CARBORUNDUM

REG. U.S PAT. OFF

IN RADIO

HOOK-UP BOOK

CARBORUNDUM

Reg. Trade Mark U. S. Pat. Off.

IN RADIO

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HOOK-UP BOOK

THE CARBORUNDUM COMPANY
NIAGARA FALLS, N. Y.

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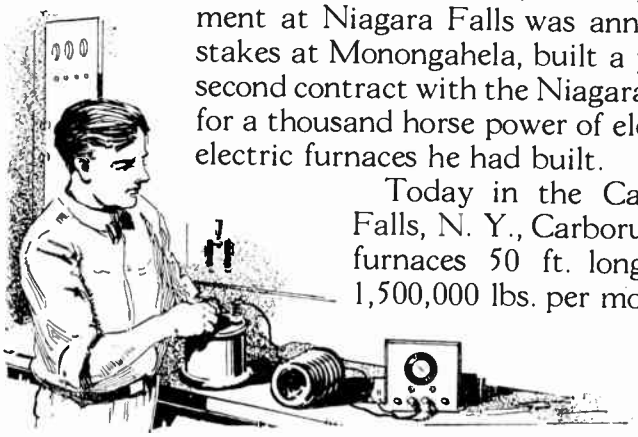
The Story of Carborundum

THE story of Carborundum is indeed an industrial romance. It is a romance of fact but it sounds more like the romance of fiction. The story begins with Edward Goodrich Acheson in his little shop in the little town of Monongahela City, Pa., in the year 1891. Dr. Acheson had just completed a series of electrical experiments with Thomas A. Edison and so he became extremely interested in the then mysterious force of electricity. In the course of his research he conceived the idea of creating an abrasive or grinding material that would take the place of emery, corundum and other similar materials made by Mother Nature.

And this is what he did. He took a tiny iron bowl such as plumbers use for melting solder. Into that bowl he put a mixture of clay and coke. In one corner of his little shop he had a little power plant. He ran two wires from his generator, grounded one and twisted the other about a piece of a carbon rod. This rod he plunged into the mixture of clay and coke and turned on his power. At the end of a stated time he pulled out what was left of the carbon rod, broke open the shell of the fused mass in the bowl and discovered a few tiny, bluish diamond-like crystals. These he found were so hard and so sharp that they would very readily scratch glass. He experimented further and made enough of the crystals to fill a tiny bottle which he took to New York and there he prevailed upon a noted jeweler to crush the crystals to a powder form and to use the powder for rough polishing diamonds, rubies, sapphires and other precious and semi-precious stones. The material, which in the meantime he called Carborundum, worked so well that he went back to Monongahela City with an order for several ounces of the new material. The first price was 40c. a carat or at the rate of $880 per pound. He then built a small furnace of fire-brick and began making Carborundum in larger quantities. This he sold for grinding valves in industrial plants. Then he began making tiny wheels of Carborundum for the grinding of teeth—dentists used them and still do. A little later, in 1895, when the great power development at Niagara Falls was announced, Dr. Acheson pulled up stakes at Monongahela, built a plant at Niagara and made the second contract with the Niagara Falls Power Company, calling for a thousand horse power of electric energy to operate the big electric furnaces he had built.



Today in the Carborundum Plant at Niagara Falls, N. Y., Carborundum is made in giant electric furnaces 50 ft. long. The plant produces about 1,500,000 lbs. per month and is equipped to handle 25,000 H.P. of electric energy on a continuous service. A far cry indeed from the little

iron bowl in the little plant at Monongahela to the largest electric furnaces in the world in the largest plant in the world devoted exclusively to the manufacture of abrasives.

Today Carborundum is made of such common materials as coke, sand, sawdust and salt. These materials are loaded into the electric furnaces of the resistance type. The mixture is subjected to the terrific heat of 4,000° F. and at the end of thirty-six hours the furnace is broken open and Carborundum is removed in the form of great masses of gorgeously colored crystals—each crystal, hard, sharp, diamond-like. These crystal masses are crushed down to the individual crystals or grains, the grains are mixed with certain bonding agents and formed into grinding wheels, sharpening stones, razor hones, scythe stones and countless other abrasive tools. Carborundum is also coated on paper and cloth for the buffing and finishing of shoes and leathers, for the finishing of metals, etc. And how remarkable it is to learn that this same Carborundum crystal which is used for so many things in the industrial world has become one of the greatest of all crystals for radio detection.

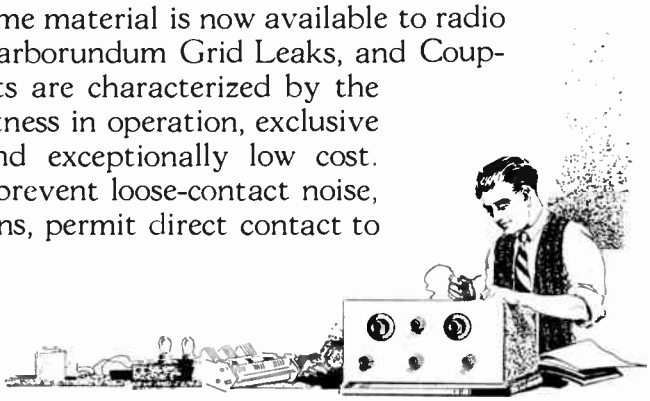
Carborundum in Radio

For a quarter of a century Carborundum has been used in radio receiving sets and during that time it has achieved world-wide popularity as the most stable of all sensitive crystal detectors. Today thousands of Carborundum Detectors and Stabilizing Units are used in broadcast receivers because they afford a pure quality of reproduction that is attainable in no other way.

The merits of the Carborundum Detectors have been further enhanced by the development of the Carborundum Stabilizing Detector Unit, which provides control of the electrical characteristics of the Carborundum Detector and thus makes it suited for all types of circuits.

It is used with gratifying success in simple crystal sets, neutrodynes, superheterodynes, reflexes and tuned radio frequency amplifying receivers.

Carborundum resistance rods and discs, made in the electric furnace from Carborundum, have been used extensively in commercial electric installations for many years. This same material is now available to radio set-builders in the form of Carborundum Grid Leaks, and Coupling Resistors. These products are characterized by the highest quality, absolute quietness in operation, exclusive one-piece mounting-angles and exceptionally low cost. The unique mounting-angles prevent loose-contact noise, eliminate numerous connections, permit direct contact to socket terminals and otherwise lend themselves admirably to all forms of radio construction.



Electrical Characteristics

THE graphs on page 5 show some of the important electrical properties of Carborundum Detectors. It will be noted that the detectors have a very high resistance to low voltages applied in the non-conducting direction. This results in decreased damping and increased selectivity. The detector impedance may be adjusted through use of a biasing voltage. The effect of this control on sensitivity is shown in the upper righthand curve. In this particular case, when using a fairly weak radio frequency input without any bias, the effective 'phone circuit current was .000007 amperes. By applying .2-volt positive bias the effective 'phone circuit current was increased to .000017 amperes, almost two and half times greater. This biasing control is provided in the Carborundum Stabilizing Detector Unit, the circuit of which is shown in the lower right-hand diagram.

Because the detectors have high resistance in the non-conducting direction they are very useful in alternating current measuring work. When properly connected in series or shunt to a direct current meter, the combination may be used to measure alternating voltages and currents, thus taking the place of an A. C. meter or a thermo-coupled D. C. meter and having the advantage of greater ruggedness, greater operative range and frequently greater sensitivity.

From an inspection of these graphs and from practical experience it is evident that the electrically controlled detector has the following advantages:

1—The resistance may be made to match the circuit impedance, resulting in maximum volume.

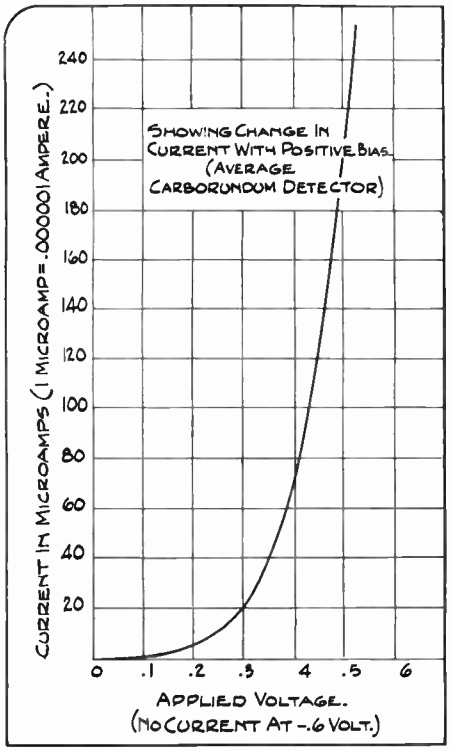
2—In vacuum tube sets the detector impedance may be adjusted so the detector circuit is always closed to just the proper degree, eliminating the open and short circuit howls of ordinary high and low resistance detectors.

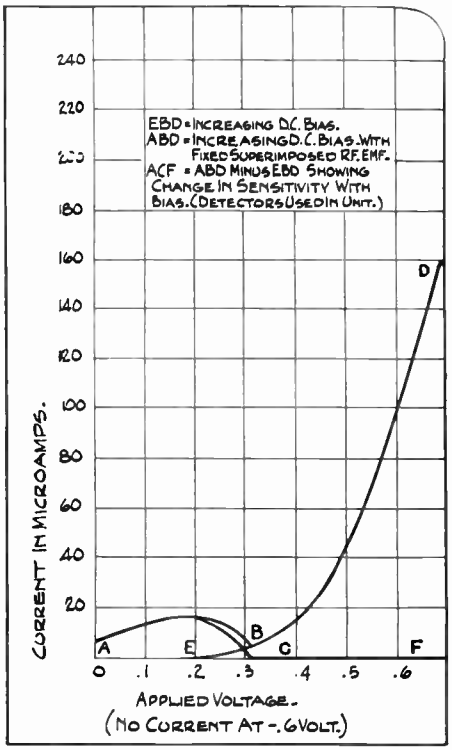
3—The detector impedance may be made high with increased selectivity, owing to decreased damping effect.

