How To Build the 635 Short Wave Set

Authoritative Construction Data for the S-M 635 Receiver

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General

It is only within recent months that the shorter wave lengths below 200 meters have been opened up for the use of transmitting amateurs and for the rebroadcasting of programs also simultaneously transmitted at same wave length in the regular broadcast spectrum by certain of the larger broadcasting stations, not only in this country but thruout the world. Under the old conditions with the amateur transmission band ranging just below 200 meters, with no rebroadcasing going on, and with practically all broadcasting ranging between 200 and 550 meters, the radio enthusiast could quite satisfactorily cover the entire range of wavelengths in use with but a single receiver.

With the popularizing of the wavelengths below 200 meters, this condition altered very considerably and special types of receiver designs have been developed for satisfactory operation on the new channels. In practically all cases these receivers are of the conventional regenerative detector and audio amplifier type; for it has been found that a simple three tube receiver properly designed will give quite satisfactory results below 200 meters. A peculiar circumstance is that the regenerative detector is one of the few types of receiving circuits that will give satisfactory results below 200 meters, aside from its simplicity.

Tuned radio frequency receivers are practically totally unfitted for operation below 200 meters because of the difficulty of obtaining satisfactory amplification with good stability; for 200 meters seems to be the low limit at which radio frequency amplifier troubles (which resulted in the design of the superheterodyne) become evident with modern equipment to an extent which renders this system entirely unsatisfactory for such work.

The superheterodyne receiver, having but the equivalent of an ordinary regenerative detector input circuit operating at the signal frequency (the oscillator may be safely ignored), is quite satisfactory below 200

meters. However, the sensitivity of a superheterodyne is hardly required for it has been found that transmission efficiency increases tremendously, in a general sense, as the frequency increases. Briefly, this means that with an ordinary three tube regenerative receiver, signals on short wavelengths may be heard with ample volume over much greater distances than could possibly be covered with much more sensitive types of receivers operating in the broadcast spectrum. It is for this reason that the common or garden variety of regenerative receiver with sufficient audio amplification to give ample signal volume is the most popular for operation below 200 meters.

The Silver-Marshall type 635 short wave receiver kit is intended to permit construction of a receiver of this type for operation over a wavelength range of 18 to 150 meters, with a sufficiently good audio amplifier to give very pleasing reproduction on rebroadcasting, which is at the same time capable of alteration so that greater audio frequencies selectivity will be obtainable in the reception of amateur telegraph signals. This kit consists of four interchangeable inductance coils, two variable condensers, a plug-in coil socket, and an antenna coupling condenser. A description of the individual parts will be of interest.

The coils are designated by a single number—117. The four different sizes may be easily differentiated upon inspection as the number of turns is approximately double, in each succeeding size, the number used on the precedingly smaller size. The wavelength ranges of these coils are given below with the grid circuits (winding 3 and 4) tuned by a 140 mmf. condenser. The circuit capacity which is made up of wiring, tube capacities, etc., has been taken as a value of 20 micromicrofarads which may be considered ample in this case. These values have been arrived at considering at the bottom or high frequency end of the range, an additional minimum capacity of 20 mmf. which would be made up by the antenna, assuming it to be of quite considerable size and with the antenna coupling condenser of 25 mmf. entirely in use. The maximum end of the range has been calculated with no additional capacity as represented by the antenna circuit. Thus it will be seen that the values given in the tables below are extremely conservative and that a considerable overlap above and below the extreme ranges given may be anticipated.

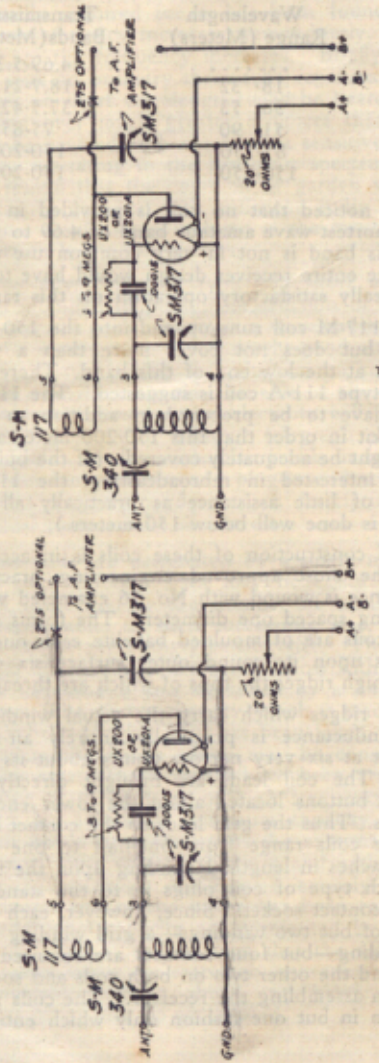
Coil Type	Wavelength Range (Meters)	Amateur Transmission Bands (Meters)
.....	.....	4.69-5.35
117-P	18- 32	18.7-21.4
117-O	30- 53	37.5-42.8
117-N	51- 90	75-85.7
117-M	85-150	150-200
111-A	150-350	150-200

It will be noticed that no coil is provided in this kit for the shortest wave amateur band of 4.69 to 5.35 meters as this band is not in very common use and, further, as the entire receiver design would have to be altered for really satisfactory operation on this range.

The type 117-M coil runs up and into the 150-200 meter band but does not cover more than a very short breadth at the low end of this band. Therefore the use of a type 111-A coil is suggested. The 111-A coil would have to be procured in addition to the regular 635 kit in order that this 150-200 meter amateur band might be adequately covered. (If the builder is primarily interested in rebroadcasting, the 111-A coil will be of little assistance as practically all rebroadcasting is done well below 150 meters.)

The actual construction of these coils is in accordance with the most approved engineering practice. Each inductance is wound with No. 26 enameled wire, the turns being spaced one diameter. The forms supporting the coils are of moulded bakelite each one of which carries upon its round outer surface six one-quarter inch high ridges the tops of which are threaded.

