

# PRACTICAL RADIO KINKS AND SHORT CUTS

The contents of this book have been planned with the view to help Radio Dealers, Servicemen, Experimenters and Set Builders overcome many of the common, simple obstacles found in everyday radio work.

By B. BAKER BRYANT



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## CHAPTER I

*Introduction*

EVERY Service Man and radio experimenter has his own "pet" way of accomplishing certain details of set repair or construction, whether it is the way in which he hangs his soldering iron on the bench or some individual way of testing a circuit or piece of apparatus. Many of these "Kinks" have a distinct advantage over the accepted ways and naturally will interest the serious radio man.

It is the purpose of this book to present some of the most useful of these "Kinks" and Short Cuts in a form that will be of interest to everyone. Naturally, we can all learn from the experience of others and even the most clever technician will profit by a careful study of this little volume.

The financial return, in servicing radio equipment today, depends to a great extent on the speed with which the Service Man eliminates the trouble and places the receiver or equipment in correct running order. The man who can handle the greatest number of service calls a day is the one who will gain most, either directly in service fees or indirectly in increased business. A number of the "Kinks" are directly applicable to service work and may be instrumental in reducing the time required to locate an obscure difficulty in some set.

We all know the peculiarities of short-wave sets and the fact that some work much better than others for no apparent reason. The Short-Wave Fan will note that he has not been slighted as a generous number of short-wave hints will be found in the chapter on this subject.

In compiling the volume, the editor found that a large percentage of the available material could be classified under general headings such as Servicing Short Cuts, Testing Equipment, Vacuum Tubes, Speakers, etc. However, some of the "Kinks" were rather stubborn and refused to be untangled into the headings selected. It was necessary to place these unruly items in the topic most nearly associated with them. The headings in the Contents can, therefore, only be used to supply a general idea of the details included.

## CHAPTER II

### SERVICING SHORT CUTS

#### A PILOT-LAMP ADAPTER

By Audie Robertson

FOR the Service Man, the device shown in Fig. 1 is very convenient when working in the dark corners of the set. A miniature socket, to fit a dial-light bulb, and a burnt-out bulb, with two flexible insulated wires, are the only requisites.

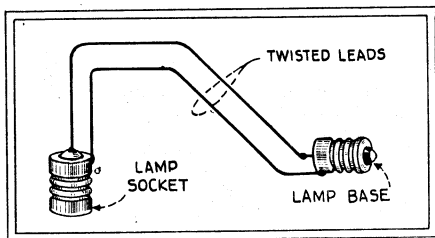


FIG. 1—The dial-light is converted into a troubleshooting lamp by the use of this simple adapter.

Take the pilot lamp out of the set, put it in the socket of the extension lead; and screw the plug of the latter into the pilot lamp's socket. The lamp continues to operate from the set's current. Two-foot leads are usually enough.

#### ILLUMINATED VERNIER DIAL

By Louis B. Sklar

A HIGHLY efficient vernier illuminated dial can be made from an RCA vernier drive, Part No. 6675. The complete assembly of parts is illustrated in Fig. 2.

Secure a piece of light-gauge celluloid, and shape it as shown in Fig. 2A. Make a mark with a needle or other sharp-pointed instrument in the center of the celluloid strip to form a "hair line." Glue strip to the outer shaft of the RCA drive as indicated. With a jig-saw or other suitable tool make a semi-circular slot in panel. The dial mark-

ings are drawn on transparent paper or tracing cloth and pasted on the back of panel. The dial markings can be drawn 0 to 100 or in kc. if you know the exact position of the variable condenser for the various frequencies.

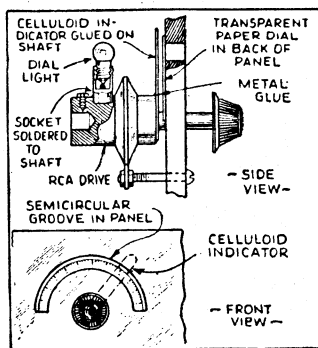


FIG. 2—Sketch of the dial shown in Fig. 2 A.

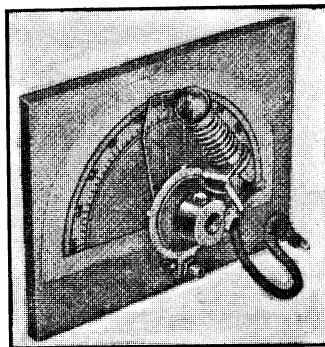


FIG. 2A—Homemade illuminated vernier dial

A miniature base socket, radio type, can be soldered on at the shaft shown so that the light will always be directly in back of the "hair line" indicator.

This vernier dial can be built for about 25c, yet, it will surpass in service and smoothness of operation, dials costing about 6 times that amount.

### HOME-MADE SET DIALS

By D. P. Hartley

IN MAKING dials for receivers, meters, etc., the idea shown in Fig. 3 will enable you to have a neater job than can be secured in the ordinary way.

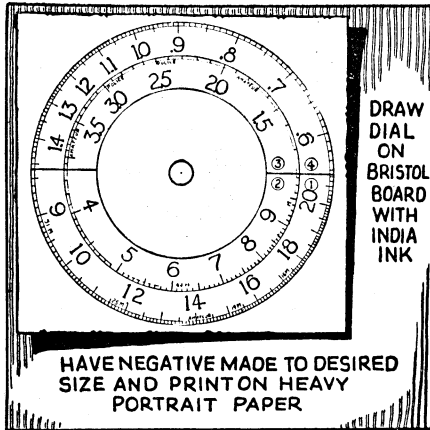


FIG. 3—Make your own all-wave dial to suit.

Make a master dial, calibrating as desired (this may be merely a sketch), then enlarge to scale, on Bristol board, to 12 ins. or more, and draw as carefully as possible in India ink. Take the drawing to a photographer, having him make a negative; and then prints, with the portrait camera, to the size you want, on heavy paper. A sample dial I made this way for an all-wave receiver is illustrated; the original was 10½ ins. in dia.

