Radio and Model Engineering

Vol. II JANUARY, 1922 No. 1

M. B. Sleeper, Editor - - - - - - W. H. Bullock, Associate Editor

Published by The General Apparatus Company, Inc.

10 Cents a Copy $1.00 Per Year

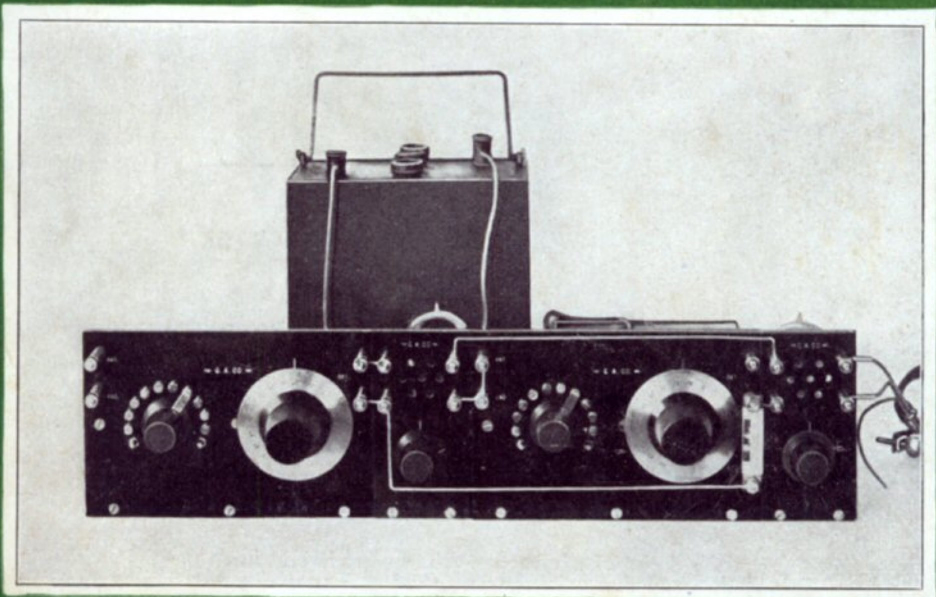


Fig. 1. The universal tuner used in a regenerative circuit

IN THIS ISSUE

A Universal Tuner
By M. B. SLEEPER

Laying Out Instrument Panels
By B. H. ROSS

A Short Wave Variocoupler
By W. H. BULLOCK

A Universal Tuner

An instrument designed especially for broadcast reception and uses where a calibrated oscillatory circuit is required.

By M. B. Sleeper

Tuners not Necessarily Complicated

JUDGING from the number and variety of articles that are being printed on the construction of radio receiving tuners it would seem to one not versed in the art, that these instruments were an extremely complicated and delicate affair. Such is not the case, however, for when the duties of a tuner are understood it will be found that quite simple apparatus answers the purpose of instruments having a more scientific or expensive appearance.

General Description

The recent popularity of radio has done more for the development of simple and efficient receiving sets than has anything else in the history of wireless. Manufacturers are gradually standardizing their equipment in sizes, construction, circuits, and number of controls. And, surprising as it may seem, about eighty per cent of the new receiving tuners now appearing on the market employ simple single circuits with from one to three adjustments. The instrument here described and shown in Figs. 1 to 5 was brought out by the G.A.Company to meet the demand for a tuner efficient in its functions, simple to operate, and comparatively inexpensive. In addition to these requirements it is all that may be hoped for in the line of "an instrument that you can add to." As seen from the illustrations, this tuner consists essentially of a single layer inductance tapped in ten places, and a variable air condenser of eleven plates. These parts are mounted on a 5 by 7½ by $\frac{3}{16}$ in. L. P. F. panel which carries the condenser dial, switch knob, and four terminals. The panel is held in an upright position by a wood base measuring 6 by 7½ by ⅜ ins., tho L. P. F. is now used for bases on these sets as well as the detectors and amplifiers. The two binding posts at the left of the panel are connected to the antenna, and ground, while those at the right are detector terminals.

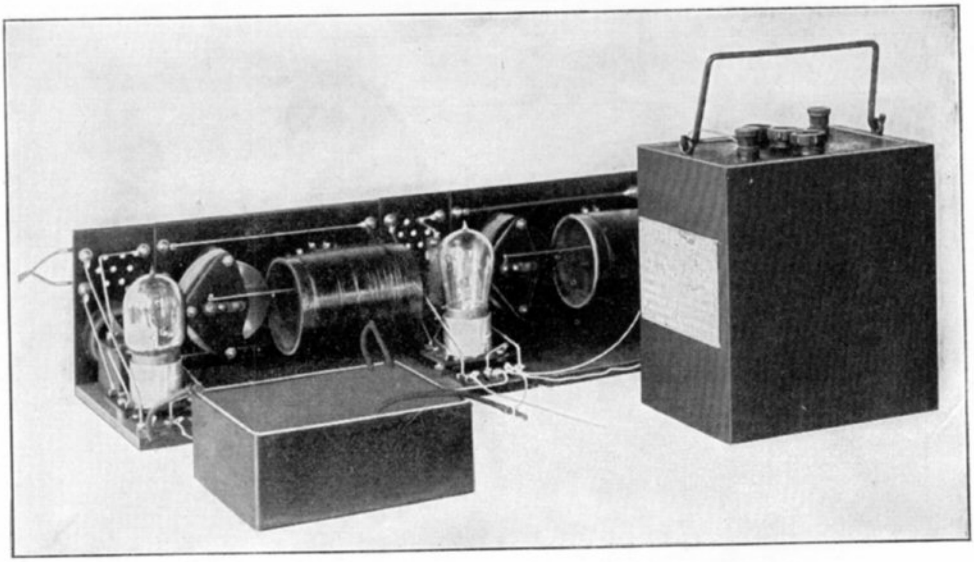


Fig. 2. Rear view of Fig. 1, showing arrangement of units

Winding the Coil

The coil is wound upon a 4 in. piece of GA-lite tubing 3 in. in diameter. This is cut from a standard 9 in. length by means of a sharp, thin cutting tool, such as a safety razor blade. If care is taken to draw the blade, more than to press downward upon it, a clean edge will result. The wire used for the winding is No. 24 S. S. C. wire, B. & S. gauge. The coil is started ⅜ in. in from one end of the tube and taps are taken off at the turns numbered in the drawing, Fig. 5. When reaching a point where a tap is to be taken off, bend the wire sharply back over the preceding turns and wind one turn over the winding that you have already made. Bring the wire down to the tube again by a sharp bend at the point where the wire left the tube. Proceed with the winding, taking off each tap in the same manner, but do not count the turns made over until you are ready for them. A coat of a good grade of varnish is necessary to hold the turns in place, and the appearance gained by its use is well worth the trouble, especially where green silk covered wire is employed.