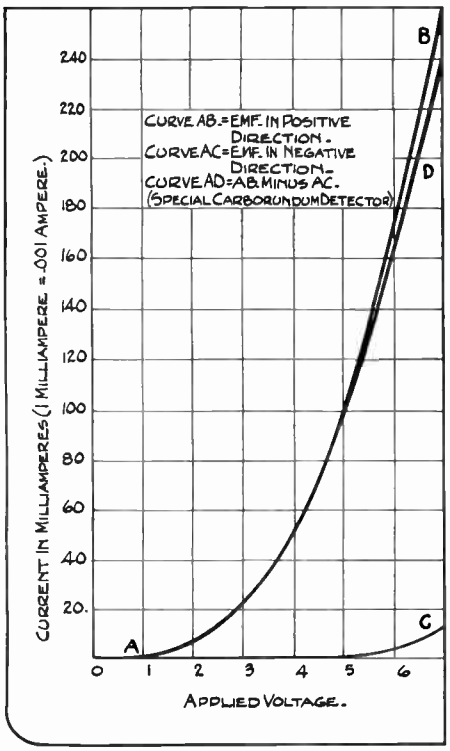
4—In tube circuits the electrically controlled detector tends to keep the radio frequency amplifying stages at the peak of regeneration, thus increasing the sensitivity.

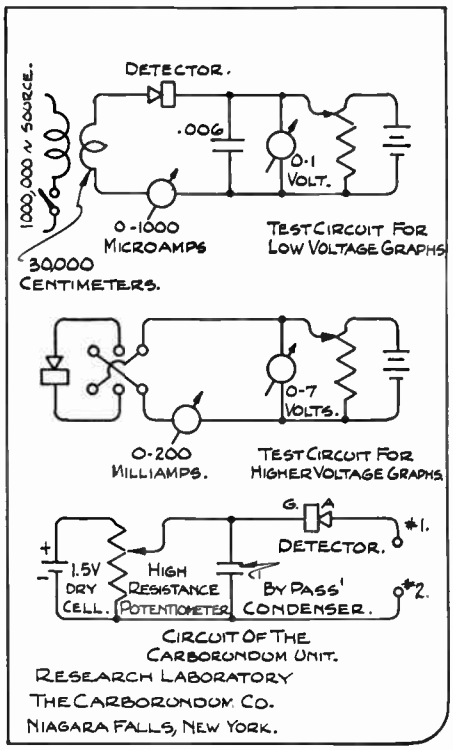
5—By regulating the detector impedance the Stabilizing Unit indirectly provides a check on self-oscillation of the radio frequency tubes, thus controlling howls and permitting peak efficiency through the entire wavelength range.

But most important of all, the Stabilizing Unit retains the pure tonal quality characteristic of crystal detectors.









Six Sensitive Coupling Circuits

How the Stabilizing Unit is Connected in Neutralized, Tuned Radio Frequency and Regenerative Circuits

THE six circuits on pages 7 and 9 have been selected, after careful tests, as being the most efficient and sensitive methods of coupling the Stabilizing Unit in radio frequency amplifiers. The diagrams may be followed in substituting the Carborundum Unit for either a regenerative or non-regenerative tube detector in neutralized, tuned radio frequency and regenerative receivers.

In these hookups the radio frequency amplifier may consist of one or more stages. If only one stage is used the primary of the R. F. transformer at the extreme left should be connected to the aerial and ground. This transformer may be wound on a 3″ diameter form, the secondary having 45 turns of No. 24 double cotton-covered wire and the primary, wound alongside the secondary, 25 turns of the same wire with a tap at the 15th turn to accommodate aerials of different lengths.

The audio frequency amplifier described on pages 24 and 25 is particularly well suited for these circuits.

TAPPED PLATE COIL NEUTRALIZATION (Figure 1). Here the radio frequency amplifier is neutralized through half of the coil (P2) and the neutralizing condenser (NC). The detector circuit is grounded to negative (A). The radio frequency transformers in this and the other five circuits should be spaced at least 7″ between centers and set at right angles in order to minimize self-oscillation.

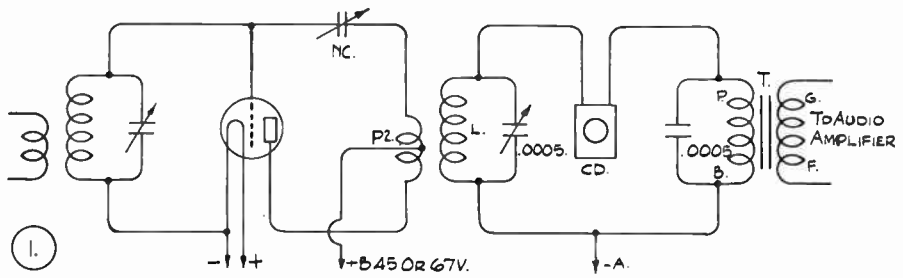
TAPPED SECONDARY NEUTRALIZATION (Figure 2). This arrangement differs from Figure 1 only in the method of neutralization, as here a portion of the secondary (L) is used in place of the extra neutralizing coil.

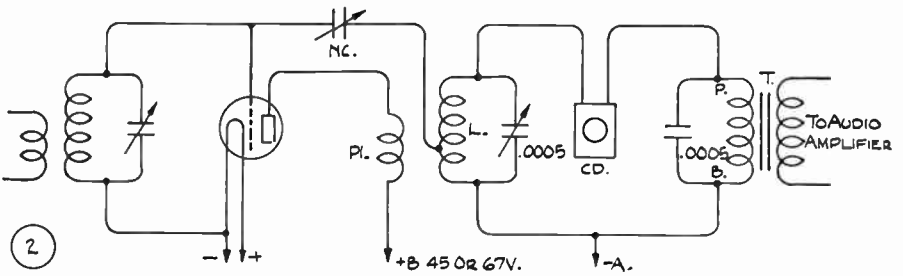
REVERSED TICKLER (Figure 3). Instead of capacitive neutralization the tickler (T1) is used to feed back energy reversely to that fed back through the grid-plate and other residual coupling. This arrangement achieved great popularity under the name "superdyne."

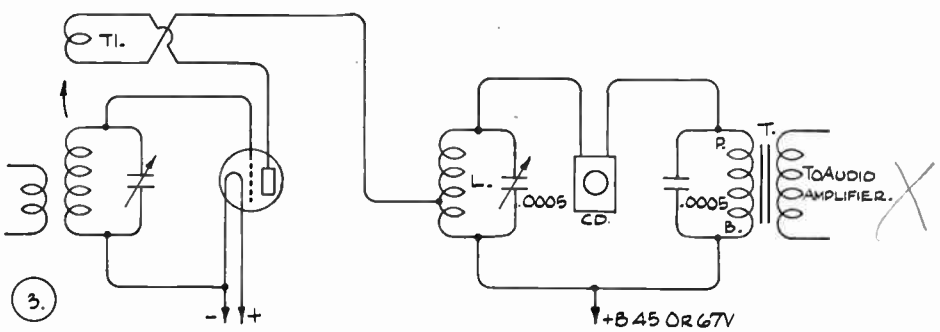
These three circuits are of the neutralized type and, when properly adjusted, the tube immediately preceding the Carborundum Stabilizing Unit is prevented from oscillating. The next three circuits to be described are not neutralized but other provisions are made to control self-oscillation.

(Continued on page 8)

Coupling the Carborundum Unit in Neutralized R. F. Amplifiers







L—45 turns No. 24 Double Cotton-Covered 3" diameter Tap at 15th turn.
T—Audio Frequency Transformer.
T1—Reversed Tickler (about 20 turns).
NC—Neutralizing Condenser.
P2—40 turns No. 28 Double Cotton-Covered wound next to "L." Tap at center.
P1—15 turns No. 28 Double Cotton-Covered wound next to "L."
CD—Carborundum Stabilizing Detector Unit.

Six Sensitive Coupling Circuits

(Continued from page 6)

TUNED IMPEDANCE (Figure 4). A highly efficient and simple circuit, in which the tendency toward self-oscillation is minimized by detuning the detector circuit slightly from the wavelength, being received.

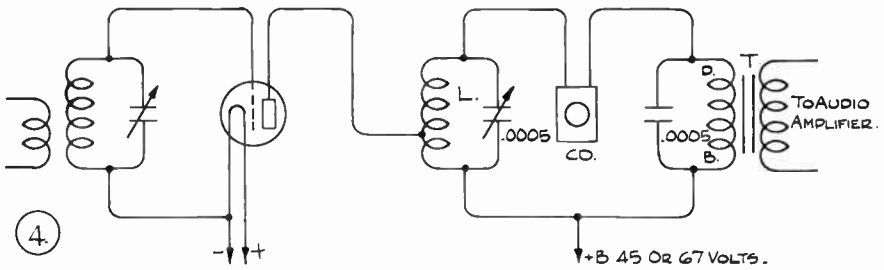
TUNED PLATE INDUCTIVE COUPLING (Figure 5). More smoothly operative and slightly more selective than Figure 4. Changing the number of turns in the plate circuit permits greatest amplification through the entire wavelength range.

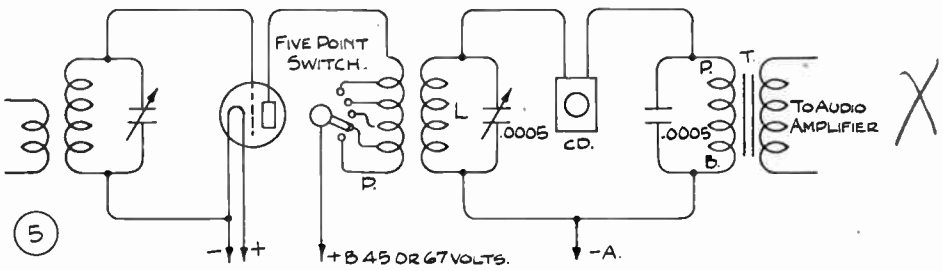
VARIOMETER TUNED IMPEDANCE (Figure 6). Similar to Figure 4, but using a variometer and small, fixed localizing capacity instead of the fixed coil and variable condenser forming the tuned impedance of Figure 4. A compact molded variometer with connection to the mid-point is preferred. This circuit gives very satisfactory results.

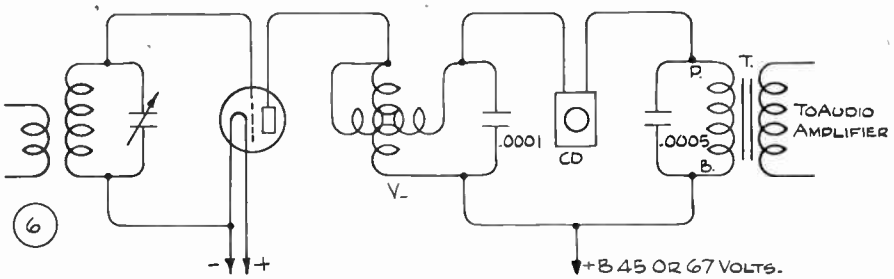
In connection with these and other circuits our tests have proved that it is advisable to couple the Carborundum Unit to the audio frequency amplifier through a good audio frequency transformer rather than a choke coil or resistance.