(A simpler scheme than using a photograph would be to get a "glossy photostat."—Editor)

### ELIMINATING HUM FROM NEARBY LIGHT LINES

By J. H. Mills

WHEN your antenna must be placed parallel and close to high-tension lines, a great deal of hum is picked up by it.

To eliminate the biggest proportion of this hum, put up a two-wire antenna, as shown in the drawing above. See Fig. 5.

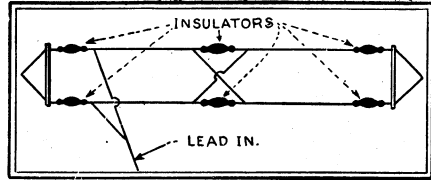


FIG. 5—"Phasing" an antenna, to reduce the effects of interference pick-up.

The wires cross in the center of the span and they must not come in contact with each other.

The principle on which this aerial works is as follows: The pick-up of the interfering current is equal in each end of the wire and as the positions of the wires are reversed at the central point, the current picked up in one of the wires opposes that picked up in the other.

### A HUM KILLER

By George W. Brown, A. I. R. E.

MANY A.C. sets hum even though the filter system is quite efficient. I have found that, in sets using push-pull audio stages, a 100,000-ohm resistor (R1) connected across the secondary of the input transformer will reduce the hum considerably. In extreme cases, another 100,000-ohm resistor (R2) may be connected across the secondary of the first audio transformer. This second resistor may make a very slight change in the volume; but it will certainly kill whatever hum may be left. See Fig. 4.

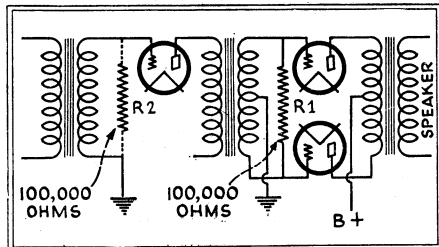


FIG. 4—These resistors give a solution of the persistent hum problem.

## CAR-RADIO IMPROVEMENTS

By John E. Mason

A CONSIDERABLE improvement in performance of car-radio sets may be had by retuning the antenna trimmer after the set has been installed and connected to the car antenna.

In some cases it is also necessary to slightly retune the first-detector trimmer.

## CLOSED-CIRCUIT TIP-JACK

By Charles Horvath, Jr.

THIS handy jack may be made from an ordinary tip-jack. All the needed instructions are given in Fig. 6. When the phone tip is inserted, the two

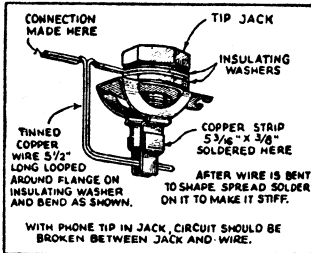


FIG. 6, above—Re-making a tip jack.

lengthened prongs spread apart and open the circuit with the heavy wire that is to be added. An ideal jack for use in test sets and many other applications.

## PLUGS AND JACKS IN THE LAB.

By Joseph Riley

SINCE the convenience and adaptability of plugs and jacks in the laboratory are not known to every experimenter, the writer ventures to call attention to the numerous arrangements illustrated in Fig. 7A. Although not new (having appeared originally in an issue of the "General Radio Experimenter") it is believed they are excellent examples of the versatility of plugs and jacks.

The following lines are quoted from this interesting number of the "Experimenter": "In the laboratory the space provided under the bench too often be-

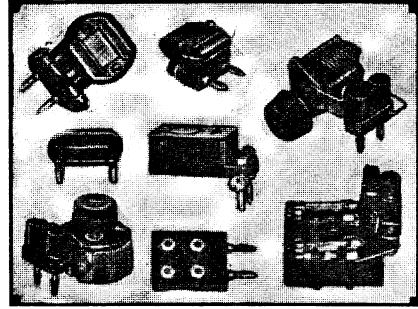


FIG. 7A—A number of plug and jack arrangements that facilitate experimental work. Clean-cut apparatus like that illustrated above makes experimenting easy.

comes the resting place for discarded bread boards, a procedure which soon proves both unsightly and uneconomical. A satisfactory solution is a universal breadboard provided with the necessary jacks for plugging in various circuit elements. This sort of device is illustrated in Fig. 7B.

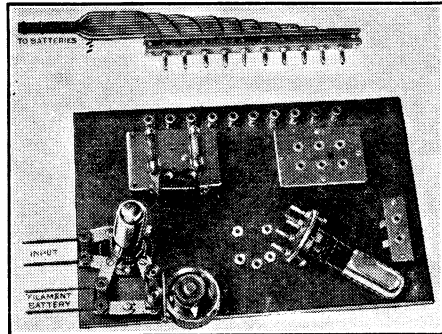


FIG. 7B—A laboratory breadboard, illustrating one of the many uses for which plugs and jacks may be used.

"To meet this need for a flexible system of connection, G. R. units have been designed around the Type 274 plugs and jacks. A spacing of 3/4-in. has been adopted.

"This manner of arranging test equipment makes it extremely convenient to make comparisons between units of a given type, such as audio transformers; for that matter, even systems of operation may be compared, such as the relative performance of transformer or resistance audio-amplification, provided the voltages, etc., are correctly balanced."

**SCREEN GRID CLIP**

By Fred Erdos

THIS "kink" used by the writer may be of interest to the readers of Radio Kinks. Fig. 8A shows the adaptation of a Fahnstock clip to fit the control-

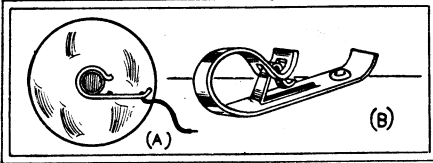


FIG. 8—A clip for the control-grid cap of a screen-grid tube is quickly and effectively made as shown.

grid cap connection on the top of a screen-grid tube. At 8B we have the clip before the little middle spring has been broken off and a larger, outer one, bent to fit

**AN EFFECTIVE INTERFERENCE ELIMINATOR**

By Ernest V. Amy

MOST Service Men are familiar with the use of a choke coil for the suppression of artificial "static" radiations. However, it is generally believed that a successful unit must be purchased. The construction and application of the unit pictured in these columns will explode that fallacy.