It is these ridges which carry the actual windings. Thus each inductance is practically entirely air-supported except at six very narrow points about its circumference. The coil leads are brought directly to small contact buttons located about the lower end of the coil forms. Thus the grid leads to the contact buttons in these coils range from one-half to one and one-quarter inches in length depending upon the type of coil. Each type of coil plugs in to the standard type 515 six-contact socket. Since, however, each coil is composed of but two windings—a grid winding and a tickler winding—but four contacts are required on this socket, and the other two on both coils and socket are ignored in assembling the receiver. The coils may be plugged in in but one fashion only which entirely



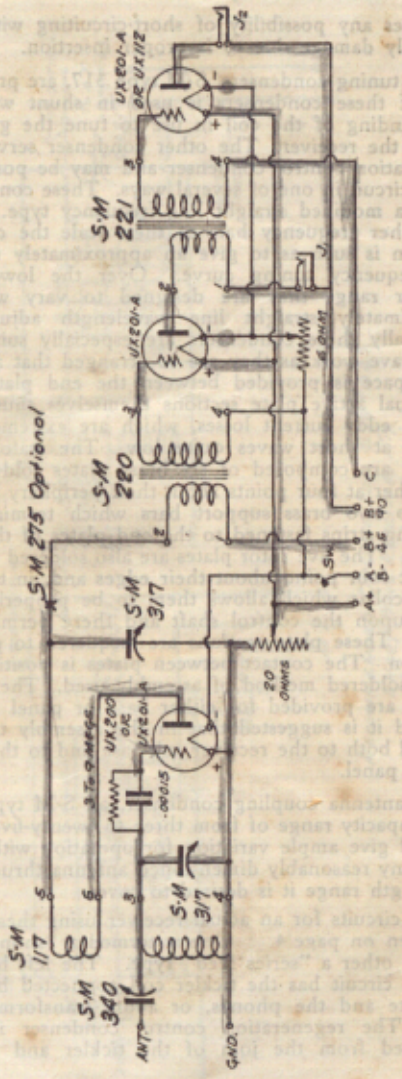
RECOMMENDED CIRCUITS FOR S-M #635 SHORT WAVE RECEIVER KIT (RANGE 18 TO 150 METERS)

precludes any possibility of short-circuiting with consequently damage due to improper insertion.

Two tuning condensers, S-M type 317, are provided. One of these condensers is used in shunt with the grid winding of the coil in use to tune the grid circuit of the receiver. The other condenser serves as a regeneration control condenser and may be positioned in the circuit in one of several ways. These condensers are of a modified straight line frequency type. Over the higher frequency half of their scale the capacity variation is such as to give an approximately straight line frequency tuning curve. Over the lower half of their range they are designed to vary with an approximately straight line wavelength adjustment. Electrically these condensers are especially suited for short wave work as they are so arranged that a maximum space is provided between the end plates and the actual active plate sections themselves thus keeping the eddy current losses, which are extremely important at short waves quite low. The stator plate sections are composed of six brass plates soldered to each other at four points about their periphery and, in turn, to two brass support bars which terminate in insulating strips fastened to the end plates of the condensers. The five rotor plates are also soldered to each other at four points about their edges and, in turn, to a lock collar which allows them to be properly positioned upon the control shaft and there permanently locked. These plate sections are lacquered to prevent corrosion. The contact between plates is positive due to the soldered method of assembly used. These condensers are provided for either base or panel mounting, and it is suggested that in the assembly they be fastened both to the receiver sub-base and to the front control panel.

The antenna coupling condenser, an S-M type 340, has a capacity range of from three to twenty-five mmf. and will give ample variation for operation with practically any reasonably dimensioned antenna thruout the wavelength range it is desired to cover.

Two circuits for an actual receiver using these parts are given on page 4. One is termed a "shunt feed" and the other a "series feed" type. The left hand or "series" circuit has the tickler coil connected between the plate and the phones, or audio transformer primary. The regeneration control condenser is then connected from the join of the tickler and phones



directly back to the filament thus providing an adjustable radio frequency path around the high impedence of the phones or audio transformer primary which allows of very satisfactory and smooth regeneration control. The second type of circuit or "shunt feed" has the plate of the detcetor tube joined directly to the output circuit (phones or transformer) and then has the regeneration condenser and tickler connected in series and shunted directly from plate to filament. The selection of either type of circuit depends primarily upon the whim of the individual builder as there is very little preference. It is suggested, however, that the shunt feed type be employed and this has been considered thruout this booklet.

A receiver employing either of these circuits and but one tube will give fairly satisfactory headphone reception over reasonable distances but it is suggested that it be used with from one to two stages of audio amplification, depending upon the class of reception that is desired.

If the builder is interested primarily in the rebroadcasted transmissions of the regular broadcasting stations it is suggested that a two-stage audio amplifier be employed which will provide ample loud speaker volume in practically all cases. (Receivers of this type located on the West Coast have been known to bring in Eastern stations quite regularly with ample loud speaker volume.)

In such a case every precaution should be taken to see that the audio amplifier will give the most satisfactory type of reproduction obtainable both from a volume and quality standpoint. For full data on amplifiers of this type, the reader is referred to "The Secret of Quality" which may be obtained from Silver-Marshall, Inc., or from practically any radio dealer. Without, however, going into any of the details enumerated in the booklet referred to, it is suggested that the audio amplifier consist of two tubes operated in conjunction with two Silver-Marshall type 220 audio transformers. The frequency charactertistic of these transformers is designed to give the finest possible quality of reproduction in conjunction with loud speakers obtainable upon the open market and with the quality of broadcasting transmitted by the average broadcast stations thruout the country in the present day.

If amateur telegraphic reception is the prime con-

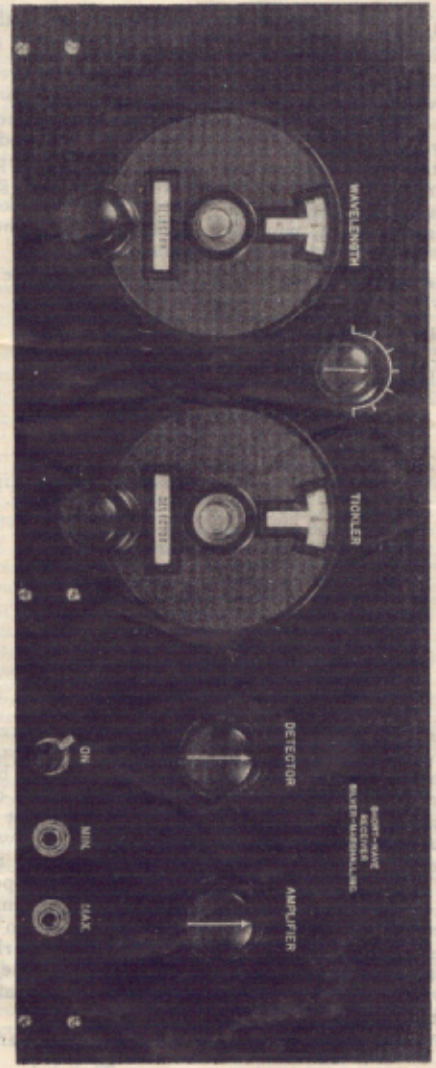
cern of the builder, then the use of a single stage of audio amplification will give all that is required in the way of ample headphone volume. Further, since in this class of reception the matter of quality of reproduction is of such slight moment, it is suggested that maximum advantage be taken of the selectivity possibilities of the audio frequency amplifiers. This may be very easily done by employing a very poor grade of audio transformer which will give maximum response at some certain frequency and comparatively poor response at all other frequencies. This will work out very nicely as every C.W. amateur telegraph station must be heterodyned to be rendered audible and it is a simple matter to adjust the heterodyne note to the point of best response for the audio transformer employed.

