads in to the prongs, a hacksaw slot the length of the form will greatly facilitate coil winding, as it saves a lot of unnecessary guessing and gauging; and besides, a much neater looking coil will result than one which is drilled with over-size, unsightly, or improperly spaced holes. If all leads are taken in to the prongs through one slot, this method does not noticeably weaken the coil.—*Contributed by Michael Schauer.*

Line Filter

In order to cut down line noises from my short wave set, I have constructed the following inexpensive line filter which



Two condensers and chokes form a line filter.

$5 Monthly for Best SHORT WAVE KINK

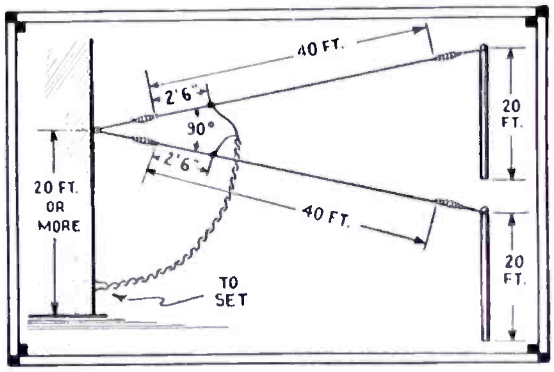
Beginning with this issue of SHORT WAVE CRAFT, the editors will award a five dollar prize each month for the best short wave kink submitted by our readers. Look over these "kinks" and they will give you some idea of what the editors are looking for. Send a typewritten or ink description, with sketch, of your favorite short wave kink to the—"Kink" Editor, SHORT WAVE CRAFT.

has worked admirably. The coils L1 are made by winding 150 turns of No. 18 D.C.C. wire on 1-inch diameter tubes. The condensers C1 may be of .5 or 1 mf. capacity.—*Contributed by N. Swerdlow.*

An Antenna That Brings 'Em In

This type of antenna will raise volume from medium phone volume to speaker volume on many short-wave sets.

The drawings of this antenna are self-explanatory. Briefly, the aerial is made up as follows: From a point 20 feet or more from the ground, two insulated wires start. Each wire is forty feet in length and stretches at a 90-degree angle from the other. Two and one-half feet from the common end, the leading taps are taken off. The two leading wires are twisted and may be of almost any length. They terminate at the grid coil of the detector, or if tuned R.F. is used, at the first R.F. coil. They are coupled to the coil by six turns of B. & S. gauge

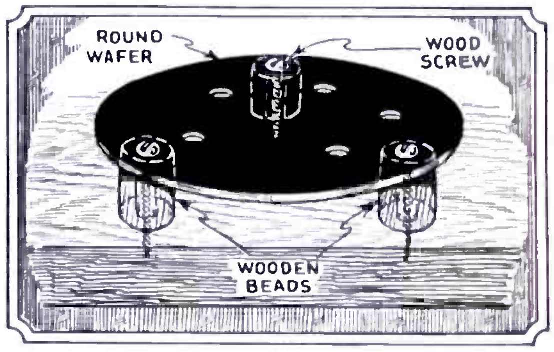


Improved aerial for short wave reception.

No. 20 D.S.C. or D.C.C. wire wound in the same direction as the other winding, either over it or, if there is space beside it, on the coil. The ground is connected to the return grid circuit. It is essential that the ground remain connected.—*Contributed by Leonard R. Greenaway.*

Wafer Socket Supports

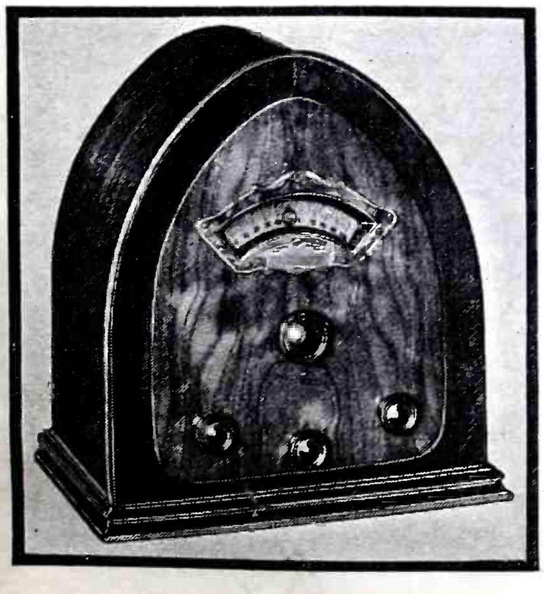
Herewith is an idea that may be useful at the service bench when revamping the old direct current designs. Instead of buying the regular socket, buy the round wafer and in the dime store you can purchase some wood beads about one-half inch high, with a hole through the center, which will hold the wafer socket at the right height.—*Contributed by A. E. Aldridge.*



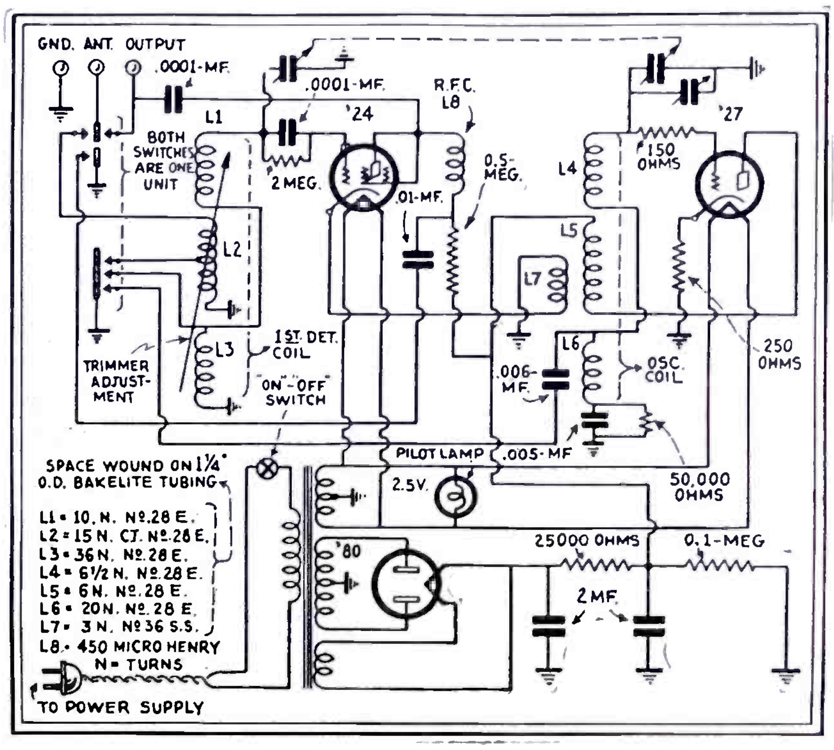
How to support wafer socket.

New Plug-less Short Wave Converter

ONE of the newest short wave converters which has been tried out by the editorial staff and which performs very smoothly, is the new Erla, illustrated in the photo at the left and diagram at right. It covers the short wave bands from 200 to 60 and from 60 to 15 meters; a wave-length chart is furnished. The condenser capacity joining L1 to ground is .00027 mf., and the capacity of the condenser joining L4 to ground is .00037 mf. with a trimmer across it having a capacity of 20 mmf. The vernier is an adjustable copper disc sliding within coil L1.



Left—The new Erla short wave converter that works with any broadcast receiver — converter diagram at right.



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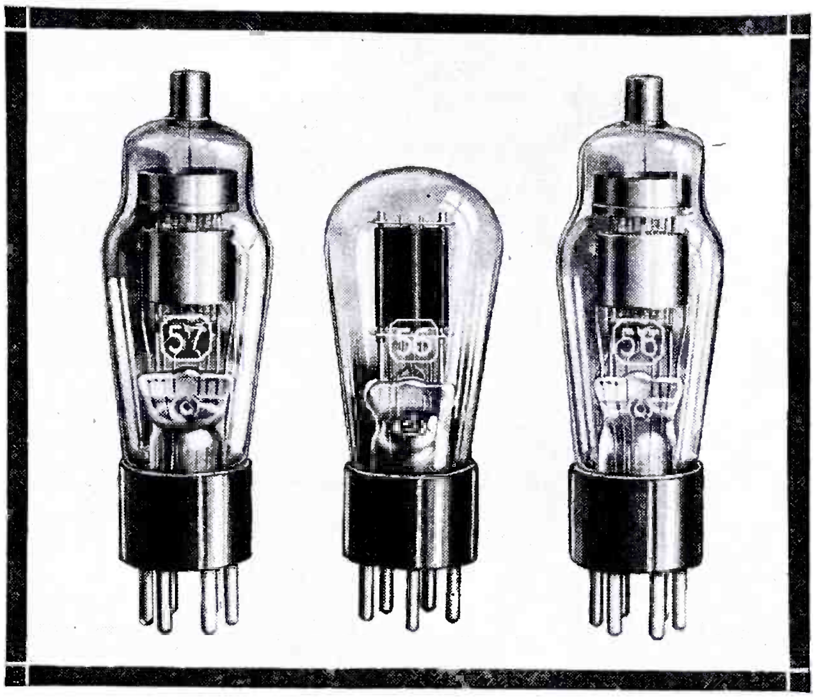


Fig. A (center)—The new "56," made by Arcturus and designed to ultimately replace the '27. Fig. B (left)—The Arcturus 57 pentode detector. The low grid-plate capacity makes this tube especially suitable for short-wave work. Fig. C (right)—Similar in appearance to the 57, the new Arcturus 58 meets a long-felt want for a variable-mu R.F. pentode suitable for short-wave work.

NEW TUBES *for the* Short Wave Receiver

By LOUIS MARTIN

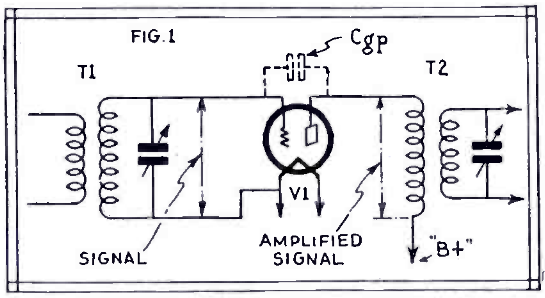
So many new types of tubes have been brought out in the past month that we have prevailed upon Mr. Martin, well-known tube expert, to tell the readers of SHORT WAVE CRAFT *just which tubes are particularly adapted to short wave reception purposes—and why! This article will be followed by one dealing with the "New S-W Transmitting Tubes."*

NEW tubes! Those who recognize the need for improved apparatus, especially tubes, will welcome the announcement of the new "50" series of tubes. Of these, two are especially adaptable for short-wave work and certainly should meet the requirements of the most exacting experimenter and set-builder. We will first begin with a discussion of the factors governing the choice of tubes suitable for short-wave work and then proceed with a description of the characteristics of the tubes themselves.

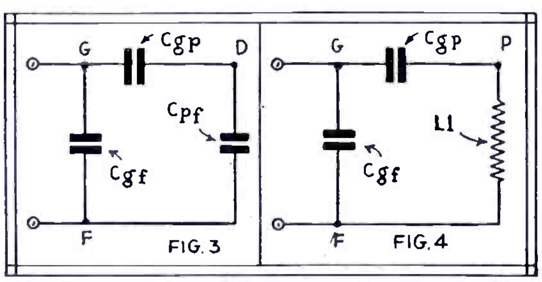
In the broadcast band, where power output and quality are of paramount importance, the number of new tube-numbers are far greater than may be used by the short-wave fan. The question that arises then is, "which tubes are suitable for short-wave use?" and, what is far more important, "why?" Before discussing the new tubes themselves, it would be well to outline, briefly, the factors which enter into the choice of "short-wave" tubes.

In any vacuum tube, a signal is fed into the input (grid-filament) of the tube and removed—amplified—from the output. Regardless of the type or sensitivity of the circuit, the above is the simple rule of tube operation. Any tube, in a given circuit, is capable of amplifying the signal a certain definite amount, the amount of amplification being primarily determined by the "amplification factor" of the tube. Now, this amplification factor is merely a number which denotes the total change in plate voltage due to a certain change in grid voltage (due, for instance, to a signal). This amplification factor or "mu" is the greatest amount of amplification that can be obtained from the tube under any conditions; in reality it is never reached, simply because the load in the plate circuit of the tube can never be made high enough.

For example: if the mu of a certain tube is 9 and it has a plate resistance of 10,000 ohms, a load impedance of 10,000 ohms would only produce an effective amplification of 4.5; a load of 50,000 ohms, an amplification of 7.5; a load of 100,000 ohms, an amplification of 8.2, etc. It is clear, then, that one of the main problems in circuit design is to obtain a *load impedance* that will produce as high a gain as possible.



Illustrating the effect of grid-plate capacity.

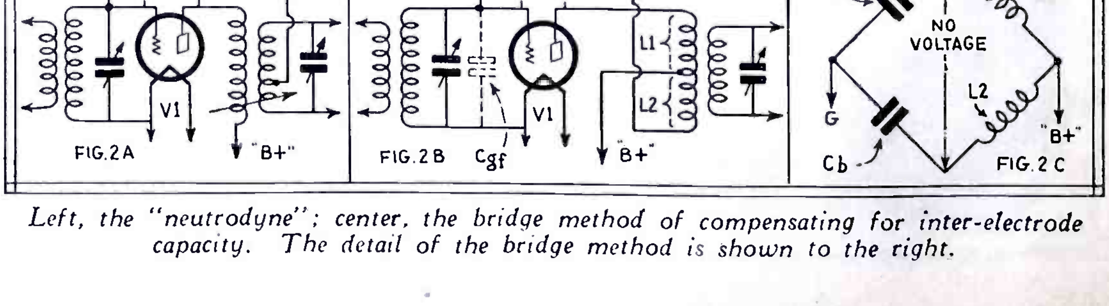


Left, the apparent; right, the correct method of computing the input capacity of a tube.

To the layman, the solution to this seemingly easy problem is self-evident—raise the load impedance, by winding large coils, to a very high value so the amplification is as close to 9 as desired. This logical reasoning would be excellent were it not for the fact that, as with all good things, it cannot be carried too far. When the load impedance is raised beyond a certain point, part of the energy in the plate circuit slips back to the grid circuit, causing the tube to *oscillate*.

How does it slip back? It may slip back because one or more wires in the plate circuit are lying too close to wires in the grid circuit; because the plate coil is too close to the grid coil; *or because the energy is going through the tube itself*. Now we have been taught that the tube is a one-way device; that is, energy can only go from the grid to the plate circuit, but not from the plate to the grid circuit. The answer is that it is not "amplified" back, but gets back in *spite* of the tube, rather than *because* of it! In other words, the input grid acts as one plate and the plate as the other plate of a *two-plate condenser;* the energy, therefore, is fed back from the plate circuit to the grid circuit, through, or by virtue of, this capacity, which exists between the plate and grid.

Now, if the energy is fed from the plate to the grid through the tube capacity, can the signal go directly from the grid to the plate without being amplified at all? The answer to this simple ques-



Left, the "neutrodyne"; center, the bridge method of compensating for inter-electrode capacity. The detail of the bridge method is shown to the right.

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tion is *yet*, the signal *can* go from the grid to the plate without being amplified. Consider the simple circuit in Fig. 1. Transformers T1 and T2 are two tuned circuits; one in the grid and the other in the plate circuit of tube V1. The signal, impressed across the grid and filament of the tube, appears across the plate load as shown. Part of the signal also passes through Cgp (grid-plate capacity of the tube) unamplified. Now, *if* the plate load is high enough, the energy in the plate circuit, being greater than that in the grid circuit, passes from the plate to the grid through this same capacity. Since two different currents cannot pass through the same condensers at the same time in opposite directions, and since the energy in the plate circuit is greater than that in the grid circuit, the net result is the passage of energy from the plate to the grid—and oscillation results. If the tube is *not* oscillating, a loss of output signal results because of the by-passing effect of Cgp.

When this oscillation is controllable, it can be made into a very desirable thing, as it increases the strength of the applied signal; but when it is *not* controllable, it becomes the worst enemy of radio receiver designers.

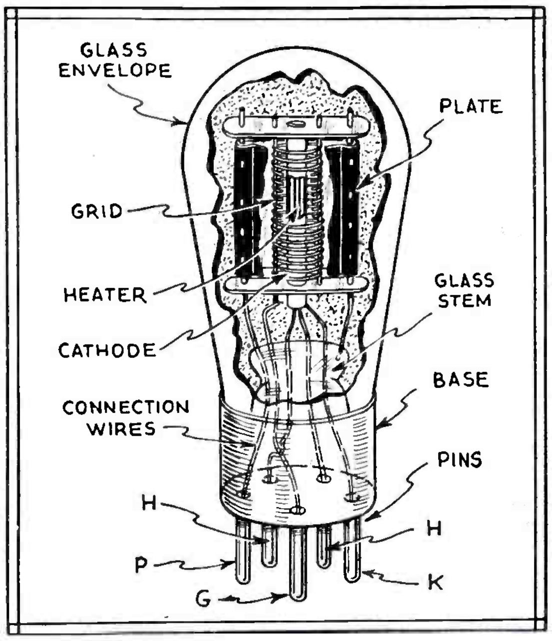
It is generally conceded that when oscillation is necessary in order to either increase the strength of a signal or for the reception of code, it should be deliberately inserted by the designer, and when not deliberately inserted, the tube (with, of course, its circuit) should show no signs of oscillation. Thus, it is clear that if stable results are to be secured, the circuit should not generate oscillations due to tube capacities, unless otherwise desired.

Neutralizing Tube Capacity

Figures 2A and 2B show two generally accepted methods of neutralizing or balancing the Cgp of a tube. At A is shown the familiar "neutrodyne" method, where part of the signal is fed from the grid through a small variable condenser Cn, to the secondary of the R.F. transformer T2; the signal is also amplified by the tube V1 and appears across the primary of T2. Because the primary and the secondary must be coupled, the energy fed through Cn is sufficient to just neutralize that due to the tube capacity Cgp, and the tube ceases to oscillate.

In the second method shown, the plate of condenser Cb is connected to the bottom end of the primary coil. A bridge arrangement, shown in Fig. 2C, is secured, and when the bridge is balanced by adjusting the size of balancing condenser Cb, the effects of the tube capacity are done away with.

The trouble with the methods shown above are numerous. First, the condition of balance does not hold over a wide frequency band; second, the condition of

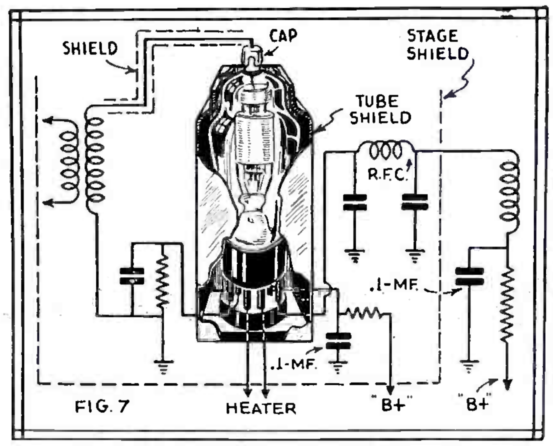


Cut-away drawing of a Triad "56," showing the placement of the elements.

balance is different for different tubes; third, and by far the most important, the methods outlined are synthetic in that they do not eliminate the *source* of trouble—the *actual grid-plate capacity.*

New Tubes Have Low Capacity

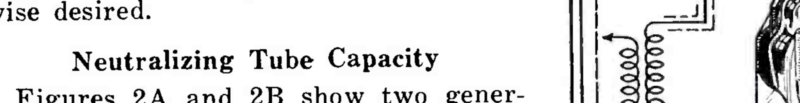
The advent of the four-element tube reduced Cgp to such an extent as to almost eliminate the necessity for any



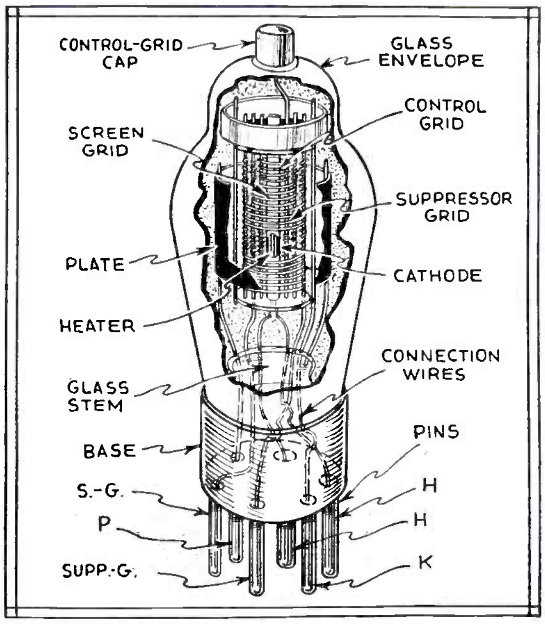
Circuit illustrating the use of shields. Note the peculiar shaped tube-shield.

balancing method, but when the frequency is high (as it is in short-wave work), and the amplification high, the need for a further reduction is again evident. *This need has been met in some of the new tubes about to be described.*

There is one more troublesome capacity which is an inherent part of every tube and which must be minimized as much as possible—the *grid-filament capacity.* As may be seen by reference to Fig. 2B, the grid-filament capacity is directly in parallel with the tuning condenser. When large size tuning capacities are used, its effects are not noticeable, but when the size of the tuning condenser is small (such as used in the 20-meter band) *the grid-filament capacity is the limiting factor in*



Left, socket connections of the "56." Right, the socket connections of the "57" and "58."



Pictorial representation of a Triad "57," illustrating the location of the three grids, cathode and plate. The heater is located "within" the cathode.

the determination of the lowest wavelength to be received.

Strange as it may seem, the actual capacity between the grid and filament of the tube does not determine the input capacity of the tube. Fig. 3 shows how all of the capacities are arranged with respect to the grid and the filament. It is seen that the grid-plate capacity in series with the plate-filament capacity are in parallel with the grid-filament capacity; it would seem, therefore, that the *total* grid-filament capacity is the combination of all three or, for the benefit of our technical readers:

$$C\text{ (input)} = Cgf + \frac{Cgp \times Cpf}{Cgp + Cpf}$$

A deeper analysis of the action of a tube shows that when the load impedance is taken into consideration (as it always should be), the arrangement of the elements in the tube and the load are as indicated in Fig. 4. In this case the plate-filament capacity is neglected, because of its extremely small size in comparison with the other capacities. The signal must not only be strong enough to charge Cgf but also Cgp; and since the potential of the plate is always mu (amplification factor) times the grid voltage, the *actual* grid-filament (input) capacity of a tube is:

$$C\text{ (input)} = Cgf + (mu + 1)\ Cgp.$$

Interpreted into plain English, the above formula means that the actual grid-filament capacity varies as the amplification factor of the tube varies, which, in turn, varies as the load varies, as illustrated above.

Tube Factors that Affect Tuning

This formula explains why the tuning of a receiver changes when any of the applied voltages (plate, grid and filament) are varied. The variation of any of the voltages changes the mu of the tube which, in turn, changes the input capacity, and since this input capacity is in shunt to the tuning condenser, the setting of the dial for a particular station varies. In fact, *anything that alters the mu of a tube alters the dial setting.*

When the tuning condenser is large, the changes are not noticeable; but, as

(Continued on page 185)

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S-W Super-Hets
Designing and BUILDING HINTS

By EDGAR MESSING

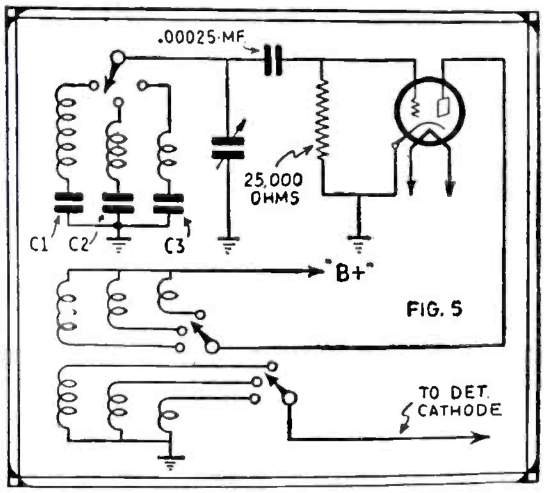

Fig. 5—Showing oscillator circuit for short wave superhet, with switches for changing to different wave bands.

NOW that the short-wave converter in combination with the regular broadcast set has proven its vast superiority over the regenerative tuners of the last decade, the next logical step is to turn the B.C. receiver back to the family circle and build a genuine short wave "super" designed from the bottom up for the reception of high frequencies. The super-het, while not at all a difficult construction, differs notably from the sets we have made hitherto and presents a lot of new problems.

This article is intended to help the chap who builds his own, to overcome, dodge or slip around these problems by giving him practical advice based upon practical experience.

Let us, for the sake of systematic procedure, attack the whole set from four general angles: the power supply, the audio amplifier, the I.F. amplifier, and the R.F. section; which is the order to follow in building the receiver.

The Power Supply

Discussing the easiest division first, we will consider the power supply (assuming its input is A.C.).

The exact nature of the power pack will depend on how many tubes are used in the set. If push pull 47's compose the output stage, and the total number of tubes exclusive of the rectifier is 8, 9 or 10, a loud-speaker field having a resistance of about 1400 ohms and capable of carrying 6 to 8 watts can be used with two condensers to form the filter section, as shown in Fig. 1. C1 should be about 4 to 8 mf. and C2 about 12 mf., and both can most economically be of the electrolytic type. These units will supply sufficient filtering.

A set with single pentode output comprising 5, 6 or 7 tubes may use a speaker field of 1600 ohms (5 to 7 watts) as a choke; C1 and C2 may be 4 and 8 mf., respectively, though 4 and 12 mf. would be safer.

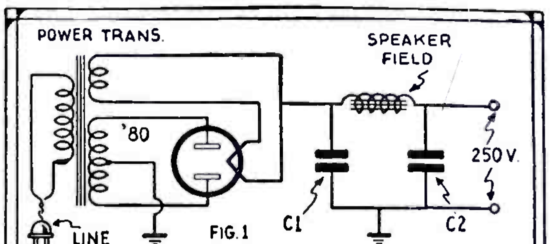

Fig. 1—High voltage plate-supply filter system, utilizing the loud-speaker field winding as the choke coil in the filter.

Little more need be said about the power supply. An appropriate transformer and a '80 rectifier tube are employed as usual. With the single pentode it may be advisable to put the field in the minus side from the transformer to bias the '47. See Fig. 2.

The second detector should preferably be a '27, self-biased as shown in Fig. 3. Resistance coupling to the output stage is cheaper than transformer coupling, but the latter should be used with push-pull output. With a transformer there is a very strong tendency toward hum-coupling between the power transformer and the audio transformer, and it is usually necessary to move the audio transformer around until some particular location on the chassis is found that gives minimum hum.

Practical information on short wave "superhets" is rather scarce and the editors are glad to present this specially written article by Mr. Messing, formerly connected with the engineering staff of Pilot Radio & Tube Corporation. Mr. Messing gives many valuable hints on superhets for short wave reception as the result of his extensive study and laboratory experience.

Effect of Changing the I.F. Frequency

The I.F. amplifier of the short-wave super is a bit more difficult to handle than ordinary 175 kc. stages. In the first place, we must decide what I.F. to use. If we wanted to go to extremes and turn out a really "super" set, we might do what the General Electric Company did in some special sets it made for the U. S. Navy—*change the I.F. with the band to be covered.* For example, when covering a range from 15-30 meters, an I.F. of 1500 might be used; covering 30-60 meters, an I.F. of 900 kc. might be employed, and so on.

The reason for this change of I.F. is to secure added selectivity, of course. As we know, the selectivity of the super depends not upon how much of the adjacent channel signal is rejected, but upon how much of the *image signal* (that is, the signal differing from the oscillator frequency by the I.F. but *lower* in frequency) is rejected compared to the desired signal. Now it is obvious that if the I.F. is 1500, then the undesired signal will be further from the tuning peak of the receiving circuit than if a lower I.F. were used. But as the tuning peak gets sharper when the receiving frequencies are lower (the peak is sharper at 30 meters than at 15), a lower I.F. can be used at the lower frequencies. It is desirable from the standpoint of stability to use a lower frequency and therefore the I.F. can be advantageously changed with the different ranges.