In practically every instance of interference from motors it is usual to apply a palliative at the point where the motor line connects to the power line. This materially reduces interference conduction into the light lines; but, it does not prevent interference

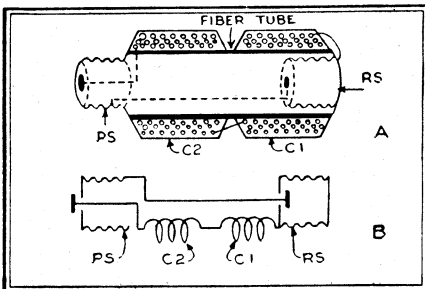


FIG. 9A—An effective "static" radiation reducer, for use on sparking devices, wired as described. It is quickly and inexpensively constructed and easily applied: and will give relief from the "man-made static" generated by so many installations. The closer it is to the sparking device, the better. FIG. 9B—"Skeleton" and schematic circuit of the radio-frequency choke coil.

radiation from the current lead between socket and motor.

The design of this device is based on the fact that all motors of any real size have "fused switches" close to them.

To install this air-core choke. (Fig. 9C) a fuse is removed from this switch box, the choke inserted, and the fuse screwed into the choke. The opposite side of the line is tried; one in each side may be necessary—in extreme cases.

Fig. 9A illustrates the series circuit so formed. This schematically indicated in Fig. 9B.

A brass shell is arranged in one end of a fiber tube. This is the receptacle shell, R.S. for the fuse. In the opposite end is fastened the plug-in-shell P.S. On the tube are two windings; each of which consists of 140 turns of No. 18 D.C.C. wire, plain layer-wound. They are spaced as shown to reduce self-capacity which would act as a high-frequency by-pass and nullify the reactive effect of the choke.

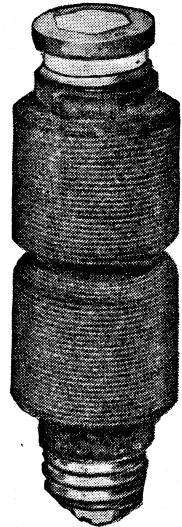


FIG. 9C

**CONVENIENT WORKBENCH LIGHT**

By Boris S. Naimark

THIS handy extension light for the workbench takes the place of several lamps permanently installed; it is available at any point of the work-bench and can be shifted from point to point with ease; and it requires nothing, that can not be found in the junk-box, for its installation.

Stretch a length of steel or "stove-pipe" wire from one end of the bench to the other, preferably over the center of the bench and approximately three feet above it. Slip over it a piece of insulating tubing which may be between three and five inches long. Secure the electric-light socket, as shown

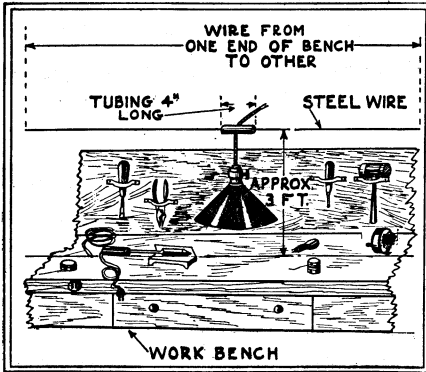


FIG. 10—The method of suspending a lamp above a work-bench is safe and convenient to a high degree.

in the accompanying drawing, at the height considered most convenient,

The lamp can now be moved the entire length of the bench, and thus makes light instantly available where it is needed most. (Fig. 10.)

POPULAR RADIO ACCESSORIES

By J. G. Sperling

IN spite of many opportunities, the average Service Man does not avail himself of the possibilities of selling various radio accessories in the home.

The writer has carried a few items in his kit for the past year, all of which have proven very successful. It is a rare home, indeed, in which at least one of these accessories could not be sold.

Noise Reducer

The first of these accessories is a noise or static reducer. As seen from Fig. 11, it consists of a neon glow-lamp in series with a variable resistance. This device is connected across the voice-coil terminals of the loud-speaker. Its operation is relatively simple, it being a form of an automatic volume-control. First, the manual volume-control is set at some definite level. It will be necessary to mark this point on the dial, for successful operation of this device depends upon the correct position of this volume control. Then the variable resistance in the unit is adjusted till the lamp starts to flicker.

Therefore, if there are any extraneous noises such as static or electrical interference it will be shunted or bypassed through this device. There will not be any loud crackling such as previously present, but only a low-pitch noise or "plop" whenever there is a large amount of static. Whenever this occurs, the neon lamp will glow.

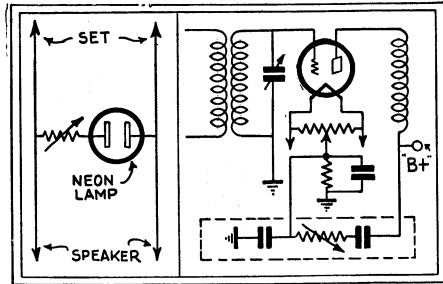


FIG. 11, left—Circuit of the static reducer. FIG. 12, right—Hum-control circuit.

The parts used in this device are a G.E. 1-watt neon glow lamp with a small Edison base, and a 100,000-ohm variable resistor. This unit is housed in a small container and sold to the customer for \$2.50. After a free demonstration on a bad night, the customer will always buy this device.

Hum Eliminator

Many of the early type as well as some of the later model A.C. sets had a very bad hum. Different methods have been tried to combat this evil but only one device seems to be the panacea for all our hum troubles. This is an adaptation of the hum-bucking unit designed by Miessner and used by Loftin-White in their amplifier. Almost everybody knows what a success it has been in the above units. It is simple to con-

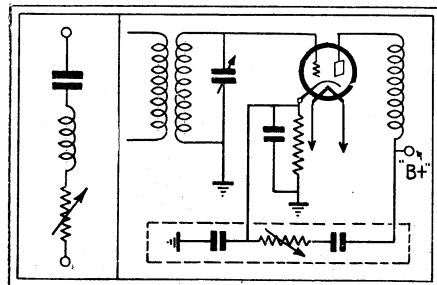


FIG. 13, right—Another hum-control connection. FIG. 14, left—Tone-control unit.



struct and adjust. It promises an inviting field of revenue for the wide-awake Service Man. As seen in Figs. 12 and 13, it consists of two .5-mf. condensers of 400-volt rating and a 5000-ohm variable resistor. When installed it is only necessary to turn the arm of the resistance to a point where no hum is heard.