The Electrical Research Laboratories of Chicago make a transformer especially designed for amateur telegraphic reception which has a very pronounced peak at one thousand cycles and which is quite satisfactory for this purpose. Another type of good "distortion" transformer for telegraph reception is the old Radio Corporation UV712, which, though now obsolete, may be obtained from many dealers.

In many cases the builder of the receiver will desire to listen not only to rebroadcasted programs but to amateur transmission as well. In such a case it is desirable that S-M 220 audio transformers be used since any of the distortion types most suited to amateur telegraph reception will give simply horrible reproduction of broadcasting programs. However, in a receiver employing 220 transformers it is quite a simple matter to alter the frequency characteristic so that the transformers will give practically any degree of distortion required, at will, for amateur telegraph transmission.

Construction

The receiver to be described in the following paragraphs consists of a regenerative detector circuit made up of the S-M type 635 kit plus certain additional parts together with a two-stage audit amplifier designed for maximum quality of reproduction since it is assumed that the average builder will be more interested in the reception of rebroadcast programs than of amateur telegraph transmissions. However, it is a simple matter to alter the audio amplifier in order to



obtain maximum audio frequency selectivity if the receiver is to be operated primarily for telegraph reception.

Two photographs of the receiver are shown—one a front panel view which indicates strikingly the simplicity of the control arrangement. The second view is of the rear of the receiver and illustrates very plainly the arrangement of the various parts excepting only the radio frequency choke coil, the output jacks, and the on-off switch, which are located beneath the sub-panel and out of sight in the photograph.

The parts necessary to build this receiver are listed below:

1—S-M 635 short wave kit
2—S-M 801 vernier dials
1—S-M 275 short wave choke
2—S-M 220 audio transformers
2—S-M 511 tube sockets
1—Cushioned socket for detector tube
2—pair S-M 540 mounting brackets
1—Polymet .00015 condenser with leak clips
1—Polymet 5 megohm grid leak
1—Yaxley 6 ohm rheostat
1—Yaxley 20 ohm rheostat
1—Yaxley No. 1 jack
1—Yaxley No. 2 jack
1—Yaxley No. 10 switch
1—Belden five lead color cable
2—Insulated top binding posts
1—7x18x3/16" bakelite panel
1—7x17x3/16" bakelite sub-panel

Assuming this material to have been procured, it is essential that every item be most carefully examined to make sure that it has suffered no damage between the time it was shipped from the factory and the day on which the builder purchases it. This test should include a very careful examination of the coil windings to see that they are not damaged; a check of the coil and tube sockets to see that they make proper contact; and an examination of the variable condensers for short circuits between plates; an examination of the jacks for proper contact, and a check of the rheostats for mechanical defects. The audio transformers need not be tested as it is improbable that any damage will have occurred to them.

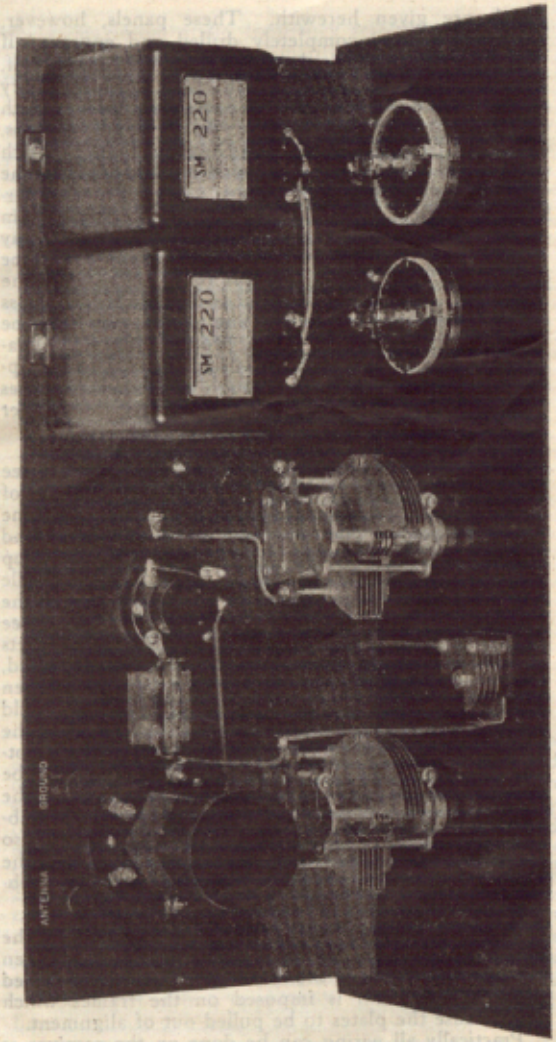
The drilling dimensions for the front and sub-

panels are given herewith. These panels, however, may be procured completely drilled and engraved if the builder does not wish to do this work himself. If, however, they are procured undrilled, it is necessary that the hole centers be laid out in accordance with the drawings, using a scriber, square, and compass. The holes should be started with a small prick punch and drilled completely thru with a hand drill in the sizes indicated on the drawings. This is not a particularly difficult operation and may be completed in approximately one-half to one hour. The panels may then either be polished or they may preferably be sanded by rubbing in one direction only with fine sandpaper and oil until all traces of the original gloss finish have been removed. The panels may then be taken to an engraver and the proper control designations engraved on them if it is desired to add to the appearance of the receiver; though for other purposes this engraving is of very little value once the builder has learned the method of tuning the receiver.