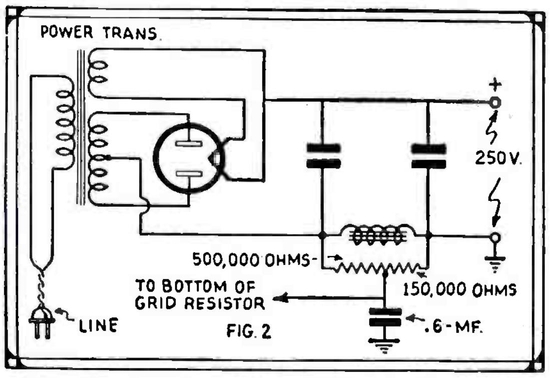

Fig. 2—Loud-speaker field winding connected as choke in the negative side of the plate-supply filter circuit, also showing method used to obtain bias for '47 tube.

For our purposes, however, this change is neither necessary nor convenient, so we may pick a good compromise frequency and fix the I.F. at that. Experience has shown that 465 kc. is a fairly safe value.

This amplifier is not to be treated lightly, however, for attempts to secure high gain at this frequency lead to an unstable set. Two stages will, of course, increase this tendency, but will make for

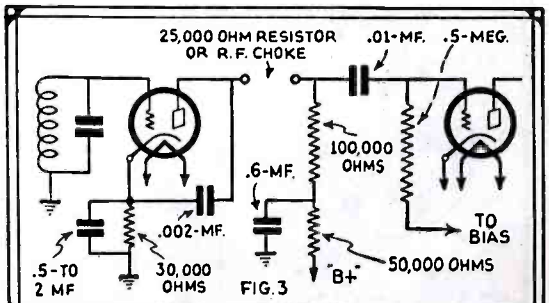

Fig. 3—Superhet "second detector" circuit suggested by the author.

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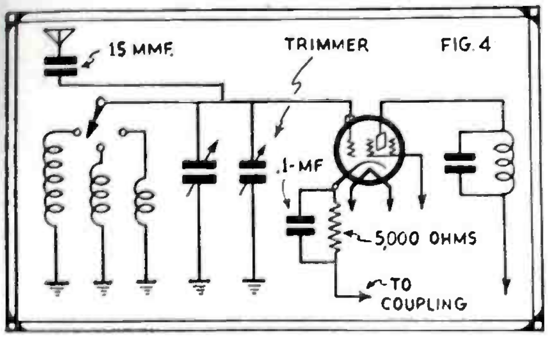


Fig. 4—One arrangement of "first detector" circuit in short wave superhet, with switch for changing wave bands.

a more sensitive set. Single I.F. stage sets can be made to be quite satisfactory.

Type '35 tubes should be used. Their plate voltage should be 180 to 250, their screen voltage from 60 to 90. The grid bias should be a minimum of three volts. The grid and plate coupling transformers may be of the usual can-enclosed type with compactly wound coils. These coils should be spaced not less than 1½ inches apart, while the tuning condensers across them should be not smaller than 70-140 mmf., maximum. While these specifications are not absolutely rigid, experience has shown that marked deviation from them will make the amplifier unstable.

The whole amplifier should be well shielded and properly and generously bypassed. Thorough shielding is necessary for two reasons: to prevent oscillation and to eliminate the possibilities of direct pick-up of stations on or about 465 kc.

If two tubes are used, volume control can be effected by varying their biases. A single I.F. stage set can be controlled by varying the I.F. basis and shunting the antenna simultaneously.

The R.F. Amplifier

Let us now drag out the R.F. section for examination. The first problem is: shall we use an R.F. stage? The only advantage of an untuned stage lies in the isolation of the detector from the antenna; any added gain will be negligible at most frequencies. A tuned stage, additionally, will help greatly in reducing image interference but will complicate the switching problem. If the builder is quite familiar with short-wave sets, the tuned stage is advisable and should follow the standard T.R.F. stage of short-wave sets. In this discussion the center of interest is the oscillator-first detector section. So far as broadcast reception is concerned, a tuned stage or pre-tuning is necessary.

If it is desired to divide the 15 to 200 meter range into four bands, the tuning condensers for oscillator and detector should have a 10-160 mmf. range; for three bands the standard 350 mmf. condenser can be used. If the broadcast band is also to be covered it is advisable to use the 350 mmf. condenser and have three short-wave bands.

Figure 4 shows a first detector circuit with switching arranged for three short-wave bands. A 15 mmf. condenser is about the right size for coupling the antenna to the tuning circuits and eliminates the necessity of using separate primaries and additional switch sections.

The Oscillator

The oscillator can most simply and effectively be of the usual tuned-grid type, as shown in Fig. 5. The grid leak and resistor combination should not be varied much from the values given because an oscillator may be easily modulated at the frequencies at which it will be working.

For best results, especially on the shorter waves, a trimmer condenser of the usual form is necessary. It can, however, be made non-critical by restricting the range of the oscillator, as is done in all broadcast super-hets. Condensers C1, C2, C3 accomplish this. Their values are determined most easily by a cut-and-try method until the proper oscillator range is secured. A trimmer of about 35-40 mmf. is sufficient.

The method of oscillator detector coupling is one that has caused much argument, but the author is inclined very strongly to believe that the least troublesome in the long run is the cathode coil method used in good broadcast supers.

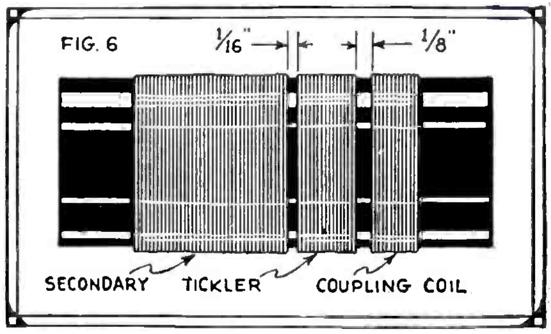


Fig. 6—Desirable arrangement of coils on tube form for superhet.

So much for the general design of the R.F. section. In short-wave sets the general design is not half so important as the way it is worked out. The following should keep the constructor on the straight and narrow path:

Hints on S-W Super-Hets

Keep all coils in the clear and as close to the switch as possible.

Keep coils at right angles to each other or well separated.

Use coil forms of 1 to 1¼ inches diameter. Space secondary turns wire thickness on bands below 80 meters.

Use No. 22-26 wire for secondaries.

Use No. 28-32 wire for ticklers. Wind ticklers 1/16 inch away from secondaries.

Use No. 28-32 wire for coupling coils. In general, coupling coils should have two-thirds the number of tickler turns and should be spaced ⅛ inch away.

Figure 6 shows the type of coil arrangement to use. It is not advisable t) place any coils over the secondary. The scheme shown provides for a minimum of trouble.

Use a good wiping contact, non-tarnishing switch, of which there are several types available.

Make all wiring as direct and short as possible.

Use only non-inductive condensers.

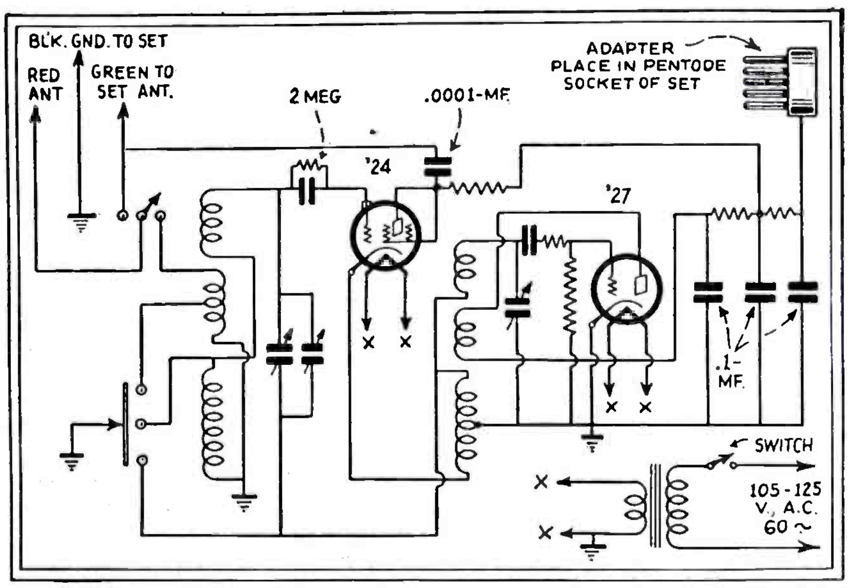
There is little more that non-participating advice can give; unforeseen troubles will always crop up. They can be eliminated by patience and common-sense.

A Short Wave Adapter Table

THE very attractive piece of furniture in the photo at the left is a cleverly designed short wave converter, which can be used in conjunction with any modern midget type broadcast receiver, and thus permit the reception of short waves. By combining a midget broadcast receiver with the Audiola short wave table illustrated you will increase your wavelength reception range from 20 to 550 meters. As the diagram shows, a detector and oscillator are used, which in conjunction with the broadcast receiver forms a superheterodyne. A switch is provided for changing the antenna from the converter to the broadcast receiver. Coil data for similar converters have been given previously.

Left—The Audiola short wave converter which converts any midget broadcast receiver for short wave reception.

Right—Wiring diagram of the Audiola converter.



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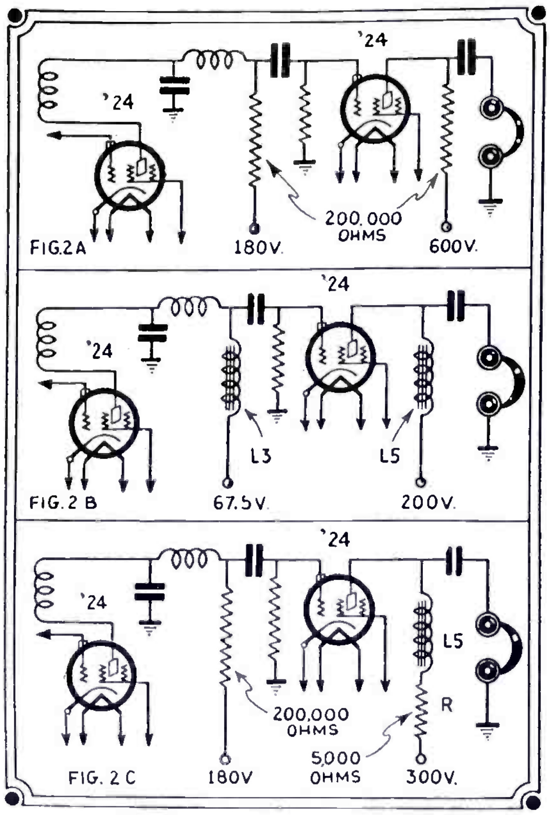
An Amateur Receiver With New Kinks

By REX E. LOVEJOY

As pointed out by Mr. Lovejoy, the ideal amateur receiver should be selective, sensitive, easy to tune and have good volume, with a low noise-level. The author points out in the accompanying article a number of valuable kinks and ways in which to improve an amateur-band short wave receiver, so as to realize as nearly as possible the attainment of the features above enumerated.

THE ideal amateur receiver should have at least five qualities: namely, (1) Selectivity, (2) Low noise level, (3) Sensitivity, (4) Volume, (5) Ease of operation.

As is the usual case, practice cannot attain the near perfection of theory, and the former must take the most efficient of several choices, none of which measures up to the ideal.



Figures 2A, B, and C, above, show several ways in which to connect a low impedance so as to match the output tube, including resistance and impedance coupling.

In order to keep the noise level conveniently low, a great number of tubes should not be used, for tubes have a characteristic of creating noise within themselves. Further, if a number of tubes are employed, there is more probability of the interlocking of the fields of different stages, thereby setting up hums, whistles, et cetera, and raising the noise level in general, as well as lowering the efficiency. The general effect of such interlocking of fields can be eliminated only by very careful shielding and laying-out of the whole receiver.

If the number of tubes is to be restricted, those tubes used must be necessarily of comparatively high amplification factor, to bring the volume to the desired level.

Ease of operation limits the number of *tuned circuits*. The smoothness of operation, as well as the sensitivity, are determined by the circuit and the tubes involved.

The receiver illustrated in the schematic diagram of Fig. 1 has all of the desirable characteristics to a very satisfactory degree. The screen-grid detector employed is highly sensitive and control of regeneration through the screen-grid is quite conventional and known for its smoothness.

The object of merit is the use of a '24 tube as an audio amplifier. The '24 has an amplification factor, or "mu," of 400 and picks up readily the very weakest of signals from the detector. The type '27 tube, commonly used, has a mu of 8, and the '47 pentode, a mu of 52. By comparison it is realized why a '24 is very much superior to either of the other types.

To realize maximum gain from any circuit, the load impedance must match the plate-to-filament impedance of the tube. With the screen-grid tube, this impedance of the plate is of comparatively high order. Obtaining a load impedance to match may be accomplished in one of several ways, as illustrated in Fig. 2.

Resistance coupling is used in Fig. 2A. This system works nicely but has the disadvantage of requiring about 600 volts to the resistor in the last stage. This is evident, for the resistors are in the neighborhood of 200,000 ohms.

Fig. 2B gives an impedance-coupled system which is very satisfactory. By experiment, it was found that if the primary and the secondary of an ordinary audio transformer were connected in series and the whole unit used as shown, the impedances obtained were very nearly correct. L3 and L5 are both audio transformers of ordinary design.

In Fig. 2C is shown another variation where a combination of inductance and resistance is used. This circuit has the same disadvantage of Fig. 2A, but to a smaller extent. The voltage required is about 300 volts. In this circuit, L5 is an output choke designed for use with a '45 power amplifier. R is approximately 5,000 ohms.

Since most receiver power-packs have an output of about 200 volts, the circuit in Fig. 2B was adopted.

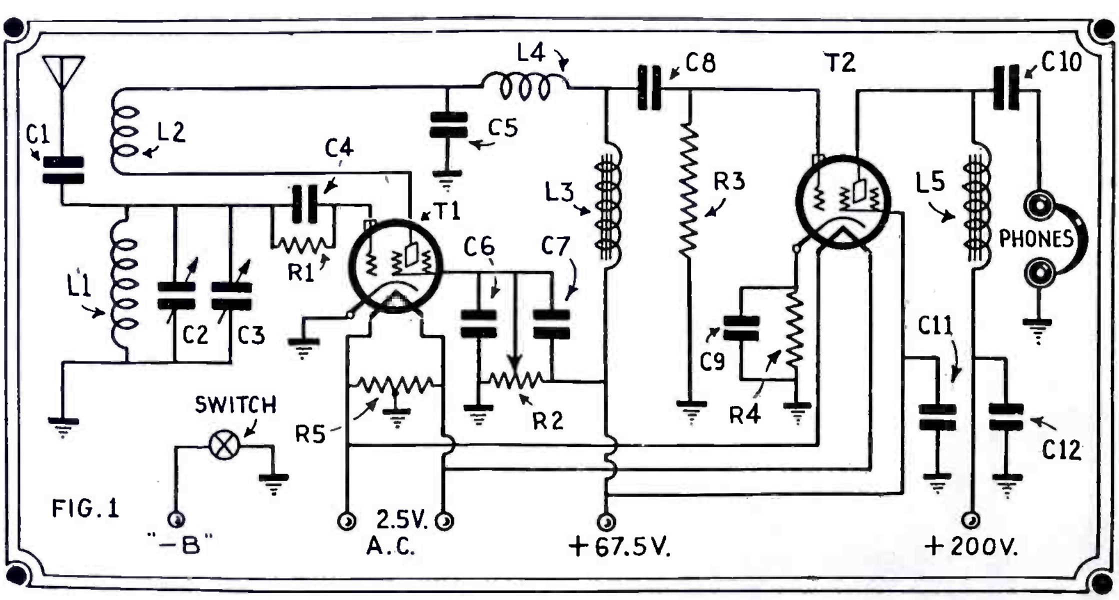
In the completed receiver, Fig. 1, C1 is a midget condenser cut down to two plates, double-spaced. C2 is a similar condenser, cut down to three plates, single-spaced, and is used for tuning. C3 is a 23-plate, 0.00015 mf. midget used for "lump" capacity for centering the amateur bands. It is mounted on the base of the subpanel. Once adjusted, it is left undisturbed.

A variable-mu, or '35, tube is used as detector T1, because of its very nice performance as a regenerative detector, although a '24 may be used almost as well. R1, Fig. 1, may need to be changed for different tubes.

C5 should not be any larger than 0.00025 mf. for maximum volume and the potentiometer R2 must be by-passed by C7, a 1 mf. condenser, to remove noise. The grid-leaks for the '24 audio tube and the detector, R3 and R1, are not critical and several values should be tried and the ones giving most volume and smoothest regeneration should be used. It is absolutely necessary to by-pass R4 with a 1 mf. condenser, designated as C9.

Any coil and condenser combination can be used for the detector circuit. If home-made coils are used, after the band has been located, the tickler L2 should be cut down or increased until oscillation just starts when the screen-grid of the detector is at a potential of about 21 volts. This adjustment is quite important, for volume is 50 per cent greater at a potential of 21 volts than at any other. Tube-base coils were used in the original receiver and the approximate

(*Continued on page* 183)



Complete wiring diagram of short wave receiver especially designed for operation on the amateur bands of 20, 40, and 80 meters and providing smooth and efficient reception of code and phone signals on these bands.

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Super-Regenerator Rolls 'Em in

By BEN. F. LOCKE

After all is said and done, the super-regenerative receiver is one of those illusive and not so well-known circuits; but with it Mr. Locke has established some very fine reception records, bringing in European and other "DX" stations.

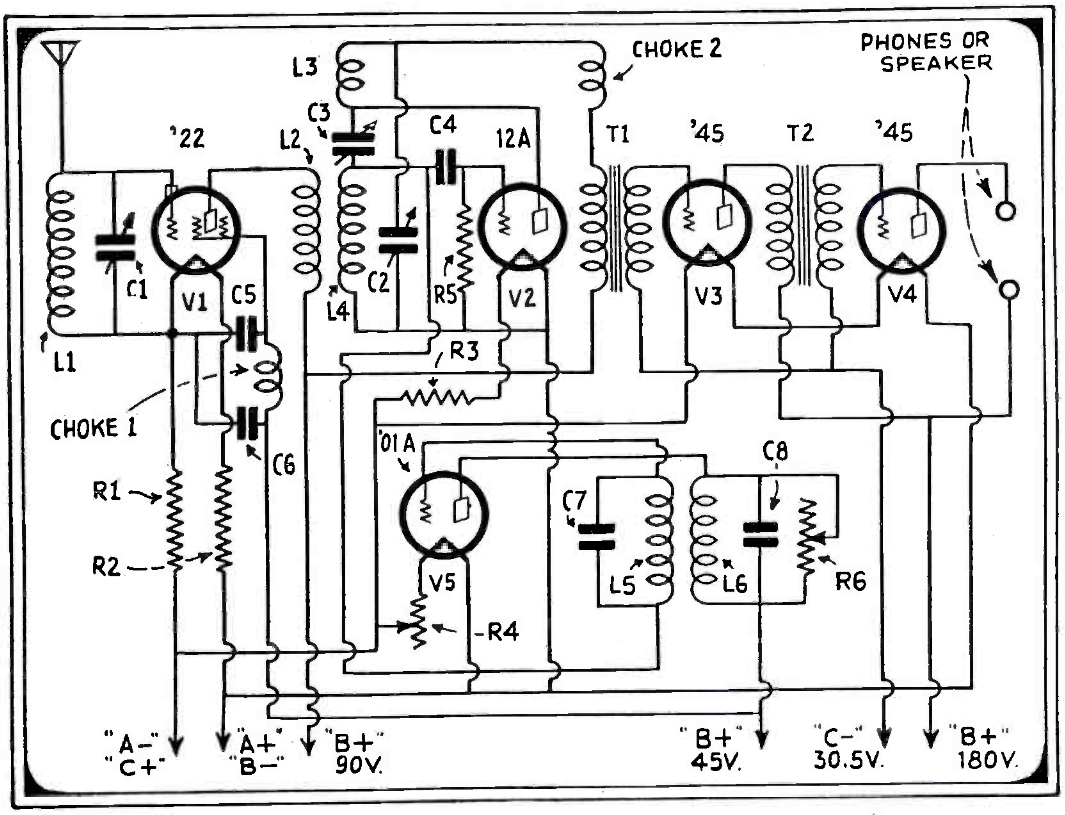
I WONDER how many of the readers of SHORT WAVE CRAFT ever give the Super-Regenerative Short Wave Circuit a thought? Well suppose that we try one and see how it comes out in the "DX" line. I give herewith a diagram for a receiver that I have designed and built myself and I say that it is there for the "DX" stuff. I bring in all the following stations on the loud speaker; G5SW, CJRX, W2XAF, W2XAD, W8XK, KWT, W6XN, W9XF, 7LO, YN, PCJ, PCL, JHBB, W3XAL, W6XAX, RFM and many amateur stations and trans-Atlantic stations. On the headphones I have brought in 3LO, EH9OC and EH9XD as my most distant "DX" stations.

The action of this receiver is very simple and it is easier than the ordinary short wave receiver to tune—that is, to me. There is no "body capacity" or "side-swiping" on the station that you are listening to.

To tune this receiver proceed as follows: Turn on the switch and leave the "super" rheostat turned off; then you tune in just like you would the ordinary receiver, till you hear the "whistle" of a station. Make the necessary adjustments till the whistle is at its loudest and then turn on the "super" rheostat and the "whistle" will entirely disappear; your station will now come in with plenty of volume. Once you get the H.C. Coils "set," they are to be left in that position.

I hope that you will publish the diagram of this wonderful receiver and I would like to hear about the results others obtain with this set.

The plug-in coils are wound as follows: Use 1¾" diameter tubing.



Hook-up of Mr. Locke's super-regenerative short wave receiver.

List of Parts for Mr. Locke's Super-Regenerative Receiver

2 Variable cons. .00014mf., C1, C2.
1 Variable con. .00025mf., C3.
1 Fixed con. .00025mf., C4.
2 Fixed cons. .006mf., C5, C6.
2 Fixed cons. .002mf., C7, C8.
2 15-ohm fixed resistors, R1, R2.
1 Amperite ¼ ampere, R3.
1 3 meg. grid leak with base clips, R5.
1 25-ohm variable rheostat, R4.
1 0-50,000-ohm variable resistor, R6.
2 A.F. transformers, 3½-1 ratio, T1, T2.
1 H.C. Coil, 1250 turns, L5.
1 H.C. Coil, 1500 turns, L6.
1 H.C. Coil mounting for two coils. Not shown.
2 R.F. Chokes, S.M. No. 277. Choke 1 : Choke 2.
5 UX tube sockets, V1, V2, V3, V4, V5.
3 Vernier dials. National Type B (0-100-0). Not shown.
1 Panel, 7x20x¼.
1 Baseboard, 7x18x¼.
3 Panel brackets.
1 Set of hardware, etc.
1 Phone or speaker plug.
1 Single Circuit jack.
1 Filament switch.

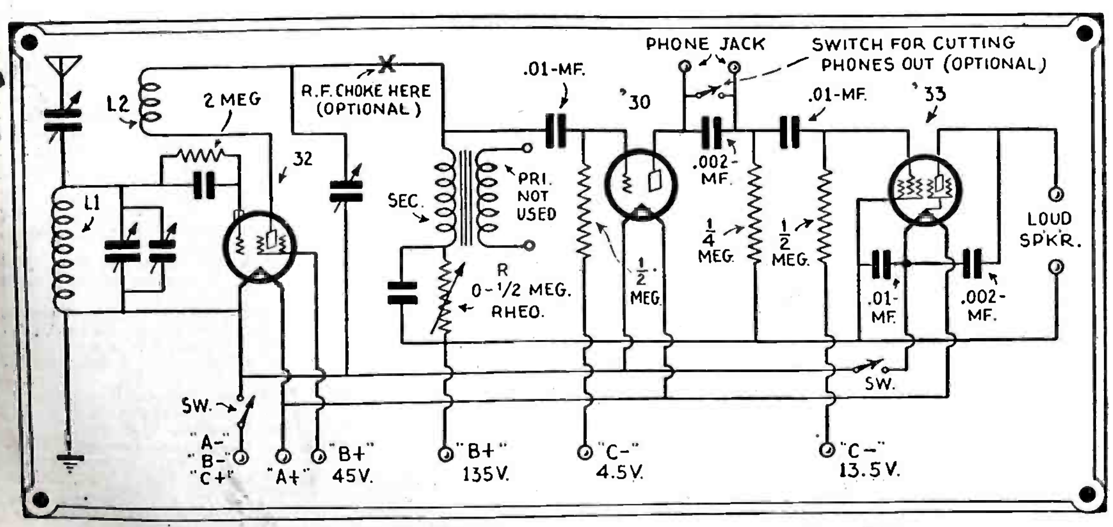
Tubes used are as follows:
1 UX 222 Cunningham as R.F.
1 UX 112-A Cunningham as Det.
2 245 Cunningham as A.F.A.
1 UX 201-A Cunningham as super regenerative circuit (or any other tube that you see fit).

Wave Length Range	L1	L2	L3	L4
15 to 40m	3 turns #18 wire	9 turns #18 wire	4 turns #28 wire	Same as L1
30 to 90m	8 turns #18 wire	9 turns #18 wire	10 turns #28 wire	Same as L1
80 to 250m	24 turns #22 wire	9 turns #18 wire	15 turns #28 wire	Same as L1
240 to 550m	80 turns #28 wire	9 turns #18 wire	15 turns #28 wire	Same as L1

A Nifty 3-Tube Receiver

I RECENTLY tried a short wave set which has the type '32 detector and a stage of audio utilizing the '33 pentode output tube. This was a nice little set, but it is somewhat difficult to tune in DX with the loud speaker alone, so I tried putting a pair of good headphones across the matching transformer. Boy, I dare anyone to try this with my little two-tuber, and leave the phones on with W3XAL, W8XAL, W1XAZ, W2XAF or any of the good broadcasters. This goes also for day or night reception of trans-atlantic telephone, police stations, or airport stations. It's just too darn loud for headphones.

Incidentally, the first signals received were of a two-way conversation on 9,490 kc. between PPU, a South American station (not listed in my call book) and W2XBJ, which is in New York. They were testing communication, and holding a conversation regarding the reception conditions, on different frequencies. I don't know who owns these stations, but they come in with plenty of volume on the loud speaker, and don't think I missed a word of the conversation from either end. This is rather unusual for this location. I heard the remark by the American end, that they would be on that same frequency again on Tuesday, March 29th, after 4 p.m., so if anybody



Interesting circuit actually tested and proven by Mr. Elder.

(Continued on page 187)

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Short Wave Stations of the World

Short Wave Broadcasting Stations

All Schedules Eastern Standard Time: Add 5 Hours for Greenwich Mean Time. No consideration has been given in this list to daylight saving time, as no standardization in this respect has been reached in either the United States or Europe.