The transformer for this purpose may have a ratio of about 4:1. This value is not critical and equally good results have been secured with transformer ratios as low as 2:1 and as high as 10:1. It should be noted particularly that *connecting a crystal in place of a tube detector to an audio transformer automatically improves the reproducing qualities of the transformer.* This is owing to the fact that when used with a tube detector the steady plate-circuit current (of from 1,000 to 1,500 microamperes) flows through the primary of the transformer and creates a magnetic stress in the core. This alters the reproducing characteristics of the transformer and decreases its efficiency. In fact, with ordinary closed-core audio transformers, the plate current may cause almost complete magnetic saturation of the core, so signal current variations have but little effect and are transferred to the secondary with loss and distortion. It is this fault, among others, that has created the preference for resistance instead of transformer coupling. The case is different for crystal detectors and for the Stabilizing Unit, as the biasing current for maximum efficiency does not exceed two or three microamperes, and this is not large enough to affect the core appreciably. So, when a transformer is connected to these detectors, it functions with the least distortion and the greatest efficiency.

Coupling the Carborundum Unit in Tuned Plate R. F. Amplifiers







L—45 turns No. 24 Double Cotton-Covered on 3" diameter Tap at 15th turn.
P—50 turns No. 28 Double Cotton-Covered wound next to "L." Tapped every 10th turn.
V—Broadcast Range Variometer, tap at center.
CD—Carborundum Stabilizing Detector Unit.
T—Audio Frequency Transformer.

Stabilizing Unit is Recommended for the Super-Heterodyne

EXPERIMENTS show that in a great many cases distortion or ragged reproduction in home-made super-heterodyne receivers may be traced to overloading of the first or second detector or both. The first detector may be overloaded by being coupled too closely to the oscillator; the second detector by excessive amplitude of the impressed intermediate frequency voltage. Loosening the oscillator coupling reduces overloading of the first detector, but in the second detector this fault can be eliminated only through use of a rectifier having a sufficiently high input-voltage operating range. At the same time this detector must be a good rectifier and sensitive to weak signals. It is very difficult, in fact almost impossible, to get a vacuum tube that meets these three requirements. Fortunately, the Carborundum Detector and the Carborundum Detector Unit can be used with EMFs having a range as great as twelve volts between positive and negative peaks. In addition, they are responsive to very weak signals and rectify without distortion on both low and high voltages.

The preferred circuit for the Carborundum Unit as second detector is shown on the opposite page (Figure 1). Here the intermediate frequency transformer (T) may be tuned or untuned as indicated by the condenser in dotted lines. The detector circuit 'phone jack is optional.

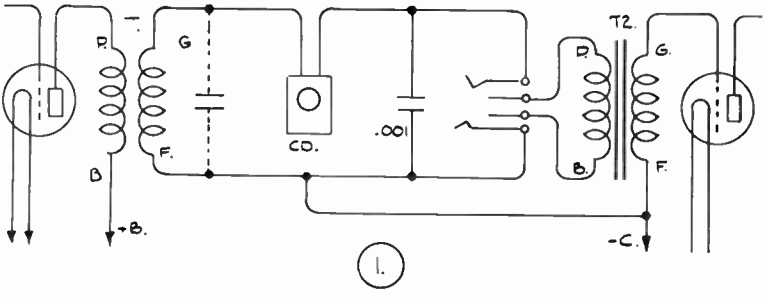
Transformer coupling is recommended (see page 8) between the detector and audio frequency amplifier; however, suitable circuits for resistance and choke coil coupling are shown in Figures 2 and 3.

The preferred circuit for the Carborundum Unit as first detector is shown in Figure 4. It is necessary to use a stage of tuned radio frequency amplification preceding the first detector; this ensures maximum range and selectivity. The radio frequency amplifier may easily be neutralized as shown. This neutralization is effective in preventing coupling of the oscillator power to the aerial circuit. It would be advisable to shield the various sections thoroughly.

It will be noted in figure 4 that the detector and primary of T1 are shunted across only twenty turns of the detector tuning circuit coil S. This minimizes damping of the detector and increases selectivity.

The adjustment of the Stabilizing Unit as first or second detector is not critical. Accordingly the Unit may be mounted on the baseboard or subpanel, if space on the front panel is limited.

The Carborundum Unit in the "Super"



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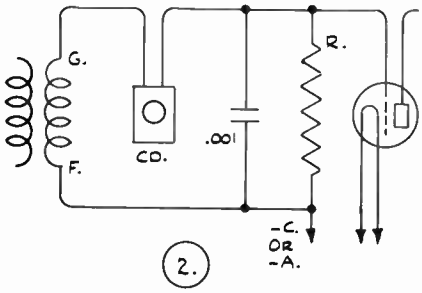

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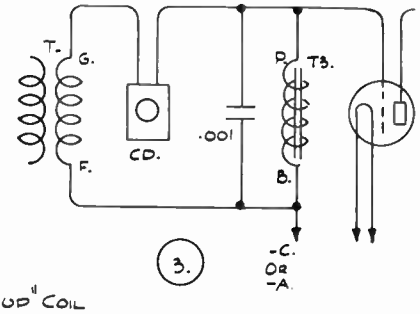

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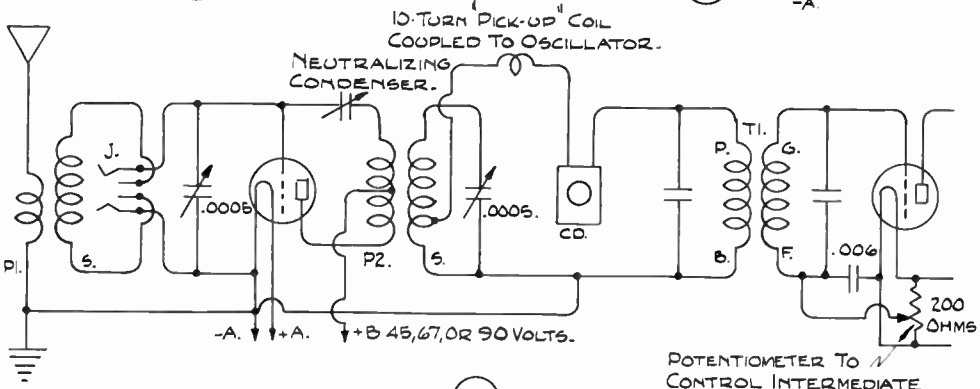


4.

T—Intermediate Frequency Transformer (tuned or untuned).
T1—Input Intermediate Frequency Transformer.
T2—Audio Frequency Transformer.
T3—Audio Frequency Impedance or Choke Coil.
R—50,000 or 100,000 Ohm Carborundum Coupling Resistors.
CD—Carborundum Stabilizing Detector Unit.
P1—10 turns No. 28 Double Cotton-Covered wound next to "S."
P2—40 turns No. 28 Double Cotton-Covered wound next to "S." Tap at center.
S—45 turns No. 24 Double Cotton-Covered on 3" diameter tapped at 20th turn.
J—Double Circuit Jack for plugging in loop.

Improved 200-Mile Crystal Set

THIS improved receiver is considerably more selective and slightly more sensitive than the original "200-Mile Crystal Set" which has created so much interest and given such splendid results in all sections of the country. Builders of the original set have reported reception of stations as far as 1,100 miles away.

The main features of this set are: (1) *Easy construction*, even a beginner will have no difficulty following the simple plan on page 13. (2) *Low cost;* this is the least expensive type of all radio receivers. (3) *Wonderfully clear reproduction*, owing to the inherently faithful and quiet rectifying characteristics of Carborundum. (4) *Unexcelled range* (for a crystal set), because of its modern design and also because of the use of the sensitive Carborundum Stabilizing Detector Unit.

The only home-made part is the tuning coil (L) which consists of 40 turns of annunciator or bell wire (No. 18 or 20 double-cotton covered) wound in a single layer on a cardboard or bakelite form 4″ in diameter and 5″ long. The coil is tapped at the 10th, 20th and 30th turns and leads are left over at the start and end of the coil. Tapping is accomplished most easily by carefully scraping away a half-inch section of the insulation on the turn to be tapped and soldering a lead to the exposed wire. The lead may be of the same wire as the coil. The parts may be connected with bus bar or lamp cord. Note that the two four-point switches are connected in parallel and four leads connect to them from the coil.

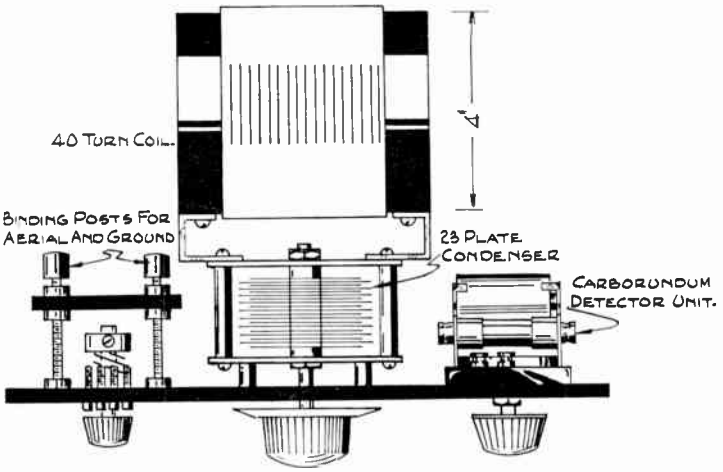
If desired, a wood baseboard about 7″ x 11″ x $\frac{5}{8}$″ may be used in constructing this receiver. The coil, the antenna binding post and the ground binding post may be mounted on this base.

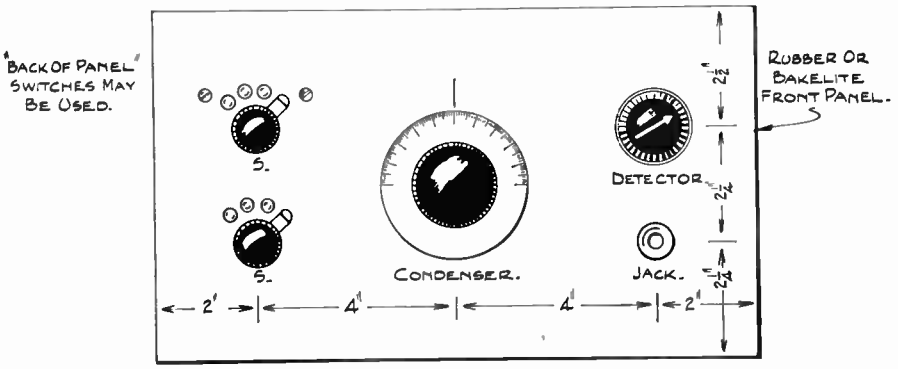
The upper switch in the diagram connects the detector and 'phone circuit across more or less of the tuning coil—it acts as a selectivity control. The lower switch serves to place the antenna and ground circuit across different portions of the coil. This later switch and the variable condenser regulate the wavelength.