Assuming the panels to have been drilled, three mounting brackets should be fastened to the bottom of the sub-panel in the holes intended for them. One mounting bracket goes at either end of the panel and one at the approximate center in order to help take up the weight of the heavy audio transformers. (While two pairs of mounting brackets are mentioned in the list, actually only one and one-half pairs, or three brackets, are used in the receiver. As these brackets are sold in pairs, it is necessary that four be purchased, however.) After the mounting brackets have been put on, the antenna and ground binding posts should be placed in the two holes intended for them on the sub-panel with lugs under the screw heads on the bottom side of the panel. The audio transformers, tube sockets and coil sockets go on next, followed by the choke coil which is hung on the under side of the sub-panel by means of the long 6/32 screw which also serves as a connection from the choke coil up thru the sub-panel to the circuit wiring lying on top of the sub-panel.

The variable condensers should be placed on the sub-panel last, and care being taken to see that when put on, the holes for them have been properly drilled and that no strain is imposed on the frames which might cause the plates to be pulled out of alignment.

Practically all wiring can be done on the receiver at



this stage with the exception only of the leads to the jacks, rheostats, on-off switch, and midget condenser. The arrangement of this wiring can best be seen from the photographs. One interesting thing that will be noted is that certain of the mounting screws used to hold down tube sockets are also used as connections to carry lead wires thru the sub-base to the instruments located below it.

The wiring on the sub-base having been completed as far as possible, the midget condenser, jacks, on-off switch, and rheostat should be mounted on the front panel. This assembly can then be fastened to the brackets on the sub-panel and the mounting screws for the variable condensers put thru the front panel and into studs on the end plates on these condensers. This will provide a rigid mechanical assembly. The remainder of the wiring may now be put in place between the instruments on the sub-base and those on the front panel after which the receiver will be completed. The wiring, however, should be very carefully checked before the set is actually hooked up for test.

It is suggested that all wiring be done using Belden flexible rubber-covered hook-up wire. This wire is very easy to handle and as it is already tinned, soldering becomes a simple matter. When the wires are cut to the proper lengths, the insulation at the ends may be scraped off with a knife to permit of soldering, or it may be pushed back if preferred. All wiring should be done to soldering lugs fastened on the instrument terminals, although in many cases the wire can be put directly under binding post screws or nuts and soldering obviated at such points. The soldering itself should preferably be done using a good electric iron or other well tinned iron heated in such a fashion that the tinned tip is not burned by the heating flame. Rosin core solder should be used and a joint made by first rubbing the iron on the lug and wire until these parts become hot enough to melt the end of a length of rosin core solder pressed to them. Enough solder should be allowed to run into each joint to make a good, smooth-looking connection. It is very necessary that the connections be carefully examined to make sure that they are solid and tight as it frequently happens that the rosin in the solder will run in between the metal and the heated solder and form a film between them. Thus a thoroughly satisfactory joint will

ppear to have been made when actually there is little or no metallic contact and the solder has entirely failed to perform its function of running in between the metal parts to be joined.

The Belden color cable is attached directly to the wiring, preferably at points where it terminates in instrument binding posts. A suggested coding is given below which it would be well to follow.

Yellow-black.....A minus, B minus, C plus
Yellow.....C minus
Black-red.....A plus
Maroon.....B plus 45
Red.....B plus 90

Testing

The receiver having been assembled and wired, it is ready for test. The following list of accessories will be required for its operation, in addition to an antenna and ground which will be described later:

1—UX200A or UX201A detector tube
2—UX201A amplifier tubes or 1 UX201A and 1 UX112 or UX171
2—large size 45-volt batteries
1—4½-volt C battery
1—6-volt storage battery
1—pair of phones and phone plug

In testing, the receiver should first be placed upon a bench or table, the three tubes inserted in their sockets and the black-yellow and red-black leads connected to the 6-volt storage battery. If the on-off switch is then turned to the right and the rheostats varied, the brilliancy of the three tubes should vary, the left hand tube, or detector, being controlled by the 20 ohm rheostat and the right hand tubes being both controlled by the 6 ohm rheostat. Assuming this to have occurred, the A circuit wiring is correct. Before proceeding further, however, the red-black wire should be removed from the A battery and in its place the maroon and red wires alternately substituted. Using either maroon or red wire, the tubes should not light. If they do, there is an error in the B battery wiring which must be corrected before proceeding further.

Assuming these tests to have checked out properly, the two B batteries should be connected in series and

the negative of one joined to the black-yellow wire which also connects to the plus side of the 4½-volt C battery. The yellow wire connects to the negative side of the C battery, the maroon wire connects to the joint between the two 45-volt B battery and the red wire connects to the plus terminal of the second B battery. The receiver is now ready for further testing. Before proceeding it will be necessary to have an antenna and ground connection.

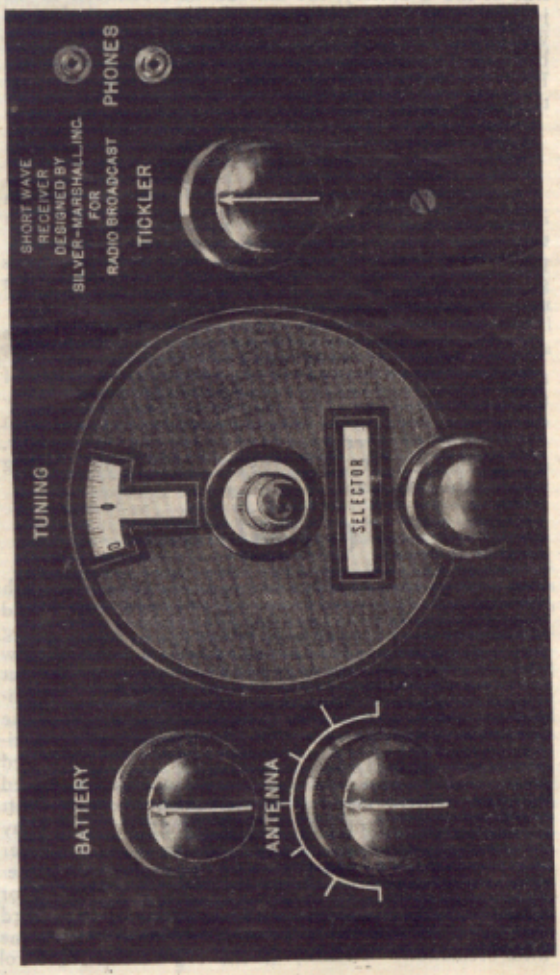
Antenna and Ground System

The ground connection may well be made thru an insulated wire to a water, steam, or gas pipe to which the wire is fastened by means of a ground clamp applied to a well scraped portion of the pipe. This ground wire is connected to the ground binding post of the receiver.