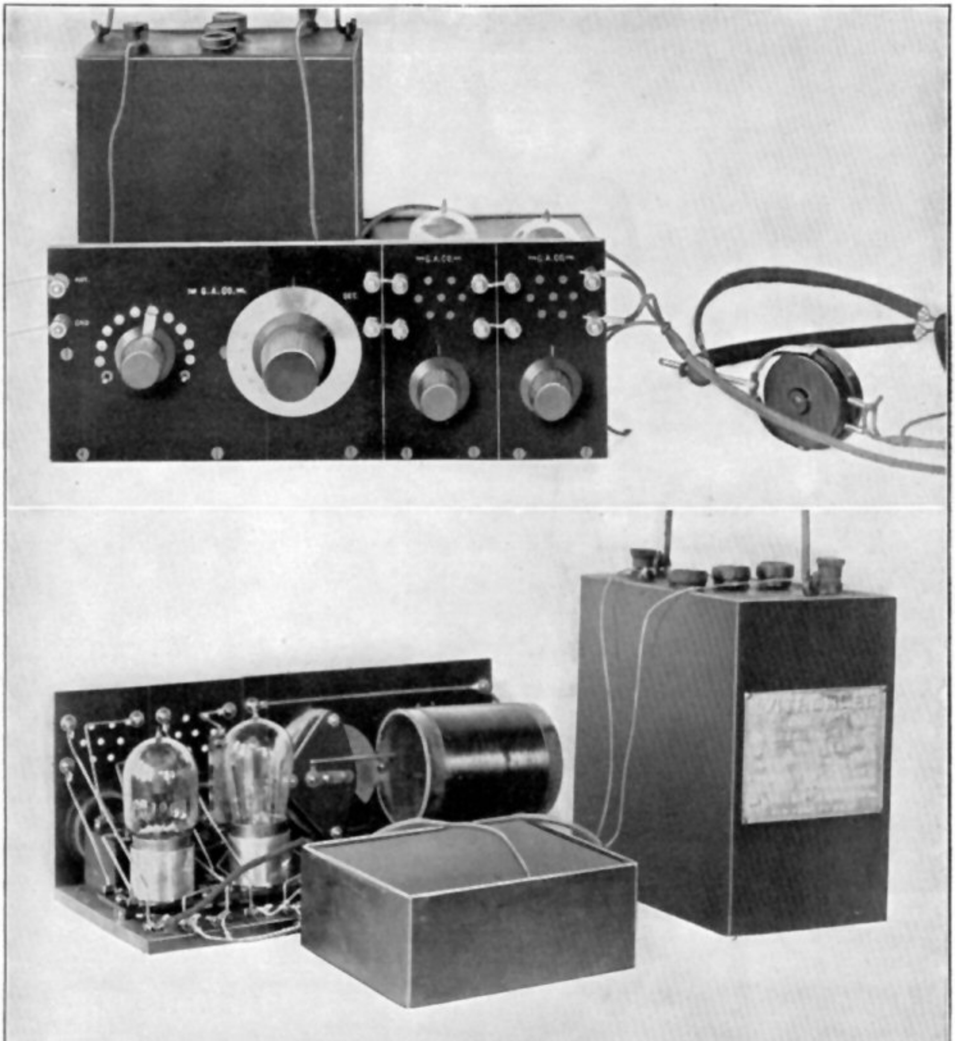


Fig. 3. Front and rear views of a complete receiving outfit employing the universal tuner

the winding at each tap, in the number of turns of winding in the coil. When the coil is completely wound, place your finger over the point where the wire leaves the tube for a tap, and cut the outside turn diametrically opposite this point. Twist the two ends thus made, and follow the same procedure for each tap. This system is not only simple but is a great convenience in winding, since all of the taps are out of the way

Drilling the Panel

Next lay out the 5 by 7½ by $\frac{3}{16}$ in. L.P.F. panel according to the drawing, Fig. 5. Dimensions may be transferred from the drawing to your work by the use of dividers. The drawing is one-half size, so all measurements must be multiplied by two. The numbers appearing beside the holes represent the size of drill to be used. Five different sizes are required.

Two concentric holes indicate that the hole is to be countersunk to take flat head screws. The panel should be laid out on the rear so that lines used for locating holes will not mar the appearance of the front of the instrument. Mark the position of all holes with a center punch before attempting to drill. This is quite important, for otherwise the hole may come anywhere within ⅛ in. of the point where it should be. When drilling from the back side of a panel, great care should be taken to prevent the drill breaking out a piece on the front side, just as it is coming thru. A common cause of such a mishap is too great pressure on the drill. To avoid an accident of this character, place the panel face downward on a smooth, flat piece of wood, and clamp it there if possible. Then drill from the upper side with a sharp twist drill, using more speed than pressure, especially as the drill is about to enter the wood. If this system is followed no trouble of any kind should be experienced.

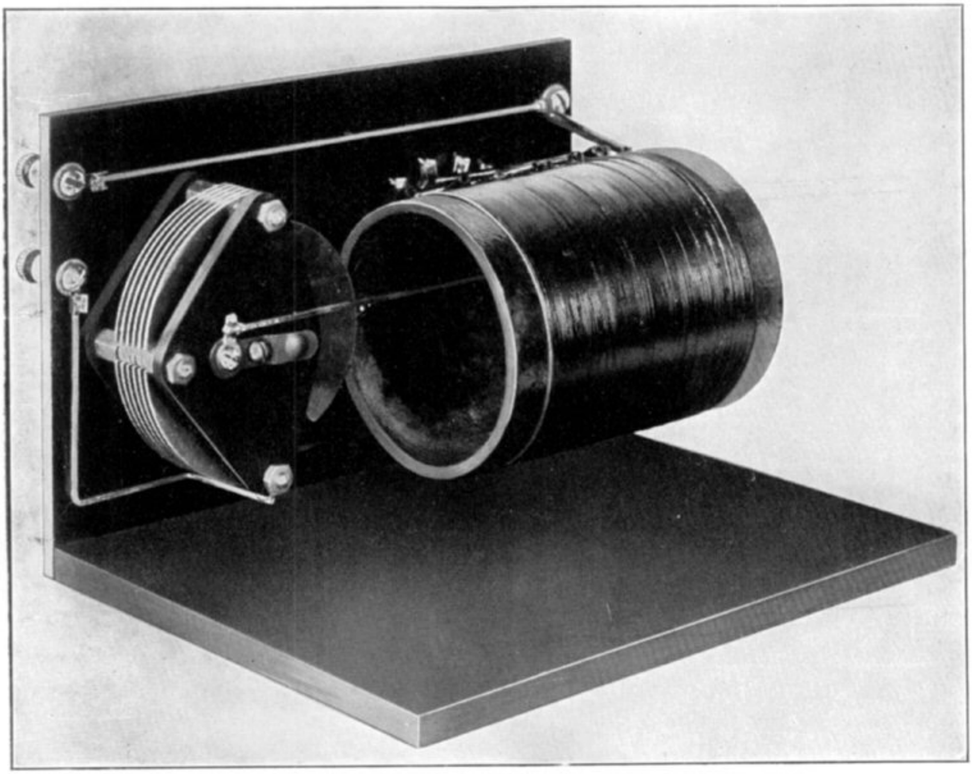


Fig. 4. Rear view of the universal tuner

Assembling the Tuner

The next phase of the work is the assembly. First mount the binding posts, coil support pillars, switch points, switch stops, and switch, on the panel. Be sure to tighten the nuts on the switch points down so that the lugs under them cannot move. Otherwise the lugs are liable to swing around and touch each other, short circuiting the section of winding between them. Even if they do not strike, the fact that they are loose means that a poor electrical contact is made, and this may give serious trouble when the set is operated. Now drill the coil tube with two No. 27 holes 3½ ins. apart, one in each margin. These are to take ¼ in. 6-32 R. H. screws for fastening the coil to its support pillars.

Mount the coil with the small taps toward the end of the panel which carries the antenna and ground binding posts. Cut the end of the winding to reach to the antenna terminal and make the taps just long enough to go into their respective switch-point lugs. Now remove the insulation from the ends of the wire and twist the two leads together. Empire tubing is used to cover the taps. Pieces should be cut from a standard 2 ft. length, long enough to extend from the coil to the edge of the lug. The use of this tubing makes a good appearance out of what would otherwise be an untidy job. Next solder the leads to the lugs, taking pains not to use more flux than is actually required. Make sure that the solder follows the surface of the lug before removing the iron, for without this precaution it frequently occurs that the solder does not adhere, although the wire seems to be firm at the time.

The mounting of the variable condenser comes next, and the instrument is ready for wiring. Two 2 ft. lengths of square tinned copper bus bar supply the necessary conductors for this work. The antenna and upper detector terminals are connected to the left end of the winding. The ground binding post is wired to the rotary plates of the condenser, and another section of wire connects the inductance switch to

should be drilled in the front edge for a depth of about one-half inch, to assist in starting the screws, and to minimize the chances of splitting the base when the screws are turned in.

The 180° dial has been left off up to this point to avoid the danger of scratching the highly polished surface during the course of construction of the instrument.