Wavelength (Meters)	Frequency (Kilocycles)	Call Letters	Address and Schedule
19.56	15,330	W2XAD	General Electric Co., Schenectady, N. Y. Broadcasts 3-6 p.m. daily; 1-6 p.m. Sat. and Sunday.
19.68	15,240		Pontoise (Paris), France. 9:30-12:30 a.m. Service de la Radiodiffusion, 103 Rue de Grenelle, Paris.
19.72	15,210	W8XK	Westinghouse Electric & Mfg. Co., Saxonburg, Pa. Tues., Thurs., Sat., Sun., 8 a.m. to noon.
		DJB	For address, see listing for DJA. Mondays, 10-11 p.m.
19.83	15,120	HVJ	Vatican City (Rome, Italy) Daily, 5:00 to 5:15 a.m.
		JIAA	Tokio, Japan. Irregular.
19.99	15,000	CM6XJ	Central Tuinucu, Cuba. Irregular.
20.50	14,620	XDA	Trens-News Agency, Mexico City, 2:30-3 p.m.
20.95	14,310	G2NM	Gerald Marcuse, Sonning-on-Thames, England. Sundays, 1:30 p.m.
21.50	13,940	......	University of Bucharest, Bucharest, Roumania, 2-5 p.m., Wed., Sat.
23.35	12,850	W2XO	General Electric Co., Schenectady, N. Y. Antipodal program 9 p.m. Mon. to 3 a.m. Tues. Noon to 5 p.m. on Tues. Thurs. and Sat.
		W2XCU	Ampere, N. J.
		W9XL	Anoka, Minn., and other experimental relay broadcasters.
23.38	12,820	......	Director General, Telegraph and Telephone Stations, Rabat, Morocco. Sun., 7:30-9 a.m. Daily 5-7 a.m. Telephony.
25.16	11,920	FYA	Pontoise, France. 1-3 p.m. daily.
25.24	11,880	W8XK	Westinghouse Electric & Mfg. Co., Saxonburg, Pa. Tues., Thurs., Sat., Sun., 11 a.m.-4 p.m.
		W9XF	National Broadcasting Co., Downers Grove (Chicago), Ill. 9-10 p.m. daily.
25.26	11,870	VUC	Calcutta, India. 9:45-10:45 p.m.; 8-9 a.m.
25.34	11,840	W2XE	Columbia Broadcasting System, 485 Madison Ave., N. Y., Jamaica, New York. 7:30 a.m. through to 2 a.m. Sundays 8 a.m. to midnight.
		W9XAA	Chicago Federation of Labor, Chicago, Ill. 7-8 a.m., 1-2, 4-5:30, 6-7:30 p.m.
25.42	11,800	VE9GW	W. A. Shane, Chief Engineer, Bowmanville, Canada. Daily, 1 p.m.-10 p.m.
25.47	11,780	VE9DR	Drummondville, Quebec, Canada. Irregular.
25.50	11,760	XDA	Trens-News Agency, Mexico City. 3-4 p.m.
25.53	11,750	G5SW	British Broadcasting Corporation, Chelmsford, England. Mon. to Sat., 1:45-7 p.m.
		VE9JR	Winnipeg, Canada. Weekdays, 5:30-7:30 p.m.
29.30	10,250	TI4	Amondo Cespedes Marin, Heredia, Costa Rica. Mon. and Wed., 7:30 to 8:30 p.m.; Thurs. and Sat., 9:00 to 10 p.m.
30.3	9,890	EAQ	Transradio Espanola, Alcala, 43-Madrid, P.O. Box 951, Spain. Daily for America, 0030-0200 G.M.T.; for Europe and Canaries, on Saturdays only, 1800-2000 G.M.T.
31.10	9,640	HSP2	Broadcasting Service, Post and Telegraph Department, Bangkok, Siam. 9-11 a.m. daily.
31.28	9,590	VK2ME	Amalgamated Wireless, Ltd., 47 York St., Sydney, Australia. Sun., 1-3 a.m. 5-9 a.m., 9:30-11:30 a.m.
		VK3ME	Amalgamated Wireless, Ltd., 47 York St., Melbourne, Australia. Wed. and Sat., 5-6:30 a.m.
31.30	9,580	W3XAU	Byberry, Pa., relays WCAU daily.
31.33	9,570	W1XAZ	Westinghouse Electric & Mfg. Co., Springfield, Mass. 6 a.m.-10 p.m. daily.
		SRI	Poznan, Poland. Tues. 1:45-4:45 p.m., Thurs. 1:30-8 p.m.
31.38	9,560	DJA	Reichspostzentralamt, 11-15 Schoenberge Strasse (Berlin). Koenigswusterhausen, Germany. Daily, 8 a.m.-7:30 p.m.
31.48	9,530	W2XAF	General Electric Co., Schenectady, N. Y., 5-11 p.m.
31.49	9,520	OXY	Skamlebaek, Denmark. 2-7 p.m. daily.
31.70	9,460	......	Radio Club of Buenos Aires, Argentina.
32.00	9,375	EH90C	Berne, Switzerland. 3-5:30 p.m.
32.26	9,290	......	Rabat, Morocco. 3-5 p.m. Sunday, and irregularly weekdays.
35.00	8,570	RV15	Far East Radio Station, Khabarovsk, Siberia. 5-7:30 a.m.
38.6	7,790	HBP	League of Nations, Geneva, Switzerland. 3-8 p.m., irregular.
39.80	7,530	......	"El Prado," Riobamba, Ecuador. Thurs., 9-11 p.m.
40.00	7,500	......	"Radio-Touraine," France.
40.20	7,460	YR	Lyons, France. Daily except Sun., 10:30 to 1:30 a.m.
40.50	7,410	......	Eberswalde, Germany. Mon., Thurs., 1-2 p.m.
40.70	7,370	X26A	Nuevo Laredo, Mexico. 9-10 a.m.; 11 a.m.-noon; 1-2; 4-5; 7-8 p.m. Tests after midnight. I.S.W.C. programs 11 p.m. Wed. A.P. 31.
40.90	7,320	ZTJ	Johannesburg, So. Africa. 9:30 a.m.-2:30 p.m.
41.46	7,230	DOA	Doeberitz, Germany.
41.50	7,220	HB9D	Zurich, Switzerland. 1st and 3rd Sundays at 7 a.m., 2 p.m.
		......	Budapest, Hungary 2:30-3:10 a.m., Tu., Thurs., Sat. Budapest Technical School, M.R.C., Budapest. Muegyetem.
41.67	7,195	VS1AB	Singapore, S. S. Mon., Wed. and Fri., 9:30-11 a.m.
42.00	7,140	HKX	Bogota, Colombia.
42.70	7,020	EAR125	Madrid, Spain. 6-7 p.m.
42.90	6,990	CT1AA	Lisbon, Portugal. Fridays, 5-7 p.m.
43.00	6,980	EAR110	Madrid, Spain. Tues. and Sat., 5:30 to 7 p.m.; Fri., 7 to 8 p.m.
43.60	6,875	F8MC	Casablanca, Morocco. Sun., Tues., Wed., Sat.
46.40	6,480	TGW	Guatamala City, Guat. 8-10 p.m.
46.70	6,425	W9XL	Anoka, Minn.
46.70	6,425	W3XL	National Broadcasting Co. Bound Brook, N. J. Relays WJZ. Irregular.
46.72	6,420	RV62	Minsk, U.S.S.R. Irregular.
47.00	6,380	HC1DR	Quito, Ecuador. 8-11 p.m.
47.35	6,335	VE9AP	Drummondville, Canada.
		CN8MC	Casablanca, Morocco. Mon. 3-4 p.m., Tues. 7-8 a.m., 3-4 p.m. Relays Rabat.
47.81	6,270	HKC	Bogota, Colombia. 8:30-11:30 p.m.
48.00	6,250	HKA	Barranquilla, Colombia. 8-10 p.m. ex. Mo., Wed., Fri.
48.62	6,170	HRB	Tegucigalpa, Honduras. Monday, Wednesday, Friday, Saturday 5-6 p.m. and 9-12 p.m.
48.83	6,140	W8XK	Westinghouse Electric and Mfg. Co., Saxonburg, Pa. Tues., Thurs., Sat., Sun., 5 p.m. to midnight.
48.99	6,120	......	Motala, Sweden, "Rundradio." 6:30-7 a.m., 11-4:30 p.m. Holidays, 5 a.m. to 5 p.m.
48.99	6,120	F31CD	106 Boulevard Charner, Chi-Hoa (Saigon), Indo-China. 6:30-10:30 a.m.
48.99	6,120	W2XE	Columbia Broadcasting System, 485 Madison Avenue, New York, N. Y. 7:00-a.m. to midnight.
		FL	Eiffel Tower, Paris. 5:30-5:45 a.m., 5:15-12:30, 4:15-4:45 p. m.
		......	Toulouse, France. Sunday, 2:30-4 p. m.
49.10	6,110	VE9CG	Calgary, Alta., Canada.
49.15	6,100	W3XAL	National Broadcasting Company, Bound Brook, N.J., Irregular.
		VE9CF	Halifax, N. S., Canada. 6-10 p.m., Tu., Thu., Fri.
49.17	6,095	VE9GW	Bowmanville, Ontario, Canada. Irregular.
49.31	6,080	W9XAA	Chicago Federation of Labor, Chicago, Ill. 6-7 a. m., 7-8 p.m., 9:30-10:15, 11-12 p.m. Int. S.-W. Club programs. From 10 p.m. Saturday to 6 a.m. Sunday.
49.40	6,070	VE9CS	Vancouver, B. C., Canada. Fridays before 1:30 a.m. Sundays, 2 and 10:30 p.m.
		......	Johanesburg, South Africa, 10:30 a.m.-3:30 p.m.
49.46	6,065	SAJ	Motala, Sweden. 6:30-7 a. m., 11 a.m. to 4:30 p.m.
49.50	6,060	W8XAL	Crosley Radio Corp., Cincinnati, O. Relays 6:30-10 a.m., 1-3 p.m., 6 p.m. to 2 a.m. daily. Sunday after 1 p.m.
49.50	6,060	VQ7LO	Imperial and International Communications, Ltd., Nairobi, Kenya, Africa. Monday, Wednesday, Friday, 11 a.m.-2:30 p.m.; Tuesday, Thursday, 11:30 a.m.-2:30 p.m.; Saturday, 11:30 a.m.-3:30 p.m.; Sunday, 11 a.m. - 1:30 p.m.; Tuesday, 3 a.m.-4 a.m.; Thursday, 8 a.m.-9 a.m.
		W3XAU	Byberry, Pa. Relays WCAU.
49.59	6,050	VE9CF	Halifax, N. S., Canada. 11 a.m.-noon, 5-6 p.m. On Wed., 8-9; Sun., 6:30-8:15 p.m.
		HKD	Barranquilla, Columbia.
49.67	6,040	PK3AN	Sourabaya, Java. 6-9 a.m.
		W4XB	Lawrence E. Dutton, care Isle of Dreams Broadcasting Corp., Miami Beach, Fla.
49.75	6,030	VE9CA	Calgary, Alta., Canada.
49.80	6,020	W9XF	National Broadcasting Co., Downers Grove (Chicago), Ill.
49.97	6,000	YV2BC	Caracas, Venezuela. 7:45-11 p.m. daily ex. Mon.
		......	Eiffel Tower, Paris, France. Testing, 6:30 to 6:45 a.m.; 1:15 to 1:30, 5:15 to 5:45 p.m., around this wave.
		VE9CU	Calgary, Canada.
49.97	6,000	......	Administration des P. T. T., Tananarive, Madagascar. Tues., Wed., Thurs., Fri., 9:30 - 11:30 a.m. Sat. and Sun., 1-3 p.m.
50.26	5,970	HVJ	Vatican City (Rome). 2-2:15 p.m., daily. Sun., 5-5:30 a.m.
50.80	5,900	HKO	Medellin, Colombia. 8-11 p.m., except Sunday.
51.40	5,835	HKD	Barranquilla, Colombia. 7:45-10:30 p.m. Mon., Wed. 8-10:30 p.m.; Sunday 7:45-8:30 p.m. Elias J. Pellet.
52.50	5,710	VE9CL	Winnipeg, Canada.
54.02	5,550	W8XJ	Columbus, Ohio.
58.00	5,170	OKIMPT	Prague, Czechoslovakia. 1-3:30 p.m., Tues. and Fri.
		PMY	Bandoeng, Java.
		PMB	Sourabaya, Java.
60.30	4,975	W2XV	Radio Engineering Laboratories, Inc., Long Island City, N. Y. Irregular.
62.56	4,795	W9XAM	Elgin, Ill. (Time signals.)
		W3XZ	Washington, D. C.
		W9XL	Chicago, Ill.
67.65	4,430	DOA	Doeberitz, Germany. 6-7 p.m., 2-3 p.m., Mon., Wed., Fri.
70.00	4,280	OHK2	Vienna, Austria. Sun., first 15 minutes of hour from 1 to 7 p.m.
70.20	4,273	RV15	Far East Radio Station, Khabarovsk, Siberia. Daily, 3-9 a.m.
80.00	3,750	F8KR	Constantine, Tunis, Africa. Mon. and Fri.
		I3RO	Prato Smeraldo, Rome, Italy. Daily, 3-5 p.m.
82.90	3,620	DOA	Doeberitz, Germany.
84.24	3,560	OZ7RL	Copenhagen, Denmark. Tues. and Fri. after 6 p.m.
128.09	2,342	W7XAW	Fisher's Blend, Inc., Fourth Ave. and University St., Seattle, Washington.

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

(Continued on opposite page)

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Short Wave Stations of the World

(Continued from opposite page)

Experimental and Commercial Radio-Telephone Stations

Wavelength (Meters)	Frequency (Kilocycles)	Call Letters	Address and Schedule
5.83	51,400	W2XBC	New Brunswick, N. J.
7.05	42,530	......	Berlin, Germany. Tues. and Thurs., 11:30-1:30 p.m. Telefunken Co.
8.67	34,600	W2XBC	New Brunswick, N. J.
9.68	31,000	W8XI	Pittsburgh, Pa.
10.79	27,800	W6XD	Palo Alto, Calif. M. R. T. Co.
11.55	25,960	G5SW	Chelmsford, England, Experimental.
11.67	25,700	W2XBC	New Brunswick, N. J.
12.48	24,000	W6XQ	San Mateo, Calif. (Several experimental stations are authorized to operate on non-exclusive waves of a series, both above this and down to 4 meters.)
			Vienna, Austria. Mon., Wed., Sat.
13.92	21,540	W8XK	Saxonburg, Pa.
14.00	21,420	W2XDJ	Deal, N. J. And other experimental stations.
14.01	21,400	WLO	American Telephone & Telegraph Co., Lawrence, N. J., transatlantic phone.
14.15	21,130	LSM	Monte Grande, Argentina.
14.27	21,020	LSN	(Hurlingham), Buenos Aires, Argentina.
14.28	21,000	OKI	Podebrady, Czechoslovakia.
14.47	20,710	LSY	Monte Grande, Argentina. Telephony.
14.50	20,680	LSN	Monte Grande, Argentina, after 10:30 p.m. Telephony with Europe.
		LSX	Buenos Aires. Telephony with U. S.
		FSR	Paris-Saigon phone.
14.54	20,620	PMB	Bandoeng, Java. After 4 a.m.
14.62	20,500	W9XF	Chicago, Ill.
14.89	20,140	DWG	Nauen, Germany. Tests 10 a.m.-3 p.m.
15.03	19,950	LSG	Monte Grande, Argentina. From 7 a.m. to 1 p.m. Telephony to Paris and Nauen (Berlin).
		DIH	Nauen, Germany.
15.07	19,906	LSG	Monte Grande, Argentina. 8-10 a.m.
15.10	19,850	WMI	Deal, N. J.
15.12	19,830	FTD	St. Assise, France.
15.45	19,400	FRO, FRE	St. Assise, France.
15.50	19,350	......	Nancy, France. 4 to 5 p.m.
15.55	19,300	FTM	St. Assise, France. 10 a.m. to noon.
15.58	19,240	DFA	Nauen, Germany.
15.60	19,220	WNC	Deal, N. J.
15.94	18,820	PLE	Bandoeng, Java. 8:40-10:40 a.m. Phone service to Holland.
16.10	18,620	GBJ	Bodmin, England. Telephony with Montreal.
16.11	18,620	GBU	Rugby, England.
16.33	18,370	PMC	Bandoeng, Java.
16.35	18,350	WND	Deal Beach, N. J. Transatlantic telephony.
16.38	18,310	GBS	Rugby, England. Telephony with New York. General Postoffice, London.
		FZS	Saigon, Indo-China. 1 to 3 p.m. Sundays.
16.44	18,240	FRO, FRE	Ste. Assise, France.
16.50	18,170	CGA	Drummondville, Quebec, Canada. Telephony to England.
16.57	18,100	GBK	Bodmin, England.
		W9XAA	Chicago, Ill. Testing, mornings.
16.61	18,050	KQJ	Bolinas, Calif.
16.80	17,850	PLF	Bandoeng, Java ("Radio Malabar").
		W2XAO	New Brunswick, N. J.
16.82	17,830	PCV	Kootwijk, Holland. 9:40 a.m. Sat.
16.87	17,780	W8XK	Westinghouse Eletcric and Mfg. Co., Saxonburg, Pa.
17.00	17,640		Ship, Phones to Shore: WSBN, "Leviathan"; GFWV, "Majestic"; GLSQ, "Olympic"; GDLJ, "Homeric"; GMJQ, "Belgeniand"; work on this and higher channels.
17.25	17,380	JIAA	Tokio, Japan.
17.34	17,300	W2XK	Schenectady, N. Y. Tues., Thurs., Sat. 12 to 5 p.m. General Electric Co.
		W8XL	Dayton, Ohio.
		W6XAJ	Oakland, Calif.
		W2XCU	Ampere, N. J.
		W9XL	Anoka, Minn., and other experimental stations.
17.52	17,110	WOO	Deal, N. J. Transatlantic phone.
		W2XDO	Ocean Gate, N. J. A. T. & T. Co.
17.55	17,080	GBC	Rugby, England.
18.40	16,300	PCL	Kootwijk, Holland. Works with Bandoeng from 7 a.m.
		WLO	Lawrence, N. J.
18.50	16,200	FZR	Saigon, Indo-China.
18.56	16,150	GBX	Rugby, England.
18.68	16,060	NAA	U. S. Navy, Arlington, Va. Time signals, 11:57 to noon.
18.80	15,950	PLG	Bandoeng, Java. Afternoons.
18.90	15,860	FTK	St. Assise, France. Telephony.
18.93	15,760	JIAA	Tokio, Japan. Up to 10 a.m. Beam transmitter.
19.60	15,300	OXY	Lyngby, Denmark. Experimental.
		W6XAL	Westminster, Calif.
20.65	14,530	LSA	Buenos Aires, Argentina.
20.70	14,480	W8XK	Saxonburg, Pa.
		GBW	Radio Section, General Post Office, London, E. C. 1. Rugby, England.
		WNC	Deal, N. J.
20.80	14,420	VPD	Suva, Fiji Islands.
21.17	14,150	KKZ	Bolinas, Calif.
22.38	13,400	WND	Deal Beach, N. J. Transatlantic telephony.
23.46	12,780	GBC	Rugby, England.
24.41	12,290	GBU	Rugby, England.
24.46	12,250	FTN	Ste. Assise (Paris), France. Works Buenos Aires, Indo-China and Java. On 9 a.m. to 1 p.m. and other hours.
		GBS	Rugby, England.
		PLM	Bandoeng, Java. 7:45 a.m.
24.68	12,150	GBS	Rugby, England. Transatlantic phone to deal. N. J. (New York).
		FQO, FQE	Ste. Assise, France.
24.80	12,090	......	Tokio, Japan. 5-8 a.m.
24.89	12,045	NAA	Arlington, Va. Time signals, 11:57 to noon.
		NSS	Annapolis, Md. Time signals, 9:57-10 p.m.
24.98*	12,000	FZG	Saigon, Indo-China. Time signals, 2-2:05 p.m.
25.10	11,945	KKQ	Bolinas, Calif.
25.65	11,680	YVQ	Maracay, Venezuela. (Also broadcasts occasionally.)
25.68	11,670	KIO	Kahuku, Hawaii.
26.00	11,530	CGA	Drummondville, Canada.
26.10	11,490	GBK	Bodmin, England.
26.15	11,470	IBDK	S.S. "Elettra," Marconi's yacht.
26.22	11,435	DHC	Nauen, Germany.
26.44	11,340	DAN	Nordeich, Germany. Time signals, 7 a.m., 7 p.m. Deutsche Seewarte, Hamburg.
27.30	10,980	ZLW	Wellington, N. Z. Tests 3-8 a.m.
28.20	10,630	PLR	Bandoeng, Java. Works with Holland and France weekdays from 7 a.m.; sometimes after 9:30.
28.44	10,540	WLO	Lawrence, N. J.
		VLK	Sydney, Australia. 1-7 a.m.
28.80	10,410	PDK	Kootwijk, Holland.
		KEZ	Bolinas, Calif.
		LSY	Buenos Aires, Argentina.
28.86	10,390	GBX	Rugby, England.
29.54	10,150	DIS	Nauen, Germany. Press (code) daily; 6 p.m., Spanish; 7 p.m., English; 7:50 p.m., German; 2:30 p.m., English; 5 p.m., German. Sundays: 6 p.m., Spanish; 7:50 p.m., German; 9:30 p.m., Spanish.
30.15	9,950	GBU	Rugby, England.
30.30	9,890	LSN	Buenos Aires, phone to Europe.
		LSA	Buenos Aires.
30.64	9,790	GBW	Rugby, England.
30.75	9,750	......	Agen, France. Tues. and Fri., 3 to 4:15 p.m.
		WNC	Deal, N. J.
30.90	9,700	WMI	Deal, N. J.
30.93	9,600	LQA	Buenos Aires.
31.23	9,600	LGN	Bergen, Norway.
32.13	9,330	CGA	Drummondville, Canada.
32.21	9,310	GBC	Rugby, England. Sundays 2:30-5 p.m.
32.40	9,250	GBK	Bodmin, England.
32.50	9,230	FL	Paris, France (Eiffel Tower). Time signals 4:56 a.m. and 4:56 p.m.
32.59	9,200	GBS	Rugby, England. Transatlantic phone.
33.26	9,010	GBS	Rugby, England.
33.81	8,872	NPO	Cavite (Manila), Philippine Islands. Time signals 9:55-10 p.m.
		NAA	Arlington, Va. Time signals 9:57-10 p.m., 2:57-3 p.m.
33.98	8,810	WSBN	S.S. "Leviathan."
34.50	8,690	W2XAC	Schenectady, New York.
34.68	8,650	W2XCU	Ampere, N. J.
		W9XL	Chicago.
34.68	8,650	W3XE	Baltimore, Md. 12:15-1:15 p.m., 10:15-11:15 p.m.
		W2XV	Radio Engineering Lab., Long Island City, N. Y.
		W8XAG	Dayton, Ohio.
		W4XG	Miami, Fla.
		W3XX	Washington, D. C. And other experimental stations.
34.74	8,630	WOO	Deal, N. J.
		W2XDO	Ocean Gate, N. J.
35.02	8,550	WOO	Ocean Gate, N. J.
35.50	8,450	PRAG	Porto Alegre, Brazil. 8:30-9:00 a.m.
36.92	8,120	PLW	Bandoeng, Java.
37.02	8,100	EATH	Vienna, Austria. Mon. and Thurs., 5:30 to 7 p.m.
		JIAA	Tokyo, Japan. Tests 5-8 a.m.
37.80	7,930	DOA	Doeberitz, Germany. 1 to 3 p.m. Reichpostzentralamt, Berlin.
38.00	7,890	VPD	Suva, Fiji Islands.
		JIAA	Tokio, Japan (Testing).
38.30	7,830	PDV	Kootwijk, Holland, after 9 a.m.
38.60	7,770	FTF	Ste. Assise, France.
		PCK	Kootwijk, Holland. 9 a.m. to 7 p.m.
39.15	7,660	FTL	Ste. Assise.
39.40	7,610	HKF	Bogota, Colombia. 8-10 p.m.
39.74	7,520	CGE	Calgary, Canada. Testing. Tues., Thurs.
43.70	6,860	KEL	Bolinas, Calif.
		Radio Vitus	Paris, France. 4-11 a.m., 3 p.m.
43.80	6,840	CFA	Drummondville, Canada.
44.40	6,753	WND	Deal, N. J.
44.99	6,660	F8KR	Constantine, Algeria. Mon., Fri., 5 p.m.
		HKM	Bogota, Colombia. 9-11 p.m.
45.50	6,560	RFN	Moscow, U.S.S.R. (Russia) 2 a.m.-4 p.m.
46.05	6,515	WOO	Deal, N. J.
62.80	4,770	ZL2XX	Wellington, New Zealand.
63.00	4,760	Radio LL	Paris, France.
63.13	4,750	WOO	Ocean Gate, N. J.
63.79	4,700	WIXAB	Portland, Me.
72.87	4,116	WOO	Deal, N. J.
74.72	4,105	NAA	Arlington, Va. Time signals, 9:57-10 pm., 11:57 a.m. to noon.
92.50	3,256	W9XL	Chicago, Ill.
95.00	3,156	PK2AG	Samarang, Java.
96.03	3,124	WOO	Deal, N. J.
97.53	3,076	W9XL	Chicago, Ill.
			Motala, Sweden. 11:30 a.m.-noon, 4-10 p.m.

(Continued on next page)

"STAR" SHORT WAVE BROADCASTING STATIONS

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

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

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

I3RO, Rome, Italy. Daily on 80 meters, from 3 to 5 p.m. Woman announcer.

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

VK3ME, Melbourne, Australia. 31.28 meters. Wednesday and Saturday, 5 to 6:30 a.m.

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

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

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

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

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

T14, Heredia, Costa Rica, Central America. 29.3 meters. Monday and Wednesday, 7:30 to 8:30 p.m.; Thursday and Saturday, 9 to 10 p.m.

XDA, Mexico City. 25.5 meters. Daily, 3 to 4 p.m.

F3ICD, Chi-Hoa, French Indo-China. 49.1 meters. Daily from 6:30 to 10:30 a.m.

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

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Short Wave Stations of the World

(Continued from preceding page)

Airport Stations

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

Television Stations

Wavelength (Meters)	Frequency	Call Letters	Address and Schedule
3.75 to 5 meters—60 to 80 megacycles.			
5.96 to 6.18 meters—48.5 to 50.3 megacycles.			
6.52 to 7.14 meters—42 to 46 megacycles.			
		W8XF	The Goodwill Station, Pontiac, Mich.
		W8XL	WGAR Broadcasting Co., Cleveland Ohio.
6.89	43,500	W9XD	Milwaukee Journal, Milwaukee, Wis.
		W3XAD	Camden, N. J. (Other experimental television permits: 48,500 to 50,300 k.c., 43,000-46,000 k.c.).
101.7 to 105.3 meters—2,850 to 2,950 kc.			
		W1XAV	Short Wave & Television Corp., Boston, Mass. 1-2, 7:30 to 10:30 p.m. daily ex. Sun. Works with W1XAU 10-11 p.m.
		W2XR	Radio Pictures, Inc., Long Island City, N. Y. 4 to 10 p.m. exc. Sundays. Silent 7-7:30 Sat.
105.9	2,833	W6XAN	Los Angeles, Calif.
		W7XAB	Spokane, Wash.
105.3 to 109.1 meters—2,750 to 2,850 kc.			
		W2XAB	Columbia Broadcasting System, 485 Madison Ave., N. Y. 8:00-10:00 p.m.
		W2XBO	Long Island City, N. Y.
		W9XAA	Chicago, Ill.
		W9XG	Lafayette, Ind. 60 holes, 1,200 r.p.m. Tuesdays and Thursdays, 2:00 p.m., 7:00 p.m., 10:00 p.m.
108.8	2,758	VE9CI	London, Ont., Canada.
136.4 to 142.9 meters—2,100 to 2,200 kc.			
		W2XBS	National Broadcasting Co., New York, N. Y., 1,200 R.P.M., 60 lines deep, 72 wide, 2-5 p.m., 7-10 p.m. ex. Sundays.
		W2XR	Radio Pictures, Inc., Long Island City, N. Y. 48 and 60 line. 5-7 p.m.
		W3XAD	R. C. A.-Victor Co., Inc., Camden, N. J.
		W2XCW	Schenectady, N. Y.
		W8XAV	Pittsburgh, Pa. 1,200 R. P.M., 60 holes. 1:30-2:30 p.m., Mon., Wed., Fri.
		W9XAP	Chicago, Ill.
		———	Kansas State Agricultural College, Manhattan, Kans.
142.9 to 150 meters—2,000 to 2,100 kc.			
		W2XAP	Jersey City, N. J.
		W2XCR	Jersey City, N. J. 3-5, 6-9 p.m. ex. Sun.
		W3XK	Wheaton, Maryland, 10:30 p.m.-midnight exc. Sun. Works with W3XJ.
		W2XCD	Passaic, N. J. 2-3 p.m. Tues., Thurs., Sat.
		W8XF	The Goodwill Station, Pontiac, Mich.
142.9 to 150 meters—2,000 to 2,100 kc.			
		W9XAQ	Chicago, Ill.
		W9XAA	Chicago, Ill.

Police Radio Stations

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

Marine Fire Stations

Wavelength	Frequency	Call Letters	Location
187.81	1,596	WRDU	Brooklyn, N. Y.
		WKDT	Detroit, Mich.
		WCF	New York, N. Y.
192.4	1,558	WEY	Boston, Mass.
		KGPD	San Francisco, Cal.

A Practical Recording Device

A new and practical radio or sound recorder has been developed by the Aeratest Products Co., and has just been announced by Federated Purchaser of New York City. The recorder has been favorably received by the engineers of the two major broadcasting systems and is being used at present for the recording of auditions made of coming radio stars in a number of the nation's most popular broadcasting stations. The outfit is extremely low-priced and well within the range of everyone. In developing this unit, special care was taken to make it extremely simple to operate, and it does not require a radio engineer or a mechanical genius to install, as but one hole is necessary for the entire fastening of the unit.

In recording, all that is necessary is to move the arm to the center of the record and throw the lifting lever to the down position. This immediately starts the recorder, which evenly grooves the record. The remarkable number of 96 grooves per inch has been accomplished in this outfit and the recording plays as long as a standard phonograph record.

This recorder does not require an extremely powerful set or power amplifier for recording, as normal, small room volume is all that is necessary. The recorder grooves its own records as blank records remove all semblance of background noise.

In utilizing this recorder a good phonograph motor is the only requisition. Records from 5 inches to 12 inches may be made at either 78 or 33⅓ r.p.m. A 16-inch arm is available at a slightly higher price. Recordings are made on aluminum discs. A new process is now available which enables the treating of aluminum discs to be used with steel needles.