This hum-bucker has been used with success in such sets as the Majestic "70" and "90," Temple "8-80," Victor "RE-32" and RCA "16," "18," "33" and "60." It should be connected in the last radio-frequency stage.

### Tone Control

In spite of the great popularity of dynamic speakers, many sets are still found employing the magnetic speaker. Very often the owner complains of insufficient bass and a superabundance of tones in the middle register. This situation can be remedied by the use of a device called the equalizer.

The constants for the trap for use with magnetic speakers are one .1-mf. condenser, one 80 mh. choke such as Samson, and a 0-50,000-ohm resistor. The device is connected across the terminals of the magnetic speaker. The resistor is then adjusted until a pleasing response is obtained. The schematic is shown in Fig. 14.

## DEMAGNETIZING PHONE POLES

By L. B. Johnson

HEAD-PHONES that give a low signal and appear worn-out often may be rejuvenated by removing the coils from the phone (the magnet may be removed instead) and connecting 5

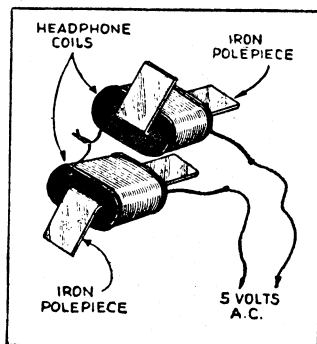


FIG. 15—Demagnetizing phone poles.

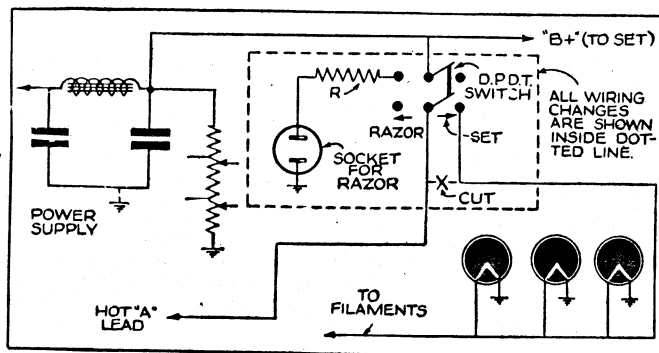
volts of A. C. across the coils for about 5 minutes. This eliminates residual magnetism in the polepieces. Headphones "treated" in this manner have outperformed previously more sensitive ones. Figure 15 indicates how this is done.

## ELECTRIC RAZOR POWER SUPPLY

By G. E. Weniger

MANY people who possess 110-volt "dry shavers" would like to be able to use them on camping trips when 110-volt electricity is not available. As these electric razors operate on either A.C. or D.C. and draw only very little current, they can be run from the power supply of an auto-radio set and may be easily connected as shown in the diagram, Fig. 16. The switch disconnects the filaments of all the tubes except the rectifier (if any), thus relieving the power supply of the plate current. The resistance, R, must be

FIG. 16—A 6-volt supply for dry shaver from a car radio.



of the correct value to reduce the voltage delivered by the power supply to approximately 110 volts when the razor is running. This value must be found by experimentation.

### PANEL ENGRAVING

By Erick Erickson

FOR the experimenter who has no facilities for the regular type of engraving, it is possible to get good results at practically no cost as follows: take ordinary painter's white lead and mix white shellac with it to the proper thickness. Using a sharp pointed instrument, apply the mixture to the panel as required. If you desire to re-engage, simply apply some plain shellac and wipe the panel clean. This type of "engraving" gives a very good appearance on test sets and the like and best of all, the mixture will not come off, even under hard use. The handier the builder is at engraving, the nicer the finished job will look. It may be necessary to experiment with the mixture to get a consistency which will flow properly and yet not be too thin.

### FINE RESISTOR ADJUSTMENTS

By J. E. Noble

WHEN a fine adjustment of resistor values was required for some experimental work, I made up the vernier slider, for a "Truvolt" wire-wound resistor, which is illustrated herewith. As may be seen, it consists of a slider made slightly wider at its midpoint, with a distinct semi-globular indentation impressed or stamped therein;

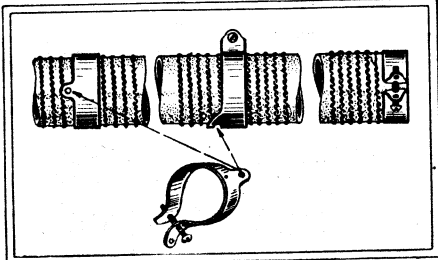


FIG. 17—This slider obtains very fine adjustments on a standard wire-wound resistor for calibration purpose.

this indentation is made to ride the threaded channels of the resistors, allowing almost a micrometric adjustment to be made. Rough adjustments are first made in the regular up-and-down manner; then a turn to the right or left does the trick.

Those who desire an easier method of constructing the slider can simply cut two small slots in a standard slider; filing away the part which is not required, and giving the remaining small portion a slight inward bend with a pair of pliers. Be sure to file off any sharp corners which remain, to prevent cutting the resistance wire when making the adjustment.

(See Fig. 17.)

### FURNITURE SCRATCH REMOVER

By Morris Dorsey

THIS idea is a remover that will eradicate the worst scratch, yet costs only a few cents to make. Grind up about a dozen pecan kernels, taken fresh from the shells and rub them into a piece of cheese cloth. You now have one of the finest scratch removers it is possible to make. The cloth will last for a year or more before needing renewal of the pecan oil. Simply rub the cloth over the scratch, let the oil dry a few moments, and polish with a clean, dry cloth.