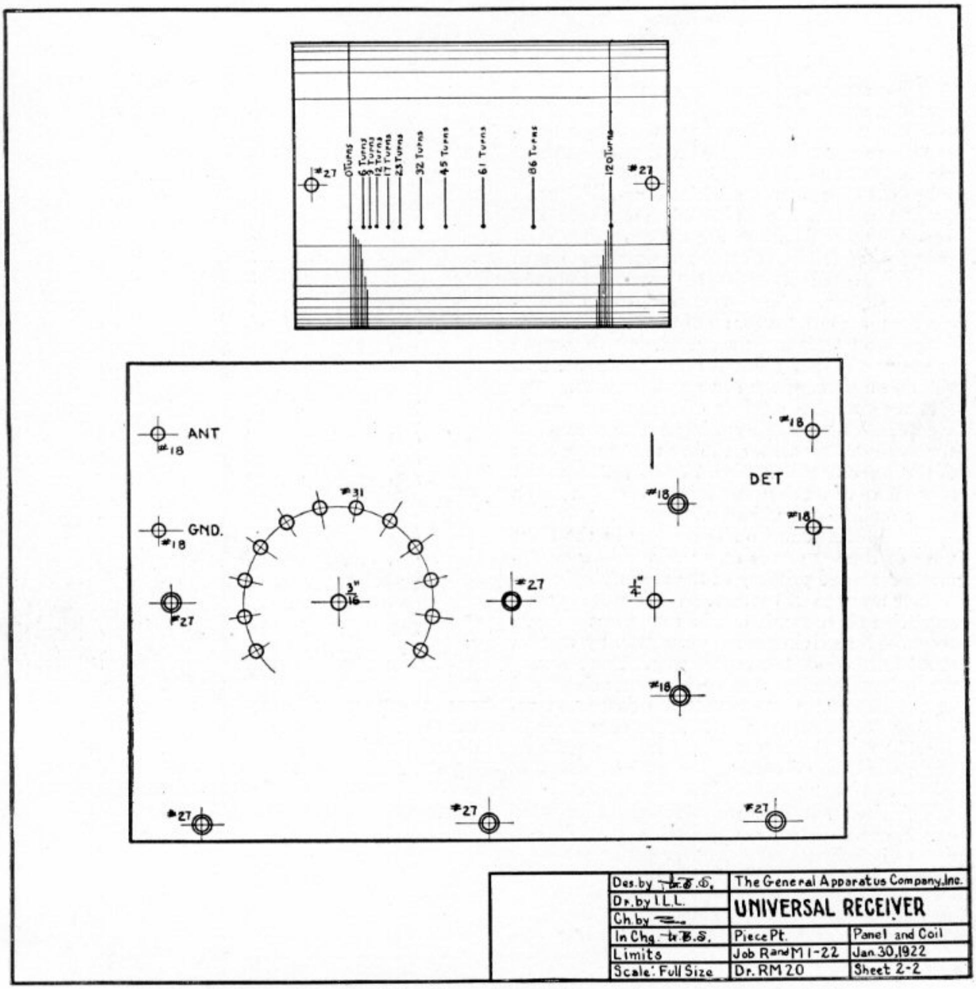


Fig. 5. Scale drawing of coil details and panel lay-out, reduced to one half size

the lower detector post and stationary condenser plates. By referring to the rear view of the set shown in Fig. 4 the method of wiring is seen to be extremely simple. The 7½ by 6 by ⅜ in. wood base is now given a coat of dark wood dye and one or more coats of shellac or varnish. Wood dye alone will not fill up the pores in the base, so it is necessary to use a varnish or shellac. This excludes moisture from the wood and tends to prevent warping. Three 1 in. No. 6 F. H. nickel plated wood screws are used for securing the L. P. F. panel to the base. No. 31 holes

Uses of the Tuner

Fig. 3 gives the front and rear views of the single circuit tuner connected to a standard detector unit, one step amplifier panel, Witherbee 6 volt 40 ampere-hour A battery, G.A. 45 volt B battery, tubes and telephones, to form a complete receiving equipment. This outfit employed in connection with an antenna having a capacity of 0.0003 mfd. will cover a wavelength range of 50 to 675 meters. On an antenna of this size wavelengths between 380 and 675 meters may be selected by rotating the condenser thru 180° with the inductance switch on the 10th tap. Similarly a range of 250 to 475 meters is covered on tap 8, and 182 to 302 meters with the switch on the sixth point. From this it can be seen that the wavelength range of the instrument is sufficient to cover amateur, broadcast, and commercial waves, with a margin great enough to allow for the different sizes of aerials encountered at experimental stations.

The B battery shown has a tap at 22½ volts which goes to the plate of the detector tubes, while the 45 volt positive terminal is connected to the amplifier. For a less expensive set, the standard amplifier unit may be omitted, a 22½ volt B battery substituted for the larger type, and the telephones connected to the output posts of the detector panel.

For stronger signals, additional amplifier units may be put on. More than three steps of audio frequency amplification are seldom used, however, for the reason that the stronger signals and tube noises are built up in greater ratios than the weaker signals. One 45 volt B battery will supply the plate current for all of the amplifier units where head telephones are used, but to get the most out of a loud talker it is advisable to use 90 volts on a plate of the last amplifier tube.

A regenerative receiver of exceptional working qualities is made by using a second tuner of the type described, for tuning the plate circuit of the detector tube. Figs. 1 and 2 are front and rear views of an outfit of this sort, employing a single audio frequency amplifier unit.

The G.A. Phone Condenser seen in the front view of the set serves as a radio frequency bypass across the primary of the amplifying transformer and the B battery. While not a necessity with all tubes, it will be found less difficult to make a receiving system oscillate, by using a 0.001 fixed condenser in this way. The antenna and ground binding posts of the tuner employed in the detector plate circuit are connected together. This places the variable condenser in parallel with the inductance, forming a periodic radio frequency circuit which may be tuned to any wavelength between 50 and 840 meters.

This combination forms a high-grade receiving outfit, complete in every detail, and when employed in connection with an antenna having a natural period of about 200 meters will be found very efficient and selective, particularly for concert and relay traffic reception.

The Tuner as a Wave Meter Besides the uses for which the tuner was originally intended, it makes a very handy and inexpensive wave meter when the various settings of the condenser are calibrated at several values of inductance. As such an instrument, the antenna and ground binding posts are connected together to form a closed oscillatory circuit. A crystal detector and phones may be wired to the detector terminals as a means of determining resonance with a source of radio energy. The table below gives the wavelengths to which the circuit is tuned, at the indicated switch and condenser settings.

Wavelengths	*Inductance Tap*	*Condenser Division*
150	4	13
175	4	40
200	4	65
225	4	90
250	7	22
275	7	29
300	7	37
325	7	45
350	7	53
375	7	65
400	7	74
425	7	85
450	7	97
475	10	23
500	10	27
525	10	31
550	10	35
575	10	39
600	10	44
625	10	51
650	10	57
675	10	65
700	10	72
725	10	77
750	10	82
775	10	88
800	10	92
825	10	97

Wavelengths between those listed may be most easily and readily found by making three curves, one for each position of the switch, plotting the wavelength values vertically and the condenser divisions horizontally. The calibrations listed were found to be within three percent accurate for the several tuners measured in the G.A. laboratory, so if the instructions for building this instrument are followed carefully an instrument accurate enough for all practical purposes will result. If tubing of a size different than that specified is used the calibrations given will not hold good. For the same reason the number of turns in the inductance must not be changed, nor a different condenser used. The type of variable air condenser employed is of particularly rugged construction and for that reason will be found to hold closely to its rated capacity, in spite of rough handling.

NOTICE TO G. A. CUSTOMERS

The address of the G.A. Company has been changed from 570 W. 184th St., New York City to 88 Park Place. This brings the factory, wholesale department, and mail order section in a more convenient part of the city, while our retail trade is cared for in the G.A. radio department of Wertheimer's Department stores, at 627 W. 181st St., and Fordham Road at Grand Concourse. We are not at present in a position to accommodate retail trade down-town but hope to be able to do so in the near future. In the meantime all goods bought at retail, with the exception of mail orders, must be purchased from our uptown retail departments. Mail orders as well as all correspondence should be addressed to 88 Park Place. Dealers and jobbers should conduct their business at this location but in no case will goods be delivered here.

Laying out Instrument Panels

A subject which seems extremely simple, but one which is given too little attention.

By B. H. Ross

Importance of Laying Out Panels

TO A GREAT many the subject of laying out instrument panels seems too simple and elementary to warrant much space being given to the matter. But it is a matter of fact that the general instructions for apparatus construction in Radio and Model Engineering have not covered this phase completely enough for those who are comparatively unfamiliar with instrument work.

Very frequently experimenters bring panels to the G.A. Company to have them laid out and drilled, quite unaware that they could save seventy-five per cent the cost of such work by marking the position of the desired holes themselves. When told this, a great many take their panels back and soon return with the location of holes indicated by soft pencil marks ⅛ in. in diameter. Quite obviously, holes may be drilled in these places and still be a long way from the position they should occupy.

Cases are also common where amateurs bring in instruments for repair which show the lack of proper instructions in the laying out of the panels. The distance between switch points vary, binding posts are not in line, and the location of the various adjusting knobs seem to bear no relation to each other. Visits to several amateur stations are quite interesting from this point of view, for it is found that the man with the most money seldom has the best appearing equipment. Many stations are composed of simple and comparatively inexpensive apparatus, but constructed and arranged so neatly that they eclipse in appearance and working qualities the equipment of stations whose owners are not limited in a financial way. And the majority of the owners of the neat and efficient outfits agree that the chief reason for this superiority of their equipment is the careful laying out of the instrument panels.