THE NEW POWERIZER MICROMIKE

The Micromike is a very sensitive, precision built microphone of very small size and weight, which can be fastened to the clothing. From the Micromike a very thin, flexible, twisted cord is run to a connector. Between the Micromike and the amplifier a very compact volume control is connected; this is called the Mikontrol. It is very small and may be held in the pocket and controlled with the hand.

The advantage of this system of amplified public speaking must at once be apparent. The speaker's view of the audience is not obstructed nor does he become "microphone conscious." Monitoring does not become necessary, as the slight variation of distance from the speaker's mouth to the microphone affects the volume but slightly. As fifteen feet of cord is provided, the speaker may move about to make his delivery more forcible. A portable amplifier and loud-speaker are furnished with Micromike.

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Letters From S-W Fans

COMING, SIR, COMING

Editor, SHORT WAVE CRAFT:

First, let me congratulate you on your excellent magazine—it ought to be a weekly!

Have just completed a "dolled-up" version of Mr. Doerle's two-tuber (added an untuned R.F. and an A.F. with '01A's). On three tubes I received the following on the loud-speaker: XDA, LQA, GMB, VE9DR, VE9GW, KKQ, W1XAZ, W2XAF, W3XAL, W3XAU, W2XAB, W8XK, W8XAL, W9XF, W9XAA, Bermuda, Honolulu and Budapest, Hungary, and "hams" in 38 states!

Here's a suggestion—why not print in each issue a list of "ham" stations—say, a page with QRA and owner, so that the readers can compile a "HAM call-book" by saving them—they could be revised in later issues from time to time. How about it?

Let's have an article or series on how to get into "ham" transmitting, with very simple transmitters. How about a "junk box" transmitter? Some "Q" signals and radio regulations?

"73's" and the best of luck. Hoping to see this soon, I am,

Yours truly,
Maurice Kraay,
R. F. D. 1,
Hammond, Ind.

(Thanks, Maurice, for the suggestion. It's a mighty good one, too, but not practical because for 35 cents you can write to the Government Printing Office, Washington, D. C., and get the complete list of the twenty-odd thousand amateurs. But as to your other suggestion, the junk box transmitter, this sure is a wow. We have commissioned Robert Hertzberg to make a trip into his attic and see what he can extract from it and you and the rest of our readers will be presented with one of these transmitters, pronto.—Editor.)

ON THE CONVERTER

Editor, SHORT WAVE CRAFT:

I enjoy reading SHORT WAVE CRAFT very much and always look forward to the coming out of a new issue. I wish to compliment you on your short wave station list. It is the *most complete list* that can be found. I am a short wave listener. The receiver I use is a short wave super converter employing one 224, one 227 and one 226. This is used in conjunction with an Atwater-Kent 55. To date I have received the following stations: FYA, G5SW, LSN, VK2ME, VK3ME, I2RO, PCJ, HKC, HKD, HRB, XDA (code), X26A, VE9CL, VE9AP, VE9DR, YVQ, KIO, VRT (Bermuda), GB5, GBC, GBU, GBK, GBR (code), W6XI (13.590 K.C.), Bolinas, Calif.; KEL, KEZ, W6XAN, Königswusterhausen, Germany; OKI (code), ten-meter coil, and LGN (code). Many of the stations I receive every day when the weather is suitable. I have received verifications from FYA, G5SW, VE9CL, I2RO, VK2ME, VK3ME and am expecting one from YVQ. As yet I have not sent for the others. I would like to correspond with other short wave DX hounds.

Yours truly,
Robert Huston,
81 Lincoln St.,
Waverly, N. Y.

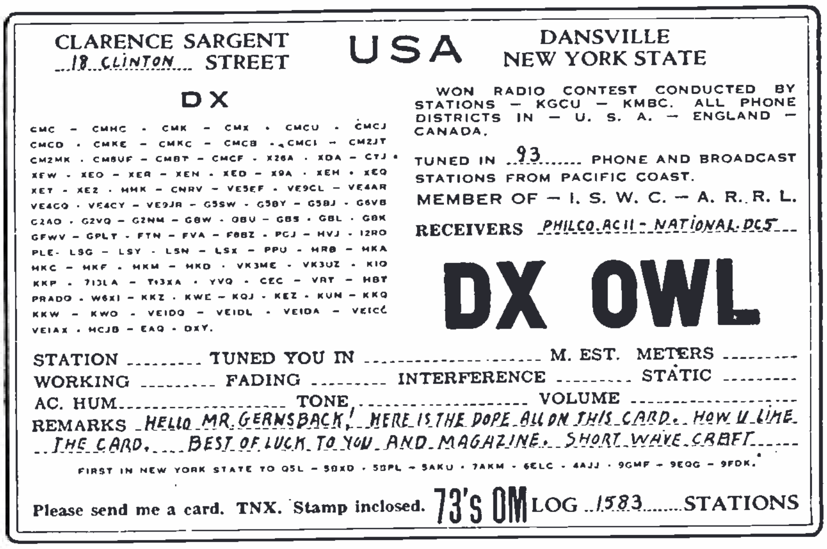
(Not bad at all, Bob, particularly on the converter. If you converter boys don't soon stop, you will put the straight short wave sets out of business by the results you are getting. At any rate, it's good and lively competition.—Editor.)

ADVICE FOR S. W. FANS

Editor, SHORT WAVE CRAFT:

Have been at the short wave game for two years and have had nearly every magazine on short waves in that time. SHORT WAVE CRAFT is the best of all! More power to you.

Radio Phone Amateurs tell me I have one of the best "DX" (distance) records in the country. So here it is: Log. 1,583 stations from 14 to 550 meters. 17 Cuba, 14 Mexico, 2 British Columbia, 6 Manitoba, 4 Alberta, 1 Haiti, 13 England, 3 France, 1 Holland, 2 Italy, 1 Java, 6 Colombia, 2 Australia, 1 Brazil, 1 Honduras, 2 Costa Rica, 2 Hawaiian Islands, 1 Chile, 1 Bermuda, 1 Switzerland, 2 Ecuador, 1 Spain, 1 Denmark, 2 Germany, 32 Texas, 93 Pacific Coast.


CLARENCE SARGENT
18 CLINTON STREET
USA
DANSVILLE
NEW YORK STATE

DX

CMC - CMHC - CMK - CMX - CMCU - CMCJ
CMCD - CMKE - CMKC - CMCB - CMCI - CM2JT
CM2MK - CM8UF - CMBT - CMCF - X26A - XDA - CTJ -
XEW - XEO - XER - XEN - XED - X9A - XEH - XEQ
XET - XEZ - MMK - CNRV - VE5EF - VE9CL - VE4AR
VE4CQ - VE4CY - VE9JR - G5SW - G5BY - G5BJ - G6VB
C2AO - G2VQ - G2NM - GBW - OBU - GBS - GBL - GBK
GFWV - GPLT - FTN - FVA - F8BZ - PCJ - HVJ - I2RO
PLE - LSG - LSY - LSN - LSX - PPU - HRB - HKA
HKC - HKF - HKM - HKD - VK3ME - VK3UZ - KIO
KKP - 7I3LA - TI3XA - YVQ - CEC - VRT - HBT
PRADO - W6XI - KKZ - KWE - KQJ - KEZ - KUN - KKQ
KKW - KWO - VEIDQ - VEIDL - VEIDA - VEICC
VEIAX - HCJB - EAQ - DXY.

WON RADIO CONTEST CONDUCTED BY STATIONS — KGCU — KMBC. ALL PHONE DISTRICTS IN — U. S. A. — ENGLAND — CANADA.

TUNED IN 93 PHONE AND BROADCAST STATIONS FROM PACIFIC COAST.

MEMBER OF — I. S. W. C. — A. R. R. L.

RECEIVERS PHILCO.AC11 - NATIONAL.DC5

DX OWL

STATION .... TUNED YOU IN .... M. EST. METERS ....
WORKING .... FADING .... INTERFERENCE .... STATIC ....
AC. HUM .... TONE .... VOLUME ....
REMARKS HELLO MR. GERNSBACK! HERE IS THE DOPE ALL ON THIS CARD. HOW U LIKE THE CARD. BEST OF LUCK TO YOU AND MAGAZINE. SHORT WAVE CRAFT

FIRST IN NEW YORK STATE TO QSL — 5QXD - 5QPL — 5AKU - 7AKM - 6ELC - 4AJJ - 9GMF — 9EQG — 9FDK.

Please send me a card. TNX. Stamp inclosed. 73's OM LOG 1583 STATIONS

An interesting Q.S.L. card. He "logged" 1.583 stations!

I use a Philco A.C. 11 and a National short wave 5. My antenna is a cage type, 60 feet long. Lots of S.W. fans are kicking because stations do not verify programs for them. One of the main reasons is that they do not enclose any stamps for a reply. I have had Radio Phone Amateurs tell me they get as high as 75 to 100 letters some days; to answer these and use their own stamps would soon make them paupers. So, S.W. fans should enclose stamps. Some of the hook-ups in your magazine look good to me, and I am going to try some of them. Am enclosing one of my cards: what do you think of it? Best of luck to the best of short wave magazines.

Yours truly,
Clarence Sargent,
18 Clinton St.,
Danville, N. Y.

(Attaboy, Clarence! That's the way we like to get 'em. Your card certainly is the "cats" and if every short wave fan were using such cards, it would enable them to plaster their attics correctly. Keep up the good work.—Editor.)

A JOLT FOR PHONE HAMS

Editor, SHORT WAVE CRAFT:

Your magazine is very fine for the "Short Wave Listener" or one just trying to get a start in the "ham" game. However, I find it lacking in articles which would appeal to a real "ham." You must remember not all of your readers are just listeners or beginners. I would like to see some articles similar to those appearing in "QST."

I have noticed that nearly all of your articles on transmitters were intended for beginners in the "sending" end of the game. At the same time these articles were pertaining to *phone* transmitters. I think it is entirely wrong for a new man to start out with a phone transmitter. Much of the trouble in our amateur bands today is caused by this. It has come to a point where there is a law pending before the Federal Radio Commission that every amateur *must operate a code transmitter one year before he may even attempt "phone." Therefore may I suggest that you encourage the new "hams" to use code (CW) not phone!*

Please accept my remarks as constructive criticism as I like your magazine, am a subscriber, and want to see it succeed.

Very truly and 73's,
JACK WAGENSELLER, W3GS,
A. R. R. L., Section Communication Manager, Eastern Penna.,
Box 338, Red Hill, Pennsylvania.

(It was very good of you to write to us as you did, Friend Jack, and we print your letter as a horrible example to the short wave hounds to mend their ways, so that the threatened big stick from Uncle Sam will not fall too heavily on us. Every short wave ham should read this letter carefully and profit thereby. 'Nuff said.—Editor.)

SALUTE TO RECRUIT

Editor, SHORT WAVE CRAFT:

I know how you, and especially the "HAMS," will laugh when you read this letter, but I guess the laugh is on me.

Some time ago I happened to stop in a radio building shop and the workman was tinkering with an outfit which I would call a piece of junk, and the thing was making a noise and it went like this, peep peep peep peep peep peep. Well, I was curious, so I admitted myself without permission.

I asked the man what caused that noise on a radio, I told him that I have a radio and in places that same noise was on mine. Uh! he says, that is what we call the "code," this is a *short wave* radio.

Well I didn't know any more then than before he told me, so I walked out for fear he would know just how dumb I was, but still I was curious. I asked many questions and found out the code was the alphabet, consisting of dots and dashes. I found a book that had them in it and in two days I had a buzzer and a key, of course I began looking for literature on this thing called short waves, and your SHORT WAVE CRAFT was the first and the last magazine that I have bought. I have every issue for ten months back. I even take them to work with me and I am wondering if they are a "drug" and if so it has no competitors.

Every spare minute I have is given to short wave radio. I started broadcasting over station WDEL in Wilmington, Del., for the sole purpose of seeing the controls of the transmitter.

I couldn't express my gratitude, Mr. Editor, should you publish this letter, and if so may I request correspondence from other "Hams"; will answer all letters from any that build sets and transmitters; would like more than ever to hear from them. I have never received a sound from any of the sets I have tried to put together, but I am going to be a first-class Amateur if it takes me twenty years!

Sincerely (the "double" ham),
CARMEN JOHNSON.

(Congratulations Carmen. Here is at last one short wave greenhorn who is not afraid to speak his piece (or her piece). That is the way to start in. Most of us have started the same way, with the difference that the years have made us so high-hat that we forget when we couldn't tell a condenser from a tube.—Editor.)

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An Automatic "CQ" CALL *for the* AMATEUR

By W. BUCHHOLZ

The author here describes an automatic transmitting device by means of which "CQ" signals can be sent out without the manipulation of a key and which is quite a desideratum after all, when we consider that 40 to 50 per cent of all transmissions are "call signals," as Mr. Buchholz points out. This signal transmitting device utilizes a drum on which the dots and dashes are drawn and a beam of light is reflected from the characters on to a photo-electric cell, which in turn transmits the code signals to an amplifier and thence to your transmitter.

PROBABLY every short wave amateur sooner or later has the wish to give his own call signal and that of the other station mechanically, since nearly 40 to 50 per cent of the transmissions are *call signals*. Above all the amateur operating in the 5 or 20 meter band will greet such a device because here the nature of things necessitates calling the other station longer than otherwise.

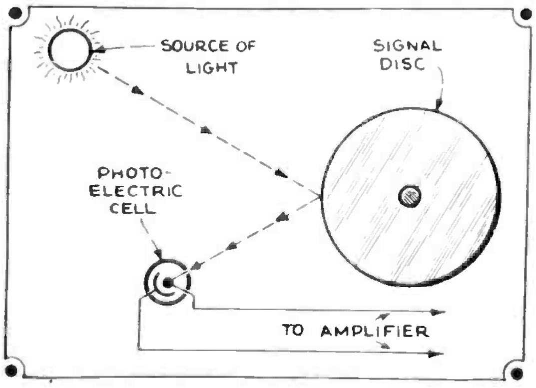

Fig. 1—Elements of automatic code transmitter in which a light beam is intermittently broken up by the dots and dashes on the drum or disc, the light pulsations being interrupted by the photo-electric cell and amplifier.

The demands put on such a machine, which a CQ machine of ordinary construction cannot fulfill, are as follows:

(1) At very high code speed, perfect certainty of operation.

(2) Very fast production of the signal band required.

An apparatus answering these requirements is here described.

How Photo-cell Is Used

The basic construction depicted in Fig. 1 rests on the fact that a ray of light in its path undergoes fluctuations in intensity, which are converted into fluctuations in current in a photo-cell. These finally, via an amplifier, activate the key-relay of the transmitter. The sketch plainly shows how the ray of light strikes the signal band, which is fastened to a rotating disc, and is reflected by it upon the photo-cell. Many readers will perhaps object that this arrangement can be simplified; and that as shown in Fig. 2, one can put between source of light and photo-cell, a band permeable to light, with signs on it opaque to light. To be sure, this arrangement actually presents the appearance of greater simplicity, but in its construction it is much harder to build than in the case of the apparatus selected by the author.

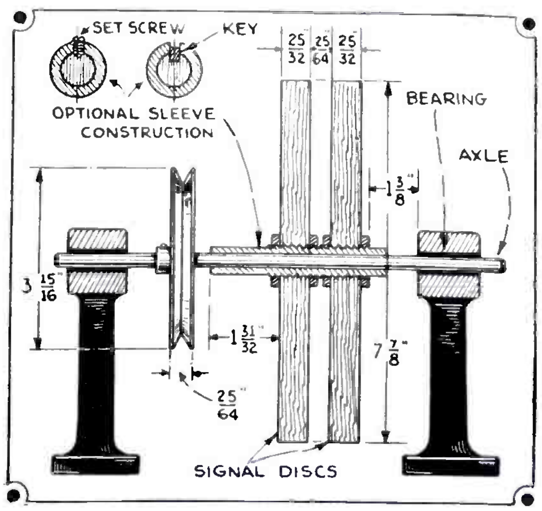

Fig. 4, shows mechanical arrangement of two signal discs in the automatic "CQ" transmitter as devised by Mr. Buchholz.

The amateur, who works only with limited means, will hardly succeed in so constructing the moving parts that perfect operation is afforded; besides, the requirement numbered "2" above is not possible in this case.

Before I pass to the practical construction of my CQ machine, I should like to mention that the idea sketched in Fig. 1 may be attained in two different ways, both leading to the same result.

In the case of the first, use is made of the fact that a ray of light corresponding to the wave length of the cathode material, produces a maximum current impulse in the photo-cell. For simplicity I give here a table of the most usual cathode materials and the appropriate colored glass filters, with their approximate wave lengths:

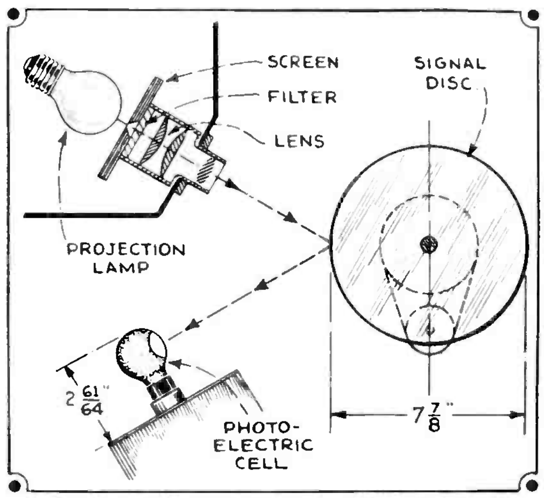

Fig. 3, shows the final development of the "CQ" automatic code transmitter with light source, condensing lens, disc containing code characters, and photo-electric cell.

Cathode material		Filter	
Potassium	4400 AE.	Indigo	4310 AE.
		Blue	4860 AE.
Carbon	5300 A.E.	Green	5270 AE.
Copper	8900 AE.	Red	7610 AE.

The practical construction simply consists in connecting in a suitable filter (see the table), which makes the light ray monochromatic. I myself use a photo-cell (filled with inert gas) having a cathode layer consisting of potassium, so that according to the table, a blue-colored glass filter must be used. The ray of light coming through the colored glass strikes the signal band, which it is best to make of white glazed paper, and this casts the ray of light on the photo-cell, in which a maximum current impulse arises. For the code signal to be put on the signal band, one chooses a color as far removed as possible from the wave length of the filter (in my case red); the signals are put on with a brush.

One obtains the same results by the method based on the second consideration, which however is somewhat simpler in construction. It is well known that a surface struck by a ray of light

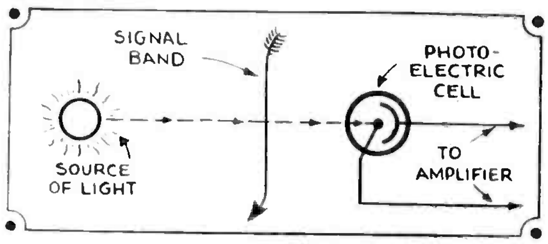

Fig. 2, above, shows another form of "CQ" transmitter, where the dots and dashes are drawn on a transparent signal band, such as a piece of film, thus intermittently interrupting the light beam.

(1) reflects back a part of the light diffusely in all directions, and

(2) reflects a further part regularly, and

(3) lets the last part pass through.

It is possible for us to make one of these three cases occur, in order to alter at will the fluctuations in intensity of the reflected ray of light. Since we use glazed paper, case 2 occurs, and if we use for "writing" a substance which appears rough on evaporation, case 1 is also in question. The result of the diffusion resulting from the rough coloring matter is a weak lighting of the photo-cell and thereby a minimum current impulse. One sees that with this design it is also possible to control the photo-cell in the rhythm of the code signals.

Importance of Lens

The design used by the author is arranged according to Fig. 3. Of course there is nothing to prevent alterations in it, but the set of lenses of the projection apparatus can in no way be dispensed with. The result would be a lack of sharpness of the refracted ray, consequently a drop in light intensity,

(Continued on page 183)

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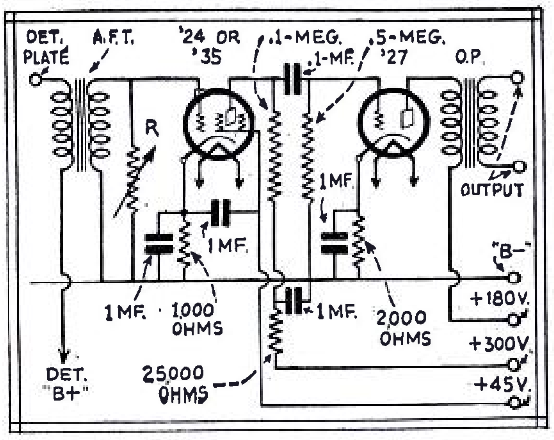
Short Wave Question Box

Audio Amplifier

Edward Newcomb, Jr., Windsor, Ont., Canada, desires:

(Q.) A circuit of an audio amplifier using a 224 and a 227 in the first and second stages respectively.



Hook-up for two-stage audio amplifier using '24 and '27 tubes.

(A.) The circuit is given in these columns. The detector is coupled to the first stage through a transformer, ratio not important. A variable resistor R of 500,000 ohms is connected across the secondary to prevent *fringe howl.* The output transformer OT must be one designed for the 227 tube or others having the same plate impedance.

(Q.) Are the new 2 volt tubes more sensitive than storage battery types?

(A.) Not at all. The only advantage is their low filament consumption.

(Q.) I have been told that about 1,500 meters is the highest wavelength that can be used. Is this right?

(A.) Stations all over the world have been in operation for many years on waves as high as 30,000 meters (10,000 cycles).

WD 12 Tube Circuit

C. Dorman, Worcester, Mass., writes as follows:

Q. Will you publish the circuit, page 94, Aug.-Sept., 1931, issue, for use with WD12 tube?

A. The circuit as it stands is suitable for a WD12 tube by merely applying the correct filament voltage.

Low-Priced Transmitter Power Supply

A. W. Hardy, Avon, Mass., would like to have:

(Q.) A circuit of an inexpensive transmittter power supply with an output of 500 volts.

(A.) The circuit appears in these columns. The transformer has a center-tapped secondary of 1,100 volts. The filter chokes MUST have sufficient current rating for the transmitter used.

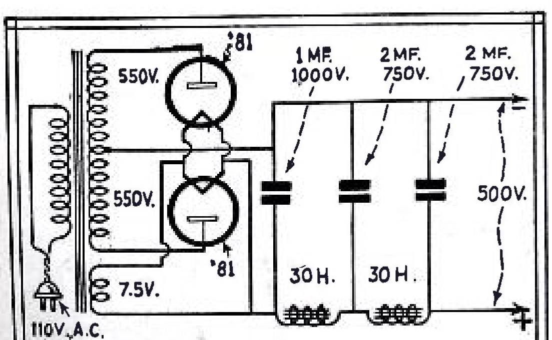


Diagram above shows hook-up of 500-volt power supply unit for transmitter.

Edited by R. William Tanner

Four Tube Hook-up

Michael Wrobel (address unknown), requests:

(Q.) A circuit of a 4-tube set employing a 235 tube.

(A.) You are referred to Page 339, Feb.-Mar. issue. It is only necessary to replace the R.F. bias resistor R1 with a resistor of 500 ohms.

Dynatron Oscillator

V. C. Compton, Cincinnati, Ohio, asks:

(Q.) Can a dynatron oscillator be used to feed a 224 buffer stage which in turn feeds a pair of 171A tubes in a phone transmitter?

(A.) While a dynatron oscillator is second only to a crystal oscillator from the standpoint of constant frequency, it is not possible to draw any amount of power from it.

(Q.) How much more power could be obtained if the 171A's were replaced with 245's?

(A.) With proper plate voltage (250 to 300 volts) the output would be at least doubled.

(Q.) What grid bias voltage would be required for 245s' operated with constant current modulation?

(A.) If the plate voltage is normal (250 volts) the bias would be about 176 volts negative. (180 is sufficiently close.)

Crystal Detector Choice

E. L. Pearson, Milwaukee, Wis., asks:

(Q.) In the question box Feb.-March issue, you state that a Carborundum crystal is the only type to use for short wave sets. Why cannot galena or some other material be used?

(A) I mentioned Carborundum since with proper pressure on the element operation is entirely stable and a loud signal cannot throw it out of adjustment. With light contact crystals, a slight jar or a loud signal will necessitate a readjustment. I have found that a Zincite-Tellurium combination is just about as stable as a Carborundum, but not quite as sensitive.

(Q.) Can variometers be used to advantage in modern short wave sets?

(A.) You certainly must be an "old timer" as your questions are about parts now obsolete but still very useful. Yes, variometers can be employed in short wave receivers and will yield results superior to the familiar coil-condenser combination. As the vacuum tube is a voltage operated device and tuning with a condenser reduces the voltage applied to the grid, it is readily apparent that tuning entirely with inductance will give greater signal strength. A variometer (like the old broadcast type) can be connected in parallel with fixed coils to cover the entire short wave channels. A total of 4 to 6 fixed coils will cover the bands from 15 to 200 meters, the number depending upon the inductance range of the variometer. An article using variometer tuning may appear in a future issue of SHORT WAVE CRAFT.

Lattice-Wound Coils

J. J. Jackson, Hamilton, Ont., Canada, writes as follows:

(Q) In the description of the circuit, page 208, Oct.-Nov. issue, mention is made of lattice-wound coils. How are these wound?

(A) Details of the winding are given in Fig. 6, page 210.

(Q) Could Pilot coils be used in this circuit?

(A) Yes; however, the tuning range would be affected only slightly.

(Q) Can you recommend the best plate and screen grid voltages?

(A) With American tubes, the R.F., I.F. and A.F. tubes would have plate voltages of 180. The detector-oscillator plate voltage should be variable. The screen grid voltage on the R.F. and I.F. may be 75 and 45 on the A.F.

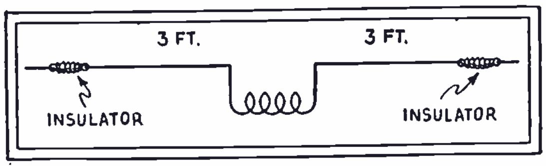
5-Meter Antenna System

Ed. Roth, Rutland, Vt., desires:

Q. A diagram and dimensions of a five-meter antenna system in which the coupling coil is at the center.

A. The diagram is given in these columns. The total length without the coupling coil would be approximately 7.8 feet or 3.9 feet in each section. With the coupling coil, the length of each section will be slightly shorter, around 3 feet. It is an easy matter to determine the length of any antenna by using the following formulae:

Total length in feet equals Wavelength x 1.56.



A five-meter antenna system with coupling coil at the center.

Best Tube for Combination Set

R. Brandt, Hoboken, N. J., writes:

Q. In regard to the combination transmitter and receiver described in April-May issue, what would be a good tube to use?

A. A 201A would be satisfactory for a D.C. layout. If a higher voltage (300 to 400) is available, a '10 tube is suitable.

Making Tuning Easier

Donald Avery, Boston, Mass., wants to know:

(Q.) I have a short wave receiver using S-M plug-in coils and .00014-mf. tuning condenser. Tuning is very critical, especially below the 80 meter band. An S-M drum dial is used on the tuning condenser: can I make any changes so that tuning will be easier?

(A.) You might modify your coils and employ a low capacity condenser of not more than .00005-mf. capacity but then there will be large gaps in the tuning range. Of course, more coils could be wound to fill in the gaps. About the simplest means of making tuning easier is to procure a National type "A" vernier dial and remove the dial from the "works." Mount the "works" only upon the control shaft of the drum dial. If the drum has a ratio of 3 to 1, the resulting ratio will be approximately 15 to 1.

(Q.) How many turns are needed on a coil for television reception with .00014-mf. condenser?

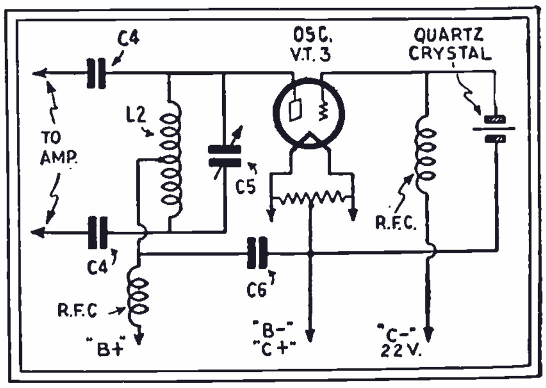
(A.) With S-M 1½" diameter form, a total of 45 turns will cover the band from approximately 100 to 200 meters.

Crystal Oscillator

Glenn Russell, Watertown, N. Y., requests:

Q. A circuit of a crystal oscillator to use in the "Beginners Phone," page 372, Feb.-Mar., 1931 issue.

A. The circuit appears in these columns.



Circuit diagram for crystal oscillator.