### MEASURING PLATE RESISTORS

By J. E. Kitchen

With the increased use of resistors in plate circuits, it may be sometimes desirable to determine their value, without pulling the chassis, and using an ohmmeter.

Plug a set tester into the receiver in the usual manner and place the tube in operation in the tester. Note the plate voltage reading, say 130 volts, and the plate current reading, say 0.2 ma. Now take a lead from the "B" tap concerned and plug it into the unused socket of the analyzer (which is connected in parallel with the socket being used). Note the new plate voltage reading, say 180 volts. The voltage drop across resistor is seen to be 50 volts. As a

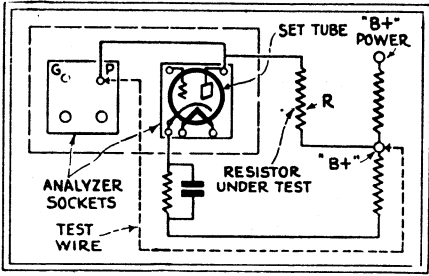


FIG. 18—This simple method of measuring voltage on both sides of a resistor, when the current is known, quickly gives its ohmage. (A high-resistance meter is needed.)

current of .0002-ampere is flowing, the resistance will therefore be  $50/.0002$ , or 250,000 ohms.

The method shows up high-resistance joints in the plate circuit and is quicker and slightly more accurate, than going over the set with an ohmmeter. It also affords an easy way to try new values of resistors. (See Fig. 18.)

### MIDGET RADIO SENSITIVITY

By G. H. BAIRD

MANY of the popular 4-tube midget sets with a single stage of R.F. are somewhat lacking in selectivity and sensitivity, and may be improved by the addition of a tuned antenna. The size of the coil will depend on the set and antenna used, but as a rule 70 T. of No. 30 D.C.C. wire on a  $1\frac{1}{4}$  in. form will be about right when tuned by a 350 mmf. condenser. The coupling coil consists of 10 or 15 turns of the same size wire wound on top of the other coil. "A" and "G" of Fig. 19 go to the antenna and ground connections of the set. If the set has no ground connection, the "G" post may be connected to chassis. In Fig. 19 B,

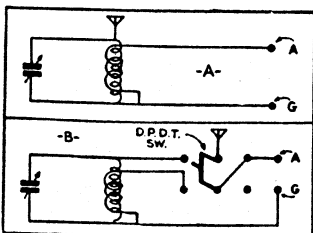


FIG. 19—Increasing sensitivity of midgets.

the same circuit is shown with a switch added to cut out the tuner if desired.

Service Men should find this gadget an excellent demonstrator to aid in showing the need for modernizing older sets.

### TIME SWITCH

By A. A. Schmitt

HERE is an idea of mine which I wish to enter in the Short-Cut ideas contest. It is a simple, inexpensive method of turning on a radio set at any predetermined time and can be assembled in a few hours. As the diagrams herewith show the only parts needed are an alarm clock, a phonograph stop switch and a thin strip of spring brass, bent as per drawing, its size depending on the type of alarm clock used.

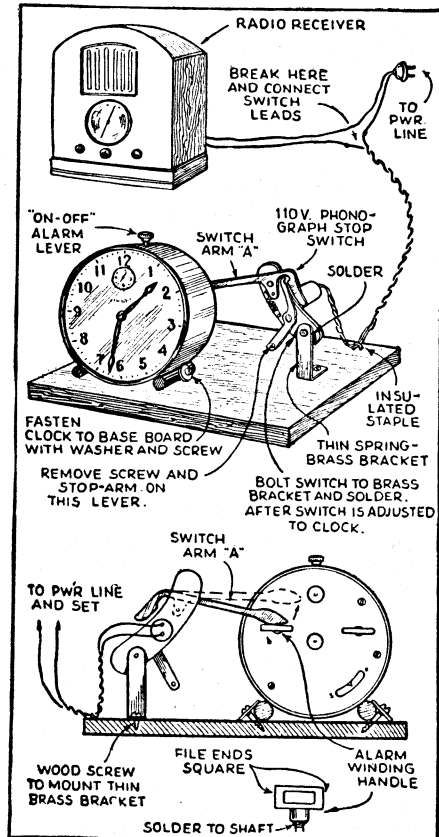


FIG. 20—Alarm clock and phonograph stop make a practical electrical time switch.

The operation is as follows:—Turn on your radio set and tune in the station you will want to hear next morning. Then set switch arm "A" (Fig. 20) in the "off" position and rest it on the alarm clock winding key in the position shown in Fig. 8B. Now set your alarm clock in the usual way and forget about it all. When the alarm goes off the alarm winding handle will unwind or turn, pushing up switch arm "A" which locks mechanically and turns on the radio receiver, lights, or what-have-you.

This little device can be made for the small sum of 60c (cost of switch) provided you already have the alarm clock. The switch assembly, for appearance's sake, can be enclosed in a small box.

**A NOVEL TEST LAMP UNIT**

By W. B. Sanford

THIS little unit is made, as Fig. 21 shows, by re-assembling a standard cube-tap. In drilling out the rivets holding the receptacle springs to the plug prongs, the hole is made large enough to admit a fibre bushing around the small screw used to reassemble the parts as shown in the self-explanatory diagram. The front spring of A is

insulated from the rest, as are the side springs of B. The connection between these two insulated springs, as in the diagram with the cover removed, completes a unit in which the side receptacles are in parallel with each other and in series with the front. Complete the equipment by adding a plug-in adapter with screw-in socket, a plug base, plug fuse, and test prods leading from a plug.

A list of applications would entail considerable space, so a few are mentioned and the rest left to the creation of the reader. A continuity tester is had by putting the adapter with a lamp into the front receptacle and the test prods in the side, or vice-versa, with the whole plugged into the 110-volt service. To use the lamp in series with the line as a current limiting device, when working on a shorted appliance or radio set, plug radio receiver in front and lamp in side. When the short is remedied shunt the lamp by joining the prods on the other side or replace the lamp with a fuse. Disconnected from the "110," with the lamp and prods in the sides, it can be used as for checking circuits other than those with standard plug connections. When fused, 110-volt flexible leads are needed, plug in adapter with a fuse on one side and the leads on front. When the writer does low-voltage testing—as on doorbells and auto systems—he uses a low-voltage lamp and drycell in place of the 110-V. supply. By fastening a plug receptacle on the battery, it makes an ideal portable set-up to use where "110" is not available.