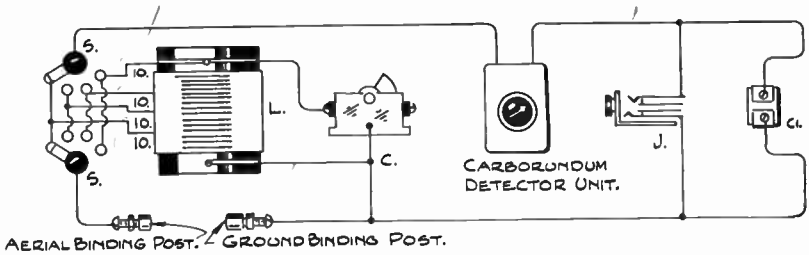
If an amplifier is to be added its "input" terminals should be connected to the two center springs of the 'phone jack. The audio amplifier, described on pages 24 and 25, is particularly well suited for use with this receiver.

A single wire aerial of No.14 enamel insulated solid copper is recommended. It should be from 100′ to 200′ total length.

Improved 200-Mile Crystal Set







C—.0005 mfd. (23-Plate) Variable Condenser.
S—4-Point Inductance Switches.
C1—.0005 mfd. Fixed Condenser.
J—Double-Circuit Jack.
L—40 turns "Bell" Wire on Form 4" diameter, 5" Long-Tapped every 10th turn.

Six-Tube Long-Distance Shielded Receiver

THIS receiver was especially designed for long distance reception; it has three stages of neutralized tuned radio frequency amplification, Carborundum detection and three stages of resistance-coupled audio. Each radio frequency stage is thoroughly shielded in order to secure maximum efficiency, and as a result the normal range under favorable conditions is upward of 3,000 miles. The shielding prevents direct-pickup and this feature, along with the four tuned stages, provides an unusual degree of selectivity. Finally, the bell-clear Carborundum Detector and the distortionless resistance-coupled power amplifier assure wonderful tone-quality and tremendous volume.

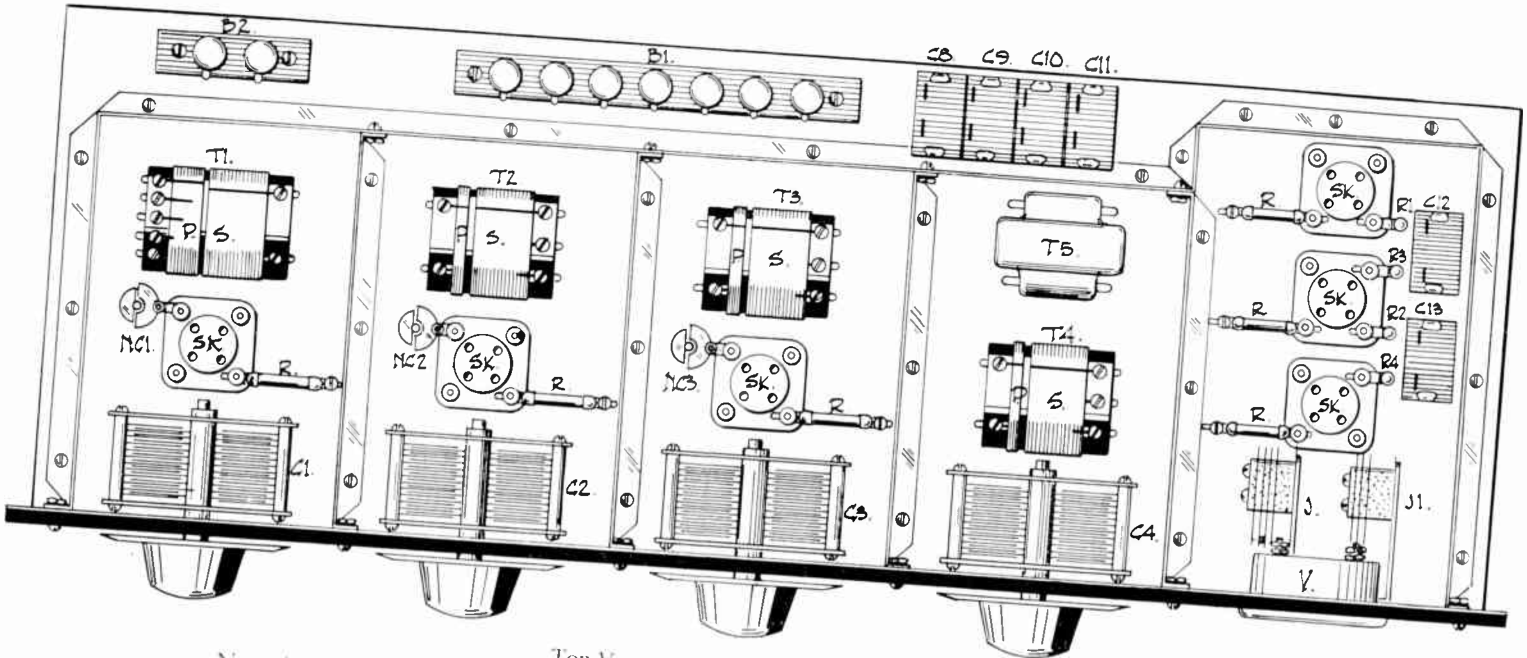
The picture circuits and sketches on pages 15, 16 and 17 should enable anyone to duplicate this splendid receiver. The radio frequency transformers can be made at home and the rest of the parts are inexpensive and easily available. Wiring is not difficult as flexible rubber insulated wire is recommended instead of bus bar because it lends itself better to the shielded construction.

The method of shielding is quite simple. A regular baseboard and front panel are used, both being lined with 24-gauge aluminum, brass or copper sheet. The back and sides of the shield are made in a single piece. Separate partitions serve as shielding between the stages as shown in the drawing on page 15.

CONSTRUCTION. Lay out the front panel (including the location of fastening screw holes for the shielding). Cut a metal shield the same size as the front panel and drill through both at the same time. Enlarge the hole for the Detector Unit and the Jacks in the shield so the bushing do not touch the shield. With the shield in place against the back of the panel, mount the variable condensers, rheostats, jacks, antenna switch, Detector Unit and voltmeter.

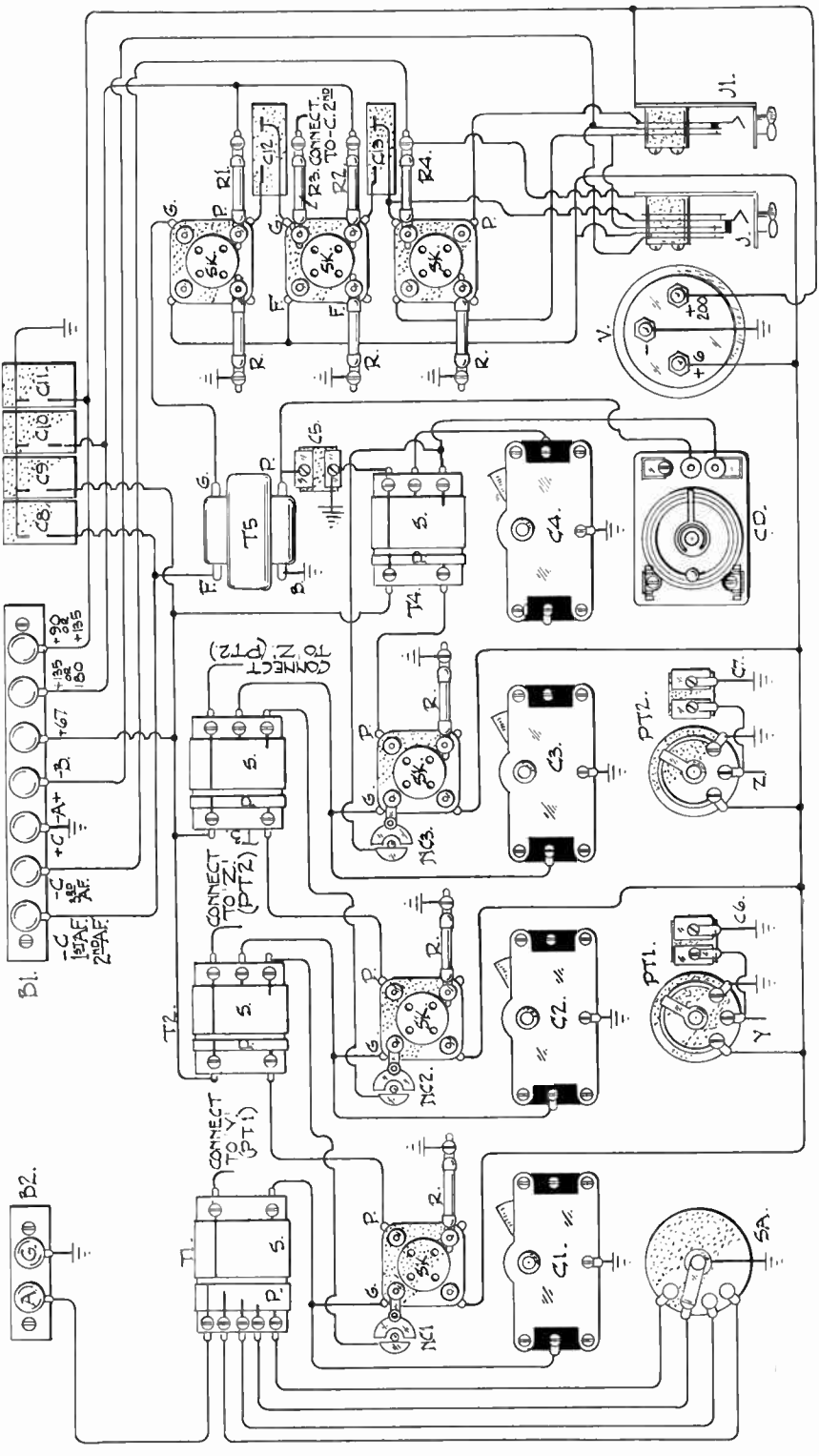
Cut a metal shield to fit the base, leaving a $\frac{5}{8}$" flap to be bent down over the front edge of the baseboard. Fasten the shield in place with wood screws and screw the panel to the front edge of the base. The base shield now makes contact with the panel shield along its entire length. Mount all the parts in place as indicated in the top view. Note that the Carborundum Coupling Resistors and Grid Leaks are mounted with one angle attached directly to the socket terminal. This not only eliminates numerous connections but avoids the necessity of further insulating these parts from the shield.