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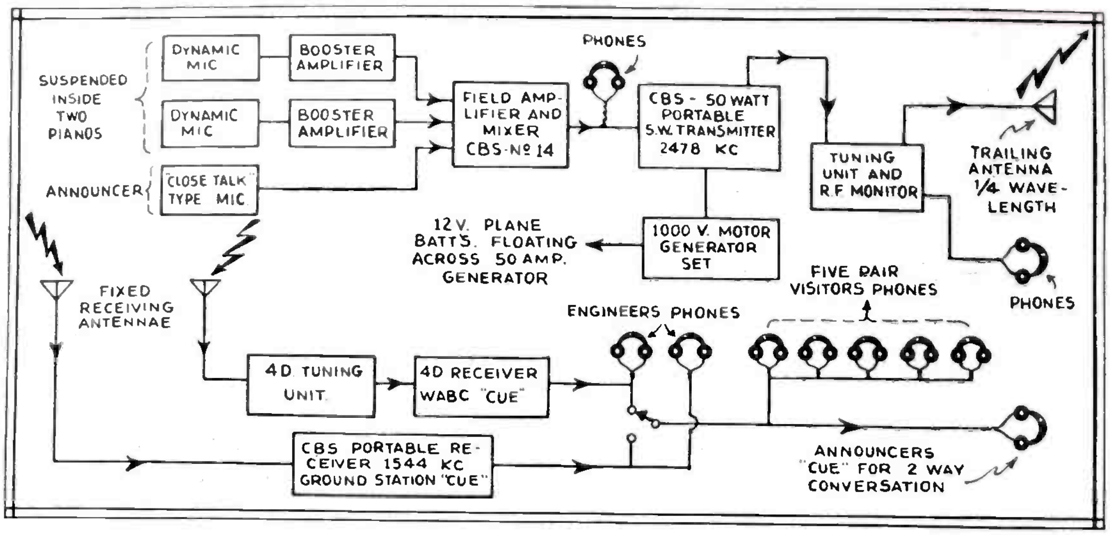
Music from the Air by Short Waves

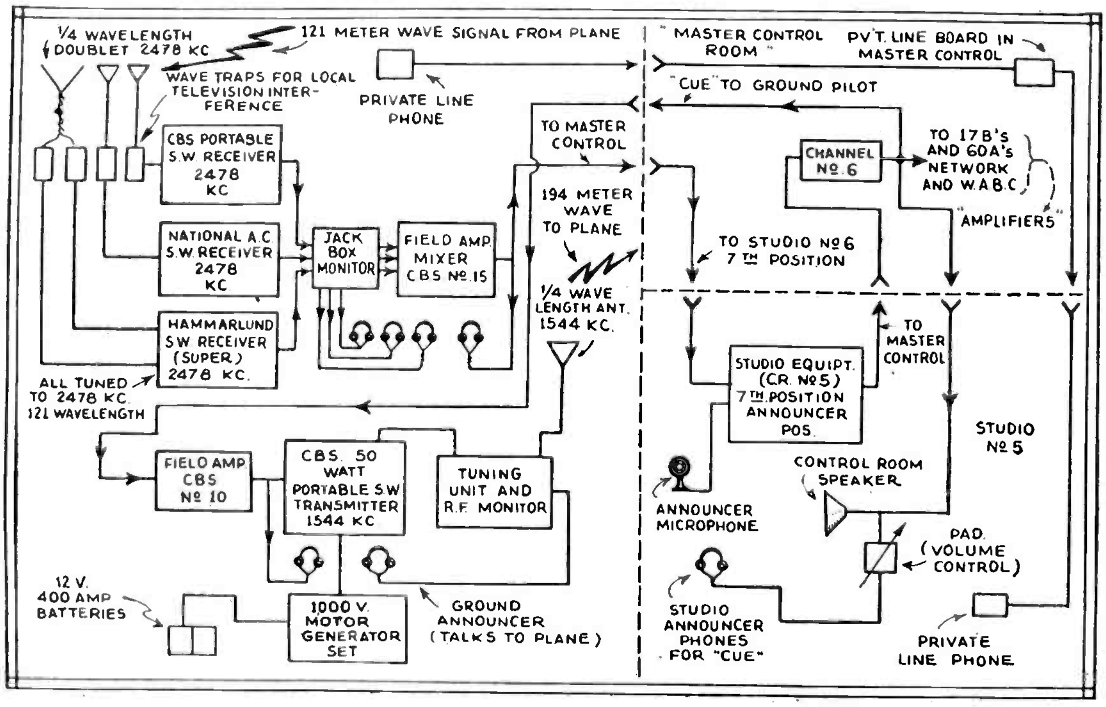
(*Continued from page* 139)

lumbia Broadcasting System Building at 485 Madison Avenue, on the corner of 52nd Street, New York, in the midst of a number of metropolitan television and short-wave transmitters.

Three different types of short-wave receivers with specially tuned antennae and wave-traps formed a diversity system, being fed through a mixer and amplified so that perfect transmission from the plane could be depended upon at all times. Thus any objectionable fading was successfully eliminated. The reception was then amplified and transmitted by wire through the master-control room to the studio control room, at which point the ground announcer was located. The program, after passing through the studio control room equipment, was transmitted back to master control, over the regular facilities associated with that particular studio, and then to the entire network. At the same time, the program was sent back from the master control room to the station on the roof of the building, at which point it was transmitted over another portable short-wave station, W2XDY, transmitting on 194 meters, so that the engineers and the announcer in the plane would be sure to receive their "cues," in the event that their reception of WABC faded during the broadcast. This double assurance was provided so that, in the event of difficulties, the rest of the network would not suffer the loss of the program.



Line-up of the radio broadcasting and receiving apparatus installed aboard airplane.



Arrangement of short wave transmitting and receiving apparatus at the ground station for the airplane broadcast.

The diagrams furnished with this article show a complete layout of equipment as installed at both points. The installation of all the equipment was actually made twice, as a complete "dress rehearsal" of the program was made ten days prior to the actual broadcast. In the interim the plane was put back into regular passenger service on its E. A. T. run between New York and Atlanta.

During the tests, Mr. Edwin K. Cohan, Columbia's Technical Director, carried on a two-way conversation from his office with Henry Grossman, Division Engineer of Columbia, who was in the plane and had charge of the technical set-up at that end. The installation was made in such a way that Mr. Cohan, sitting at his desk by a window, from which he could see the plane flying over the East River, could talk from his office over the ground "cueing" station, W2XDY, using no other microphone than his telephone handset, and give Mr. Grossman reports from time to time on the reception of the tests from the plane. As his loud-speaker was tuned in to the tests, Cohan could not only hear Grossman's voice broadcast from the plane, but his own conversation with Grossman as well.

Immediately after the conclusion of the broadcast, which was carried on for 15 minutes during the afternoon of May 2, highly favorable reports started to come in, and for several days after that congratulations were coming to Columbia in profuse quantities. Despite the fact that this was the most difficult aviation broadcast yet attempted, all reports agreed that it was entirely clear and most successful, due to the many thorough tests and precautions which were taken to assure the elimination of all interference.

Congratulations are due to the engineers who handled the broadcast: Messrs. Grossman, Thompson, and Gilbert of C. B. S., and Manley of the E. A. T. in the plane, and Messrs. Cohan, Bowman, Sponseller, Hillegas, and Butler at the ground station. With this, another unique short-wave broadcast has been concluded and added to the list of Columbia's trail-blazing broadcast events.

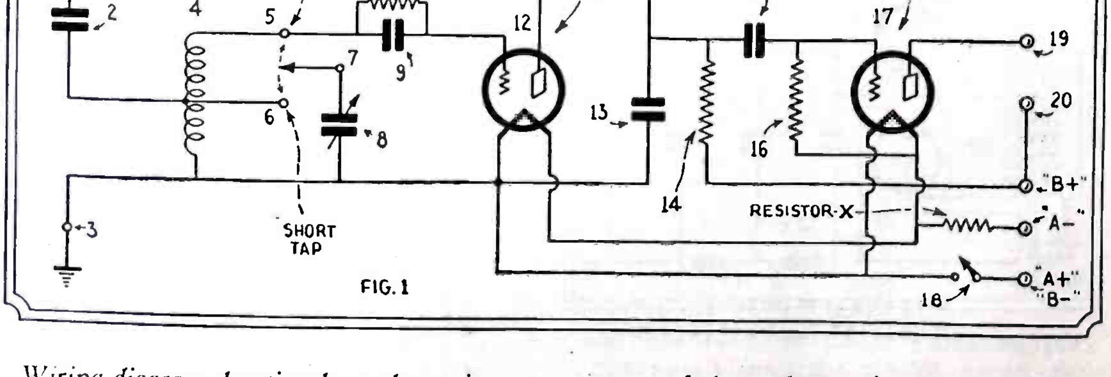
Build This Pocket Short Wave Receiver By HUGO GERNSBACK and C. E. DENTON

(*Continued from page* 145)

cuit are not designed for use with metal boxes.

Parts List (Denton Pocket Radio Set)

1, 3—Antenna-ground connection wire.
2—.0001 mf. mica condenser (Aerovox).
4—Tuning coils (see specifications).
5, 6—Yaxley tip jacks.
19, 20—Yaxley tip jacks.
7—Phone tip plug.
8—.0001 mf. tuning condenser (Dejur or Pilot).
9—.0001 mf. mica condenser (Micamold).
10—2 meg. ½ watt resistor (Aeratest).
11—50,000 ohm potentiometer, with filament switch (No. 18 Frost).
12, 17—Four-prong sockets (Pilot).
13—.001 mf. mica condenser (Micamold).
14—75,000 ohm ½ watt resistor (Lynch).
15—.004 mf. mica condenser (Micamold).
16—1 meg. resistor, ½ watt (Aeratest).
X—8 ohm fixed resistor (Carter or Yaxley).
Two '30 tubes.
Batteries as described in text.



Wiring diagram showing how the various components of the pocket receiver are connected.

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With the New MIDWEST SHORT-WAVE CONVERTER!

If you now have a late model super-heterodyne of ample power—9 tubes or more—you can easily convert it to an ALL-WORLD, ALL-WAVE set by adding a Midwest Converter to it. This new, self-powered Midwest Converter easily converts any AC set of adequate sensitivity into a short-wave receiver that will bring in foreign stations of England, Holland, France, Germany, Italy, South America, Mexico, Australia and many other countries. This is not only the best and most powerful but the lowest-priced super-het converter on the market. Buying direct from the factory saves you 50% or more. And every Midwest Converter is backed by 30 days FREE trial and a positive guarantee of satisfaction.

only **$16.75** COMPLETELY ASSEMBLED—

Self-Powered

Many converters recently put on the market depend on the radio for power which puts a strain on the power supply of the set. Not so with the Midwest Converter. It has its own power supply which not only avoids overloading the transformer and other parts of the set as well as poor reception due to reduced voltage.

NO PLUG-IN COILS
Every Important Feature

1. Ball-bearing variable condenser floated in rubber
2. Accurately peaked I. F. at 575 K. C.
3. No changes required in set
4. Complete power unit fil. and B supply (80 rectifier)
5. Self-healing electrolytics
6. Scientifically shielded
7. Noiseless low-loss switching device
8. Thoroughly filtered
9. Non-regenerative detector
10. Vernier 6-1 slow motion dial (illuminated)
11. No troublesome body capacity.
12. Proven circuit
13. Shielded output cable
14. Extremely simple to connect

Enjoy Radio All Summer Long!

Short-wave reception is at its best during the Spring and Summer months. When static and other interferences make your ordinary set unenjoyable, you can have hour after hour of delightful entertainment listening to foreign stations, ships at sea, airplane calls, Police messages and other short-wave broadcasts. That's what it means to have your set equipped with a Midwest Converter.

Read These Letters!

NEW ZEALAND USER HAS LOGGED 141 STATIONS ALL OVER THE WORLD

"I would stack my Midwest up against any other make on the market. I have a log of 141 stations, 'Midwest gets 'em all over the world.' 36 stations in New Zealand, 34 Australian, 10 in Japan, 1 in China, 2 in India, 1 in Czechoslovakia, Bratislava, and Siam, 'Radio Bankok,' 2 in Honolulu, and a total of 156 stations in the U. S. A., including New York, Cincinnati and Los Angeles. This is a log which would be hard to eclipse by any other make of any power."—Fred W. Morley, 1000 Fitzroy Ave., Hastings, Hawks Bay, New Zealand.

GETS MANY FOREIGN STATIONS

"During the past week I logged the following: FYA Pontoise, France; GBW Rugby, England; HVJ Vatican City, Italy; XLA Mexico City; VK2ME Sydney, Australia; VE9GW Bowmanville, Canada; 12Ro, Rome, Italy; G5SW Chemlsford, England; CGA and VE9DR Drummondville, Canada. Also picked up many amateur and airport stations from all over United States. Numerous ships, shore and transatlantic phones from both sides and an Hawaiian Test Station came in clear and sharp. Several Spanish and German speaking stations have also been received but not yet identified. Have received every broadcast from FYA, morning and afternoon, for over a week with wonderful tone and volume. The Midwest Combination Set is certainly one to be proud of."—Wm. S. Teter, Winter-park, Fla.

USE WITH ANY GOOD SUPER-HET.

The Midwest Converter is usable with any standard super-heterodyne of ample power and selectivity. If you do not now have such a set, mail coupon at once for the big new Midwest catalog showing sensational direct-from-factory bargains in 9 and 11-tube super-heterodynes, 13 and 15-tube ALL-WORLD, ALL-WAVE COMBINATIONS, battery sets, auto radios, etc. Deal direct with the Midwest factory and SAVE UP to 50%, whether you need just a Converter or a complete new set.

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Without obligation send me your new 1932 catalog and complete details of 13- and 15-tube All-World, All-Wave Combinations, 4-tube Converter, 9- and 11-tube Super-Heterodynes, low factory prices, easy terms and liberal 30-day free trial offer. This is NOT an order.

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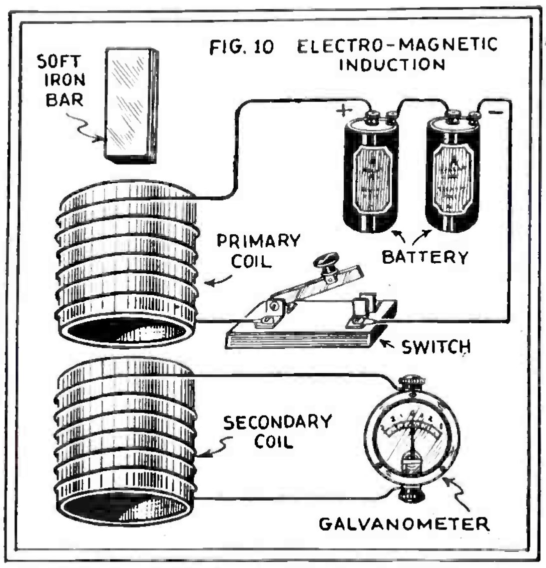
The Short Wave Beginner

By C. W. PALMER

(*Continued from page* 151)

Normally, each atom contains a definite number of electrons and protons, in such a combination that the charges just equal each other. The atom is then said to be uncharged or neutral. Figures 1 and 2 show examples or normal atoms. However, if a force is applied to the atom, some of the electrons will be pulled away from it and it will have an excess of positive electricity compared to the remaining negative charges. Conversely, if a force is applied in the opposite manner, too many electrons are present in the atom and it is said to have a negative charge.

We can perform an interesting experiment at this time, to illustrate the effect of charging a body. For this experiment we need a rod of hard rubber (some fountain pens are made of this material), a glass rod, a piece of silk cloth and a small piece of pith from a corn cob. We suspend the pith on a silk thread, as shown in Fig. 3. Then we rub the glass rod vigorously with the silk cloth and bring it near the pith ball. It will be found that the pith ball will follow the glass rod—it is attracted by it. Then we allow the rod to touch the pith ball and notice that it now repels it. Now rub the rubber rod and bring it near the pith ball—it attracts it.



With the simple apparatus illustrated the basic laws of electromagnetic induction can be easily demonstrated.

The glass rod receives a positive charge when rubbed and the rubber rod receives a negative charge. This is the reason why we notice the difference in their actions on the pith ball. From this experiment, we learn that two like charges repel (the pith ball and the glass rod were both positive when they were allowed to touch) and unlike charges attract (the positively charged pith ball was attracted by the negative rubber rod).

Conductors and Non-conductors

Some materials, such as gold, copper, silver, brass, aluminum, etc., present very little opposition to the passage of electric currents. Others, such as cotton, silk, rubber, wood, mica, etc., will not readily pass a current. The first class of substances is called *conductors*. The atoms of most metals apparently do not have a very strong hold on the electrons which make up their negative charge. An external force can easily remove some electrons or add some to the normal number. The second class of substances mentioned is known as *non-conductors*. They have a strong hold on the electrons and will not readily change from their neutral state.

Potential

We have learned that like charges repel each other and unlike charges have an attraction for each other. If we translate this into terms of electrons, it will read: electrons repel each other but attract protons, and similarly, protons repel each other but attract electrons. Apparently the feeling of the protons and electrons is mutual.

If we charge a body with negative electricity (add electrons) a stress or strained condition is set up in that body by the electrons repelling each other. Some of these "free" electrons move to the surface of the body to get away from the others. The more electrons we put into the body, the greater becomes the force of the electrons trying to escape. This force which tends to return a body to neutral is called a "potential." The same effect is noticed in a body from which electrons are removed.

To illustrate the effect described, suppose we refer to Fig. 4. The two balls shown are charged, one negatively and the other positively. If we touch these balls together, the excess electrons in the negative one will rush to the positive one. It follows directly from this that a current will flow, as we already explained that electrons are electric charges. Several other examples of current flow are shown in Fig. 5. At A, the left copper ball has a higher negative charge than the right one, causing a current to flow from left to right. At B, the left copper ball has a higher positive charge than the right one and a current will flow right to left—the right ball has more electrons than the left one.

It will be noticed that the electrons move from negative to positive and since we know that electrons are electricity, it follows that the current is also from negative to positive. A number of years ago, before we knew as much about electricity as we do now, physicists experimenting with it decided that the current flowed from positive to negative and this illusion has been passed down to the present time and is still commonly used. We must keep this discrepancy in mind as it is important in understanding the operation of vacuum tubes and other electric devices.

The difference in potential, as that shown in Figs. 4 and 5, is measured in *volts*. Because a difference in potential always causes a current to flow, we sometimes call it an electro-motive force (E.M.F.) Current strength, that is, the number of electrons passing through an electric conductor per second, is measured in *amperes*.

Resistance

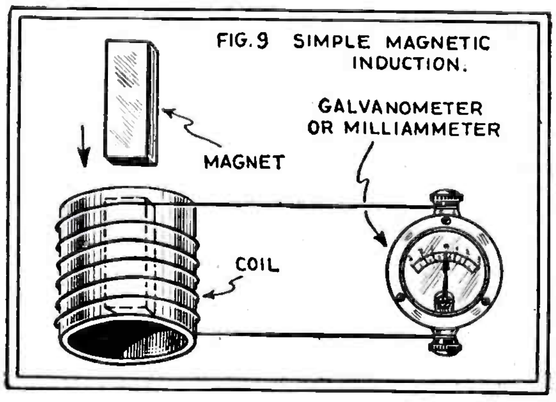
We have found that the current flowing through an electric circuit is dependent on the potential. We also learned that some materials will carry a current (lose and gain electrons) more easily than others. The opposition that a conductor offers to the passage of a current is known as resistance. The resistance depends on the kind of material, the length of the conductor and the cross-sectional area. To be exact, the resistance increases directly as the length of the conductor. A standard unit of resistance has been set up and is called the *ohm*, in honor of the noted German physicist, George Simon Ohm.

If we analyze the above information, we learn that the current depends on the volts and also on the resistance. In 1827, George Simon Ohm put this relationship into terms of arithmetic and it is known as Ohm's Law. There are three forms of Ohm's Law. The first tells us that the current in a circuit is equal to the potential (volts) divided by the resistance (ohms). The second tells us that the resistance in a circuit is equal to the potential (volts) divided by the current (amperes), and the third tells us that the volts equal the amperes times the ohms. We will learn the application of these three formulas as we progress further into the subject of short-wave radio.

Production of an Electric Current

In the foregoing discussion, we have referred to a force (E.M.F.) that would cause electrons to be separated from atoms and move through a conductor to other atoms. This E.M.F. can be maintained by means of a battery or a generator. The former consists of plates of certain materials immersed in certain solutions that cause a chemical action, resulting in the production of free electrons at one of the plates. We will not go into the details of these chemical actions at this time. The interested radio fan can find this information in books on electricity or batteries. Several common types of batteries are shown in Fig. 6.

The other common source of E.M.F. is a generator which depends on the effect of induction and magnetism. We already encountered the effects of induction when we noted that the pith ball was attracted by the glass rod, even though it was not touching it in any way. Inductive actions are very important in radio, in tuning coils, transformers, etc.



Magnetic induction is demonstrable by plunging the steel magnet into the coil, the current induced being indicated on meter.

Magnetism

When a current flows through a conductor, two principal effects can be noticed. The first is that heat is produced. The current encounters a certain opposition (resistance) in the conductor and part of the electric energy is used up in overcoming this "frictional" resistance. The energy used up in this manner makes itself evident in the form of heat.

The second effect is known as magnetism and we can best illustrate this by considering Fig. 7. This illustration shows a coil of wire wound around a bar of soft iron. A current from a battery is flowing through the coil. While the current is flowing, the iron bar will be found to have the power of attracting small pieces of iron and steel. When the current from the battery is not flowing, the iron bar no longer attracts the iron pieces. Thus we can see that the current passing through the coil of wire has given it a new property which we call *magnetism*, and since it has this property only when the electric current flows, we call it an *electromagnet*.

Now, if we replace the soft iron bar with one of hard steel and allow the current to flow for some time, we will find that the steel will attract the pieces of iron even when the current flow has stopped. We have now made a *permanent magnet*. A careful examination of the soft iron bar will show that it also retains a small amount of magnetism, although in a smaller degree than the steel. The steel is said to have a higher degree of retentivity than the iron.

If we drop a permanent magnet into a box of iron filings, we will notice that there are two places on the magnet to which the most filings cling. See Fig 8. These places near the ends of the steel bar are called the *poles* of the magnet. One pole is called the north

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pole and the other the south pole, or more accurately the north-seeking pole and the south-seeking pole, for if we suspend the magnet from a thread, it will swing around until the north-seeking pole faces the north and the south-seeking pole faces the south. This is the effect used in the magnetic compass.

Magnets and magnetism are used in a number of different ways in radio receivers. Headphones and loud speakers contain magnets. The transformers used in radio amplifiers depend on magnetism. Even the actual transmission and reception of the radio waves depends on magnetic principles.

Induction

One of the greatest discoveries in electricity was the fact that a magnetic field in motion will cause a movement of electrons which we know as an electric current. If we connect a coil of wire across an indicating instrument (such as a galvanometer, which indicates the presence of current) and run a permanent magnet through it, as shown in Fig. 9, the needle of the galvanometer will move, indicating the presence of current in the coil. The needle of the meter will quickly return to the zero position when the magnet is at rest in the coil. Then if we draw it out again quickly, the galvanometer needle will again move, but this time in the opposite direction. It will be found that the faster the magnet is moved, the greater will be the deflection.

If we substitute a piece of unmagnetised steel for the magnet there is no current indicated. The difference between the magnet and the steel is the presence of the magnetic lines of force surrounding the former. This experiment shows that whenever a conductor is placed in the presence of a moving magnetic field, a current is produced. This current is caused by *induction*.

A similar action can be obtained if the magnetic field is produced by a current instead of a permanent magnet. Suppose we wind two coils and place them end to end as shown in Fig. 10, one coil being connected to the galvanometer and the other to the battery, with a switch to open the battery circuit. When we close the switch, the galvanometer indicates a momentary current. Then open the switch again and the galvanometer needle shows another current, opposite to the first.

If we insert a piece of soft iron through the coils, the action is the same as before, but much stronger. This is the principle of the *tuning coils* and *transformers* used in radio reception. It will be noticed that we did not move the coil as we did the magnet. The magnetic field, building up in the coil when we closed the switch, gave the necessary "moving" field to induce the current in the second coil, or the *secondary*, as it is called.

Direct and Alternating Current

Up to this time, we have limited our discussion to currents flowing in one direction in a conductor. This type of current is known as *direct current*. It will be remembered that when the magnet was plunged into the coil and withdrawn, the current reversed its direction when the magnet was withdrawn. To state this in another way, we can say that the direction of the current was alternating in one direction and then in the other. This type of current is known as an *alternating current*.

Alternating currents are used extensively in radio. In fact, the radio waves themselves are alternating currents which reverse very fast, in the neighborhood of 1,000,000 times per second or even more. Currents which have a frequency (reverse their direction of flow) of less than 10,000 cycles (complete reversals) per second are known as *audio frequencies*, and those over 10,000 cycles per second as *radio frequencies*.

It is suggested that the reader perform the various simple experiments in this discussion in order to fix the facts firmly in mind, as these principles are all directly applicable to the operation of radio apparatus.

In the next issue, we will consider the construction of a simple and inexpensive short-wave receiver.

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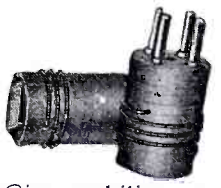

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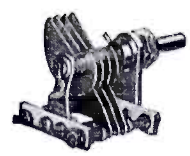

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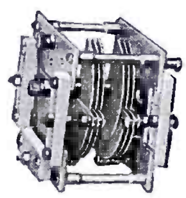

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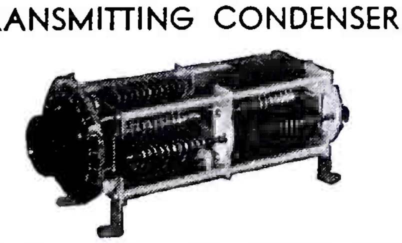

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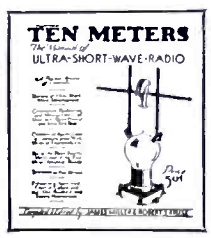

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Demonstrating Short Waves

By D. L. BARR

(*Continued from page* 153)

In the models of antennas furnished with the outfit, the lengths of the rods are adjustable by telescoping tubes, which may be adjusted to the proper length either by trial or measurement or both. For attaching the Hertzian antenna to the oscillator, posts are provided for attaching a coupling coil and the antenna rods may be attached to the ends of this coupling coil by resistance-box plugs, thus making good contact and serving as a support.

If a milliammeter is connected across the binding posts which are provided in the plate circuit, it will be noted that the greatest current is drawn by the oscillator when the radiating antenna is adjusted correctly to one-half wave length and when the coupling between the oscillator coil and antenna coil is increased. The coupling between these coils should be adjusted so that excessive current will not be supplied to the oscillator.

For coupling to the Marconi antenna, the oscillator is merely placed on the metal base, which simulates the ground connection, and the vertical antenna is inductively coupled by moving the oscillator loop close to the vertical rod. Maximum radiation will be obtained with the rod adjusted to one-quarter of the wave length being transmitted as shown by the maximum brilliancy of the bulb connected between the rod and the metal plate.

The waves are received by two telescoping rods comprising a linear Hertzian oscillator which has connected in its center a flashlight bulb. The receiving antenna should be adjusted to one-half wave length for maximum reception, and when properly adjusted, it will receive waves being transmitted from the Hertzian or Marconi antenna at the transmitter at a distance of several feet.

Polarization Experiments

Many interesting experiments may be shown with this receiving antenna. The waves are proved to be *polarized* in one plane by noting that minimum reception is obtained when the receiving antenna is rotated so that it makes an angle of 90 degrees with the transmitting antenna. *Standing waves* may be shown to exist in the space between the transmitter and a reflector. The reflector may be a straight rod, one-half wave length long, which may be placed at various quarter-wave distances from the transmitter. A screen made of several parallel wires spaced about four inches apart and of the length of the radiating antenna will screen these waves when they are placed *parallel to the radiating antenna, but not when they are placed at right-angles to it.* If a meter is substituted for the bulb in the receiving antenna, field strength measurements may be made, and it may be shown that *beam transmission* occurs with the proper reflectors.

There is furnished for teaching purposes a loop aerial adjusted to 150 meters which may be plugged into the oscillator circuit, and a similar loop connected to a straight detector and resistance-coupled amplifier circuit. A dynamic loud-speaker is connected to this amplifier and a microphone is connected to a small absorption loop. When the waves travel from the transmitting to the receiving loop, nothing but a slight hum is heard in the speaker; but when the *absorption loop*, which is attached to an extension handle, is brought in proximity to the transmitting loop and the microphone spoken into, the waves are modulated by the absorption circuit of the loop and microphone, and sound-waves issue from the loud-speaker. This experiment shows to a school class (or club, etc.), in a rather graphic way, how modulation of inaudible radio waves is accomplished.