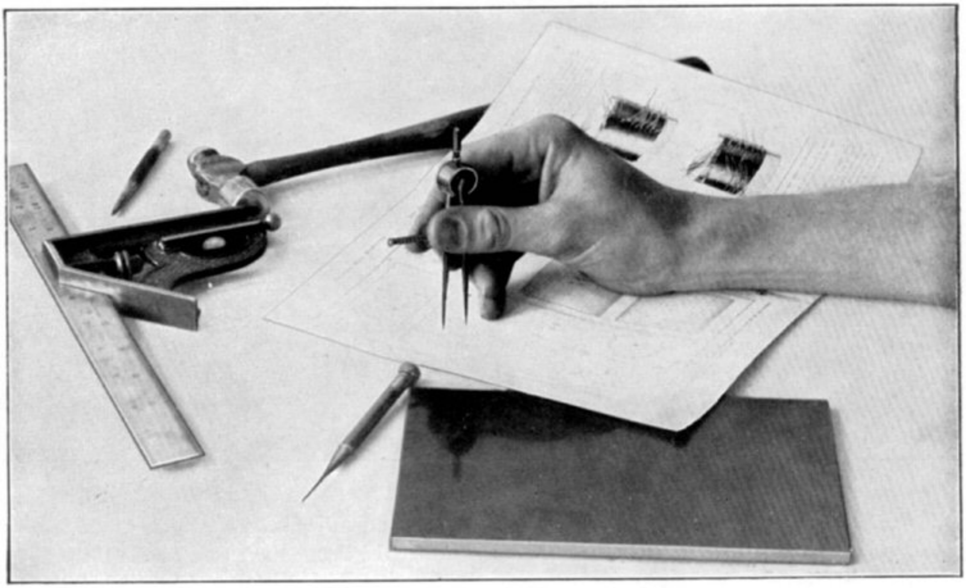


Fig. 1. Showing method of taking measurements from scale drawings

Some Causes of Errors

The poor appearance of some instruments is often the result of insufficient time spent in laying out the panel. This, of course, is bad economy. The use of a pencil or blunt marking tool accounts for a large number of misplaced holes and the dependence upon a mark rather than a center punch hole for starting the drill ranks next as a cause for this error. With many, the fault lies in the fact that they are not careful or accurate in transferring dimensions from scale drawings to their work, while others can trace their trouble to the use of panels whose adjacent edges are not exactly at right angles. The latter is quite common where panels are purchased from dealers who cut their material from large pieces into any size desired by the customer. The edges are seldom straight or at right angles, and the instrument builder finds it necessary to spend considerable time to square the edges so that he may make measurements from them to locate his holes. The experimenter building apparatus from Radio and Model Engineering instructions finds less difficulty than the man who follows other directions for he usually employs L.P.F. panels which have perfectly straight edges and right angle corners. With this stock to work upon, the job resolves itself into a matter of the use of tools.

The Tools Required The builder should provide himself with a pair of dividers, scriber, square, center-punch, hammer, and hand drill. The dividers should be capable of covering a radius of about 2 ins., the points should be sharp, and the joint firm. Errors are frequently made by an accidental change in setting of loose dividers. The only requirement of the scriber is that it have a sharp hard point. A combination square of the type shown in Figs. 1, 2 and 3 is recommended, and the blade should be at least six inches long, with divisions to 1-32 in. or finer. A hard conical point is necessary for center punch. Instruments are often re-sharpened to a point which is not truly conical, and to use them, one runs the risk of centering the hole a little distance from the place where it should be located. When struck with the hammer the center punch will move slightly in the direction of that part of the tapering point which is most nearly vertical. A four-ounce ball-pean hammer is heavy enough for this class of work, altho almost any kind will serve the purpose. The hand drill is of the familiar type shown in Fig. 3. The chuck should have a drill capacity up to $\frac{1}{4}$ in. An ordinary brace is used by most experimenters for larger drills.

Purpose of the Tools The dividers are used for transferring measurements made upon the drawing, to the scale, and for measurements wholly upon the surface of the panel. They should not be employed for locating a point from the edge of the L.P.F. for the reason that it is inconvenient if not impossible to set the very point of the instrument on the upper edge of the panel, as would be necessary for accurate work. The combination square should always be used for making measurements from the edge of the panel. All straight lines and points are made with the scriber used in the manner illustrated in Fig. 2. Note that the point is kept close to the scale while the square is held firmly by the left hand. The principal functions of the combination square are the making of measurements from the panel edges, measuring the distance between the divider points when taking dimensions from drawings, and for use as a straight edge, particularly for drawing lines parallel or at right angles to an edge of the panel. While using the instrument as a square, care should be taken to see that the knurled nut which locks the scale is turned down tightly. The center punch is used only for marking holes to be drilled. This tool is held perpendicular to the surface of the panel at a point determined by two intersecting lines, and struck squarely with the hammer. This operation starts the hole which is easily followed by the drill. The drill should be held very firmly in a vertical position by the left hand while the right is used for turning. For this class of work comparatively light pressure with high speed should be given the drill, to minimize the chances of breaking the panel out on the front, as the drill is about to come thru.

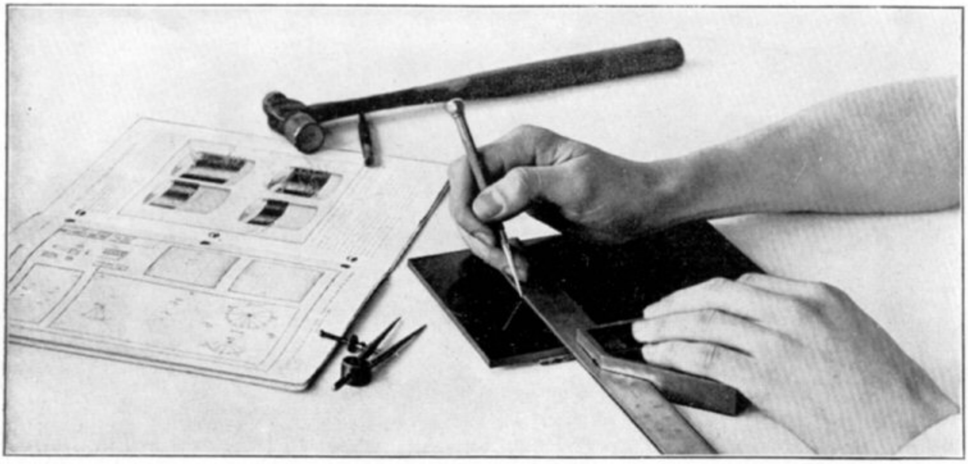


Fig. 2. Illustrating use of scriber

Uses of the Tool All panels should be laid out on the reverse side so that any defacing of the L.P.F. required to locate holes will not be seen on the front of the instrument. This, of course, necessitates laying the panel out in negative, that is, the holes shown on the left of the panel drawings will be drilled on the right of the reversed panel.

Start at one end of the panel drawing and measure the distance the first holes are located from the edge, multiply this dimension by two when the drawings are half size, and the result will be the distance the holes are located from the edge of the panel. Place the combination square firmly against the panel and with the scriber make a point on the L.P.F. at the scale division representing this distance. Now change the square to an adjacent edge and with the point of the scriber held closely against the scale, draw a line thru the point just made. The hole or holes to be located will lie somewhere in this line, and their exact position will be found by measuring from the edge of the panel along the line, and placing a point where the center of the hole is to come. A short line crossing the first, at right angles at this point will definitely determine the location of the hole. Next place the point of the center-punch at the intersection of the two lines and hold the tool perfectly vertical while it is struck a blow with the hammer. In a similar manner locate all holes by intersecting lines, at least by a point on a line, and start them with a center punch to insure accurate drilling. The drill started in a center punch hole will not move along the surface of the panel as it is liable to do when no punch is used, but will hold its position during the drilling of the required hole.

Results of Careful Work

Every minute of time devoted to careful and accurate work in laying out panels will be amply realized in the values of the completed instrument. Experimenters who give a sufficient amount of attention to the details of this phase of apparatus construction always have radio outfits of the highest class. They take a feeling of pride in the pleasing appearance of their instruments, which are always a subject of envy of their fellow amateurs, who regard the laying out of panels as an unimportant detail. This tends to increase their interest in apparatus design and construction and they find the work more easy and enjoyable with each instrument built.