(Continued on page 18)

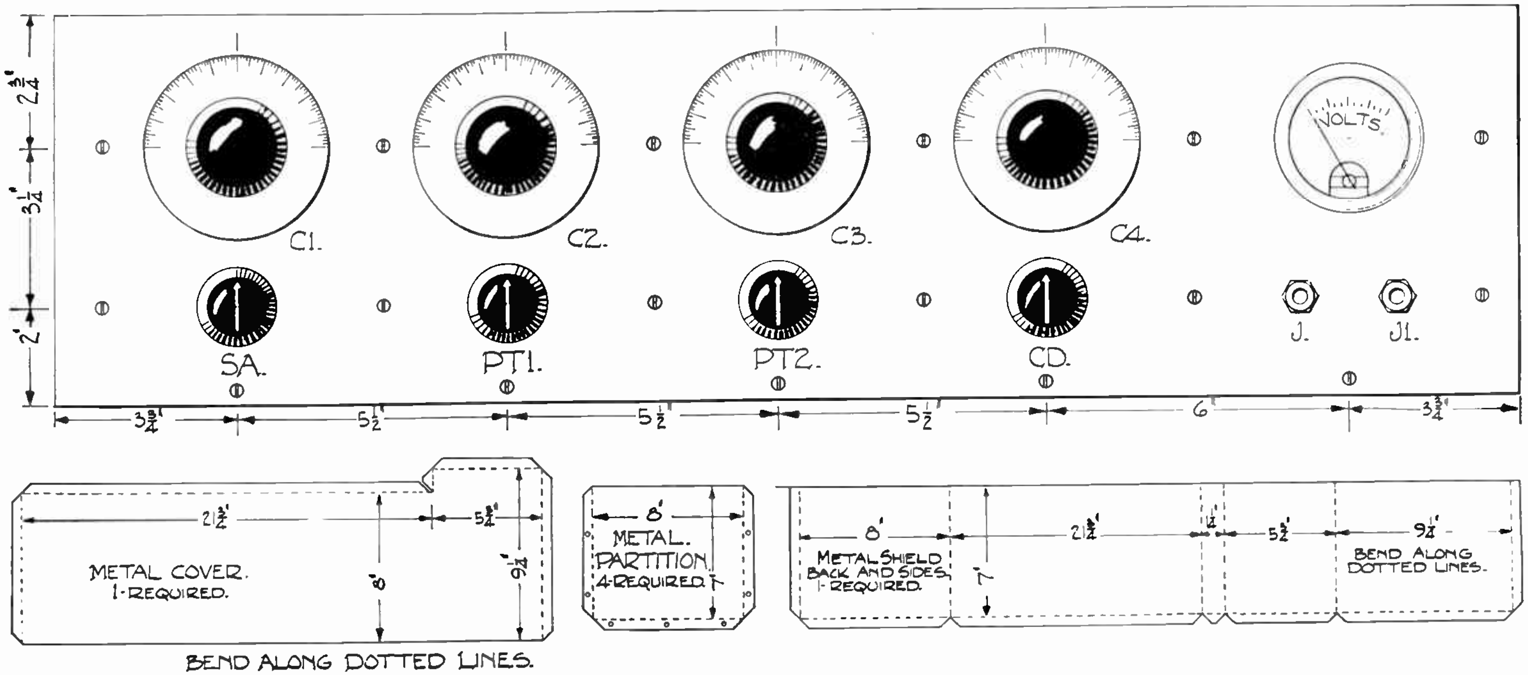


Top View of the Six-Tube Receiver

Note that each stage of radio frequency amplification is separately shielded. Dimensions of the shielding are given on page 17. The key letters are indicated in the list of parts.



PICTURE DIAGRAM OF THE SIX-TUBE CIRCUIT



Front View and Shielding Dimensions

Six-Tube Long-Distance Shielded Receiver

(Continued from page 14)

When all the parts are in place construct the rest of the shielding and arrange it on the set to make certain that everything fits properly. Remove the shielding and wire the circuit with rubber-covered stranded wire. The battery leads may be bunched together and run along the base shield. However, the plate and neutralizing condenser leads which connect the radio frequency stages should be brought through small holes, which must be made in the partitions, so these leads are short and direct. Also these leads should be kept away from the metal as much as possible. All holes in the shields must be of minimum size and the edges and covers of the cases must have a practically air-tight fit. Wire the filament circuit first, then the grid and finally the plate sections. Solder all joints if possible.

When the wiring is finished except for the plate and neutralizing condenser leads, put the shielding back in place, fastening it to the base with wood screws and to the panel with ⅜" 6-32 machine screws. Then connect the remaining leads. The necessary holes in the partitions for these leads may be made easily with a punch; the holes should be located in such places that the leads run through them in a straight line between terminals. It is essential, of course, that only those contacts which are to be grounded or connected to the negative (A) line should touch the shielding. All other terminals, wires, etc., should be well insulated from the metal. For this reason it is advisable to tape all exposed connections that might accidentally touch the shields.

'201A tubes may be used throughout, though it is advisable to use a small-power tube in the last stage; '199s are also satisfactory provided a '120 is used in the last socket.

The four dials will be found to read practically alike over the entire wavelength range. Neutralization may be carried out when tuned to a local station. This adjustment is not very critical as the two potentiometers serve as additional self-oscillation controls. The antenna circuit switch will be found to have a very beneficial effect, as it eliminates the customary dropping-off in efficiency at the ends of the wavelength range. The potentiometers may be adjusted after tuning in distant stations. The Detector Unit adjustment is not critical.

List of Parts for Six-Tube Receiver

Six Non-Microphonic Tube Sockets, push type. (SK)
Four Radio Frequency Transformers, details in text. (T1, T2, T3, T4)
One Good Audio Frequency Transformer. (T5)
Six Ballast Resistors for the tubes being used. (R)
Two .05 megohm Carborundum Coupling Resistors. (R1, R2)
One .5 megohm Carborundum Grid Leak. (R3)
One .25 megohm Carborundum Grid Leak. (R4)
Four .0005 mfd. Straight Line Frequency Variable Condensers. (C1, C2, C3, C4)
One Carborundum Stabilizing Detector Unit, No. 32. (CD)
One .0005 mfd. Fixed Condenser. (C5)
Two 200-ohm Potentiometers. (PT1, PT2)
One Double-circuit Automatic Filament Control Jack. (J)
One Single-circuit Automatic Filament Control Jack. (J1)
Two .006 mfd. Fixed Condensers. (C6, C7)
Six 1 mfd. Fixed Condensers. (C8, C9, C10, C11, C12, C13)
Five yards of No. 24 Gauge Sheet Aluminum about 10″ wide.
One Front Panel 8″ x 30″.
One Wood Base, 10″ x 29″ x 5/8″.
One Binding Post Strip with seven terminals. (B1)
One Binding Post Strip with two terminals. (B2)
Fifty feet rubber insulated stranded copper wire.
Three Neutralizing Condensers. (NC1, NC2, NC3)
One Double-range Voltmeter (about 6 and 200 volts). (V)
Four dozen 6/32 round head machine screws, 3/8″ long.
Two dozen 6/32 round head machine screws, 1/4″ long.
Six dozen 6/32 hexagon brass nuts.
Four dozen 3/8″ round head wood screws.
Three dozen small soldering lugs.
One small four-point inductance switch, back of panel. (SA)

Radio Frequency Transformers

For .0005 Mfd. Condensers

	Form, thin bakelite	P (No. 30 Double Cotton-Covered Wire throughout)	S (No. 30 Double Cotton-Covered Wire throughout)
T1	2″ diameter, 3″ long	32 turns tapped at 8, 16, 24, 32	50 turns
T2 T3 T4	2″ diameter, 2½″ long	12 turns	50 turns, tapped at 12th turn (counting from filament end)

Coil terminals consist of 1/4″ 6/32 screws and nuts with soldering lugs. All coils should be coated with collodion when finished. If .00035 mfd. Variable Condensers are used, the secondaries should have 60 turns.

Loudspeaker Volume with One Tube

THE drawings on pages 20 to 24 show full constructional details of what is probably the loudest and most sensitive one-tube broadcast receiver ever designed. It has a maximum receiving range in excess of 2,000 miles and operates a loudspeaker on stations within approximately 200 miles. The construction is simple and the parts are inexpensive.

The Carborundum Stabilizing Unit plays a very important part in the success of this receiver, as the electrically controlled detector permits operation at the peak of regeneration throughout the entire wavelength range.