The antenna may consist of a single wire from 30 to 50 feet long stretched between suitable supports preferably outdoor. It might also be located indoors if necessary, strung around a picture moulding or located in an attic. The lead-in from the antenna which should not be over 15 to 20 feet long, preferably, should be connected directly to the antenna binding post of the receiver.

Operation

In preliminary testing, the type 117-O coil, which has next to the smallest amount of wire on it, should be inserted in the coil socket and the antenna coupling condenser turned all the way in so that the arrow points directly to the right. The amplifier rheostat should be turned so that the arrowhead, which falls directly over the contact arm, also points directly to the right. The detector rheostat should be set in approximately the same position. With the phones plugged into the minimum jack and the on-off switch turned on, the receiver may be tuned starting with the left hand or antenna condenser set approximately half way in, or at 50 degrees. The regeneration condenser should then be turned from the "all out" or 100 degree position slowly thru its range to the "all in" or zero position. As this is done, a plunk will be heard at some point indicating that the receiver has gone into oscillation. Possibly if the regeneration control



condenser is increased further, a steady squeal will be heard the pitch of which does not vary appreciably as the antenna condenser is tuned. Such a squeal would be generated by the receiver and would indicate too much regeneration capacity. If the pitch of the squeal varies with a very slight adjustment of the antenna tuning condenser, it would indicate that a station was being heard. If this were a telegraph station, the whistle would be broken up into periodic dots and dashes. If it were a broadcast station, the whistle would be approximately continuous and to detect the modulation it would be necessary to reduce the regeneration or tickler capacity to a point where the squeal just ceased and the voice or music was audible.

Normally, in tuning a receiver of this type, the regeneration or tickler condenser could be advanced until the receiver just goes into oscillation and in this condition all tuning could be done by adjusting the antenna condenser only, the degree of regeneration remaining approximately constant. This would be an ideal condition and would assume that the natural period of the antenna fell well outside of the wavelength range in use and that the antenna resistance characteristics were unusually satisfactory.

Actually, in tuning, it will be necessary to vary the regeneration condenser, which will follow no set rule, for proper setting for critical regeneration or oscillation. This is because the actual effective resistance of the antenna varies as the wavelength varies and at certain adjustments of the antenna tuning condenser, it dampens the receiver to a point where a much greater value of tickler is required to get oscillation than at other points.

This condition may be corrected in a measure by the use of very low values of antenna coupling condenser and it is suggested that the antenna coupling condenser always be set at not over one to two divisions on its scale for most satisfactory regeneration control.

Tuning Adjustments for Maximum Volume

On a radiophone station maximum volume will be obtained assuming the antenna condenser having been tuned to the station, with a tickler condenser set just below the oscillating point, or in the critically regener-

ative position where a slight movement of the dial will cause the set to oscillate and the signal to be heard as a squeal. Likewise, maximum intensity of signal will be obtained in telegraph reception with a tickler capacity set so that the receiver has just passed into oscillation and is just over the verge, so to speak. If tickler capacity is set too high, the sensitivity of the receiver will be badly impaired and telegraph signals will be heard only very weakly. It is therefore necessary in tuning with the antenna dial to adjust the tickler condenser so that the receiver is either just over into oscillation for all adjustments of the antenna condenser if telegraph stations are being received or just under it if broadcasting stations are being received. (An exception is in the case of picking up broadcasting stations when it is much simpler to tune the receiver to the station squeal when in an oscillating condition.)

Logging

Once a station has been heard it may be retuned using the same size coil at approximately the same dial settings of the wavelength, tickler, and antenna coupling dial controls. The tickler adjustment is not particularly critical and does not react very pronouncedly upon the wavelength adjustment. However, as the receiver is of the single circuit type, the wavelength dial readings are reacted upon by the setting of the smill midget antenna coupling condenser. It is therefore necessary in logging the receiver to always make an accurate record of the setting of the wavelength dial and the antenna coupling condenser dial together with an approximate record of the tickler setting. . In operation, it is advisable that the antenna coupling condenser be set at either one or two divisions and that it be not varied except as coils are changed. The only good reason for varying this coupling would be to eliminate dead spots at which the receiver would not oscillate due to the dampening effect of the antenna at certain of the wavelength dial positions.

Antenna Condenser Location

Inasmuch as the setting of the antenna condenser directly affects the logging of the antenna dial, it has been suggested—and particularly by F. H. Schnell of American Radio Relay League fame and a recognized authority on short wave receivers—that the antenna

coupling condenser be located on the sub-base of the receiver in such a position that the shortest possible leads will result between terminal No. 3 of the coil socket and the antenna binding post. This arrangement can very easily be effected by drilling a hole in the sub-panel in which the condenser should be fastened with only the knob appearing on the upper side of this panel.

A further advantage of so locating the antenna coupling condenser is that the tendency toward hand capacity effect frequently evident when it is located on the front panel is done away with to a very great extent.

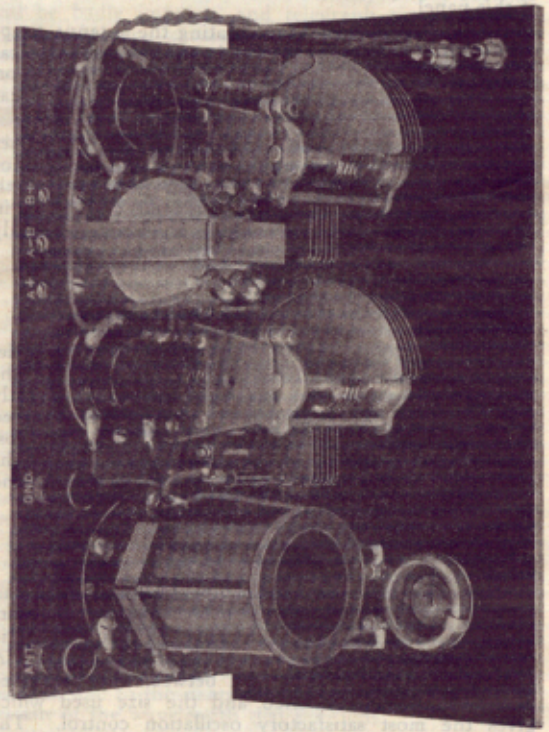
In actual operation the midget condenser may be set at one position for almost any antenna and it need not be adjusted in tuning. The proper position is with the plates practically entirely disengaged, and is one in which the receiver may be made to regenerate smoothly over its entire range with no dead spots apparent.