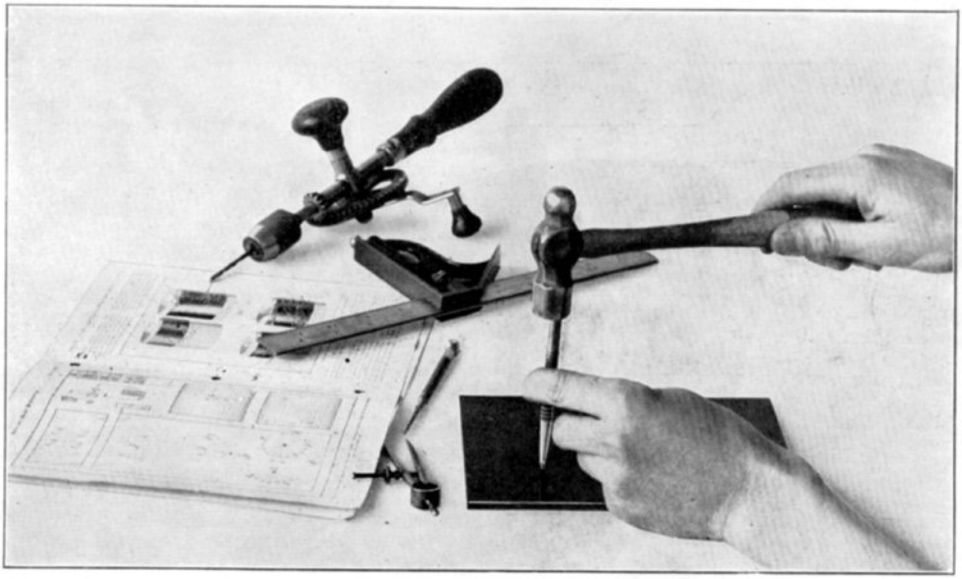


Fig. 3. Punch mark makes accurate drilling easier

DESIGN OF MODERN RADIO RECEIVING SETS

Owing to the popularity of "Radio and Model Engineering," among wireless experimenters, it was decided that a book containing reprints of all articles on receiving equipment that had appeared in the magazine during 1921 be published for the benefit of new-comers in the radio ranks and those who did not possess a complete file of back numbers. Consequently the material was put together in the form of a forty-eight page book entitled "Design of Modern Radio Receiving Sets."

Allowance was made for a large sale which the present popularity of radio promised, but in spite of this, the first edition which appeared on a Monday afternoon was completely exhausted by Saturday noon of the same week. A second edition of twice the quantity of books was immediately ordered and after two weeks that has been practically exhausted. From all indications a third edition will be required to supply the present demand.

"Design of Modern Radio Receiving Sets," sells for fifty cents per copy, with liberal discounts in quantities.

RADIO AND MODEL ENGINEERING

A monthly magazine published by
The General Apparatus Company, Inc.,
88 Park Place, New York City.

Editor
M. B. SLEEPER

Associate Editor
W. H. BULLOCK

Subscription Rates

Ten cents per copy in the United States and Canada; in foreign countries fifteen cents.
One dollar per year, twelve numbers, in the United States and Canada; one dollar twenty-five cents in foreign countries.
Radio and Model Engineering is mailed to subscribers on the first of the month, and appears in the radio stores on that date.

EDITORIAL

UP another step! R and M is steadily gaining both in number of pages and circulation. Another important addition to the magazine is Mr. W. H. Bullock, whose name appears in this number as associate editor, a man right from the ranks of the experimenters, the sort who has done in his own workshop the kind of things that every experimenter at one stage or another of the game is bound to tackle, from rewinding motors to making vacuum tubes, and from working with crystal detectors in the old days to building radio frequency amplifiers today. With all this, he has had the practical shop and drafting room experience, as well as the broadening out that comes from the Navy and ship operating.

You will find Mr. Bullock a mighty good friend when it comes to helping you with things that puzzle, for questions addressed to him, unless they require an unreasonable amount of data, will be answered promptly. Remember that he is on the job all the time, looking for new ideas to work out for you, so help him with suggestions when you can.

HAVE you been chasing the illusive radio apparatus lately? If so, you will probably agree that it is a nice game to let someone else play. Because other magazines are not intimately connected with Radio manufacturing and its problems, the public has had little opportunity to learn exactly the difficulties with which manufacturers are confronted.

Last fall, when broadcasting started in earnest, the radio industry, such as it was, found itself gasping after the struggle with the worst summer, so far as sales were concerned, that radio has ever known. Due to the loyalty and interest of the readers of R and M, the G.A. Company was in a somewhat more fortunate condition, but the steady increase of sales of G.A. Standardized Parts during the summer was looked upon, in the light of results of other companies, as an unstable condition, with the winter season as an unknown quantity.

By the first of December, mail order business was holding its own while orders from dealers literally poured in.

During the Christmas rush, as it was then called, manufacturing and storage space was increased, for even then we did not believe, in common with others, that the volume of Christmas business would be maintained. On the contrary, orders increased in number and size. More employees were put on and stocks increased to a point where there was room for goods or workers, but not both. In the meantime, we were in touch with real estate brokers to determine upon new quarters. Finally 88 Park Place was chosen, because in addition to increasing our floor space to nearly 5,000 square feet, the quarters, in the very center of the radio district, offered great advantages in light and comfort to the employees. Almost like a fairy story reads the progress which has been made, tho it is not unlike those of other of the old time radio companies. No sooner had benches, partitions, machinery and shelves been installed than it was found necessary to increase the offices. A new sales manager, production manager, purchasing agent, with their clerks and stenographers, and expansion in the book-keeping department called for space.

Fortunately the firm on the floor above moved out, and the space they occupied was given over entirely to manufacturing, with the lower floor for offices, stock, packing, and shipping. Difficulties attending these continual changes cannot be appreciated by those outside, for, between the hubbub of moving and the inconvenience caused by carpenters, electricians, plumbers, inspectors, and whatnot, production had to be not only maintained but increased.

And was the output maintained? During the month of March alone it was increased nine times. Under the skillful direction of Mr. O'Rorke, in charge of the factory, new men and women were trained as fast as supplies came in for them to assemble into G.A. Standardized parts and equipment. There has been the real difficulty. Material which had been bought by the hundred has been ordered by the hundred thousands, but it has been painfully slow in coming in. Coils can be wound only as fast as wire comes in. Variable condensers call for sheet aluminum. Machine screw stocks are still very low. No. 44 wire for transformers is as scarce as blue fox skins, molds for bakelite parts require four to six weeks to complete. I know how much you want things, and I want you to know everything humanly possible is being done to get them for you.

M. B. SLEEPER.
Editor.

A Short Wave Variocoupler

A tuning instrument that can be used in a variety of simple and regenerative circuits.

By W. H. Bullock

Variocoupler a Popular Instrument

SINCE the 150 to 600 meter regenerative receiver was described, there has been an ever-increasing demand for a variocoupler of the type specified for that set, and as a result, it has been decided to devote an article to the construction and use of such an instrument.

A variocoupler has many uses in receiving circuits and is one of the handiest pieces of apparatus an experimenter can have about his station. Its range of utility covers practically all receiving systems from a single circuit crystal receiver to a complicated loosely coupled regenerative equipment. Fig. 1 depicts seven of the most popular circuits in which this variocoupler can be efficiently employed. From this it is seen that it is quite a simple matter to get a receiving set together once a variocoupler is built, and unlike most other instruments, it does not have to be discarded when improvements are desired. There are always uses for the variocoupler. The fact that you may at present have a receiving tuner with which you are satisfied does not mean that it would be inadvisable for you to build the instrument here described. Many amateurs who have followed radio for years use such instruments in addition to some previously built set, for experimental work, for motor boat equipment, portable outfits for vacation purposes, and as handy tuners for temporary installations, such as demonstration equipment. We find that a large number of enthusiastic wireless men purchase variocouplers for short wave regenerative receivers, to be used in addition to the 150-2600 meter regenerator previously described.

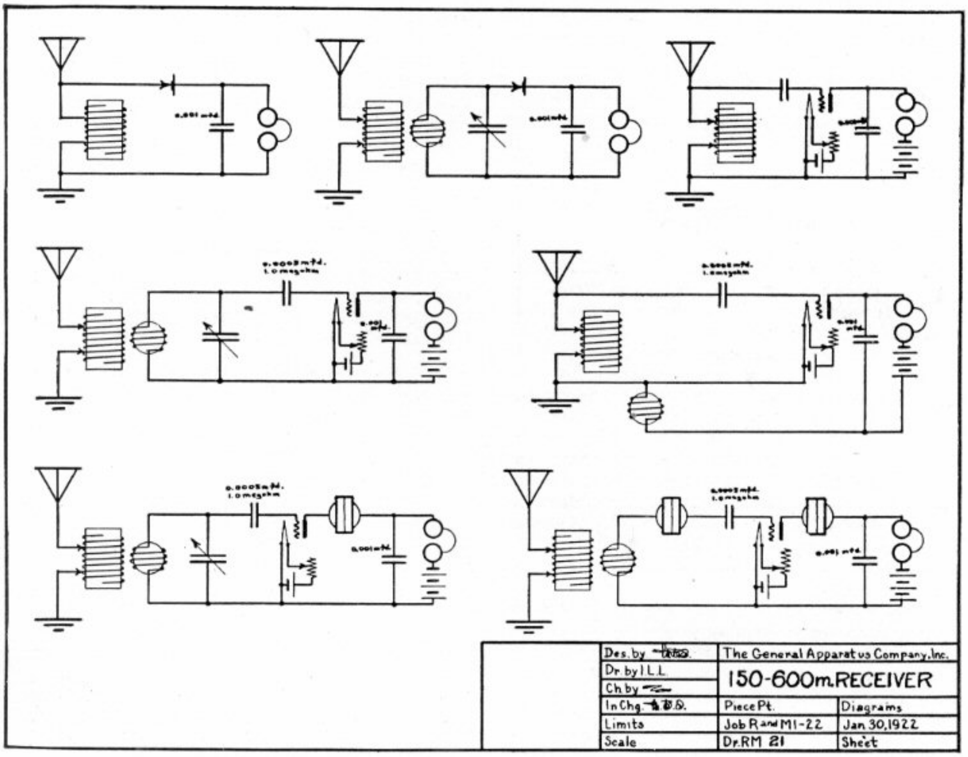


Fig. 1. Some of the many circuits in which the variocoupler can be employed

General Description As seen from Figs. 2 and 3, the variocoupler is mounted on a 5 by 7½ by $\frac{3}{16}$ in. L.P.F. panel, so that it may not only be employed in connection with variometers for a loosely coupled regenerator, but may be used for a complete regenerative tuner in itself. To make connections simple and neat, four special nickel plated Fahnestock terminals are mounted upon the L.P.F. tube and connections made with square tinned wire.