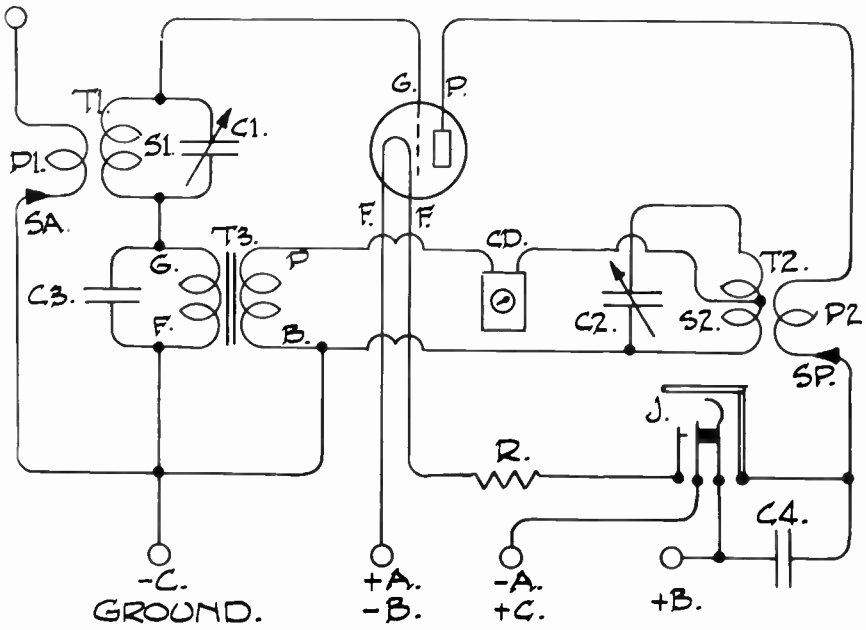
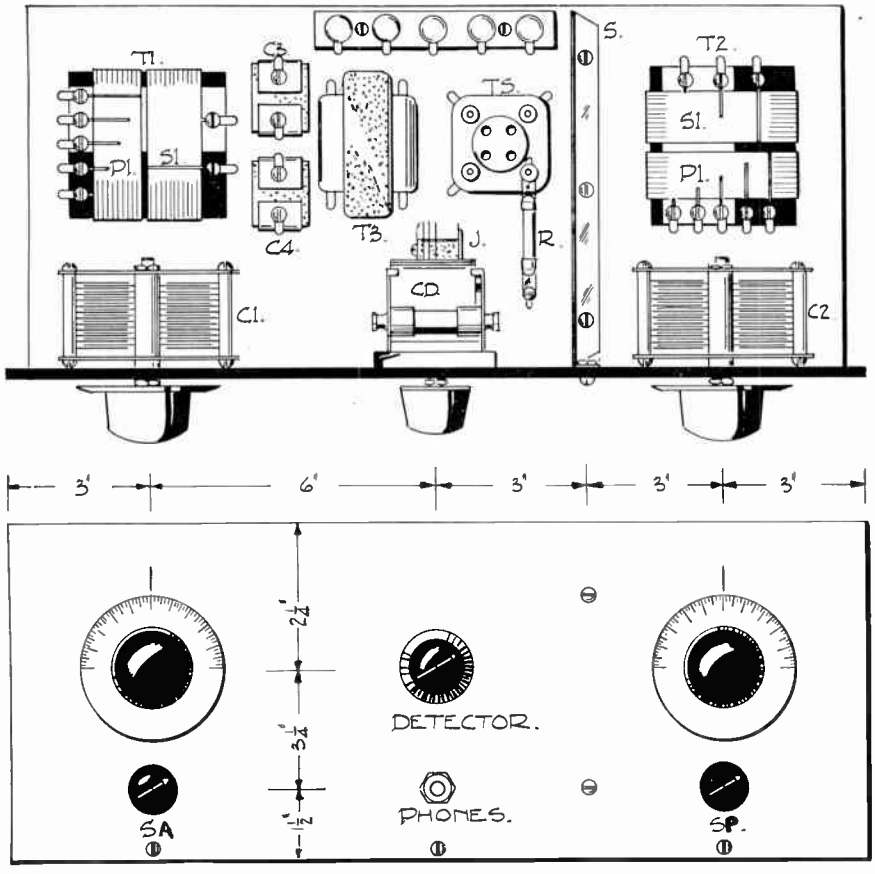


DIAGRAM OF THE ONE-TUBE REFLEX
Note that the primaries of both radio frequency transformers are tapped, thus providing unusual sensitivity.

A single shield, connected to the A battery circuit, allows greater amplification without undue self-oscillation. The shield is of No. 20 gauge aluminum, but brass, copper, tin, zinc and other sheet metals may be used.

Transformers T1 and T2 can easily be made at home. The primaries of these transformers are semi-tuned through use of small inductance switches. This feature results in much greater efficiency than would otherwise be possible. The secondaries and antenna coil are of No. 24 double cotton-covered wire. The plate circuit coil is of No. 30 double cotton-covered wire. The primaries are tapped after winding by scraping off a ¼" section of the insulation on the turn to be tapped and soldering the tap lead (No. 24 wire run in "spaghetti") to the exposed wire. Bus bar or No. 18 rubber-insulated

(Continued on page 22)



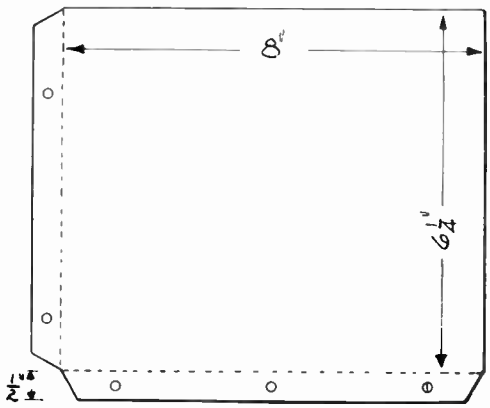
C1, C2—.0005 mfd. grounded Rotor Variable Condensers.
C3—.0001 mfd. Fixed Condenser.
C4—.0005 mfd. Fixed Condenser.
CD—Carborundum Stabilizing Detector Unit.
TS—Non-Microphonic Tube Socket.
R—Ballast Resistor for tube being used.
T3—Audio Frequency Transformer.
S—Metal Shield, Aluminum or Copper.
J—Single Circuit Automatic Filament Control Jack.
T1—Radio Frequency Transformer wound on bakelite form 3" diameter and 3½" long with No. 24 Double Cotton-Covered Wire. Primary, P1, 32 turns tapped at the 8th, 16th, 24th and last turn. Secondary, S1, 45 turns. ⅛" space between primary and secondary.
T2—Radio Frequency Transformer similar to T1 but with primary, P1, of 48 turns No. 30 Double Cotton-Covered tapped at 12th, 24th, 36th and last turn. Secondary 45 turns No. 24 Double Cotton-Covered tapped at center.
SA, SP—Back of Panel, 4-point, Inductance Switches.
Panel, 18" x 7". Wood Base, 17" x 8" x ⅝".

Loudspeaker Volume with One Tube

(Continued from page 20)

stranded wire may be used in connecting the parts. The four leads that pass through the shield should be carefully insulated in order not to touch the metal.

The circuit as shown, with a good 4:1 ratio audio frequency transformer, will not oscillate at audio frequencies; but should this occur (as evidenced by "howling" that is not affected by turning the condensers), it may be stopped by connecting a variable high resistance across the secondary terminals (G and F) of the audio frequency transformer (T3). This resistance should have a minimum value of about 50,000 ohms and a maximum value of about 500,000.

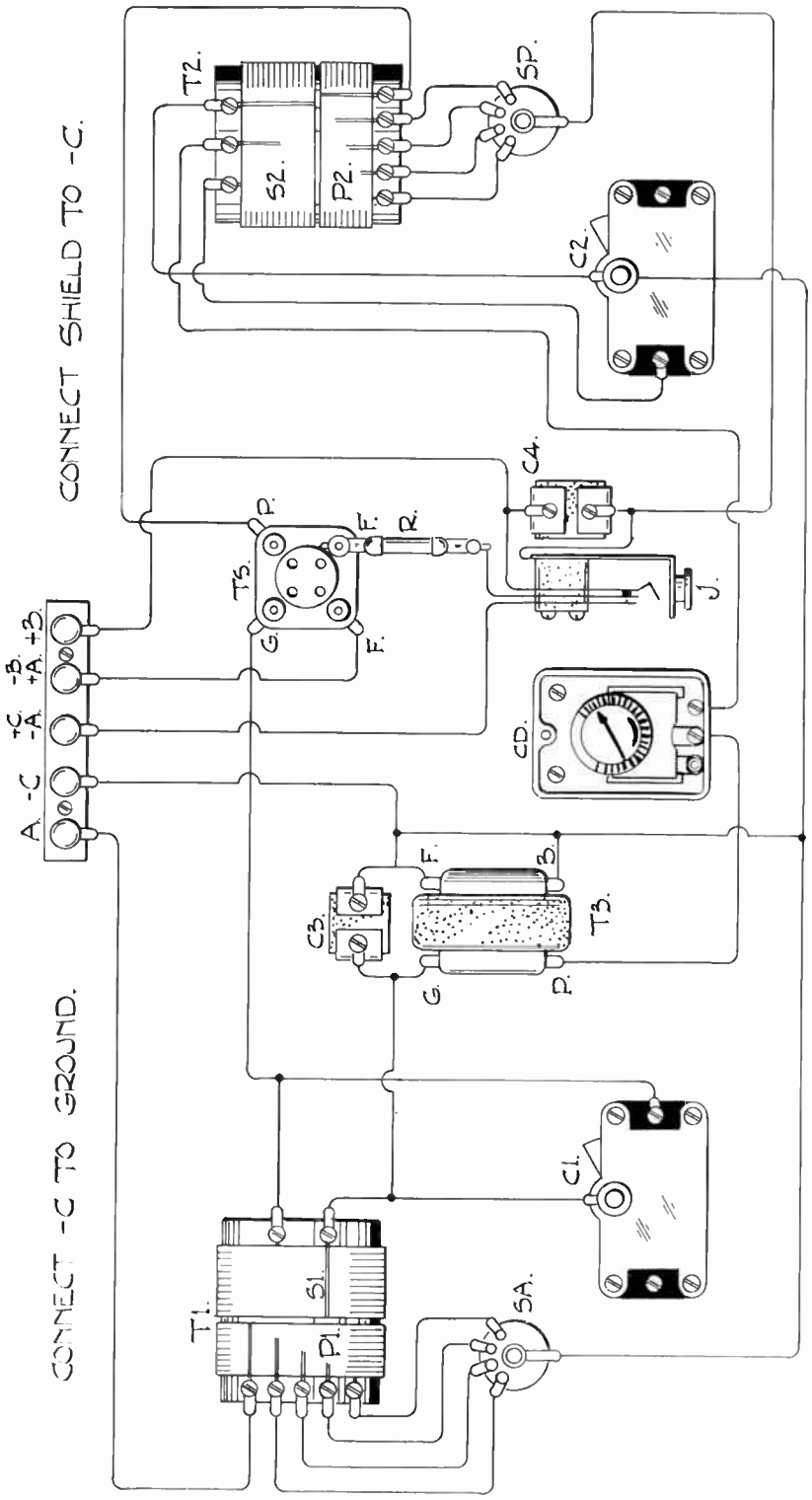


SKETCH OF THE SHIELD USED IN THIS ONE-TUBE SET
(Shown as "S" on page 21)

Either a UX 201A or a UX 199 (or corresponding tubes) may be used. The '201A filament requires a 6-volt storage battery or four large dry cells connected in series. The '199 tube requires three large dry cells connected in series for the A battery. The B battery in either case should be from 90 to 135 volts. The C battery should be adjustable from 3 to 9 volts; it may be made up from six regular dry cells connected in series. A single No. 14 enamel-insulated solid copper wire is recommended for the aerial. It should be from 100′ to 150′ in length. The ground connection should be made to the water-pipe system.

The variable condensers are the wavelength controls. The inductance switches regulate the volume and are not critical. The Detector Unit should be adjusted for strongest and clearest signals.