Rheostat Adjustments

If the UX200A or UX201A tube is used as a detector, maximum sensitivity will be obtained but the detector rheostat setting will be found to be slightly critical. The proper adjustment is very easily arrived at and it is probably well to bear in mind that the most satisfactory adjustment of both rheostats is so that the tubes burn as dimly as possible, for good volume and quality.

Grid Leaks

Grid condenser and leak rectification is used in this receiver as such a method gives greater sensitivity than grid bias rectification. The value of the grid leak, while not critical, can well stand adjustment. A number of different sizes, say, between three and ten megohms, should be tried and the size used which gives the most satisfactory oscillation control. The most satisfactory oscillation control is the condition in which, as the tickler condenser capacity is increased, the regenerative condition is progressed thru slowly and smoothly and the receiver goes into oscillation without an audible plunk. Further, the receiver should go into oscillation at the same point on the dial that it comes out. Methods of arriving at such an



adjustment would be by varying the grid leak, the detector plate voltage, and the antenna coupling condenser. Under no circumstances should a variable type leak be used.

Choke Coil

The choke coil is shown as option at points "X" on the diagrams. Its use is recommended in practically all cases as difficulty may be experienced in making the receiver oscillate without it. The S-M type 275 choke is tapped. It should normally be used with both windings in series; that is, with connections made to the outside lugs. If, however, too pronounced a tendency is evinced on the part of the receiver to oscillate, only half of the choke should be used, which would mean that connections should be made to the center lug and either one of the outside lugs of the choke.

Stability

It frequently happens in assembling a receiver of this type that the isolation of the RF and AF circuits is not as satisfactory as it should be with the result that if the receiver is set in a critically regenerative condition and the phones plugged from first to second stage jack the receiver may burst into oscillation and become very sticky in control. This condition can best be eliminated by decreasing the plate voltage on the detector tube to the minimum allowable value which will be in the neighborhood of 20 volts. At the same time the connection of .002 condensers from plate to plus filament of the first and second audio stages, will assist materially.

It may frequently even be advisable to connect small RF choke coils in series with the telephone cords, with the telephone cords bypassed on the phone side of the chokes by means of a .002 condenser (type 275 chokes may be used for this purpose).

Dry Cell Tubes

Dry cell tubes may be used in the receiver satisfactorily, though preference should be given to the storage battery types as they will handle more adequately the volume which will be developed in the reception of rebroadcast programs. For amateur telegraph reception dry cell tubes will be practically as satisfactory as

the larger types. Either UX199s or WX11s may be used, depending upon the builder's preference.

Audio Amplifier Selectivity

In amateur telegraph reception where all stations must be heterodyned to an audible note which may be adjusted at the will of the operator, it is frequently desirable that the audio frequency amplifier have a characteristic exactly opposite that of the broadcast amplifier. In other words, the audio amplifier should amplify at a maximum somewhere in the neighborhood of a thousand cycles and should give very poor amplification at all other frequencies.

The simplest method of producing such an amplifier is to use a very poor audio transformer or one intentionally designed for this purpose. The use of an audio transformer giving the required amount of distortion or audio and frequency selectivity is illustrated in the photos of the receiver built for the Dyott Expedition. A simpler method of arriving at the same result can very easily be effected with the receiver herein described, which would thus be suited both to rebroadcast and amateur reception. (A receiver built with poor audio transformers would be totally unsuited to rebroadcast reception where quality was desired.)

If series resistances on the order of 10 to 50 thousand ohms are connected in series with the primaries of the audio transformers, low frequency reproduction will be very badly affected. If any decrease in signal is noticed, this may be compensated for by an increase in plate voltage. The important thing, however, is to get a fair amount of resistance in series with the audio frequency transformer primaries in order to ruin low note reproduction. The next step is the connection of condensers on the order of .00025 to .0005 across the secondaries of the audio transformers which will effectively damage high frequency reproduction. The net result of both these changes is to provide an audio amplifier giving maximum amplification in the neighborhood of one thousand cycles.

These resistances and condensers may be arranged so that they can be easily clipped into a circuit when maximum results are desired in telegraph reception and clipped out when broadcast programs are to be received thus rendering the receiver very flexible, indeed.

Shorter Waves

While the receiver described using the S-M 635 kit is not intended for operation below 18 meters, it will probably go down to approximately 15 with the antenna coupling condenser practically all out.

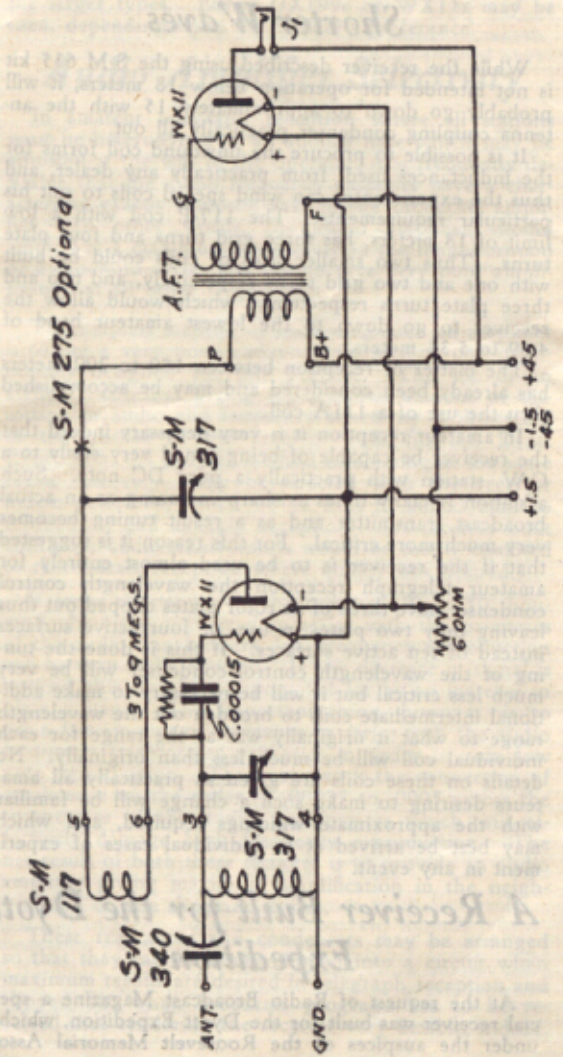
It is possible to procure the unwound coil forms for the inductances used, from practically any dealer, and thus the experimenter can wind special coils to suit his particular requirements. The 117-P coil with a low limit of 18 meters, has three grid turns and four plate turns. Thus two smaller sizes of coils could be built with one and two grid turns respectively, and two and three plate turns respectively, which would allow the receiver to go down to the lowest amateur band of 4.69 to 5.35 meters.