Preparing the Tube The coil is wound of No. 20 D.C.C. wire upon a 3½ in. L.P.F. tube, 5 ins. in length. The first operation is to lay out and drill the holes in the tube for the coil support pillars, shaft, contact springs, terminals and taps. A line parallel to the axis of the tube is scribed on its outer surface, and upon it are located the holes for the support pillars and one

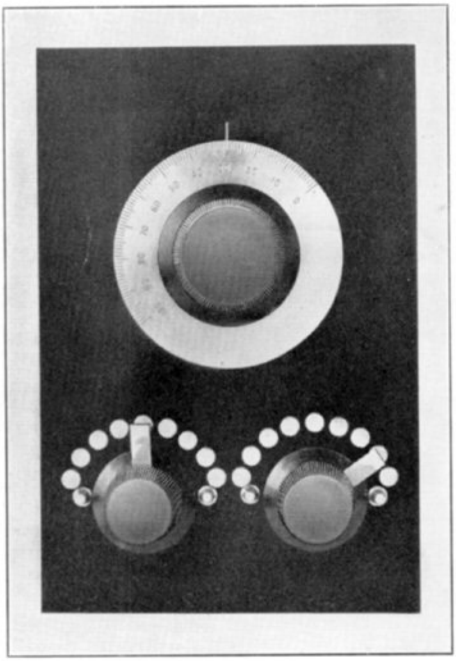


Fig. 2. Front view of mounted variocoupler

end of the shaft. The first hole—made with a No. 27 drill—is placed $\frac{3}{16}$ in. down from one end of the tube, and the second, of the same size, is drilled $\frac{13}{16}$ in. from the end. 1⅛ ins. from the end of the tube the ¼ in. shaft hole is drilled. Thru the center of this hole a line is drawn at least half way around the tube and parallel to the edge. Upon it, a point diametrically opposite the first shaft hole is located by means of dividers, and the second ¼ in. hole drilled. ¾ in. from each shaft hole a No. 27 hole is drilled upon the line to take the screws which secure the shaft contact springs. No. 27 holes for the Fahnestocks are located ½ in. down from the top of the tube and spaced 1¼ in. apart, two on each side of the rear shaft hole.

Allowance is made for starting the winding $\frac{1}{16}$ in. below the shaft, and sets of three No. 42 holes are drilled for each tap. The three holes lie in a line with the direction of winding and are spaced $\frac{3}{16}$ in. apart. Those on one side of the front shaft hole, for nine one-turn taps, are stag-

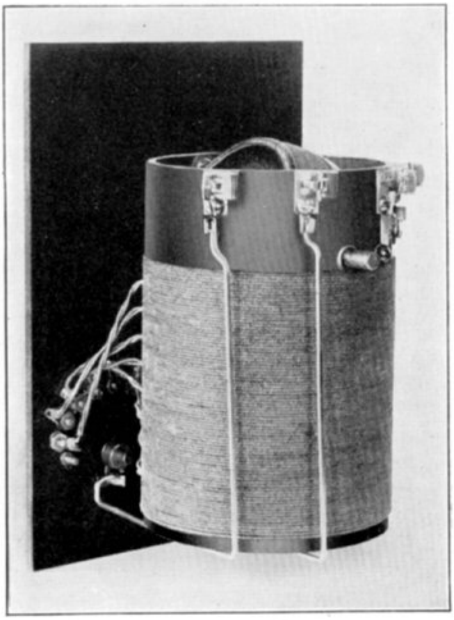


Fig. 3. Rear view

gered to prevent the tube from breaking out between them. The vertical distance between these sets of holes is, of course, equal to the diameter of the wire. Similar clusters of three holes for the remaining nine taps of nine turns each, are drilled on the other side of the shaft, and spaced 25/64 in. apart. In drilling these holes it is well to place a block of wood in the tube to drill against. This prevents the breaking out of the tubing when the drill is about to come through, and is as good as any means of holding the tube for the drilling process.

Method of Winding Start the winding $\frac{1}{16}$ in. down from the shaft hole by fastening the end of the wire in the first group of three holes. Wind on one turn and cut the wire four inches longer than required for that turn. Insert the end of the wire in the first hole of the second group and draw the wire tight. Now bring the end of this first turn back thru the second hole. Start the second turn by putting the end of the wire in the third hole and bringing it out thru the second hole. The two leads are twisted together to form the tap. The same procedure is followed for each tap, until nine taps one turn apart, and nine taps nine turns apart are taken off. The two ends of the winding are counted as taps. If the wire has been kept clean during the winding process, and the turns are drawn up tight, no varnish need be applied. But if, as often happens with the first job, the wire is soiled or some of the turns are found to be a little loose, a coat of varnish of a grade that will not absorb moisture will improve the appearance of the winding and hold the turns fast.

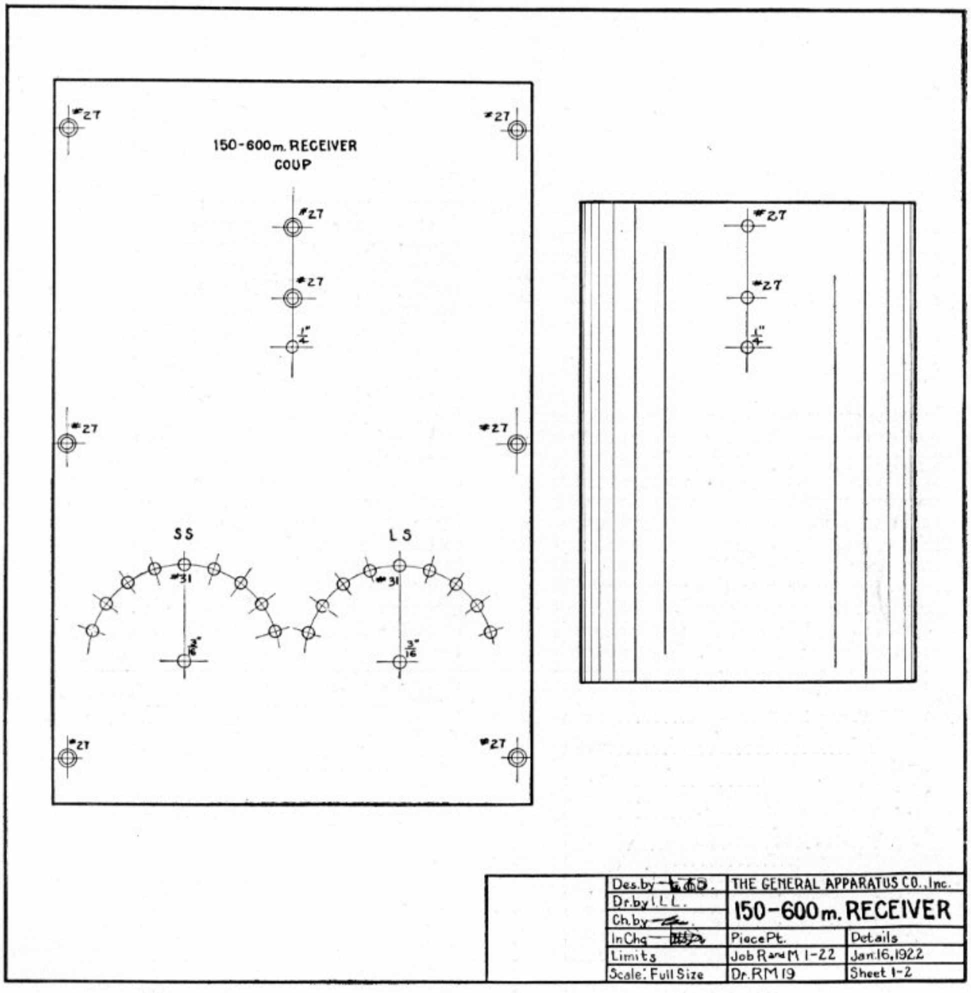


Fig. 4. Scale drawing of panel and tube, reduced to one half size

Assembling the Coupler Now mount the coil support pillars, the Fahnestocks, and the shaft contact springs. ¼ in. 6-32 R.H. screws are used for the purpose. A standard 3 in. mahogany rotor ball is now wound full of No. 20 D.C.C. wire. The shaft is made in two sections cut from a 12 in. piece of ¼ in. round brass rod. One is 3¼ ins. long, and the other 2 ins. Place one end of the long section into its bearing in the tube, just far enough to permit two fibre washers to be held on its inner end. Put the rotor in place and force the shaft into it. The short section is similarly fitted in. G.A. shafts are three one-thousandths of an inch over ¼ in., so that they fit tightly enough into the ¼ in. hole of the standard rotor ball to make a pin or other means of securing them unnecessary.