The audio amplifier, described on pages 24 and 25, may be used in conjunction with this one-tube set. The input terminals of the amplifier should be connected with flexible leads to a plug which is inserted in the jack (J). The 'phones or 'speaker is then plugged in one of the jacks on the amplifier. The same batteries may be used for both the receiver and amplifier.



PICTURE DIAGRAM OF THE ONE-TUBE REFLEX
The Reference Letters are given on page 21

Powerful Three-Stage Amplifier

THIS resistance coupled audio frequency amplifying circuit is designed to afford the very best reproducing quality and it is capable of handling considerable power without overloading. The construction is simple, the parts are inexpensive and if the diagram is carefully followed perfect results are assured.

The amplifier may be used with any receiving circuit either as a separate unit or built right in with the rest of the set. It is particularly well suited to follow a Carborundum Detector or Stabilizing Unit. (See page 8).

It should be noted that the coupling resistors have a value of 50,000 ohms. This size permits use of either '201A or "hi mu" type tubes in the first and second stages. It also affords greater amplification for a given "B" battery voltage as the potential drop across the resistors is not as great as if they were of 100,000 ohms. The coupling resistors are large enough however, to minimize uneven amplification of the positive and negative cycles.

The coupling condensers are sufficiently large to avoid loss of power on the lower frequency: The grid leak values are chosen to give stable amplification with these coupling condensers.

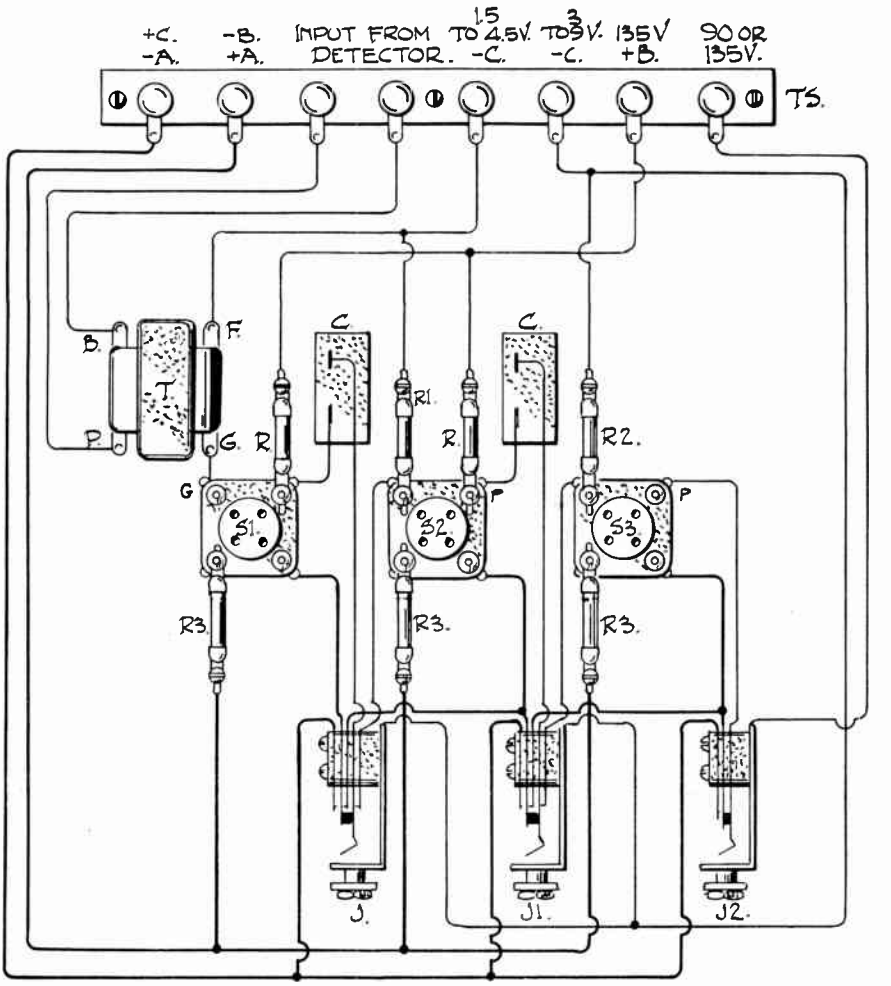
When plugged into the first or second stage jack the 'phones (or speaker) are connected in series with the first or second coupling condenser so the steady "B" battery current does not pass thru the windings. This is a very desirable feature.

The filament circuit has automatic switching jack control: When the 'speaker or 'phone plug is set in the first jack, only the first filament is connected to the "A" battery; when the plug is set in the second jack, the first and second filament are connected to the "A" battery; when set in the last jack, all three filaments are connected in the circuit. Also when the plug is not in any of the jacks, all the filaments are disconnected, and no current is taken by the amplifier from either the "A" or "B" battery.

"Hi mu" or '201A tubes may be used in the first and second stages. A '201A, '112 or '171 may be used in the third stage. With a '112 or '171, it is generally advisable to use a coupling transformer between the plate circuit of the third tube and the 'speaker. This transformer should be suited for the speaker; it sometimes has a ratio of 1:1 or even less if the 'speaker impedance is low. With a '201A tube in the last stage and with a suitable "C" bias, most 'speakers may be connected directly in the plate circuit with the precaution that the connections must be made properly to give the best results. It is also possible to use a choke coil (audio frequency impedance) and coupling condenser instead of a transformer to connect the speaker to the last stage.

Three-Stage Resistance Coupled Audio Amplifier

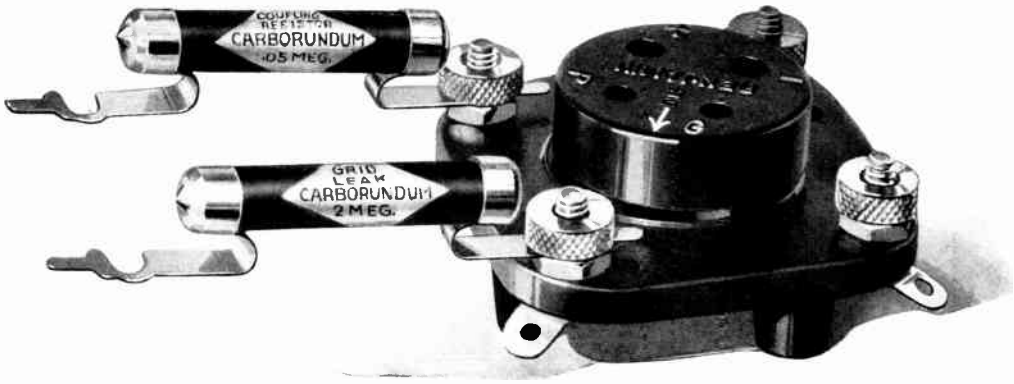
(With Automatic Filament Jack Circuit)



TS—Binding Post Strip, seven terminals.
T—Audio Frequency Transformer.
C—1 mfd. Fixed Condenser.
R—50,000 ohm Carborundum Coupling Resistors.
R1—.5 megohm Carborundum Grid Leak.
R2—.25 megohm Carborundum Grid Leak.
R3—Ballast Resistors for tubes being used.
J, J1—Double-Circuit Automatic Filament Control Jacks
J2—Single-Circuit Automatic Filament Control Jack.
S1, S2, S3—Non-Microphonic Tube Sockets, push type.

Carborundum Coupling Resistors

35c. EACH IN U. S. A.



How Carborundum Coupling Resistors and Grid Leaks may be mounted directly on socket

PRACTICALLY all grid leaks and coupling resistors on the market are made with a thin metallic film sprayed between contacts on an insulating base. Under a high-power microscope this film appears as a cluster of separate particles which are not well bound together either mechanically or electrically. Consequently, with usage and time the particles tend to separate—the film disintegrates. This causes variation of the resistance and the movement of the particles together with the minute arcs between the particles makes the resistor noisy, erratic and sometimes microphonic. Placing such resistors in vacuum containers does not diminish the arcing between particles. Carborundum Grid Leaks and Coupling Resistors do not depend upon a metallic film, but are made in the electric furnace and consist of solid unbreakable rock-like Carborundum.

Angles may be bent as desired.
Slotted Holes permit interchanging.
Convenient Soldering Lugs.

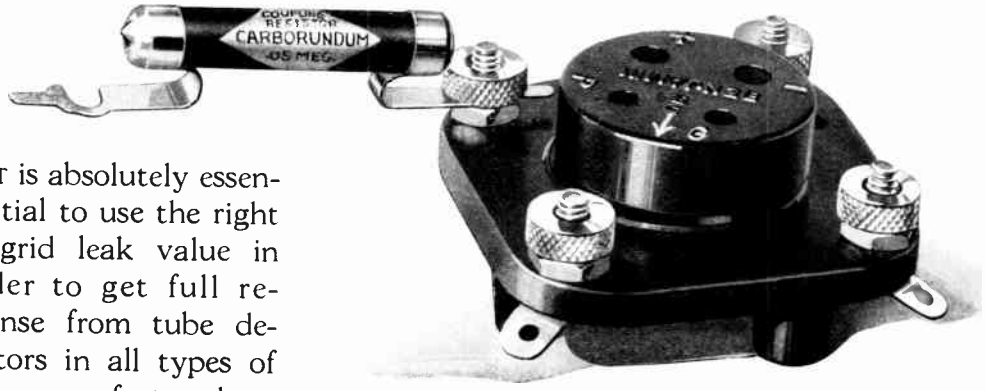
The distinctive feature of these products is that they are absolutely noiseless and do not disintegrate with use or time. In radio sets they provide the utmost freedom from "back-ground" noise and hence increase the effective receiving range.

This high quality is the result of many years experience in the manufacture of Carborundum Resistors for commercial electric installations.

Carborundum Coupling Resistors are made in two Resistances, 50,000 and 100,000 ohms. The 50,000 ohm type is recommended for the plate circuit of 201A type tubes. The 100,000 ohm type is recommended for the plate circuit of three "hi mu" tubes.