The matter of reception between 150 to 200 meters has already been considered and may be accomplished thru the use of a 111A coil.

In amateur reception it is very necessary indeed that the receiver be capable of being tuned very easily to a C.W. station with practically a pure DC note. Such a station is many times as sharp in tuning as an actual broadcast transmitter and as a result tuning becomes very much more critical. For this reason it is suggested that if the receiver is to be used almost entirely for amateur telegraph reception the wavelength control condenser have three of its rotor plates clipped out thus leaving only two plates in use, or four active surfaces instead of ten active surfaces. If this is done the tuning of the wavelength control condenser will be very much less critical but it will be necessary to make additional intermediate coils to broaden out the wavelength range to what it originally was as the range for each individual coil will be much less than originally. No details on these coils are given as practically all amateurs desiring to make such a change will be familiar with the approximate windings required, and which may best be arrived at in individual cases of experiment in any event.

A Receiver Built for the Dyott Expedition

At the request of Radio Broadcast Magazine a special receiver was built for the Dyott Expedition, which, under the auspices of the Roosevelt Memorial Asso-



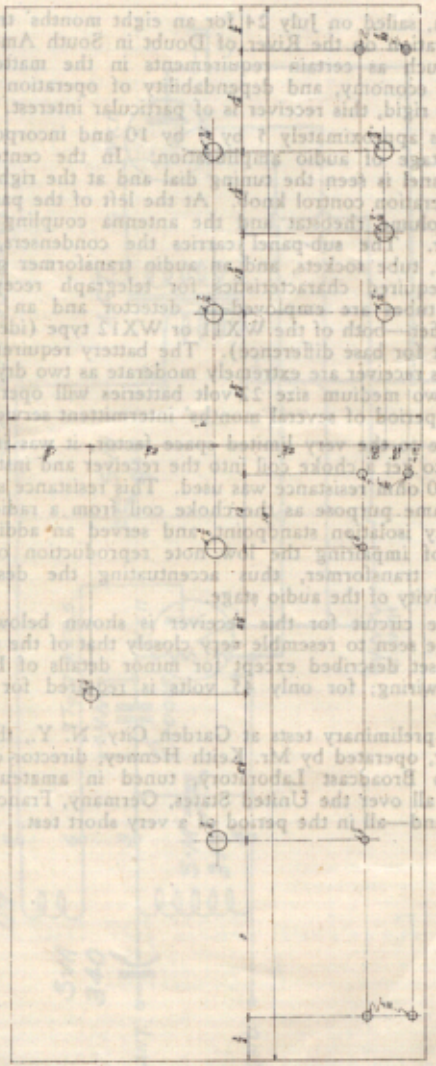
ciation, sailed on July 24 for an eight months' trip of exploration on the River of Doubt in South America. Inasmuch as certain requirements in the matter of space, economy, and dependability of operation were rather rigid, this receiver is of particular interest.

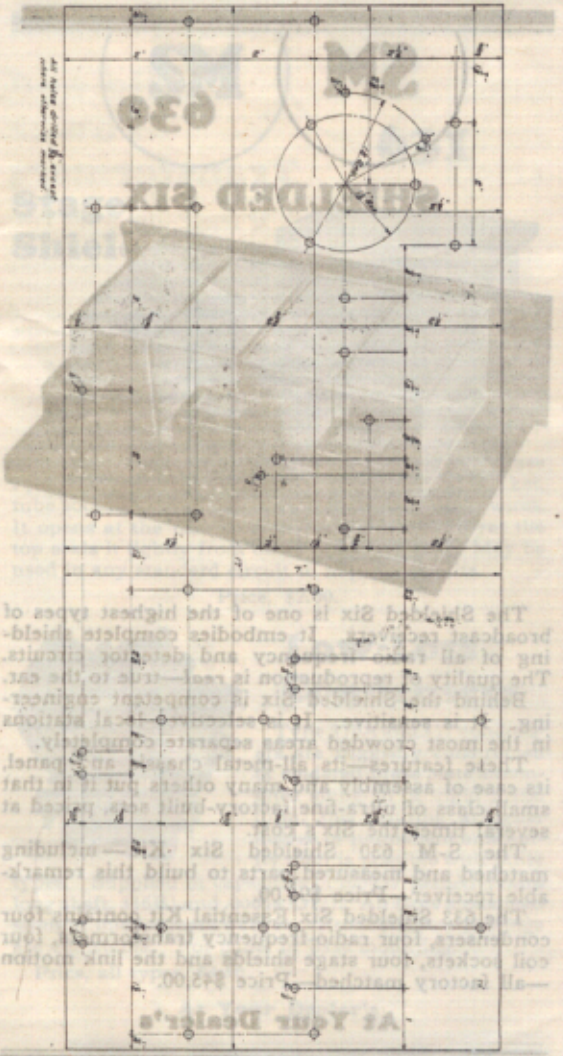
It is approximately 5 by 5 by 10 and incorporates one stage of audio amplification. In the center of the panel is seen the tuning dial and at the right the regeneration control knob. At the left of the panel is the volume rheostat and the antenna coupling condenser. The sub-panel carries the condensers, coil socket, tube sockets, and an audio transformer giving the required characteristics for telegraph reception. Two tubes are employed—a detector and an audio amplifier—both of the WX11 or WX12 type (identical except for base difference). The battery requirements of this receiver are extremely moderate as two dry cells and two medium size 22-volt batteries will operate it for a period of several months' intermittent service.