Drilling the Panel With the coupler thus completed, the panel is laid out and drilled according to drawing, Fig. 4. This illustration is half size, so all dimensions scaled from the drawing must be doubled before transferring them to the work. Numbers appearing beside each hole indicate the size of drill to be used. As soon as the panel is drilled, switch points ¼ in. in diameter are put in the proper holes and small copper lugs are clamped under the nuts on the rear.

Mounting the Coupler The coupler is next secured to the panel by two ½ in. F.H. screws and the taps are soldered to the switch point lugs. The front of the panel is completed with the mounting of two switches and a 90° dial and knob of a similar design, for the rotor shaft. Exactly one 2 ft. length of square tinned copper wire is required for connecting the switches to two of the Fahnestocks, and the shaft contacts to the remaining two. If instructions are carefully followed, and the builder is accurate and neat in his work, a very efficient instrument of a pleasing appearance will result.

Uses of the Variocoupler Let us consider some of the many uses of the variocoupler. Referring again to Fig. 1, we see that by disregarding the rotor winding, the stator may be connected to an antenna and ground system, detector, fixed condensers, and phones, to form a very simple receiving set. If it is found that even the single turn taps are not close enough to tune in the sharp waves of a radio telephone or an undamped wave transmitter, still finer adjustment to the transmitter frequency may be had by short circuiting the rotor. When used in this way, the ball should be set at nearly zero coupling until the desired signal is tuned in, and then rotated until maximum response is obtained. Where selective tuning is desired, the variocoupler should be hooked up as a two circuit receiver, or loose coupler. Since the inductance of the rotor is not variable, it will be found necessary to connect a variable condenser across its terminals to provide a means of tuning this circuit. A condenser having a maximum capacity of 0.0008 mfds. is quite suitable of the purpose. It has become a common practice to use a variometer in series with the rotor for tuning the secondary circuit, when a vacuum tube detector is employed. The question as to which system is the better is a subject on which there is a difference of opinion among the best informed.

A circuit to be recommended because of its simplicity and efficiency is the single circuit regenerator shown in one of the diagrams, Fig. 1. A standard audion detector control unit and phones are the only other instruments required for the complete set. Connect one of the variocoupler switches to the antenna and grid condenser of the vacuum tube, the other to the ground and filament, and place the rotor in the plate circuit, between the phones and plate, to act as a tickler coil. Any number of turns from one to ninety-nine may be obtained on the stator for tuning, and the position of the rotor will regulate the regeneration or oscillation of the set. In case the system does not oscillate as freely as desired, place a 0.001 mfd. fixed condenser across the phones and B battery. This provides a path for radio frequency currents, from the tickler coil to the filament. Try rotating the coupling ball in each direction from the position of zero coupling to determine which is the correct way for proper regeneration. The direction will depend upon the side of the rotor that is connected to the plate.

STANDARDIZED PARTS FOR UNIVERSAL RECEIVER

1—L.P.F. panel 5x7½x3/16 ins.	(6 oz.)	$.99
1—Length GA-Lite tubing 3 in. diameter	(5 oz.)	.32
1—GA-STD-A15 0.00025 mfd. variable condenser	(10 oz.)	3.25
1—¼ lb. spool No. 24 S.S.C. wire	(6 oz.)	.70
1—2 ft. length empire tubing	(2 oz.)	.30
1—180° dial and knob, ¼ in. hole	(2 oz.)	1.25
1—Complete switch, 1 in. radius	(2 oz.)	.65
10—Switch points	(1 oz.)	.40
2—Stopping points	(1 oz.)	.10
4—GA-STD-A10 binding posts	(10 oz.)	.40
2—Coil mounting pillars	(3 oz.)	.16
2—2 ft. lengths square tinned copper wire	(1 oz.)	.12
1—Pkg. of 20 small soldering lugs	(2 oz.)	.25
1—Pkg. of 10 ¼ in. 6-32 R.H. nickeled screws	(3 oz.)	.11
1—Pkg. of 10 ½ in. 6-32 F.H. nickeled screws	(1 oz.)	.12
1—Pkg. of 10 1 in. No. 6 F.H. nickeled wood screws	(1 oz.)	.12
1—6x7½x⅜ in. wood base	(4 oz.)	.30
COMPLETE SET OF PARTS LISTED ABOVE	(3 lbs.)	9.16
THE UNIVERSAL TUNER COMPLETE, READY TO USE	(3 lbs.)	15.50
SEMI FINISHED PARTS		
Inductance wound and tapped	(10 oz.)	1.00
Panel drilled, extra		.35
Panel engraved, extra		1.05
AUXILIARY APPARATUS		
GA-STD-A5 laboratory type detector control	(1 lb.)	5.95
Radiotron U.V. 200 detector tube	(8 oz.)	5.00
GA-STD-A11 plate battery, 22½ volts	(2 lbs.)	1.75
GA-STD-A12 plate battery, 45 volts with 22½ volt tap	(4 lbs.)	3.20
GA-STD-A6 laboratory type amplifier control	(2 lbs.)	$13.95
Radiotron U.V. 201 amplifier tube	(8 oz.)	6.50
Witherbee 6 volt, 40-ampere-hour storage battery, charged and ready to use	(15 lbs.)	14.00
GA-STD-3 phone condensers, 0.001 mfds.	(1 oz.)	.35
Murdock 2,000-ohm phones	(1½ lbs.)	5.00

STANDARDIZED PARTS FOR VARIOCOUPLER

1—L.P.F. tube 3½ in. diameter, 5 in. long	(8 oz.)	$1.48
1—L.P.F. panel 5x7½x3/16 in.	(8 oz.)	.99
1—GA-STD-11 Mahogany rotor ball	(5 oz.)	.90
½—lb. No. 20 D.C.C. wire	(11 oz.)	.80
1—GA-STD-A8, 50 division dial and knob for ¼ in. shaft	(9 oz.)	1.25
2—GA-STD-A9 1 in. radius switches	(10 oz.)	1.30
1—12 in. length ¼ in. brass rod	(7 oz.)	.15
2—Coil mounting pillars	(3 oz.)	.16
4—Special Fahnestock binding posts	(1 oz.)	.16
18—GA-STD-A13 Switch points	(1 oz.)	.72
4—Stopping points	(1 oz.)	.20
1—2 ft. length square tinned copper wire	(1 oz.)	.06
4—Fibre spacing washers for rotor shaft	(1 oz.)	.16
1—Pkg. of 10 ¼ in. 6-32 R.H. nickeled screws	(2 oz.)	.11
1—Pkg. of 10 ½ in. 6-32 F.H. nickeled screws	(2 oz.)	.12
1—Pkg. of 10 6-32 nickeled nuts	(2 oz.)	.08
2—Rotor shaft contact springs	(1 oz.)	.08
2—Pkgs. of 20 small soldering lugs	(4 oz.)	.50
COMPLETE SET OF PARTS AS LISTED ABOVE	(5 lbs.)	8.78
Coils wound and rotor ball assembled, with contact springs and support pillars ready to mount on panel	(6 lbs.)	5.95

Antenna Wire

G. A. Standardized

ANTENNA WIRE OF ELECTROLYTIC COPPER

The resistance of the wire used for a radio antenna is an important factor frequently overlooked by experimenters. Earth resistance and other losses which cannot be readily overcome make it imperative to save where saving can be effected. In G. A. Standardized electrolytic copper resistance losses are absolutely at minimum. Moreover, a strength is obtained which safely permits stretches up to 300 ft. The gauge is No. 14 B. & S.

Price:

GA-STD-W8 electrolytic copper antenna wire, per 100 ft. .... $ .94

Postage 10c.