Limiting the Tuning Range of Short Wave Receivers

By R. NEUROTH

(*Continued from page* 150)

100 mmf. the total capacity of Ca and Ck would fluctuate say between 10 and 16 mmf. (According to the formula for series connection of capacities.) Now on the other hand if we set Ck for 5 mmf. then the capacity from Ca plus Ck will lie between 3 mmf. and 4.5 mmf. In the first case we therefore have a capacity change of about 6 mmf, in the second case only 1.5 mmf. With simple parallel connection of an equalizing condenser to C of course, as things come out, nothing would be gained, for with a single fine adjustment condenser with fixed capacity value, it is not possible to make such fine adjustments as with the arrangement of C, Ca, and Ck. As is easily calculated from this formula:

$$\lambda_{cm} = 2\pi\sqrt{C_{cm} \times L_{cm}}$$

with the indicated capacities by means of the arrangement described the tuning range of such oscillation circuits can directly be limited to wave bands of 1 to 4 meters.—*Funk Bastler.*

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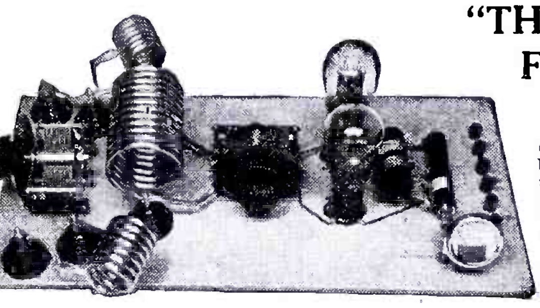

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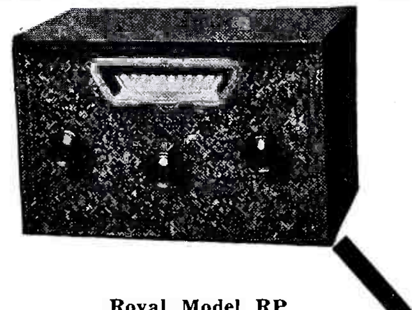

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How to Become a Radio Amateur

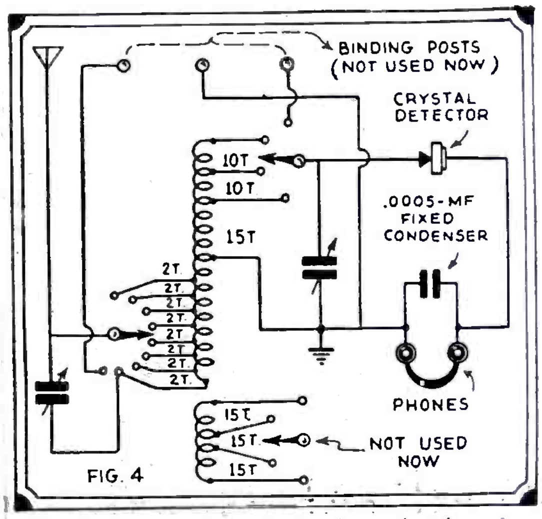
By JOHN L. REINARTZ

(*Continued from page* 143)

front from being marred, as the parts are spaced so that each half of the panel balances the other half. No trouble will be experienced through drilling all holes from the back of the panel. Over the center top of each dial on the front of the panel make a line a half inch long for a reference line, rub some white paint into it so that it can be seen plainly. Be sure to remove any excess paint that may have gotten on the panel.

Connecting the Parts

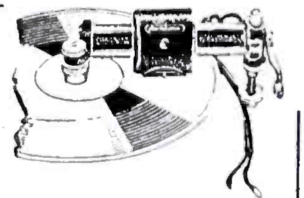
After all the parts are mounted we connect the coil to the switch points at the rear of the panel, starting with the beginning of the windings as number one. Looking at the rear of the panel, the right-hand top switch point will be number one, the next loop connects with number two switch point next to number one, the next to number three, the next to number four; that ends the first set of loops. Now we go to the center switch points. This time we go from right to left, leaving the first one blank for the time. Connect coil wire number five to the second point, number six to the third point, number seven to the fourth point,



Mr. Reinartz's simple receiver circuit using a crystal detector.

number eight to the fifth point, number nine to the sixth point, number ten to the seventh point, number eleven to the eighth point and number twelve to the ninth point. Number thirteen we connect to the rotary plate connection of the left hand condenser looking at the rear of the panel. Number fourteen loop of the coil connects to the bottom switch point of the left-hand set looking at the rear of the panel, number fifteen to the next point to it, number sixteen to the third point, and we leave the last or top point empty for the time being. This connects the coil into the receiver.

Still looking at the rear of the panel, we connect a wire from the top left-hand binding post to the stationary plates of the left-hand condenser. This same wire also connects with the left-hand switch lever. The bottom binding post on the left-hand side connects with the rotary plates of the left-hand condenser and to the bottom binding post on the right-hand side of the panel. The top binding post on the right-hand side connects to the bottom switch lever in the middle of the panel and also to the rotary plates of the right-hand condenser, while the stationary plates of the same condenser connect with number five end of the coil. The three binding posts at the top center of the panel connect to the switch points as follows: at the rear of the panel the left binding post connects to the top switch point of the left lever. The center binding post connects to the rotary plates of the left condenser, and the right binding post to the empty point on the bottom set of points. We have



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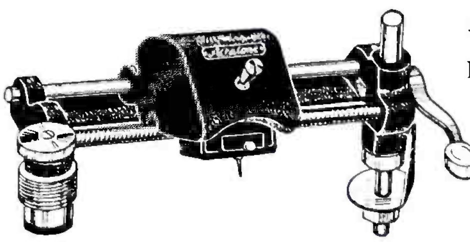

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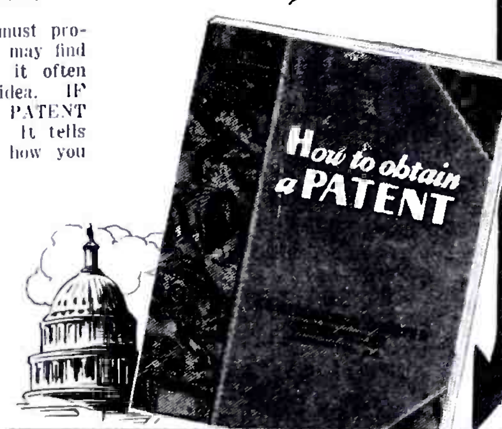

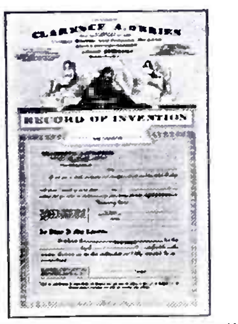

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Clarence A. O'Brien, Registered Patent Attorney, 23 A Adams Building, Washington, D. C.

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(Important—Write or print plainly)

now completed the entire panel connections and proceed to mount the panel in a nice-looking cabinet of your own choosing.

Next we take a small wood base and mount on it two battery clips, one with the jaws vertical and one with the jaws horizontal, about three inches apart. See Fig. 3. One of the clips will hold a piece of galena crystal, which can be purchased from most radio supply houses for about twenty-five cents and the other will hold a piece of brass rod with a handle on one end and a piece of No. 30 or 32 copper wire on the other. This "cat whisker" wire is to just touch the piece of galena crystal. The jaws of the clip will allow it to be moved about until the most sensitive spot on the crystal is found. This crystal is connected from the top right-hand binding post on the front of the panel to a pair of phones and then back to the lower right-hand binding post on the front of the panel. The antenna connects to the top left-hand binding post and the ground connects to the lower left-hand binding post.

We are now ready to try out the receiver. If we are near a powerful transmitting station we will have no trouble adjusting the crystal for greatest sensitivity. If we are more than twenty-five miles away from a station we will have to get ourselves a small buzzer and connect it to a dry cell and a push-button. We connect one wire from the buzzer to the antenna connection and while it is buzzing adjust the crystal for the greatest response in the ear phones. Then we shut off the buzzer and try different switch points with the center and the right hand switch levers until we hear a station best. The tuning range as we have built the set is from 100 meters to 500 meters. This will take in the police transmissions, many amateurs and all the broadcast stations between 200 and 500 meters.

The left-hand switch lever is not in use, nor are the binding posts in the top center of the panel. These we are going to use later when we change our crystal detector for a tube detector.

It may be necessary to shunt a small fixed condenser across the phones. Try a .001 or a .0005 mf. We can use it later, so it won't be wasted. The complete schematic diagram is shown in Fig. 4.

In our next article we will show you how you can add a tube detector to this receiver with very little trouble and not have to undo a thing.

New Five Meter Apparatus

In keeping with their policy of ever being in the van of short-wave progress, the Royal Short-Wave and Television Company of New York City have just announced through their distributors, the Harrison Radio Company, the introduction of several new five-meter receivers and transmitters.

Model RE is a three-tube super-regenerative receiver using two type 237 tubes and a type 238 power pentode output tube. By painstaking research and experimentation this company has developed a superior receiver giving unusually fine results. Outstanding features of this receiver are all aluminum chassis, micro-vernier full-vision dial, wavelength range of 3 to 10 meters, no special antenna needed, extremely easy operation, and the use of highest grade apparatus throughout. Batteries required are three 45-volt "B" batteries and a six-volt storage battery or four dry cells. By use of special AC tubes the entire receiver may be operated from a power-pack.

Because of its compact size and light weight this model is excellent for use as a portable. It is ruggedly built to withstand hard knocks and to give consistent service.

Transmitter, Model TE, is a compact, highly efficient push-pull oscillator using any UX base tubes from '99s up to '10's. Special provision is made for its use as a phone transmitter. A power-pack or batteries may be used; it needs only an 8 to 12 foot antenna.

It must be borne in mind that five meters is useful solely for short-distance work. The average range of a low-power transmitter is only about 6 to 12 miles.

No Fading With These Aerials

(*Continued from page* 142)

Between the ends of the beams are stretched the most varied wires and ropes. About 15 meters (49.2 ft.) apart lie four square of wire contains four wires a, a_1, b, b_1, mutually separated by several insulators. Each of these wires is again 15 (49.2 ft.) meters long. Two wires in each square, a and a^1, b and b^1, always form together an antenna. Each wire oscillates in half a wave length, and also in fact the individual antennas in each square, taken together with half a wavelength phase displacement, with regard to the antennas of the square lying below. Besides this, however, the four individual antenna wires of each square work together as follows:

Wires a and b or a^1 and b^1 oscillate in the same phase, but the wires a^1 and b^1 are again displaced in phase 180 degrees or half a wavelength with respect to a and b. The lead wires are attached at corners A or B. The ends lying at these corners of antennas a are joined together by a conductor La; the ends of wires a^1 by a conductor La^1; correspondingly antennas b by a conductor Lb and antennas b^1 by a conductor Lb^1. These conductors lead to the transmitter as so-called energy conductors.

According to theoretical calculations the new antenna produces at the point of reception, *eight times as much reception energy;* in practice, however, the signals are radiated in all directions equally. It forces the waves, as it were, toward the ground, and above 20 degrees from the transmitting antenna, sends practically no wave out into space.

The antenna plan as drawn does not entirely correspond to the antenna actually built, but shows better than any photograph the effect and operation of the new antenna.

TELEVISOR

Most efficient televisor produced for home use. Equipped with Duraluminum lens disc 16" diameter. Each of its 60 lenses accurately adjusted focally to produce clear, definite images on screen. Disc driven by heavy duty Synchronous motor, with switch and framing device operated from front panel.

SHORT WAVE

The Rawls Short Wave Unit in connection with the broadcast receiver has been especially designed for long distance short wave reception from 15 to 200 meters, Super Heterodyne Circuit incorporating 9 tubes in the combination. The use of the new multi mu and pentode tubes give exceptional tone and power. To switch from one short wave band to another, it is unnecessary to change coils—just the click of a panel switch and the change is made automatically.

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A six-tube receiver, designed to give the ultimate in tone, selectivity and power. Uses the following tubes: two 235 Multi Mu, one 224A Detector, one 227 and one 247 Pentode output with 280 rectifier. The tone quality of the set is due to the accurate matching of all parts. Its eight-inch Dynamic speaker handles, without distortion, the tremendous output of the pentode tube. Designed especially for reception of the synchronized voice with television image.

TELEVISION

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USING MICROMIKE WITH POWERIZER

MAKING AND USING 4 INCH WAVES

By H. RINDFLEISCH and DR. L. ROHDE

(Continued from page 159)

will be pointed out that with a simple detector-receiver in the vicinity of the transmitter, one can conveniently test the modulation.

The Magnetron

An entirely different and quite peculiar method of producing electron oscillations depends on the effect which a magnetic field exerts on the paths of flying electrons. In this case tubes are used having only a filament and a cylindrical plate. The electrons, normally flying radially from the cathode to the plate, describe, under the influence of the magnetic field (which is produced by a coil applied on the outside) curved paths, analogous to the deflection undergone by a conductor with current flowing through it in the magnetic field. With a definite strength of the magnetic field the deflection of the paths is so great that the electrons only just reach the plate. Then the conditions are propitious for the formation of electron oscillations, for whose frequency the running time from cathode-to-plate is the determinant. With such tubes, which bear the name *magnetron* (German tube) one can in the case of the one-meter wave length, produce up to 10 watts, while the shortest attainable wave length has been 6 cm. (2.4 inches).

Propagation of Decimeter Waves

The shorter the waves, the nearer they approach the light waves in their propagation. Hence the waves of less than one meter (3.28 feet) in length become an important means for communication within the field of optical vision. Reception is possible only at points *at which there is a clear view to the transmitter*, for which reason locating the sets high up is advisable. Experiments have shown that reception is strongly affected by obstacles in the way of direct vision, like trees, houses, and the like. In this the decimeter (.1 meter or 3.28 inches) waves accordingly differ entirely from the waves of 6 to 9 meters (19 to 29 feet, approx.) which, because of their favorable propagation conditions, were proposed years ago by Prof. Esau for *local* radio broadcasting. In contrast with optical methods of signalling, the electric ones have the advantage of being independent of the state of the atmosphere. Since the energy can be concentrated in a very sharp pencil, and also since there is the possibility of strong low frequency amplification, on account of the unimportance of atmospheric disturbances in this region, the range of a decimeter (.1 meter) wave transmitter is, above all, limited only by the bounds of direct vision. For two points with heights h_1 and h_2, this is calculated as.

$$a_{km} = 113\left(\sqrt{h_{1\,km}} + \sqrt{h_{2\,km}}\right) \qquad (4)$$

On the ocean there results, for example, for two sets raised 10 meters (32.8 feet) above sea level, a range of 22.6 kilometers (13.56 miles).

The special advantage of the decimeter waves as against one-meter waves lies in the convenient possibility of concentrating the energy with mirrors. For one-meter waves the mirrors take on huge dimensions and therefore are impractical, especially for most transportable sets. A decimeter wave mirror, on the other hand, already has very handy forms. In the simplest form it consists of a plane quadratic sheet of metal, which is set up behind the transmitter, parallel to the plane in which the radiation dipole and Lecher system lie. One attains thereby a concentration of the energy in a ray, perpendicular to the plane of the mirror, so that in a receiver located in this direction an amplified sound intensity is attained, while outside the ray no reception is possible. The directional effect is, at the same time, much sharper than is attained with directional antenna systems with short waves of 20 to 40 meters (1 meter equals 3.28 feet).

The edge length of such a mirror must be at least 1.5 times the wave length. An important factor is the right distance from the transmitter; if one increases the distance and at the same time observes in a receiver the sound intensity in the direction of radiation, then one determines periodic *maxima* and *minima*, which follow at distances of one-quarter the wave length. The first maximum lies about .2 of a wave length from the dipole; frequently a better directional effect is obtained by operating in the second maximum.

Instead of the solid metal mirror one can also used mirrors of wire netting or wire mesh, which give about the same amplification and are especially suitable for portable sets, on account of their slight weight.

The greatest amplifications are obtained with cylindrical-parabolic or paraboloid mirrors, as they have been used above all with 20 cm. (8 inch) waves. Likewise, at the receiving end mirrors have an amplifying effect, which however in the case of the same arrangement is less than at the transmitting end.

Reception Methods

The decimeter (.1 meter) waves could not be used for communication until one had learned to build sufficiently sensitive receivers, which was chiefly made possible through the

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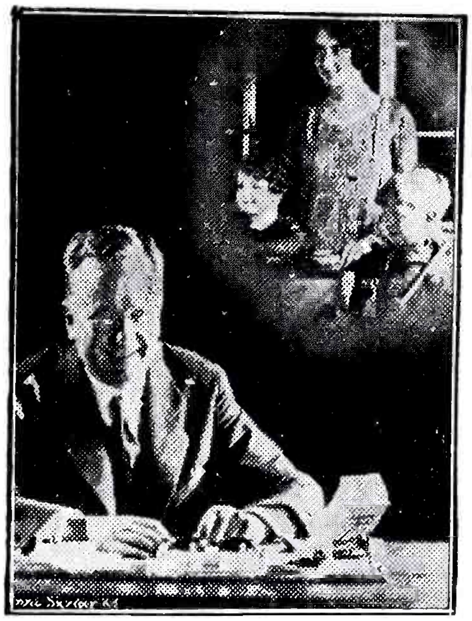

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use of the *super-regenerative* method of reception. First, however, take a glance at the simplest receiver (Fig. 7). It consists of a tuned dipole, whose halves are joined by a detector T. From the detector a conductor leads via chokes to the phones. It is not a question of exact tuning, since on account of the high detector resistance, the dipole becomes almost aperiodic. This fact one can also use for testing the transmission modulation, since such a dipole cannot receive a transmitter with only *frequency modulation*.

For the detector there come in question only a few of the combinations usual with longer waves. By experiment the old Telefunken detector with pyrites and a gold point has proved very serviceable; likewise the steel-carborundum combination. On account of its very slight sensitivity, the detector receiver can be used only extremely close to the transmitter, say, for testing the modulation, the directional sharpness, etc.

The *polarization* of the waves can also be very beautifully demonstrated with it. One hears only when the receiving and transmitting dipoles (aerials) are approximately parallel. For increasing the sensitivity one can use instead of the crystal detector a vacuum tube with galvanically coupled, tunable Lecher system. Even here, however, the running times of the electrons can make themselves disturbingly perceptible. In the receiver it is better to use the same principle as in the transmitter, and to construct a sort of oscillation detector in a Barkhausen hook-up. At the start of the oscillations, as we already saw in the transmitter, a rectifier effect of course sets in in the plate circuit, whereby the high frequency can be demodulated. One therefore gets maximum reception sound-intensity in the field of the strongest change of the rectifier effect.

Basically, the receiver does not differ in its construction from the transmitter: only in its case the Lecher system is not needed, which is used at the transmitting end to increase the energy. The dipole is directly connected to the electrode lead-outs, and for tuning to the transmitter wave it is provided with a mechanism (geared) for changing its length. For reception one first tunes the dipole approximately to the transmitter wave, and then starts the electron frequency in the tube for regulating the voltages. By increasing the heating the emission is then increased, until the oscillations set in, when one tunes the dipole to the maximum sound intensity. It is best to have the phones in the plate circuit.

For reception the same tubes are suitable as for transmitting, especially also the double grid tube.

Heterodyne reception has thus far not been worked out for decimeter waves, since the constancy of frequency of transmitter and receiver is far from sufficient.

Super-Regeneration

A number of the above difficulties of reception can be removed by using super-regeneration (Figs. 8 and 9). The grid direct potential has superimposed an auxiliary frequency lying above the limit of audibility, the latter being so regulated that the oscillations start and stop in the rhythm of the auxiliary frequency. By this means one attains the high amplification characteristic of super-regeneration. A special advantage of the use of this reception principle for decimeter waves lies in the fact that because of the superimposed auxiliary frequency the wave of the receiver fluctuates- whereby an easier tuning of the receiver results. One obtains, so to speak, a wide resonance curve with high amplification. The super-regeneration frequency may also be produced in the same tube by using the falling characteristic of the plate current, which results for some oscillation fields (Fig. 10).

A disadvantage of the super-regenerative reception is the well--known whistling noise.

For every receiver a high position is desirable, aside from the thereby increased range, so that there may not be disturbing reflections from the ground, due to the brushing fall of the wave.

—TELEVISION—

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How Far on What K-C?

(*Continued from page* 160)

ception in the presence of actual background noise. For the broadcasting frequencies this does not mean satisfactory program reception. The limiting field intensity is taken to be 10 microvolts per meter for frequencies up to 2,000 kc., decreasing from this value at 2,000 kc. to about 1 microvolt per meter at 20,000 kc. When atmospherics or other sources of interference are great, *e.g.*, in the tropics, much larger received field intensities are required and the distance ranges are less. The graphs assume the use of about 5 kilowatts radiated power, and non-directional antennas. For transmission over a given path, received field intensity is proportional to the square root of radiated power, but there is no simple relation between distance range and either radiated power or received field intensity.

Separate graph sheets are given for day and night transmission. Above about 3,000 kc., as shown, the distance ranges (and in most cases also the skip distances) are greater in the winter than in the summer. The distance ranges in spring and autumn are intermediate between the limits shown for summer and winter. In general, the distance ranges for paths which lie partly in day and partly in night portions of the globe are intermediate between those shown in the day and the night graphs. For such paths, the distance ranges are greater than would be expected from inspection of the day graph, as the waves under these conditions travel over greater distances in the illuminated portion of the earth's surface: for this reason it is possible to use a lower frequency for a part day, part night path than is indicated for the day portion of the path on the day graph.

The distance ranges given in the graphs are the distances for reliable reception; they are not the limits of distance at which interference can be caused. A field intensity sufficient to cause troublesome interference may be produced at a much greater distance than the maximum distance of reliable reception.

An Automatic "CQ" Call for the Amateur

(*Continued from page* 172)

so that the illumination of the photo-cell would be insufficient. The width of the ray is best chosen as 20 mm. (.8 inch) (width of disc); the height is on the other hand to be made as small as possible (1—3 mm. or .04 to .12 inch). As a source of light one can use any usual projection lamp of high candle-power. The colored glass can be inserted at any desired place between the source of light and the slit.

Regarding the details of construction of the rotating parts, a few words may be said. It is well to select the disc 200 mm. (8 inches) in diameter and 20 mm. (.8 inch) thick. For propulsion one can use the spring system of an old phonograph, on the hub of which is put a pulley 50 mm. (2 inches) in diameter. Of course one can also use a small electric motor, but it must be possible to regulate the number of revolutions, which must be relatively small on account of the small size of the code signals applied to the disc. The number of revolutions must be between 5 and 40 per minute.

Since the signal band is the principal part of the machine, it is to be made with the greatest care. As already said, we use for it white glazed paper and the strip of paper must be 628 mm. (25.1 inches) long. In putting on the signals it is to be watched that a coloring matter is used which absorbs as strongly as possible the rays of light striking it. In the case of a photo-cell with a potassium cathode, one uses for this purpose red color. If the photo-cell is provided with a copper cathode, then one uses as filter a red glass and for "writing" indigo blue or, still better, violet. The code dots are made 6—7 mm. (.24 to .28 inch) long, the dashes being 2 to 2½ times as long.

Cell Should Have High Sensitivity

In choosing the photo-cell one will naturally take care to use a cell of high sensitivity. Therefore the photo-cells filled with an inert gas are preferable to vacuum cells, for the inert gas cells are about ten times as sensitive. Also in the case of these an ordinary, two-stage audio frequency amplifier is sufficient to activate the relay of the transmitter.

The arrangement of the discs is seen in Fig. 4. The two discs, made of light wood, each 20 mm. (.8 inch) wide, are mounted 10 mm. (.40 inch) apart on a metal socket, in such a way that they are fixed firmly on the socket, whose diameter may be chosen at will. The length depends on the number of discs, since one can of course also use more than two. The socket is fixed so as to be easily slipped on the propulsion shaft and is provided with a slit 30 mm. (1.2 inches) long (from the middle of disc 1 to the middle of disc 2). On the same axle or shaft is the propulsion pulley, which is to have a diameter of 100 mm. (4 inches), if the spring system of a phonograph is to be used for propulsion. Then one obtains a maximum rotation of 40 revolutions a minute.—*Rafa.*

An Amateur Receiver with New Kinks

By REX E. LOVEJOY

(*Continued from page* 166)

number of turns is given in the table under Fig. 1.

C11 and C12 are 1 mf. by-pass condensers and may be placed in the power-pack or in the receiver proper.

The panel should be of aluminum, copper or brass, to eliminate body capacity effects, etc. A metal subpanel is advisable, with filament wires below it and all other wiring above. A non-metal subpanel can be used; if the filament wires are twisted together and kept as far from other wiring as possible, induced hum will not be noticeable.

For amateurs desiring to listen to phone transmission, it is better to substitute 1 mf. condensers for the 0.01 mf. condensers used as C8 and C10. For C. W. work there is no benefit.

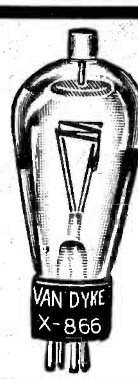
The author has tried several types of tubes for T2 and has found that a '24 is best of all. More volume was experienced with a '24 than with a '47 pentode and the former's high sensitivity brings signals through that cannot be heard at all with a pentode or a type '27.

List of Parts

C1, C2—See text for details.
C3—0.00015 mf. variable midget condenser (23 plates).
C4—0.0001 mf. fixed condenser.
C5—0.0001 or 0.00025 mf fixed condenser.
C6, C8, C10—0.01 mf. fixed condensers.
C7, C9, C11, C12—1 mf. fixed condensers.
R1—3 megohm grid leak.
R2—0-100,000 ohm potentiometer.
R3—2 megohm grid leak.
R4—400 ohm bias resistor.
R5—20 ohm center-tapped resistor.
L1, L2—Tube-base coils.
L3, L5—Audio transformers—primary and secondary windings in series (see text).
L4—Radio-frequency choke, about 80 millihenries.

Tube Base Coil Data
No. 30 S.S.C. Wire

Band	*Number of turns* L1	L2
80 m.	25	11
40 m.	12	9
20 m.	5	7



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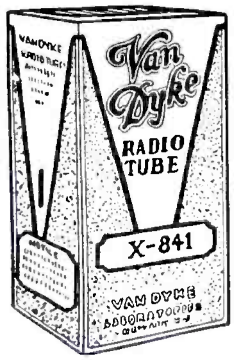

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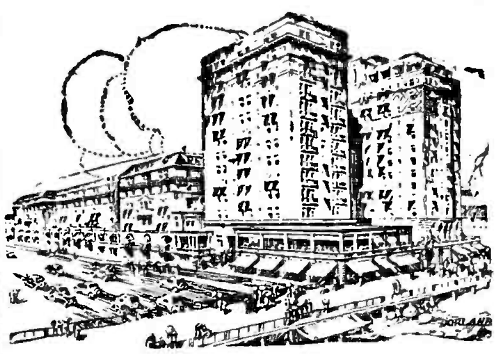

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HOW TO LEARN THE CODE

By H. L. BLOXOM

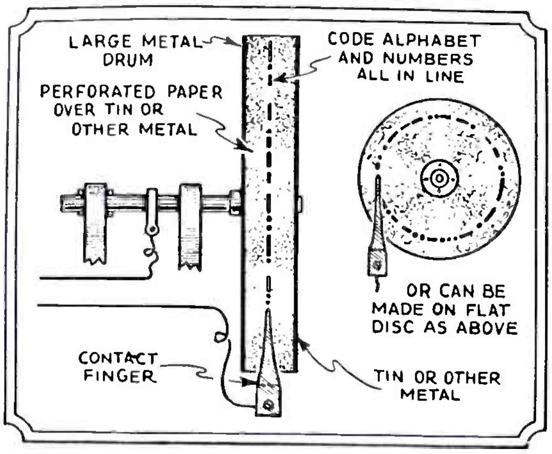
(*Continued from page* 157)

an eight-penny nail by hammering and dressing until the end presented a square with clean cut edges. The second was made from a much larger nail. The heads were cut off and the punches made short to improve their cutting qualities. Then a piece of hard, thick cardboard was placed upon a smooth solid surface and the paper to be punched was pressed down upon the cardboard with a straight edge, so that the edge of the paper was exactly parallel to it. With a light hammer the punches were driven through the paper into the cardboard to form the characters as shown in the second illustration. The punch with the square end was used for the dots and the larger punch for the dashes. Between dots and dashes a space equivalent to one dot was left, but between letters more than the ordinary space was left to give greater time for recognition.

Several rows were made on one sheet, since the contact brush could be made to follow any one of several rows by simply bending it into place. In these rows a letter that is often mistaken for another was arranged to succeed the one it resembles. Compare in succession, for instance, V, X, Q, and C; or W, R, L, and D. Several such sheets with letters rearranged, and with short words, were also prepared. Such words as *the, this, that, and,* etc., may well be learned as units.