Due to the very limited space factor, it was impossible to get a choke coil into the receiver and instead a 10,000 ohm resistance was used. This resistance served the same purpose as the choke coil from a radio frequency isolation standpoint, and served an additional one of impairing the low note reproduction of the audio transformer, thus accentuating the desirable selectivity of the audio stage.

The circuit for this receiver is shown below and will be seen to resemble very closely that of the three-tube set described except for minor details of B battery wiring; for only 45 volts is required for both tubes.

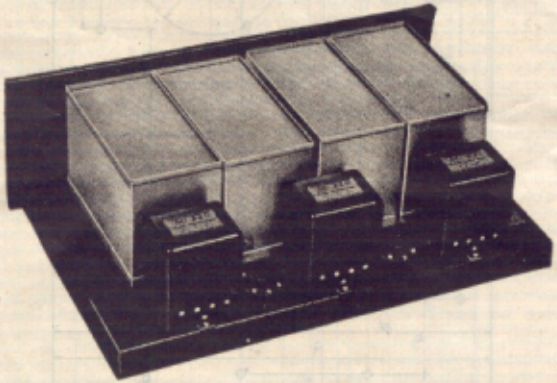
In preliminary tests at Garden City, N. Y., this receiver, operated by Mr. Keith Henney, director of the Radio Broadcast Laboratory, tuned in amateur stations all over the United States, Germany, France and Holland—all in the period of a very short test.





SM 630

SHIELDED SIX



The Shielded Six is one of the highest types of broadcast receivers. It embodies complete shielding of all radio frequency and detector circuits. The quality of reproduction is *real*—true to the ear.

Behind the Shielded Six is competent engineering. It is sensitive. It is selective—local stations in the most crowded areas separate completely.

These features—its all-metal chassis and panel, its ease of assembly and many others put it in that small class of ultra-fine factory-built sets, priced at several times the Six's cost.

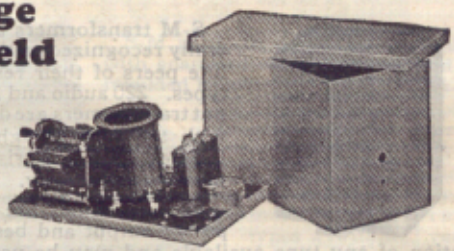
The S-M 630 Shielded Six Kit—including matched and measured parts to build this remarkable receiver—Price $95.00.

The 633 Shielded Six Essential Kit contains four condensers, four radio frequency transformers, four coil sockets, four stage shields and the link motion—all factory matched—Price $45.00.

At Your Dealer's

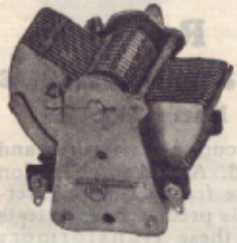
SM 631

Stage Shield



The S-M type 631 stage shield is an aluminum case 7½ x 5 x 3¾ inches, pierced for a condenser, coil socket, tube socket, choke, bypass condensers and lead wires. It opens at the bottom allowing easy wiring, yet the top seals it tightly from outside interference. May be used in any standard circuit to improve results.

Price, $2.00.



Low-Loss Condensers

Type 316A and 317 condensers are ruggedly constructed of soldered brass plate assemblies slung in a rigid metal form, this insuring a higher degree of permanent uniformity than is possible with other types. Supplied in capacities of .00035 (316A) (extra long shaft, 316B) and .00014 (317). All have a modified straight line frequency curve. Front and rear bearings are adjustable. For panel or base mounting.

Price, all types, $4.50.

At Your Dealer's

SM Audio and Power Transformers

S-M transformers are generally recognized as the absolute peers of their respective types. 220 audio and 221 output transformers are designed with the falling high-to-low frequency characteristic that means real quality.

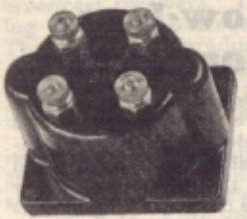
330 power has the highest power output and best regulation of any type available and may be used with Raytheon or Rectron tubes. 331 Unichoke is the only choke built on the new Clough filter principle —a revolutionary development.

322 condenser bank completes the power supply assembly using 330 and 331.

Price, 220, 221, 330 or 331 ..... $ 6.00
Price, 332 condenser bank 10.00

Radio Transformers

Long Wave



Accurately measured and tested. Actual amplification to the fraction of one percent is predicted in the tests that these transformers have to pass. Type 210 is an untuned iron core transformer and 211 a sharply tuned air core filter.

Available peaking at any frequency between 40 and 65 kilocycles for 199 or 201A tubes. Price, $6.00.

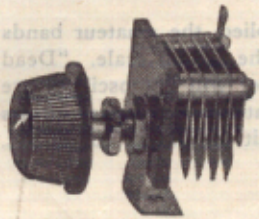
At Your Dealer's

SM Uniform Plug-In Coils

S-M plug-in coils are wound with enameled wire upon threaded, moulded bakelite forms, with a guaranteed accuracy of one half of one percent. As R. F. transformers they are the most efficient and permanently uniform types available, yet the various sizes, ranging from 30 to 1800 meters, may be used for any purpose.

Price, A, B or C size $2.50
Price, D size 3.25
Price, No. 515 Universal socket 1.00

Midget Condenser



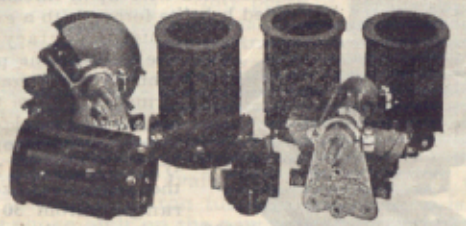
Type 340 is a .000025 Mfd. condenser of low loss construction that will meet a surprising variety of requirements. Supplied with knob for panel or base mounting.

Price, $1.50.

At Your Dealer's

SM 635

SHORT WAVE KIT



The Type 635 Short Wave Receiver Kit contains the carefully designed and matched essentials for a real short wave set. Its range is 18 to 150 meters. The kit contains a set of four plug-in coils, one coil socket, one coupling condenser and two 140 mmf. condensers. These parts are all carefully designed for operation together.

With the four coils supplied, the amateur bands fall well to the center of the tuning scale. "Dead spots" at which the receiver will not oscillate are totally eliminated. The antenna condenser allows coupling adjustment to suit individual conditions. Price $23.00.

At Your Dealer's