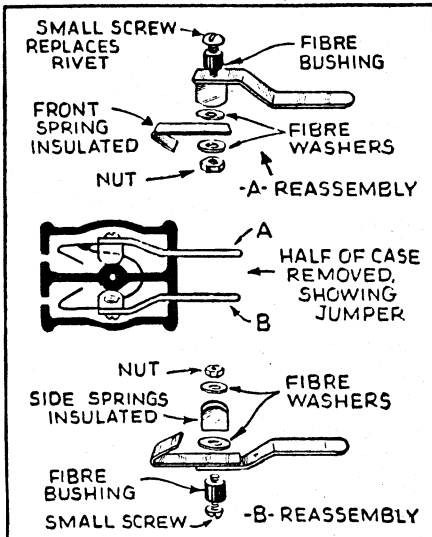


FIG. 21—The test-lamp adapter unit.

**HOME-MADE PHOTO-VOLTAIC CELL**

By Donald Roberts

MY contribution is a home-made photo-voltaic cell for the experimenter. This cell changes varying light intensities into electrical impulses by varying the potential between the electrodes of a primary cell. The solution is made by adding 1 oz. of lead nitrate crystals to 1 gill of distilled water (4 gills = 1 pt.). An ordinary pickle bot-

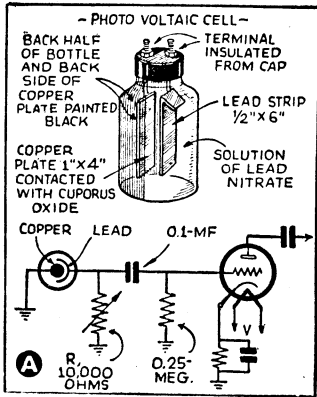


FIG. 22—Home-made photo-voltaic cell.

tle is used for a container. See diagram A. The electrodes used are a lead strip  $\frac{1}{2}$  by 6 ins. and a copper plate 1 by 4 ins. Heat the copper plate in a flame until the entire surface is coated with a black flaky substance called cupric oxide. (Use a blue flame instead of a yellow one, to avoid a deposit of soot.—Editor.) Now wash the plate in a weak solution of ammonia water to dissolve the cupric oxide. This leaves a golden brown coating of cuprous oxide, which is light-sensitive. The back half of the pickle bottle and the back side of the copper plate should be painted with black lacquer. See Fig. 22.



### CHAPTER III

### TESTING METHODS

#### FREQUENCY-DOUBLING IDEA

By John E. Clark

HERE is a frequency-doubling idea which I have found useful when a relatively small amount of power is required at a frequency higher than that of the available supply voltage. The circuit shown in Fig. 1 was used when a frequency of 120 cycles was desired. The arrangement shown readily adapts itself to multi-stage doubling but requires the addition of a power amplifier of some sort if other than a few milliwatts of power output is desired. The doubling arrangement is nothing more than a full-wave rectifier with output filter purposely omitted and a suitable A.C. output coupling device substituted in its place.

Standard audio components are entirely satisfactory for the circuit and

the output coupling can be of any type which will be suitable to feed into the following amplifier.

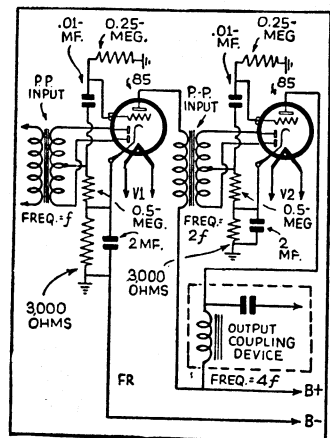


FIG. 1—Circuit of frequency-doubling idea. Lower right, frequency quadrupled.

## FINDING ELIMINATOR "REGULATION"

By Samuel Eidensohn

IF the experimenter knows just how the voltage delivered by his power supply varies with the load, he is in possession of some important information.

He knows, for instance, whether he can change the audio circuit to include push-pull operation without altering his "B" supply; perhaps by purchasing a new power transformer.

The simplest method of determining the "regulation" of the "B" output is to connect a 0-100 milliammeter MA a 0-500 voltmeter VM, and a 0-25,000-ohm variable resistor R3 (capable of carrying 100 milliamps without burning) in accordance with the diagram (Fig. 2) R1 and R2 are portions of the voltage divider in the "B" unit.

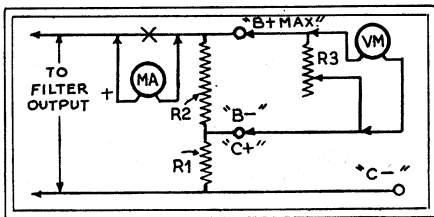


FIG. 2.—It is standard practice now to test the A.C. input for fluctuations. It should be equally so, to test the D.C. input of the voltage divider.

As indicated, only one wire in the unit, the "B Max.", is broken. The lead from the rectifier and filter network is to be connected to the "+" post on the milliammeter.

The resistance of the voltmeter does not matter; because the current it consumes is a relatively slight proportion of the total amount indicated by the milliammeter. However, if the resistance of the voltmeter VM is wanted the following procedure is followed: Read MA with VM disconnected; reading equals  $I_0$ . Re-connect VM, and read both meters; current in milliamps  $I_a$ , and voltage equals  $V$ . To find the resistance of the voltmeter, these values are to be interpolated in the following formula:

$$\frac{V}{I_a - I_0} = 1000$$

With the instruments connected as shown in the diagram, resistor R3 is varied and the readings on the meters are plotted.