Paper Wrapped Around Drum

One of these sheets was wrapped around the drum so that its ends matched perfectly and was held in place by stout rubber bands along the edges, or simply glued. When two dry cells and a buzzer were connected in series with the assembled device and the crank was turned slowly and steadily, the buzzer repeated the letters with surprising and pleasing accuracy, so that mistakes that had been made in keying could even be detected.



One way to arrange the code drum—use a large diameter form to accommodate the whole code.

Contrary to what one might think, previous knowledge of the order of letters did not relieve the effort required to name the letter sounded, for by turning at just the right speed the learner's attention was devoted entirely to the recognition of letters, rather than the recall of arrangement. The element of surprise remained and it proved excellent practice.

It is bad practice to listen long to code that is sent too fast, recognizing letters here and there while those intervening escape attention. It develops a habit of suspended attention that is very hard to overcome. The advantage of this device is that the listener can control the speed and develop a tendency to associate absolutely every group of sounds with the intended meaning. It is certainly worth the time required to construct it.

See Next Issue—
The "MEGADYNE"
Hugo Gernsback's Newest Sensation in S-W Receivers!

A De Luxe Amateur Station Built in a Tiny Space

By ROBERT HERTZBERG

(*Continued from page* 141)

tions excepted, it contains a single card for every short-wave station in the world, each card being marked with call letters, location, name of owner, frequency, and class of service. Cards of different color are used to distinguish between different classes of stations, the color scheme being as follows: white, land telegraph stations; cherry, ship stations; blue, land phone stations; green, aircraft stations; brown, television stations; yellow, beam transmitters; and orange, portable stations.

In checking and maintaining this extraordinary "log," Mr. Parsons follows the Radio Service Bulletin of the Department of Commerce, the Berne list, and numerous call books. The amount of time and effort involved in this undertaking may well be imagined. Fig. F shows a close-up of Mr. Parsons at the filing cabinet.

The walls of the room are filled with large maps, and a 15-inch globe occupies a prominent position on the left of the operating table.

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Partial List of Contents

The "S. W. C." Two Tube Portable Works "Speaker"—Clyde Fitch

How to Operate a Short Wave Receiver

Two-Volt Tube Receiver

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"My Favorite" Short Wave Receiver—F. H. Schnell

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How to Obtain Smooth Regeneration in S. W. Receivers—"Bob" Hertzberg

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How to Build the S. W. Superregenode—Clifford E. Denton

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Short Wave Converters—How to Build Various Types

A Short Wave "Fun Box"

How to Build a Good Television Receiver—R. William Tanner

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New Tubes for S.W. Receivers

By LOUIS MARTIN

(*Continued from page* 163)

in *short-wave* work, when they are *small*, then every precaution must be taken to stabilize the mu of the tube.

The requirements of a tube in order that it be suitable for short-wave work, then, are as follows:

(1) Low grid-to-plate capacity, in order to minimize oscillation;

(2) High amplification factor (mu) in order to secure high gain but at the same time have a low input capacity. As may be seen by reference to the formula above, this may be secured by making the grid-plate capacity as low as possible, as stated in (1);

(3) Have a rigid construction, thus minimizing microphonic noises;

(4) Be of the "low noise" type, that is, they should not generate any (or at least a small amount of) noise so that reception of weak signals is possible.

How the latest tubes meet these requirements will be seen in the following discussion.

Tube Factors that Effect Tuning

This new tube, illustrated in Fig. A, while not especially adaptable for short-wave work, will be described because it is one of a series of new tubes which may be used as either amplifier, detector or oscillator.

In appearance and general construction it is similar to the familiar '27, which has found such wide application in radio. The size of the envelope, however, has been reduced, the plate blackened and the filament consumption reduced to 1 ampere.

The following are the characteristics of the tube when used as a *class A* amplifier:

Heater voltage, 2.5; plate voltage, 250 (max.); grid bias, —13.5 (if a grid-coupling resistor is used, its value should not exceed 1 megohm); amplification factor, 13.8; plate resistance, 9500 ohms; mutual conductance, 1450 micromhos; plate current, 5 ma.

When used as a *biased* detector, the grid bias should be changed to —20 volts; the plate current should then be 0.2 ma. with no A.C. signal input.

When used as a *grid-leak* detector, the grid condenser should have a value of .00025 mf. and the grid leak 1 to 5 meghoms.

As an *oscillator*, the plate voltage may have a value of 90 volts and the grid bias a value of 0 (returned directly to the cathode).

The connections, looking *down* on the socket, are as shown in Fig. 5.

For purposes of comparison with other tubes to follow, the various capacitances of the tube are as follows:

Grid-plate capacity, 3.2 mmf. (micro-microfarads);

Grid-cathode (input) capacity, 3.2 mmf.;

Plate-cathode capacity, 2.2 mmf.

As stated heretofore, this tube has no really important meritorious features which warrant its use in short-wave receivers, but it is described solely for the purpose of comparison with the types "57" and "58" to be described shortly.

The "57"—Amplifier, Detector

Figure B shows a tube that is especially adaptable for short-wave work inasmuch as special precautions have been taken to reduce the *inter-electrode capacitances*. This tube is especially suited as a biased detector in A.C. operated receivers. Other uses are as a *screen-grid amplifier* for small signals and as an *automatic volume control* tube. For *short waves*, however, the only interesting feature is its use as a *detector*.

The *suppressor grid* (third grid) used in this tube is placed between the screen-grid and the plate and has its own base-pin connection; this grid may or may not be connected to the cathode, depending upon circuit requirements. When the cathode *is* connected to the suppressor grid, the tube is a typical pentode and is effective in eliminating the effects of secondary emission from the plate, thus producing a smooth plate-voltage—plate-current curve.

The effect of this connection, therefore, is to make possible the efficient operation of the tube at low plate voltages—which is not possible with present-day four-element tubes. In view of the above, of course, it cannot be used as a dynatron oscillator.

When the suppressor grid is *not* connected directly to the cathode, the tube may be used in a number of unique ways for obtaining modified tube characteristics and for the application of the tube to special circuits.

An *internal shield* is a distinctive feature in the design of this tube. As may be seen by reference to the photograph, it is placed in the bulb dome above the element assembly and is connected within the bulb directly to the cathode. *This dome top bulb makes possible the close proximity of the external and internal shields.* The close spacing of the two shields makes available a low effective grid-plate capacity, which is all important in short-wave work. In fact, the physical shape of the

(*Continued on page* 188)

A New High Gain T.R.F. Receiver

(*Continued from page* 156)

background noise, which, added to that already prevalent on short waves, mitigates strongly against the use of such a receiver. While it is true that by special design, such as directional systems and the highly elaborate receivers employed commercially in trans-oceanic work, these disadvantages can be considerably circumvented, the cost is prohibitive as far as the amateur and the experimenter are concerned.

A highly efficient tuned radio frequency receiver, such as that diagrammed in Fig. 1, and photographically displayed in Figs. 2, 3 and 4, is probably the amateur's best bet. The efficiency attained through the use of the laboratory apparatus previously referred to, plus the added advantages contributed by the new radio frequency pentodes, result in sensitivity and overall characteristics which compare favorably with those of a high grade superheterodyne, with the added recommendations of simplicity and economy. This receiver represents the most advanced stage in the evolution of the famous line of "Thrill Boxes"—the SW-3, SW-5, the SW-45 and the SW-58.

The R.F. Pentode

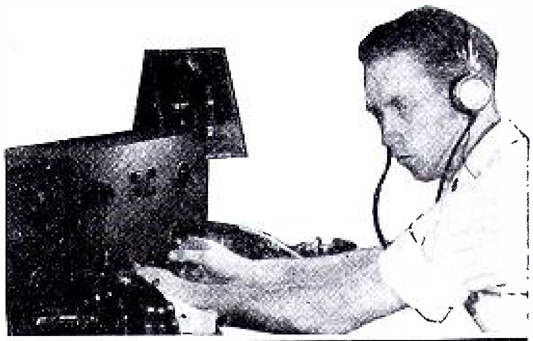
The type '58 tube has been made to order for a circuit of this design. Its high amplification factor, trans-conductance, and above all its high plate impedance, enable the engineer to obtain a degree of sensitivity and selectivity in the radio frequency circuits which has previously been impossible.

These tubes, having twice the impedance of the '24, of course necessitated the design of special coils, data on which are contained in the following coil table:

Coil Winding Data

Coil	*Primary*	*Secondary*	*Tickler*
No. 61	6¼ turns	6¼ turns	2 turns
No. 62	10⅝ turns	11⅝ turns	2½ turns
No. 63	15⅝ turns	19⅝ turns	3 turns
No. 64	28⅝ turns	34⅝ turns	3 turns

The tuning curves in Fig. 5 show the manner in which the various bands are covered with these coils. The inductors are wound on the low loss R-39 material, which, in conjunction with Isolantite, is the only insulating material employed in the SW-58. The two tuning condensers each have a capacity of 90 mmf. and the R.F. choke has an inductance of 2.5 m.h.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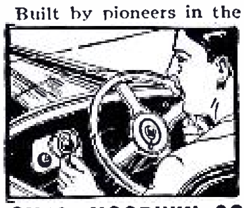

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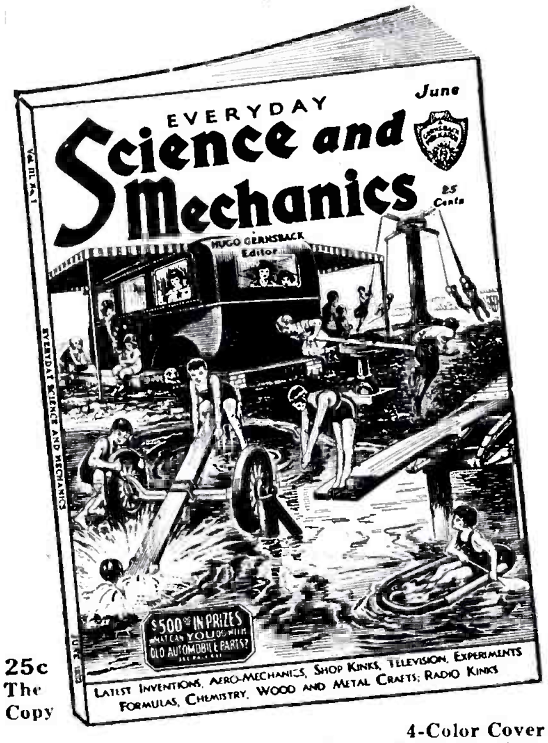

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Short Wave Events of the month

May 2—Short waves carried concert from large airplane flying over New York City to special pick-up station and antenna mounted on the roof of the Columbia Broadcasting System Building, from which it was broadcast over the Columbia network throughout the country.

May 14—Blimp was used to direct traffic during "Beer" parade in New York City. The location of traffic snarls was radioed by short waves to police headquarters and short wave orders relayed in turn to police cars stationed along the route.

May 15—Westinghouse Electric & Mfg. Co., at East Pittsburgh, Pa., announced that the short wave transmitting equipment of the Westinghouse radio station W8XK has been consolidated with the broadcast wave transmitting facilities of KDKA, the famous station located at Saxonburg, Pa., about 30 miles from Pittsburgh.

May 17—Television demonstrated on ultra short waves on a wavelength of 6.8 meters from the R. C. A. transmitter on top of the Empire State Building, New York City, the images having been picked up and demonstrated at a private exhibition to the licensees of the R. C. A., shown by means of the new R. C. A. cathode-tube receivers. The image was about 5 inches square and said to be quite clear. Direct pick-up of living persons as well as images from movie films were shown. After the demonstration it was reported that the R. C. A. officials said their television apparatus was not yet ready for the public and that it was not to be shown before it was suitable and in satisfactory form to be used for public entertainment.

May 21 (London)—Passengers traveling from London to Glasgow on the crack train, The Flying Scotsman, at a speed of ninety miles an hour, today directed by short wave radiophone the movements of a forty-passenger air liner Hercules, flying overhead. Pilot O. B. Jones turned the machine whenever requested, while several of his passengers spoke with persons aboard the train. This is believed to have been the first two-way conversation between an airplane and a train. An aerial was slung inside the observation car, as there was not sufficient clearance on the roof when the train passed under bridges.

Short Wave League

(*Continued from page* 155)

Short Wave League:

I buy your magazine from the newsstand every month and think it a fair magazine. Lately you are having too many articles on "Ultra-Short-Waves."

I certainly agree with you that a C-W examination does a 5-meter phone operator no good. If it wasn't for the code exam. I would be operating a good transmitter at 5 meters.

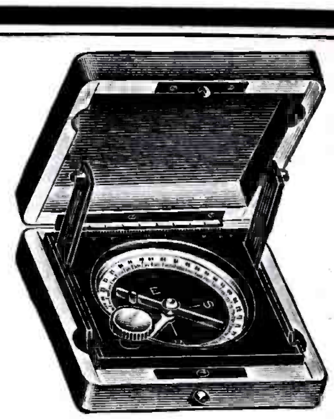
I have built many receivers and know what kind of results that I can get. But if I built a transmitter I couldn't even test it just because of the C-W exam. required by the F.R.C. If I operated on 5 meter phone I would try to experiment with different apparatus to get as good DX as possible.

The transmitter I have in mind is the one described in April SHORT WAVE CRAFT, and would use a 250 modulator and 2 amplifiers with 500 volts on plate from 2 81's.

I think this arrangement would work but I can't, as you know, test it.

Hoping that the F.R.C. omits the C-W exam, I remain, a

"Would-Be Ham",
CLARENCE GRIMM,
Mt. Prospect, Ill.



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May Be Used As a Galvanometer

Because of its uniform magnetic properties, high sensitivity, and delicate frictionless bearings, the Stoppani compass may be utilized to advantage as a highly precise galvanometer **for detecting electric currents in experimental or conventional radio circuits**. The Compass is easily and readily converted into said galvanometer by merely winding several turns of ordinary radio wire completely around the face and lower case of the compass; leaving small spaces between turns to observe the movements of the needle. The ends of the wire are brought out as test leads to be inserted in series in circuits under test. A deflection of the compass needle in either direction indicates the presence of an electric current. Incidentally the **intensity** of the current may be closely approximated since the force with which the needle gyrates is **proportional to the intensity of the current flowing through the wire.**

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Amateurs who made good

EDWIN K. COHAN

EDWIN K. COHAN, technical director of the Columbia Broadcasting System.

It was long before the World War broke out, in fact it was coincident with the sinking of the *Titanic*, that Edwin K. Cohan was bitten by the wireless bug.

Cat-whiskers, galena and coils soon appeared in the Cohan home in New York City and before you could say CQ twice, young Ed Cohan was listening-in. This, naturally, could not last long . . . not long, anyway, before Cohan reached the stage where he simply had to have a transmitter with which to talk to all the "hams" he heard on his home-made receiver.

Cohan's first transmitter consisted of a crude one-inch spark coil transmitter that emitted varying waves on equally varying frequencies. Several months later his station, licensed under the call of 2MY, became the pride of New York. It had a half-kilowatt spark transmitter that roared and sputtered until the neighbors wondered whether the world wasn't actually coming coming to an end.

In 1917 Cohan received his commercial radio operator's license. After the war his station became "key" station in the New York area for the U. S. Army Amateur Radio Reserve.

In the spring of 1918 Cohan became radio engineer for the Panama Canal Commission and in the fall of the same year was appointed engineer for the Naval Radio Laboratories.

Early in 1921 he stepped into commercial radio as service manager for E. B. Meyers Radio Tube Company, which took him into the field of broadcast sets. He participated in the "gold rush" of building receivers, manufacturing them and selling them from 1922 to 1926.

Edwin K. Cohan, who holds the highly important position of technical director of the Columbia Broadcasting System. Mr. Cohan started as a radio amateur and his enthusiasm and education in radio matters have carried him to his present position, where he directs the technical destiny of 89 broadcasting stations spread across the country.

Soon afterward he joined the technical staff of station WOR and in 1929 resigned to become Managing Director of the Judson studios.

Since 1930 Cohan has been technical director of WABC and the Columbia Broadcasting System. During this brief period he personally supervised the installation of the new C. B. S. key station WABC, one of the most modern 50,000-watt broadcasting stations in the world.

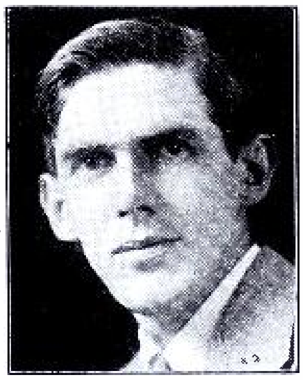
Edwin K. Cohan is a member of The Institute of Radio Engineers: The Society of Motion Picture Engineers; American Academy of Air Law: Engineering Committee of the National Advisory Council on Radio in Education and the Engineering Committee of the National Association of Broadcasters.—*Bill Schudt, Jr.*

JAMES MILLEN

JAMES MILLEN—one of the rapidly rising stars in the radio manufacturing and engineering firmament. Mr. Millen is a radio "ham" at heart and he started "rattling a key" back in 1921, in New York City. His call then was 2BYP. In 1925 Mr. Millen joined *Radio Broadcast* magazine, for which he devised many new circuits and wrote numerous articles. In 1926 he left New York and went to Boston, where he became associated with the National Company at Malden. Here he has resumed his amateur activity through W1XAL. Mr. Millen has done considerable writing on radio subjects and has acted as consulting expert to several tube and resistor manufacturers.

James Millen, or "Jim" as he is familiarly known to his many friends, has contributed a wealth of ideas, both from an engineering and business point of view, to the manufacturers of the well-known National line of radio receivers and transmitting equipment, and he combines a pleasing personality with excellent business and technical attributes. Mr. Millen is a graduate of the Stevens Institute of Technology, where he took the degree of Mechanical Engineer.

Just what constitutes a successful executive in radio industry today? That is a difficult question to answer and probably the easiest way to find the answer is to analyze or study those who have been successful in such a position with its many attendant responsibilities. Mr. Millen has the faculty of sensing the business and technical possibilities of a new invention very quickly and this is an asset which has been lacking on the part of many radio executives. Many new radio inventions are placed on the market which do not have sound engineering behind them, and when this is the case it is rare indeed that a new receiver or other radio apparatus can command a substantial and lasting market. To hold a position as important as Mr. Millen's today, one has to be an inveterate reader of radio literature so as to keep abreast of the very newest developments in radio, both from a technical and business standpoint.



James Millen is responsible for the rapidly growing popularity and improved engineering designs offered in the well-known National Receivers and transmitting equipment. Mr. Millen is a graduate Mechanical Engineer from the Stevens Institute of Technology; he is a radio amateur at heart and first started "pounding brass" in 1921.

(Clip and paste this column in your scrapbook and in the course of a year, you will have an interesting and valuable list of the prominent men affiliated in some manner with this great industry.)

A Nifty 3-Tube Receiver

(Continued from page 167)

knows these stations and cares to ask them, they can verify the reception of this test conversation. It is not clear in my mind whether the PPU station was located in Rio de Janeiro or Buenos Aires, due only to my absent-mindedness at the time, for the reception was perfectly clear.

I enclose herewith a sketch of the revised set I am now using, which has the headphones cut in the circuit of the first audio, and which allows the speaker to be cut in by merely completing the filament circuit of the pentode. This makes for very good DX, and I have gotten plenty which I will not list, as I have not taken trouble to get verifications. I do not hesitate to recommend this circuit as being about the best I have tried, next to a superhet of course, and it is very economical, both of operation and construction. A panel of aluminum or copper is almost a necessity, and I use a tube shield over the detector, which helps some on capacity effects, but the average person can construct this outfit with a metal panel and will have no difficulty with body capacity.

I hope the appended diagram may be of interest to some of the boys.—*O. D. Elder, Spring Valley, Wyoming.*

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TELEVISION News

New Tubes for Short Wave Receivers

(*Continued from page* 185)

external shield may be varied to obtain a minimum of grid-plate and output capacitance. This tube should always be used with an *external shield-can,* if its true merits are to be realized.

When (and if) used as a *class A* amplifier, the following characteristics should be noted: Heater voltage, 2.5; heater current, 1 ampere; plate voltage, 250; screen-grid voltage, 100; control-grid bias, —3; amplification factor, 1500; plate resistance, 1.5 meghoms; mutual conductance, 1225 micromhos; plate current, 2 ma.; screen current, 1 ma.

The effective *inter-electrode capacitances* of the tube are as follows:

Grid-plate capacity, .01 mmf.;
Input capacity, 5.2 mmf.;
Output capacity, 6.8 mmf.

When used as a detector, all applied voltages are the same as stated above with the exception of the grid bias, which is changed to —6 volts. For the plate load, a 250,000 ohm resistor or a 500 henry choke shunted by a .25 megohm resistor may be used. With a resistive load, the voltage of the source of supply must be equal to that required on the plate, plus that lost as *voltage drop* across the load. Thus, when operated as a detector (in which case the plate current would be approximately .1 ma.), the plate supply voltage must be 275 volts in order to obtain 250 volts on the plate.

The base of the tube is of the small 6-pin type, requiring the use of the new 6-prong sockets, the connections of which, looking *down,* are as shown in Fig. 6.

The "58"—Variable-Mu Amplifier

The 57 described above is especially suitable as a *detector,* since the "cut-off" point is sharp—that is, the plate current very rapidly reduces to a value approaching zero, thus making the tube suitable as a detector. If it were used as an amplifier of strong signals, the plate current would be cut off during certain parts of the cycle, rendering the tube useless. In order to reduce the rate at which the tube "cuts-off," then, the grid action must be so changed that, with any reasonable size signal, the grid-voltage—plate-current curve must be a slanting straight line. This is exactly what is accomplished by the variable-mu action of the "58," illustrated in Fig. C.

The construction of the tube is exactly the same as the "57" described above, with the exception, of course, of the grid, which is non-linearly space-wound in order to produce variable-mu action. The question of shielding, filtering, etc., is exactly the same as for the "57" and consequently will not be repeated here. Except for the method of *volume control,* the discussion would be about complete.

In the ordinary four-electrode tube used as an amplifier, control of volume is usually secured by varying the screen-grid voltage. When the screen voltage is lowered, the plate impedance of the tube is raised and the volume is decreased; the opposite is true for an increase in screen voltage. Now in such a tube, if the screen voltage is raised to too high a value, it becomes about equal to the plate voltage during certain parts of the cycle, secondary emission takes place and the output is distorted. With the addition of the *fifth element,* the *suppressor grid,* the effects of secondary emission are minimized and consequently the above-mentioned distortion does not take place. Thus the tube is capable of amplifying greater signals than was heretofore possible.

It would seem, therefore, that an R.F. pentode solves the above problem successfully. It does, but not successfully enough. When a very strong signal is received, the plate current would *cut-off* due to the action of the grid, and when the screen voltage is lowered in order to reduce the volume, the cut-off point is approached more rapidly, thus hastening the production of distortion.

(*Continued on page* 191)

A LOW-POWERED PHONE TRANSMITTER
OF THE PORTABLE TYPE
By JOHN B. BRENNAN, JR. — W2DJU

(*Continued from page* 148)

ing the neon tube against some portion of this circuit, maximum glow is obtained. At point of maximum glow this circuit is said to be in resonance with the previous circuit.

Next, proceed to the push-pull power amplifier stage and repeat the process of determining the proper "C" bias voltage and then tuning the circuit to resonance with the previous stage, having first reconnected the coupling condenser, C9.

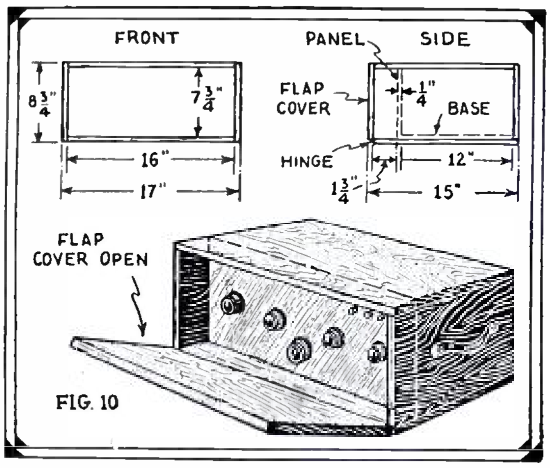


Fig. 10—Mr. Brennan's suggestion for portable phone transmitter cabinet, with leather handle on one end for carrying.

It is not a bad idea to retrace your steps and repeat the whole process so as to make certain that you will not be working "off frequency."

In checking over the operation of the audio system, merely keep in mind that you are working with a straight audio amplifier. The rules which govern the construction of any good audio system hold true here also. For the purpose of determining whether the amplifier is functioning properly, a loud speaker may be connected to the plates of the two output push-pull tubes.

In closing, it is well to point out that the constructional details outlined here must not of necessity be adhered to rigidly. It is assumed that the prospective builder has obtained a portable station license and has complied with government regulations in the operation of radiophone transmitters by passing successfully the required examinations, which will allow him to operate either under the regular amateur license, or else under the special *first class, unlimited radiophone class of license*. In either case, sufficient knowledge of the operation of transmitters and receivers must have been demonstrated to secure the license, so that detailed information on the construction, wiring and adjustment is not only out of place here but also an insult to the intelligence of the builder.

For the sake of convenience and economy, but at the cost of some slight distortion (harmonic), or shall we say, tone quality, the choke and condenser combination, shown connected to the output circuit of the class B output transformer, in Fig. 9, has been eliminated. For those whose constructional layout and pocketbook allow it, the use of this equipment is recommended. Instructions for its use are supplied by the manufacturers of the transformers.

The coils employed in the tuned circuits of this transmitter are of the plug-in type, allowing for change from one band of frequencies to another, and are wound on standard National coil forms ordinarily used for receivers.

In the table accompanying are given the winding details for the so-called 80 and 160 meter phone bands. As a matter of fact, the coils used by the author are revamped receiving coils, supplied by the National Company for use in their SW-5 short-wave receiver. The revamping consists of removing the primary and tickler coils and in their stead making a tap on the existing secondary, as indicated in the table.

The antenna coil, L4, has been put in the same form as that holding L3. This is the only coil having five connections. Approximately 10 or 12 turns compose this winding, which is located on a separate piece of tubing and then inserted within the coil form. Experimentation is necessary in the proper placement of this coil, L4, so as to obtain the correct value of coupling between it and L3.

It will be noted that the parts list does not call for dials. It was felt that for a transmitter which would be tuned to probably no more than four different settings, that expensive dials were unnecessary, a plain knob serving just as well. For this reason the shafts of the tuning condensers have been fitted with large knobs and it behooves the constructor, in tuning and adjusting the transmitter for operation, to make marks on the panel surface at appropriate places above these knobs to indicate the correct setting of the knobs for any particular or specific frequency adjustment.

Parts List

4 National SW condensers, 100 mmf., type SE100.
3 National 6-prong coil sockets.
3 National 6-prong coil forms.
8 Pilot 5-prong tube sockets, No. 217.
5 Acratest by-pass condenser blocks, 0-.1-.1 mf., No. 2784 (C6-C7, C10-C11, C12-C13, C14-C15, C16-C17).
5 R.F. choke coils.
1 Lynch resistor mount for R1.
2 Aerovox mica fixed condensers, .002 mf. (C8, C9).
1 Aerovox mica fixed condenser, .00025 mf. (C2).
1 Aerovox mica fixed condenser, .0005 mf. (C18).
1 Electrad potentiometer, 0-500,000 ohms (R4).
1 pilot-light and socket (P).
2 binding posts.
1 Thordarson microphone transformer, No. 3020 (T1).
1 National interstage audio transformer, A100 (T2).
1 National class B input push pull audio transformer, type BI (T3).
1 National class B output push-pull audio transformer, type BO (T4).
2 Triad T-237 tubes (V1 and V5).
6 Triad T-238 tubes (V2, V3, V4, V6, V7, V8).
1 contact strip, 8 posts.
1 copper shield can for oscillator stage (see Fig. 6 for details).
6 National grid grips.
1 wood base, 12 inches by 16 inches.
1 panel, 7¾ inches by 17 inches.
1 Lynch pigtail resistor, 20,000 ohms (R1).
1 Lynch pigtail resistor, 2,000 ohms (R5).
2 Lynch pigtail resistors, 1,700 ohms (R2, R6).
2 Lynch pigtail resistors, 850 ohms (R3, R7).
1 cabinet (see Fig. 10).
1 Frost DB (double button) microphone: 200 ohms per button.