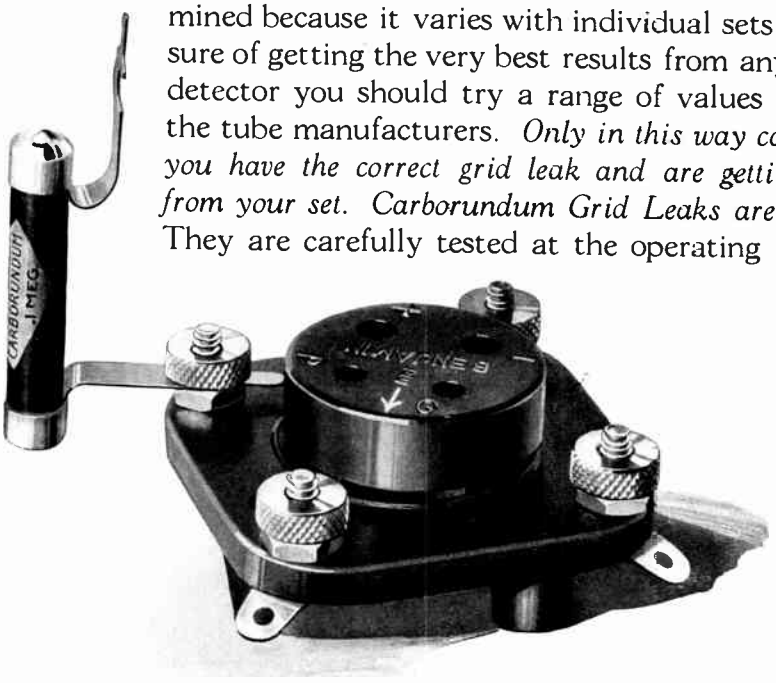
Carborundum Grid Leaks

35c. EACH IN U. S. A.



Mounts directly on Socket Terminal. Eliminates connections. Makes short leads. Fits in standard clips

IT is absolutely essential to use the right grid leak value in order to get full response from tube detectors in all types of sets, manufactured or home-made, neutrodynes, tuned R. F., super-heterodynes, etc. This value can not be predetermined because it varies with individual sets and tubes; so to be sure of getting the very best results from any tube being used as detector you should try a range of values as recommended by the tube manufacturers. *Only in this way can you be certain that you have the correct grid leak and are getting maximum results from your set. Carborundum Grid Leaks are absolutely noiseless.* They are carefully tested at the operating voltage.



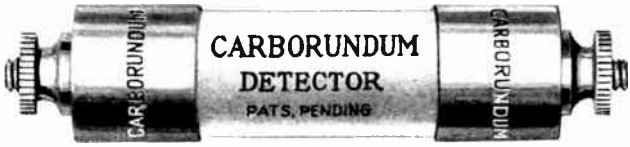
The Grid Leaks, like the Coupling Resistors, are provided with handy mounting angles so they may be mounted directly on the grid terminal and thus eliminate long grid leads and minimize "feedback."

Carborundum Grid Leaks are made in the following values: .25, .5, 2, 3, 4, 5, 6, 7, 8 and 9 megohms.

LEAK VALUES RECOMMENDED BY MANUFACTURERS

Tubes	UX 201A CX 301A	UX 199 C 199	WD 11 C 11	WD 12 C 12	UX 200A
Grid Leak in Megohms	2 to 9	2 to 9	3 to 5	3 to 5	2 to 3

Carborundum Detector



No. 30

$1.50 IN U. S. A.

Bell-clear, Noiseless, Sensitive

CARBORUNDUM is the only rectifying substance that can be used with a heavy pressure contact; so it is really the only material suited for permanent detectors. Carborundum Detectors are built with five-pound contact pressure and retain their sensitivity indefinitely. They are tested for permanence and must pass a rigid electrical and radio frequency check for rectification. This includes testing with high frequency currents of the order of .000005 amperes.

The Detectors may be checked for rectification by connecting a dry cell (1½ volt), pair of 'phones and the detector in series; a strong click should be heard when the detector is connected in one direction and almost no click when reversed. This indicates that the Detector functions properly.

The Detector alone is suited for use in any set that is properly designed to work with a good permanent crystal detector.

RADIO DATA COUPON

THE CARBORUNDUM COMPANY,
NIAGARA FALLS, N. Y., U. S. A.

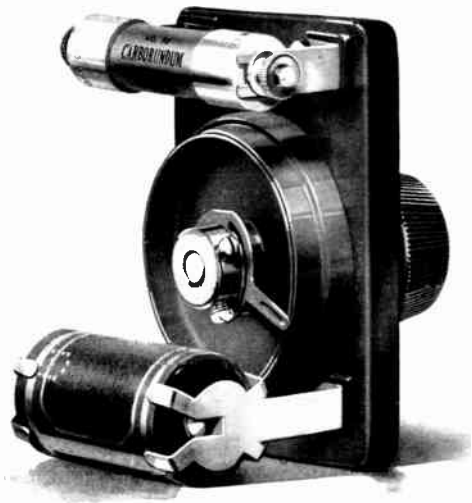
Without obligation to me, please send me any radio data or construction plans that you may prepare in the future.

I am particularly interested in

Name

Address

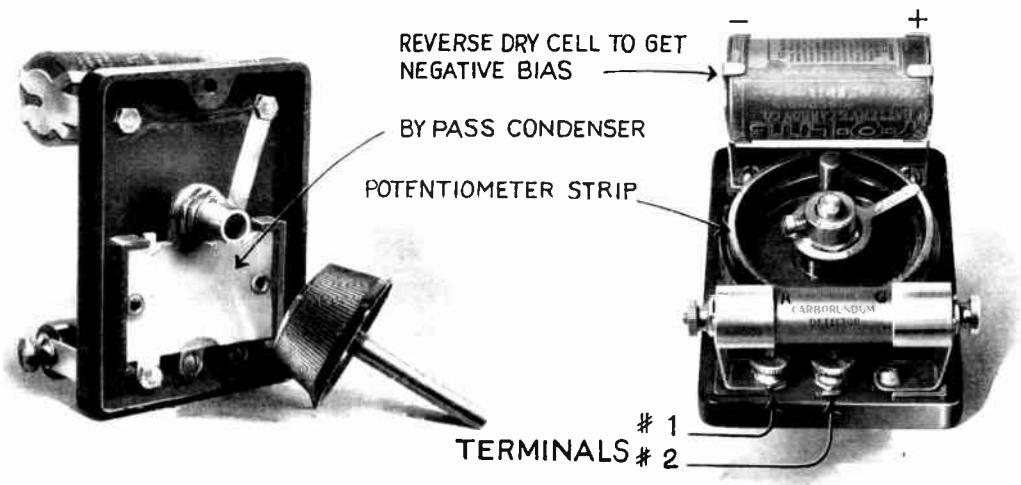
Carborundum Stabilizing Unit



No. 32
$3.50 (Without Dry Cell)
Gives Remarkable Results

THE Stabilizing Unit is an electrically controlled Carborundum Detector and is adaptable to all detector circuits. This is because the detector impedance may be regulated, by the turn of a knob, so it exactly matches or meets the circuit requirements. (See page 4.) The Unit control is exceptionally fine and smooth, accurate to about 1/1000th of a volt.

The Unit consists of a high resistance potentiometer, built-in mica condenser, holders for a standard size flashlight cell and a selected Carborundum Detector, which is provided. The two terminals are to be connected in the circuit just as though they were the terminals of a regular crystal detector. No. 1 may be connected to the R. F. and No. 2 to the A. F. side of the circuit. The Unit mounts on panel or table with a single hole. The dry cell should last from three to six months. The cardboard cover should be in place on the cell. Eveready 935, Niagara 100 and Burgess No. 1 Uni-Cell all fit the Unit. Dent the ends of the cells to make it fit snugly in the connecting clips.



Carborundum Products for the Radio Set Builder

THE fine grades of Carborundum Brand Garnet Paper are excellent for graining Bakelite or rubber panels to secure the satin finish that is used so extensively in government and commercial receivers. The panel should be rubbed down with fine steel wool and machine or olive oil after graining.

Carborundum Paper is also recommended for brightening aluminum, copper and brass shielding that is becoming so popular in modern broadcast receivers. After rubbing the surface spotlessly clean with Carborundum Paper, a coat of clear lacquer or collodion should be applied to the metal to prevent tarnishing.

Other Carborundum Products described on these pages will find a welcome and useful place on the work bench of every radio set builder. These products may be purchased at all hardware and supply dealers. A complete catalog will be sent on request.

CARBORUNDUM COMBINATION STONES

FOR keeping all of your edge tools sharp. One side of the stone is of a coarse grit for taking out nicks and bringing the tool quickly to an edge; the other side is of a fine grit for giving the tool a smooth keen finished edge. Listed below are some of the popular sizes of these stones.

No. 108—8 x 2 x 1 inch	$1.75
No. 109—6 x 2 x 1 inch	1.25
No. 111—5 x 2 x ¾ inch	1.00
No. 112—4 x 1¾ x ⅝ inch	.85

CARBORUNDUM BRAND GARNET PAPER

CARBORUNDUM Brand Garnet Paper is for sanding and finishing all wood work such as panels, bases, frames, etc. Radio set builders will find that it cuts faster, lasts longer, gives a far superior finish than the ordinary "sand paper." Get it from your hardware dealer in the handy 9 x 11 inch sheets in any standard grits you desire.

CARBORUNDUM HAND-POWER GRINDERS

YOUR equipment should include a Carborundum Hand-Power Grinder fitted with a Carborundum wheel for grinding tools and all sorts of metal parts. Strong, durable, perfectly made machines.

Niagara No. 1, 4-inch wheel	$5.75
Niagara No. 2, 5-inch wheel	6.50
Niagara No. 3, 6-inch wheel	9.50
No. A Blue Knight, 4-inch wheel	3.50
No. B Blue Knight, 5-inch wheel	4.75
No. C Blue Knight, 6-inch wheel	6.50
No. E Blue Knight, 3½ inch wheel	2.50

CARBORUNDUM AND ALOXITE STICKS

FOR reaming out holes in Bakelite panels, for touching up or filing various metal parts, Carborundum and Aloxite Sticks are recommended. These are made in the round, square, half-round and triangular shapes. They are made in 4, 6 and 8 inch lengths ¼ to 1 inch thick in fine, medium and coarse grits.

ALOXITE REDMANOL WHEELS FOR CUTTING PANELS

THE quickest, most efficient way to saw, slot or cut holes in radio panels of Bakelite or rubber is with Aloxite Redmanol Wheels.

For sawing or slotting, thin blade-like wheels in various diameters are furnished for use in any cut-off machine.

For cutting holes a special slotted cup wheel should be used. The wheel can be fitted to a fixture or bit which is chucked to an ordinary drill press. These wheels cut faster leave a truer, cleaner hole than the fly-cutter tool. No trouble—no adjustments. These wheels are made in various diameters. Complete sizes, grits, prices, etc., upon application.

THE WHITNEY-GRAHAM CO., INC
BUFFALO AND NEW YORK CITY

Printed in U. S. A.

Form A662