This method is applicable to all power supplies. It is advisable to keep the voltage-divider unit, R1-R2, and the milliammeter permanently in circuit to avoid the strain on the filter condensers that would result if this portion of the filter circuit were open while the current is on.

## RAPID METHODS OF LOCATING FAULTS IN RADIO RECEIVERS

By Delbert Myers

FAULTS occurring in radio receivers are all similar in characteristic manifestation.

One common trouble or fault in sets is tube failure. For rapid work we proceed by the process of elimination. All tubes are tested for emission, and possible shorts, and all faulty tubes are replaced.

To test, put receiver in operation. Remove detector tube and replace. If this action produces a click, we can consider that the audio system is O. K. Tapping the detector tube lightly with the finger should produce a ring in the speaker if the detector and audio system are O. K. We, therefore, eliminate this part of our circuit. Next pull out the tube in the radio-frequency amplifier preceding the detector and replace. If click is heard the trouble is in preceding stages. Take each succeeding R. F. tube out of socket and replace. If one of the tubes does not produce a click the fault is in that stage or in one of the preceding stages. This process will work for any part of the circuit.

## METHOD OF DETERMINING POWER (WATTS) CONSUMPTION

By A. E. French

FOR the Service Man, experimenter or amateur a means of accurately determining the power in watts consumed by any electrical apparatus, radio receiving set or transmitter, which derives its power from the usual alternating current power lines, is very oft-

en beyond the range of available test equipment, due mainly to the expense involved in securing an accurate A. C. wattmeter.

In order to determine the power or watts input to any electrical equipment where a wattmeter is not available, the service kilowatt-hour meter which is provided for utility customers can be used. Connect the unit to be checked to the source of supply, being very sure that it is the only equipment connected to the load side of the meter. Next count the number of revolutions made by the meter disc. Next determine the meter disc constant. This will be found on the nameplate.

After determining the meter disc constant and the number of revolutions per minute, it is only necessary to apply the following formula: Revolutions per minute x basic constant x 60 = Load in watts.

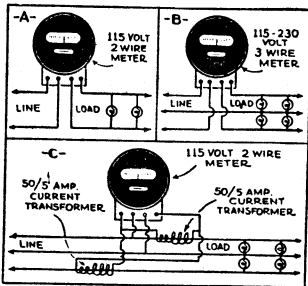


FIG. 3—How to figure wattage drain by use of the regular light-line power meter.

The basic constant is usually found on the name plate of the meter. Some of the constants watt-hours-per-revolution of the more commonly used meters follows:

General Electric—0.3 Duncan— $\frac{1}{4}$   
Westinghouse— $\frac{1}{3}$  Sangamo— $\frac{5}{24}$

These are all 60-cycle, single-phase meters of the basic 5 A., 115 V. 2-wire type. For 220 volt meters, the constant is doubled, while if it has a higher current rating, such as 10, 15, or 25 amperes, the rating is doubled, tripled, etc. Where instrument current transformers are used with a meter on larger installations, the result, after solving the formula must be multiplied by the transformer ratio.

A power rating in D. C. watts is figured the same way. (See Fig. 3.)

## METHOD OF DETERMINING PARALLEL RESISTANCE

By Al Robinson

TIME is money, so this time-saver is a moneymaker, when no resistance chart is handy and the resultant resistance of parallel resistors must be computed. It avoids the confusing "reciprocals of reciprocals" which must be used in computing values by means of the formula.

From any two points on a horizontal line, erect the perpendiculars, AB and CD (see Fig. 4A), proportional to the respective known resistances, R1 and R2, using any convenient scale such as, 1000 ohms to each 1/16th of an inch, etc. Join AD and BC. From F, the point where AD and BC intersect, drop a perpendicular (FE) to AC. The length of this perpendicular, FE, represents the total resistance (Rx) desired to the same scale. If more than 2 resistors are to be used in parallel, take any 2 and work out as before. Then apply the same method again, using the result of the first 2 with the next, and so on.

If the required resistance is known and you have none of the right value, you can select from your stock those which, in combination, will fill your need, by using the following method, shown in Fig. 4B.

On a horizontal straight line erect AB representing the required value (for

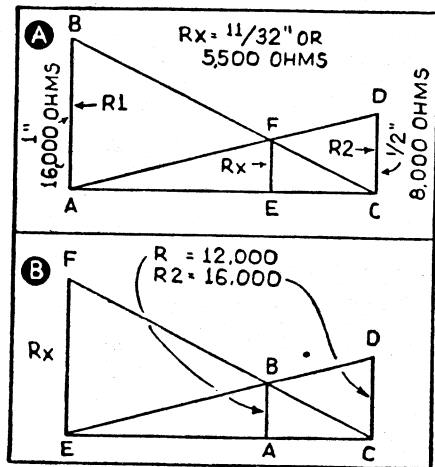


FIG. 4—Simple graphic calculating of parallel resistances.

example, 12,000 ohms, R; the scale might be, as above, 1/16-inch per 1,000 ohms). If you have, among others, a 16,000-ohm resistor (R2), erect the perpendicular CD to the same scale. Run a straight line from D through B to a point, E, on the horizontal line, and erect a perpendicular there. Then run a line from C through B to this perpendicular, intersecting it at a point, F. Measuring EF, you will find that you require an additional resistor of approximately 54,000 ohms.

**A SIMPLE METHOD FOR MEASURING A.C. RIPPLE IN FILTERS**

By Clifford E. Denton

THERE are many times when the experimenter or Service Man wants to know the exact ripple voltage from a high voltage power system or motor-generator.

A simple method which has been used by the author for this purpose employs a rectifier-type A.C. voltmeter, which will measure the average (0.636) value of the A.C. or "ripple" voltage. See Fig. 5.

To isolate the meter M from the DC., but allow the A.C. to pass through it, condenser C is used; a 4-mf. high-voltage type unit will be satisfactory.

It is important that the "working" voltage of the condenser be equal to, or greater than, the power supply's "peak" voltage; which is equal to the "R.M.S." value of the voltage applied to the plate of the rectifier tube, multiplied by 1.41.