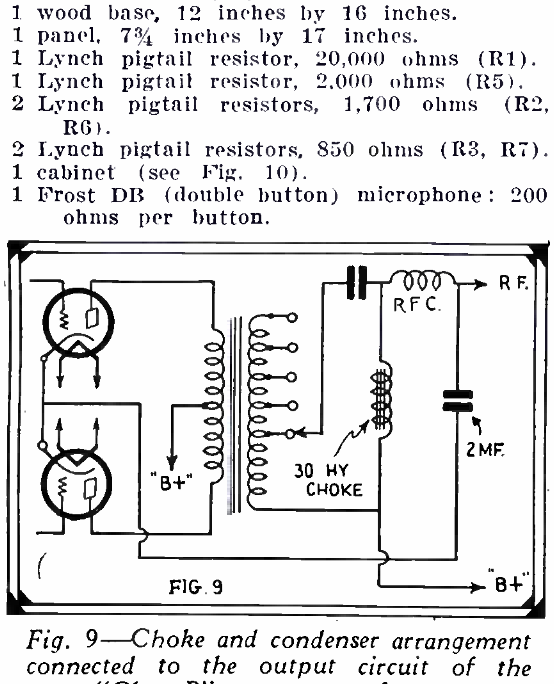
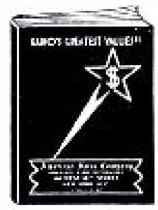


Fig. 9—Choke and condenser arrangement connected to the output circuit of the "Class B" output transformer.



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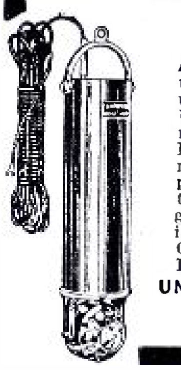

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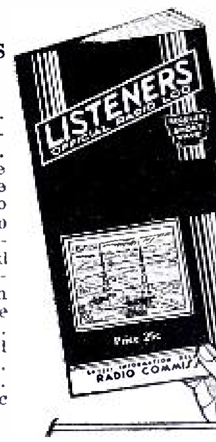

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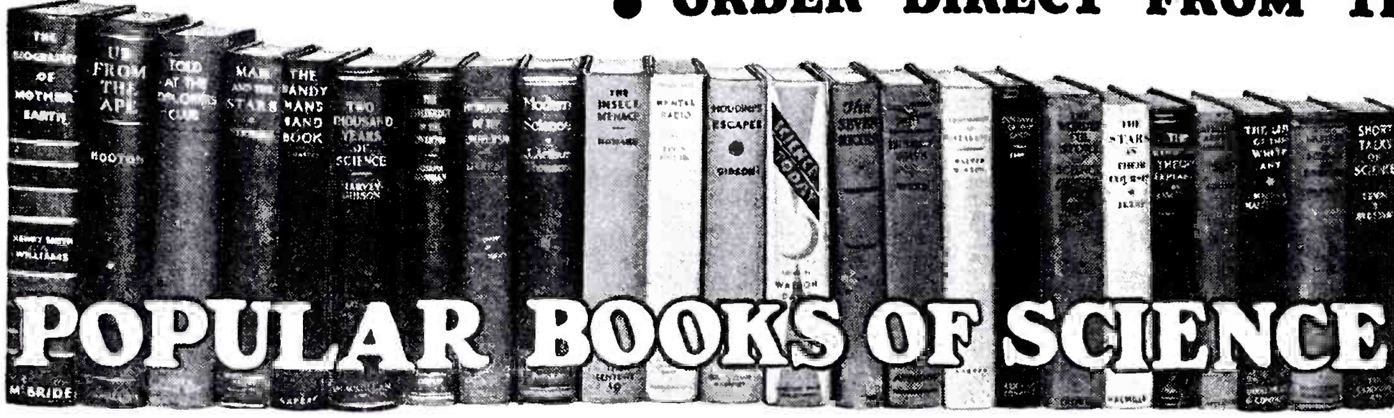

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WHEN TO LISTEN IN

By ROBERT "BOB" HERTZBERG

(Note: This department is prepared just before SHORT WAVE CRAFT *goes to press, and contains the latest, last-minute "dope." This may conflict in some details with the information in the regular list of short-wave stations of the world (printed elsewhere in this issue), as the long list must of necessity be made up in advance. You can easily make corrections or additions to the list on the margins of the pages.)*

Central America

OUR old friend Amondo Cespedes Marin, owner of "the smallest broadcaster on earth," is now operating on 19.9 meters in addition to 31 meters. We are indebted to Mr. Ralph F. Smith, of Camden, N. J., for this information. The letter he received from Mr. Marin is published herewith:

"It was good of you to report our first test program on 19.9 meters, given on Sunday afternoon, April 17th, from 3 to 4 p.m., our time, which is Chicago time as well. As you have been the first listener to report it, I am enclosing the TI4NRH diploma, which verifies your log and stipulates that you were the first to report it in U.S.A. My congratulations therefore to you and your set.

"It is certain you heard plainly all my announcements concerning this amateur broadcasting station, pleasing the world just for fun, for we carry no advertising at all, the way it should be in radio land.

"I hope you will listen often and report both waves, either 19.9 or 31 meters during the week nights, from 8 to 9 p.m., Central Standard Time. I am very interested in the day broadcasting, which takes place as follows:

"On 19.9 meters: Saturday, Sunday and Monday, from 10 to 11 a.m. and 3 to 4 p.m.: Saturday only, from 9 a.m. to 1 p.m. On 31 meters: Monday to Friday, from 8 to 9 p.m. All Central Standard Time.

"You will do a favor to these efforts by advising your friends and writing to clubs and magazines concerning the daylight broadcasting as done by me and the little TI4NRH. Please remember that it is a 15-watt, tuned-grid, tuned-plate transmitter with 550 volts power and Heising 100 per cent modulation. My antenna has 30 feet in each leg and points in the obtuse angle to heaven east to west, about ten feet from the roof, which is iron, grounded.

"AMONDO CESPEDES MARIN."

Madrid Active Again

Short wave station EAQ, whose status has been in doubt for many months, is now definitely on the air again, many American listeners having heard it broadcasting voice and music. George Emmott, of North Andover, Mass., writes:

"I have received verification from EAQ, Madrid. They ask that the 'dope' on them be given to the press, and they would be glad to hear reports from anyone who has heard them. The details are as follows: EAQ, Madrid, Transradio Espanola S. A., Alcala, 43, Madrid, P. O. Box 951, Spain. Wavelength, 30.3 meters. Power, 20 kilowatts. Daily for America, 0030 to 0200 G. M. T. Saturday only, for Canary Islands and Europe, 1800 to 2000 G. M. T."

Dr. Richard S. Pearse, of Brooklyn, N. Y., writes:

"For your own information will let you know that for the past week I have had very good reception over the short waves from Spain. Nearly every evening between about 8:45 and 10 o'clock (Eastern Daylight Saving Time), I have been hearing broadcast programs from EAQ, Madrid, Spain. The station is easy to identify, though it transmits entirely in Spanish. After nearly every selection the announcer says 'Eh (E) Ah (A) Koo (Q), Radio Spagnola, Madrid'."

Those Wavelength Figures

As we have frequently remarked in these columns, wavelengths, frequencies and even time schedules are figured differently in different parts of the world, and not infrequently the information released by some stations does not "check." All we can do is go by their written statements, although their announcements over the air may not coincide exactly. For instance, we plead not guilty to the mistakes mentioned in the following letter:

"I noticed two mistakes published in the 'Star' short wave list in your May issue. VK3ME, Melbourne, Australia, should be 31.55 meters, not 31.28 meters. The latter is correct for VK2ME, Sydney. Schedules for both stations are correct.

"The listing as FYA, Pointoise, is not FYA. It is the comparatively new Post d'Etat, Radio Colonial, Pointoise (a suburb of Paris), but is announced as 'Ici Paris' ('This is Paris'). The first two waves, 19.68 and 25.16 meters, are correct, but the 25.63 wave should be 25.60. (Different methods of figuring the wavelength-frequency relationship account for this slight difference—*Editor.*) All the above is from personally listening to these stations over a considerable period of time and checked up to date.

"VK2ME is making a partial change of schedule, to keep in line with British Summer Time. I expect to get a complete line on this change from their next broadcast and will advise you when I have it."

"JAMES LAUGHLIN, 3rd,
"Daytona Beach, Fla."

New Tubes for Short Wave Receivers

(Continued from page 188)

The ultimate solution, then, would be to have an R.F. pentode, but vary the spacing of the grid in order that the cut-off point be far removed and change the volume by varying the grid bias, which would have the effect of always keeping that part of the curve being used, a straight line. *This is exactly what the "58" does!*

Here, then, is a tube that is capable of amplifying weak or strong signals with equal efficiency, but the question which arises is, can it be used in short-wave receivers? The answer is decidedly *yes!* Both the "57" and "58" may be used successfully for frequencies up to 60 megacycles! (5 meters). And as for the *inter-electrode capacities,* they are given below, with the rest of the electrical constants.

Heater voltage, 2.5; heater current, 1 ampere; plate voltage, 250; screen voltage, 100; grid bias, —3 to —50; amplification factor, 1280; plate resistance, 800,000 ohms; mutual conductance at —3 volts bias, 1600 micromhos, at —50 volts bias, 2 micromhos; plate current, 8.2 milliamperes; screen current, 3 milliamperes; filament current, 1 ampere; grid-plate capacity, .01 mmf. (with shield can); input capacity, 5.2 mmf.; output capacity, 6.8 mmf.

The connections of the tube are identical with those shown in Fig. 6.

The use of the internal shield reduces, as in the case of the "57," the *grid-plate capacity* of the tube. The closer the external shield-can is placed to this internal shield, the more effective the internal shield becomes,—hence the inward curve of the glass around this internal shield.

In a forthcoming article on the subject of tubes, the author will endeavor to explain the action of the latest types of transmitting tubes, and in another article an analysis of the action of special-type tubes designed for specific purposes.

Correction Notice

In the article entitled, "The Denton Plugless Superheterodyne," on page 84 of the June issue, the capacity of each variable tuning condenser should have been given as 140 mmf. (150 mmf. will be near enough).

"HAM" ADS

Advertisements in this section are inserted at 4c per word to strictly amateurs, or 8c a word (8 words to the line) to manufacturers or dealers for each insertion. Name, initial and address each count as one word. Cash should accompany all "Ham" advertisements. No less than 10 words are accepted. Advertising for the August issue should reach us not later than June 20.

FOR SALE—Pilot D.C. Super-Wasp. Make offer. Will trade taxidermy course for radio course or Aero-Digest magazines for radio magazines. LeRoy Burgee, Sulphur Springs, Mo.

GUARANTEED MICROPHONE REPAIRS—Any make or model—24 hour service. Stretched diaphragm double button repairs, $7.50. Others $3.00. Single button repairs, $1.50. Write for 1932 Catalog with diagrams. Universal Microphone Co., Ltd., Inglewood, Calif.

JEWELL 199 set Analyzer, perfect working condition, complete, instructions. Write-Price-low. Chokes, transformers, all equipment must be sold; cheap. Charles E. Wilson, 100 Conklin Ave., Hillsdale, N. J.

CRYSTAL CONTROLLED TRANSMITTER—Steady pure D.C. signal. Neatly built. Uses type 47 tube. With crystal and dustproof holder—$18. Also trade crystals for good meters. W5ACH, C. E. Pearce, 427 Asia St., Baton Rouge, La.

BEST OFFER, trade or cash, takes these—204A condenser microphone, 2000-volt 800-watt power supply complete, 600-volt 300-watt power supply, 500-volt 200-mill Westinghouse motor generator, several 211E's. Will trade for anything. W9ER, Timken, Kansas.

QST, 1923-1931 (80 books), good condition. Will sell or trade. Prefer short wave receiver. John Hilton, 1821 Gillingham St., Frankford, Philadelphia.

NEW LATEST MODEL Sargent special amateur super-heterodynes, tune 9-200 meters; 9-tube A.C. complete with RCA tubes; Jensen dynamic speaker, $55; 8-tube D.C. $40; Silver-Marshall Round the World Four, $9. National, Pilot receivers, other short wave apparatus. List free. W9ARA, Butler, Mo.

SHORT WAVE LISTENERS CARDS—We print just the type of card you need for reporting the stations you hear. Write for free samples today. W1BEF, 16 Stockbridge Ave., Lowell, Mass.

AERO WORLDWIDE Short Wave Receiver, coils and tube. Perfect condition. $5.00. Robt. Kalahar, 717 S. Union St., Traverse City, Mich.

SHORT WAVE plug-in coils, set of four, 50c; 15-210 meters. Noel, 419 Mulberry, Scranton, Pa.

TRANSFORMERS and chokes built or rewound. Moderate prices. Boston Transformer Co., 886 Main St., Cambridge, Mass.

HAVE R.C.A. INSTITUTE RADIO COURSE. Will trade for short wave receiver or what have you. Paul Edmondson, P. O. Box 174, Elizabethtown, Kentucky.

Power Generator

For Short Wave Broadcasting Reg. Price Was $75.00. U. S. Gov. power generator for radio transmitting made by Westinghouse. Ideal for Amateur Broadcasting. Limited quantity purchased from U. S. Gov. Signal Corps. 900 cycles, 200 watts, 110 Volt, R.P.M. 4500. Can be connected direct, belt driven or wind propelled for Aeroplanes. Guaranteed new and perfect. Worth $75.00, but while they last, only $4.95, plus shipping charges. Send check or money order.

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BLUEPRINTS

of RADIO WORLD'S Star Circuits

80-550-METER T-R-F RECEIVER

BLUEPRINT No. 627, full-scale, with schematic diagram also included, as well as a list of parts, is our most popular star circuit, since it is a-c operated and covers from 80 to 550 meters. Thus you can tune in television, police calls, some relay stations and the broadcast band. It uses five tubes: two vari-mu, either —35 or —51, one —24, one —47 and one —80. The chassis is 14½x7¾ inches, so may be fitted into a midget cabinet as illustrated.

The reason for the great popularity of this circuit is that it represents the highest achievement so far in a five-tube tuned radio frequency design, with high sensitivity all over the dial, including the high wavelengths, on which most t-r-f sets drop off considerably. For instance, patients at a sanitarium at Liberty, N. Y., were most eager to receive WEAF, 660 kc, about 150 miles distant, and all sets tried, including supers, failed to produce sufficient volume. But the 627 circuit not only brought in WEAF loudly but met all other requirements, arousing such enthusiasm that several such receivers now will be found in that sanitarium.

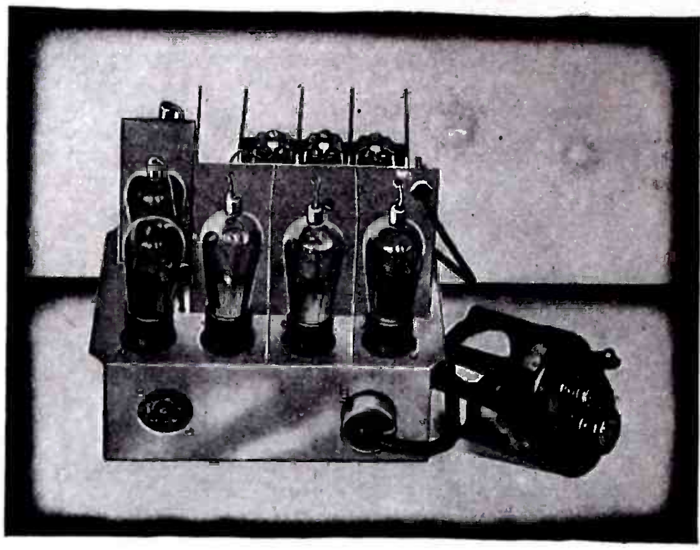
As to selectivity, strong local stations can be cut out within a very few degrees of the dial, to bring in distant stations, and it is nothing unusual of an evening, in Winter or Summer, to tune in fifty or sixty different stations without interference. From various points in the United States many users receive Cuban and Mexican stations with plenty of volume.

Special precautions have been taken to make the tone the very best. This includes complete filtration in the B supply, since hum is ruinous to tone quality. The circuit is as free from hum as any a-c receiver can be, which means you can scarcely hear the hum with no station tuned in, and your ear against the grille.

The 627 circuit was carefully engineered in **Radio World's** Laboratories, and represents the selection of fourteen different circuits, all of the five-tube t-r-f variety. So not only has the trouble been taken out by experts, but the virtues have been built in with great engineering skill.

Order BP-627 @ 25c

6-TUBE AUTO SET



A SIX-TUBE automobile receiver, using remote control tuning, with tuning-switch-volume control assembly on the steering post, is covered by our Blueprint No. 629. The size of the chassis is only 7x9 inches, and the chassis, enclosed in a steel cover, may be placed at rear of the fireboard, just under the instrument board, to the driver's right. Since there will be little aerial pickup the receiver has been made extremely sensitive. It is of the t-r-f type, using the new —39 variable mu r-f pentode tubes, and two pentode output tubes, —38's, in push-pull. All the tubes are of the 6-volt automotive series, to work from the car's storage battery, and requiring 135 volts of B battery.

Steel partition walls serve to shield the r-f and detector tubes, while two outlets are for plugging in the remote control unit and the speaker, which should be an automobile dynamic, as set forth in the blueprint. A schematic diagram and list of parts are included on the full-scale print.

Order BP-629 @ 25c

WE have just completed an 8-tube pentode push-pull automobile superheterodyne, designed by J. E. Anderson, technical editor of **Radio World**. This is Blueprint No. 631, full-scale, including schematic diagram and list of parts.

Order BP-631 @ 50c

SHORT WAVES

A TOTALLY a-c operated short-wave converter that can be built for $7.60, comprising three tubes, and affording excellent results when worked with any broadcast receiver, including a superheterodyne, is covered by Blueprint No. 630. No plug-in coils are used, there are two tuning controls for maximum sensitivity, both oscillator and modulator tuned, and the construction is so simple that any novice can make a great success of this circuit.

Order BP-630 @ 25c

OUR blueprints also include two short-wave receivers for battery operation, one for earphone use, the other to work a speaker. These models use plug-in coils, with UX sockets as coil receptacles. The 2-volt tubes are used in both instances.

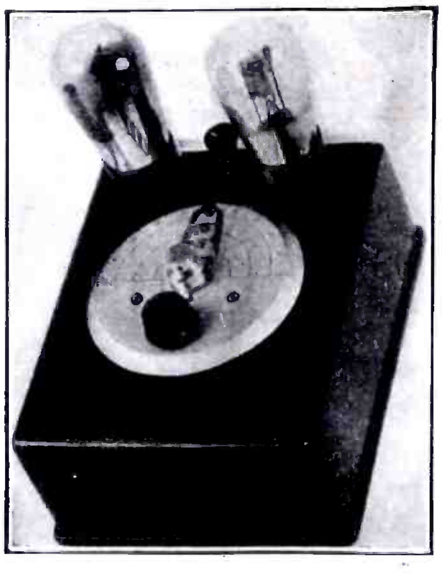
The earphone model, Blueprint No. 633, consists of an efficient and specially sensitized detector, with one stage of transformer coupled audio. With this circuit many foreign stations have been tuned in by hundreds of users. In fact, all our short-wave blueprints call for designs that yield foreign reception not as a rarity but as a fairly steady record. Two —32 tubes used.

The four-tube model, Blueprint 634, uses a stage of tuned r-f, a tuned detector specially sensitized, and two stages of transformer-coupled audio frequency amplification, the r-f tube being the —34 vari-mu r-f pentode, and the output being a —33 pentode. Schematic diagram and and list of parts included on blueprint.

These two blueprints, Nos. 632 and 633, are full-scale, on one large sheet, the complete data for one on one side, and for the other on the other side.

Order BP-633-634 @ 30c

OSCILLATOR



A MODULATED battery-operated oscillator, 540 to 1,500 kc. and 150 to 250 kc. by switching. One tube is the oscillator, the other is the modulator. Modulated-unmodulated service by switching.

Order BP-635 @ 25c

GUARANTEE

WE guarantee that the circuits embodied in the blueprints listed on this page have been carefully engineered.

Radio World takes great pains with its circuits and renders them as free from trouble and as abundant in satisfactory results as is possible. This record for authenticity has helped to make **Radio World** one of the most outstanding publications in its field.

Now in its eleventh year, **Radio World** has been catering to the home experimenter and service man with a faithfulness that has won it a wide following. Published every week, dated Saturday, **Radio World** is obtainable at newsstands at 15c per copy, or by subscription at $6 per year (52 issues), $3 per six months (26 issues), or trial subscription, $1 per 8 weeks. No extra charge for subscriptions to Canada.

Radio World, the first and only national radio weekly, technical accuracy second to none, invites you to familiarize yourself with the exceptional service it is rendering to radioists the world over, and to profit by the expert engineering reflected by the circuits featured in its columns.

The circuits listed on this page were engineered by our laboratories with great pains, but no greater pains than attach to all the circuits featured in our columns from week to week.

Parts for all our circuits are readily obtainable.

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A complete study of the proper method of merchandising tubes, in order to protect the seller as well as the buyer has resulted in the adoption of an entirely new form of distribution. The CERTIFIED TRIAD SERVICEMAN is the key stone. You can become one of the agents, who are taking a handsome profit from these tubes, by filling in the coupon. The whole interesting story will come to you by return mail.

If you are selected to represent TRIAD, we will protect your territory, for you. Every Tom, Dick and Harry will not be competing with you.

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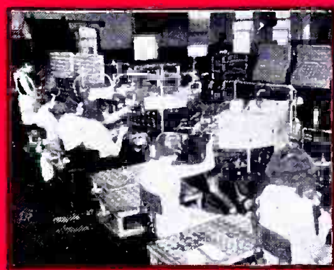
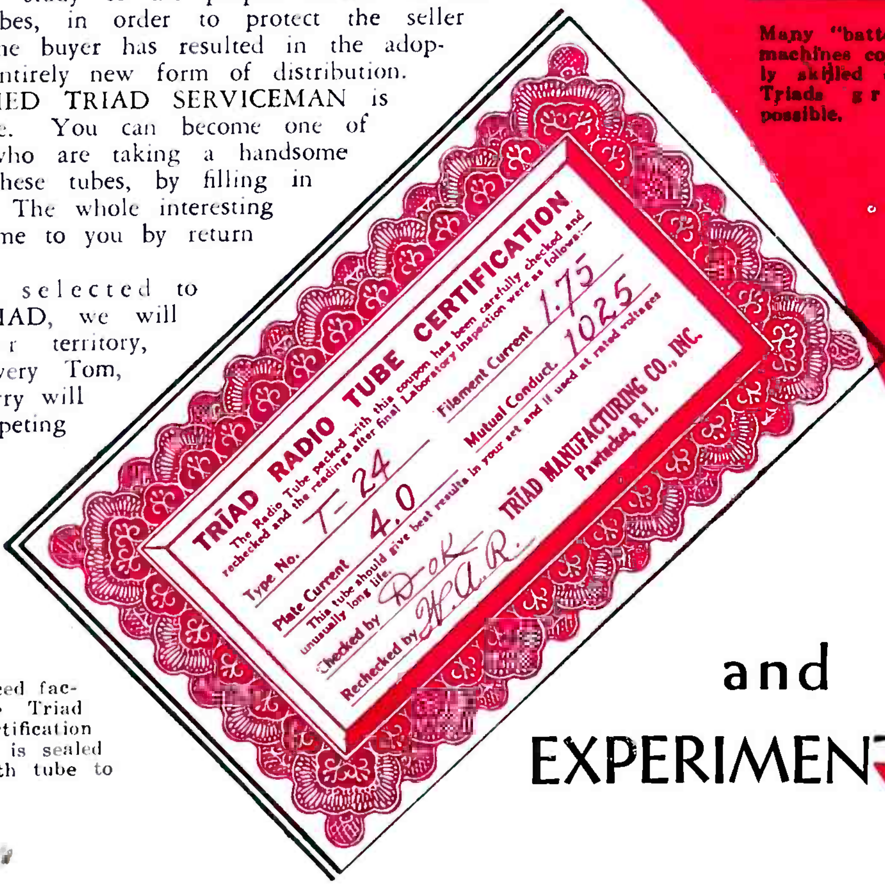


Many "batteries" of sealing machines controlled by highly skilled co-workers make Triads great production possible.



TRIAD RADIO TUBE CERTIFICATION

The Radio Tube packed with this coupon has been carefully checked and rechecked and the readings after final Laboratory inspection were as follows:—

Type No. T-24 Filament Current 1.75

Plate Current 4.0 Mutual Conduct. 1025

This tube should give best results in your set and if used at rated voltages unusually long life.

Checked by D-OK

Rechecked by W.A.R.

TRIAD MANUFACTURING CO., INC.
Pawtucket, R.I.

This is a reduced facsimile of the Triad Radio Tube Certification Coupon, which is sealed in the box with tube to which it refers.

At the end of every production line, the tubes are given their first check. Ten characteristics are checked here. Even this is more than is done with the average tube, but it is not enough for "Double-Checked," Certified Triads.

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Even a good radio receiver will sound like "nothing at all" if it is equipped with poor tubes. Most people realize that the radio tube is the heart of their receiver. Ordinary tubes can be bought for a song, but you usually get what you pay for. No on expects to get Cadillac or Lincoln service from an Austin. No one looks for custom-made shoes for three dollars. Those who expect the very best performance from inferior tubes are not logical and they are sure to be disappointed. No form of entertainment is as inexpensive as radio. Isn't it good business to keep it working at its best? You can be sure of doing so, by insisting on CERTIFIED TRIAD TUBES. *A line to us will enable us to send you the CERTIFIED TRIAD SERVICEMAN, we have selected to serve your vicinity.*

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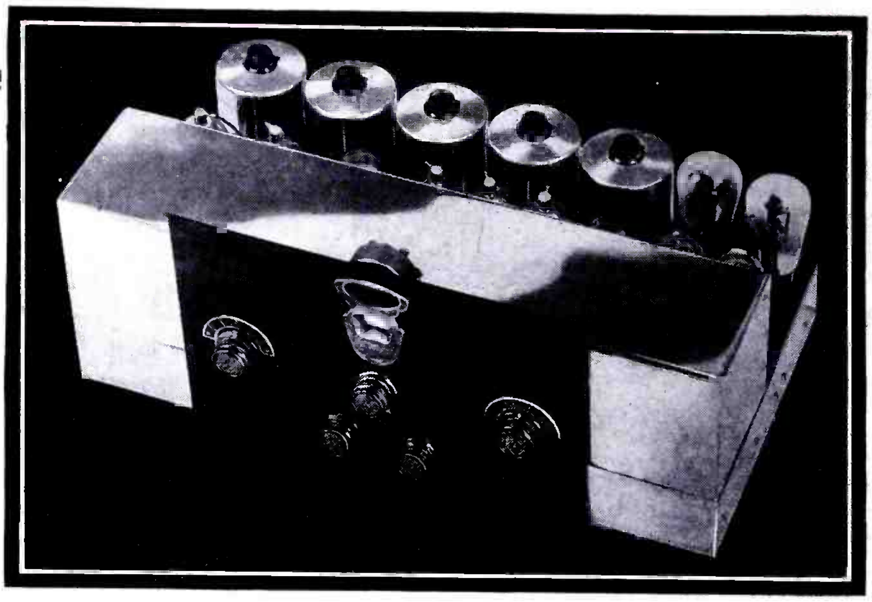

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- New Low-Loss Tuning Assembly
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"I have spent over twenty-five years in radio experimentation, but every time I tune the NEW LINCOLN DELUXE SW-33, I simply marvel. The results of the first test I gave this new model in my home, were simply unbelievable. An amateur station PY2BQ, Sao Paulo, Brazil came pounding in with the volume of a local. Pontoise, France came in for two hours without a sign of a fade with full volume, and clear as a bell. South America, Europe, Australia all the same way. The new Lincoln has a register of musical frequencies I never heard equalled in any of the finest power amplifiers.

It is a pleasure to recommend this great receiver to you."

W. H. Hollister, *President,*
LINCOLN RADIO CORPORATION.

Lincoln DeLuxe SW33

NOT JUST AN IMPROVEMENT—
But a Radically New Kind of Radio Reception

Records made by Lincoln Super-Powered receivers are well known the world over—records made by individual owners of Lincoln receivers *right in the home, not by the manufacturer under favorable conditions!*

Now- FOR THE FIRST TIME startling new developments have been perfected by Lincoln engineers making possible the most sensational performance which has been the dream of every radio fan.

WHEN RECEIVER IS TUNED TO RESONANCE all background noise is reduced to a minimum, and only the signal is heard.

YOU CAN TUNE IN A LOCAL station, reduce volume to minimum and tune every channel with equal volume without touching the volume control.

YOU CAN ENJOY PERFECT AUTOMATIC VOLUME LEVEL on short-wave signals.

YOU CAN TUNE TO PERFECT resonance by meter, producing complete register of musical frequencies impossible to adjust by ear.

YOU CAN HAVE AUTOMATICALLY INCREASED sensitivity on low volume for the first time eliminating static and noise.

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