Magnet Wire and Litz

G. A. Standardized

WIRE FOR LOW DECREMENT INDUCTANCES

G. A. Standardized magnet wire is specifically intended to be used on inductances for radio frequency circuits where the slightest loss, due to impure copper or faulty insulation, must be guarded against. First lot electrolytic copper is wrapped with genuine Italian silk or grade 0 cotton in a machine which stops automatically when contact can be made through the slightest abrasion in the insulation. The extra cost of G. A. Standardized magnet wire allows a quality which is readily appreciated by those who use it.

Prices:

GA-STD-W1 No. 24 B. & S. gauge wire, single silk wrapped, ¼ lb. spool .... $ .70

GA-STD-W2 No. 24 B. & S. gauge wire, single silk wrapped, ½ lb. spool 1.25

GA-STD-W3 No. 24 B. & S. gauge wire, single silk wrapped, 1 lb. spool 2.25

GA-STD-W4 No. 20 B. & S. gauge wire, double cotton wrapped, ½ lb. spool .... .80

Postage 5c per spool.

High frequency cable, made up of a number of No. 38 B. & S. gauge enameled wires, slightly twisted is used wherever sharper tuning and louder signals are required, than can be obtained with coils of solid wire.

Even greater care is taken in manufacturing G. A. Standardized high frequency cable than is needed for magnet wire. A single broken strand not only gives a corresponding increase in resistance but, in addition, it absorbs energy from the other conductors. Therefore, it is necessary to test each length of cable strand by strand as assurance against broken wires. Two layers of Italian silk floss are wrapped around the cable.

10-38 cable, of 10 strands of No. 38 enameled wire, double silk covered, one used for short wave receivers where space is limited. The 20-30 is preferable, however, for wave lengths up to 3,000 meters. Above this value the 3 x 16-38 cable is needed. It is composed of 16 strands, each of 3 No. 38 enameled wires.

GA-STD-W5 10-38 high frequency cable, per 100 ft. .... $ .98

GA-STD-W6 20-38 high frequency cable, per 100 ft. 1.87

GA-STD-W7 3 x 16-38 high frequency cable, per 100 ft. 4.28

Postage per 100 ft. 2 c.

Square Tinned Copper Bus Bar

G. A. Standardized

EVER-BRIGHT CONNECTION WIRE

For appearance and ease of handling nothing can equal G. A. Standardized square tinned copper bus bar. It comes in straightened lengths of 24 ins. ready to be cut and bent for wiring. The tinning takes half the work from soldering and the bright finish lasts longer than nickel. Use G. A. bus bar and you'll find that your set will almost wire itself. Equal to No. 14 B. & S. gauge.

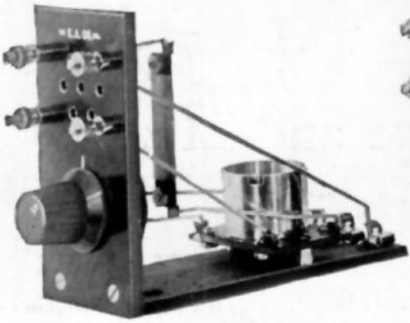
Price:

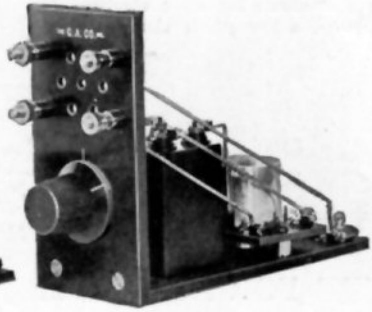
GA-STD-W8 square tinned copper bus bar...... $ .06

Postage per half-dozen lengths 3c.

G.A.

G. A. Standardized Supplies and Equipment for Experimental Work





G. A. Standardized

LABORATORY TYPE CONTROLS FOR ALL USES

Regardless of the price you pay, you can't buy better stuff than is used in G. A. Standardized audion controls. Originally designed for laboratory use, they have come into wide demand for general receiving purposes.

The front panel for either instrument is a 3/16-in. plate of polished L. P. F. 2½ by 5 ins. This is held to another L. P. F. plate 3/16-in. thick and 6 ins. long by a nickeled angle brace. Polished nickel binding posts on the left of the panel are for input connections, and on the right for output. Filament and plate battery terminals are at the rear.

The Laboratory Type detectors and amplifiers are guaranteed to give signals as loud as those produced by any other controls. Actually, they are superior to many more expensive types. In details of finish you will find them perfect, right from the polished L. P. F. panels and bases to the everbright square tinned bus bars with which connections are made.

Diagrams beneath the bases give you a variety of circuits. Radiotrons, Audiotrons, or A. P. tubes can be used with these controls. If it is desired, 5-watt tubes can be used in the last unit of a two or three-step amplifier, with 90, 135, or 180 volts on the plate.

An addition to this line is the Laboratory Type detector and two step amplifier, with a panel 7½ by 5 ins. high with an L. P. F. base 7½ by 6 ins. Input and output terminals are provided on the front panel, and battery connections at the rear. An extra plate battery terminal is provided for use when 90 volts or more are put on the last step. Up to 180 volts can be employed to operate a loud speaker. Two posts are also furnished to insert a tickler.

Prices:

GA-STD-A23 laboratory type detector and 2-step amplifier control....................$28.90
Postage 35c.

GA-STD-A5 laboratory type detector control... 5.95
Postage 10c.

GA-STD-A6 laboratory type amplifier control.. 13.95
Postage 20c.

A-P Electron Relay audion detector tube...... 5.00

A-P Audion amplifier tube.................... 6.50

Radiotron UV202 5-watt power tube.......... 8.00

Postage per tube 10c.

The General Apparatus Co., Inc.

88 PARK PLACE - - NEW YORK CITY

In the center of New York's radio district. Dealers coming to the City are invited to make the G. A. their headquarters. Every courtesy and convenience is at their disposal.

The General Apparatus Co., Inc.

Sleeper Radio Corporation

Successors

88 Park Place — New York City

Name...

Street...

City...

No.	DESCRIPTION	Price

Send this order to your nearest G.A. Dealer. Deliveries are slow now, requiring as much as two weeks, particularly on semi-assembled apparatus.

NOTE: Insurance costs 10c per $25.00. The G. A. Company is not responsible for non-delivery on orders not insured.

Total..............

Postage............

Insurance..........

Total..............

Where To Buy G. A. Standardized Supplies

SAGE ALLEN COMPANY, Inc.

Hartford, Conn.

G. A. Standardized Supplies Save Both Time and Money

THE O-B RADIO SUPPLY CO.

515 Brown Bldg.

Omaha, Nebraska

The Largest Retail and Mail Sales Stock of G. A. Supplies in the State

I. E. SWEAZEY

208 E. Main St.

Bound Brook, N. J.

A Full Line of GA-STD Parts Carried in Stock for Immediate Supply

G. A. SERVICE STATION

At Wertheimer's Department Store

Fordham Road and Grand Concourse

Take East Side Subway to Fordham Road

G. A. SERVICE STATION

At Wertheimer's Department Store
181st St., between St. Nicholas
and Wadsworth Aves.

Take Broadway Subway to 181st St.

M. A. MODELL & SON

71 Cortlandt St.

New York City

For Service on G. A. Standardized Parts and Supplies

A. S. ROBBINS

1764 44th St.

Brooklyn, N. Y.

G. A. Success Insurance for the Man Who Builds His Own

SECORD ELECTRIC CO.

2 West 28th St.

New York City

Let Us Help You Build Your Apparatus of G. A. Standardized Parts

GIMBEL BROTHERS

33rd St. and Broadway

New York City

Sets of Parts for Building Apparatus Described in R. & M.

HACK ELECTRIC CO.

306 Bedford St.

Johnston, Pa.

Full Stock Equipment GA-STD Parts. An Unbeatable Combination of Quality and Economy

THE KING RADIO CO.

113 Sheridan Ave.

East Liberty, Pittsburgh, Pa.

Full Line of GA-STD Parts Carried in Stock

DeLANCEY, FELCH & COMPANY

12 Meeting St.

Pawtucket, R. I.

Order GA-STD Supplies From Us by Mail or Get Them at Our Retail Store

THE SOUTHWEST RADIO SUPPLY CO.

317 St. Paul St.
Dallas, Texas

Complete Line of G. A. Standardized Supplies. We Can Insure Prompt Shipment.

TEXAS RADIO COMPANY

2105 Fairmount Ave.

Fort Worth, Texas

Build Your Own GA-STD Parts. Solve the Problem. "Service" Our Motto.

N. T. HARRISON

Petersburg, Va.

Anything You Need in G. A. Standardized Supplies

EDESON ELECTRIC COMPANY

1120 First Ave.

Seattle, Wash.

We Can Supply G. A. Standardized Parts to West Coast Experimenters