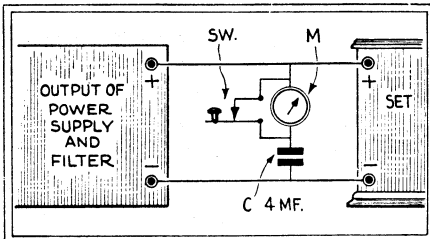


FIG. 5—Measuring "ripple." A.C. Voltmeter M, D.C.insulated by C, indicates potential when switch Sw. is depressed.

The switch Sw. should be of the closed-circuit type, which remains closed except when pressed; this prevents the initial charging current drawn by the condenser C from passing through the meter. The meter should be connected into the circuit only after the receiver is in operation. This places the actual working load on the filter system and reduces the chances of ruining the meter.

If we have a power supply which delivers, say, 500 volts under load, and the meter range is 50 volts, then a full-scale reading would indicate that the ripple is 10% of the applied voltage. It can readily be seen that this method requires a minimum of parts; and satisfactory approximations of the ripple voltage can be obtained.

**TESTING TRANSFORMERS**

By G. H. Nakas

ONE of the most frequent causes of noisy or scratchy reception in receivers is a defective winding of an A.F. transformer. It is very difficult to test for such a condition, since the winding is not actually open. A 4.5 V. battery

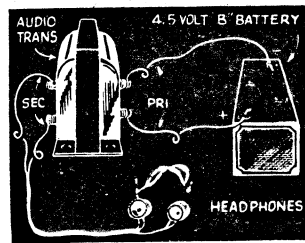


FIG. 6—Testing for noisy audio transformers.

may be connected across either winding of a suspected transformer, and a pair of phones across the other winding. If the transformer is faulty, a loud scratching sound will develop in a few minutes. In case no noise shows up, reverse the phones and battery, connecting each where the other previously was, so as to test both windings. (See Fig. 6.)





## CHAPTER IV

### TESTING EQUIPMENT AND METERS

#### CALIBRATED AUDIO-FREQUENCY ALTERNATOR

By Cal Brainard

HAVING need for a source of A.C. of known frequency, I made a simple machine from a portable phonograph, the general layout being shown in Fig. 1. A 9-in. gear wheel is mounted on the turntable, and a (Brandes) headphone unit is used as a pickup. The phone is used without the cap and diaphragm, and is mounted on a heavy lead block so that it may be moved for best position. The pole pieces are set so that they are parallel-to, and just clear, the gear teeth, and they must be even with any 2 of the teeth.

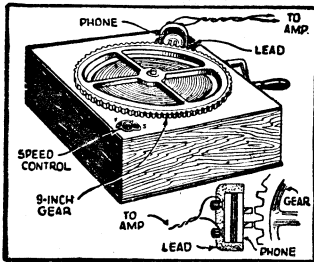


FIG. 1—Calibrated A.F. Alternator.

The speed of the turntable is 80 r.p.m., so 12,000 teeth pass the pole pieces per minute, or 200 per second, giving a 200-cycle note. The output may be amplified to any level.

#### THE "HOWLER" AS A SERVICE OSCILLATOR

By B. Fox

THE old idea of putting a microphone transmitter against a receiver may now be put to more practical use than annoying the party at the other end of the wire, as illustrated in Fig. 2.

Transformers T1 and T2 are any handy telephone or high-radio audio transformers; while condenser C (or-

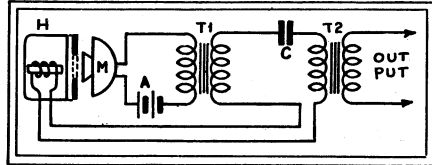


FIG. 2—A telephone transmitter, receiver, and transformer, are the essentials of this "audio howler" designed for use in radio adjustment.

dinary about .01-mf.) may be varied for different tones. The telephone receiver is designated as H; the microphone, M; the voltage supply for the microphone, A (which will vary with each mike—although its average value is 3 to 4½ volts).

If no microphone is available, one may be conveniently made by mounting on the diaphragm of the receiver a "microphone button," obtainable for about a dollar. The assembly is to be taped together and placed in a box, padded with felt or cotton to prevent the audio howl being heard in the room.

#### JUNK-BOX CONDENSER TESTER

By L. H. C. Smout

FIG. 3 shows a circuit diagram of a useful radio servicing device. The job can be constructed very cheaply, in fact most of the components will be found in the Service Man's junk box. Owing to the advent of the "tuning eye" tube, the older tuning meters are being discarded and the device has been designed around a Weston Tune-a-Light meter. The plate voltage and grid bias resistor are selected to suit the tube

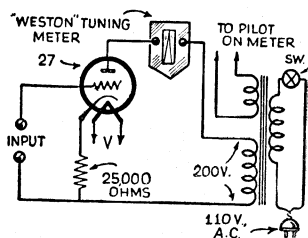


FIG. 3—Circuit of Junk-Box condenser tester.

used, so that with a free grid, the plate current will have a value of about 5 ma. which, with a Weston tuning meter, will cause the light beam to practically disappear. However, when the bias is applied to the grid by shorting the input terminals, the plate current will be reduced to about 0.5-ma. which will give nearly a full-scale light beam. Thus when the device is switched on, the light beam will disappear, but by connecting a high resistance between input terminals the bias is applied with a consequent appearance of the light beam. The job will detect leakages above 10 megs., and I have found it very useful in detecting inter-element leaks in tubes and small-value coupling condensers. Condensers of a value of .01-mf. and over show a full light beam which gradually disappears as condenser charges up, the time varying from a second or two to several minutes with large-capacity condensers. The job will not give quantitative measurements, and care must be taken not to touch anything connected to the grid terminal while operating, as body capacity will give a false reading; also the grid terminal must be insulated with a good quality insulator as any high-resistance leak in the material will nullify results.

### A LOW-CAPACITY CONDENSER TESTER

By Arthur Zagon

THIS novel circuit will test condensers as low as 50 mmf. Enough plate voltage is used on V2 to cause the meter to swing to maximum with no voltage applied to V1. The latter tube acts as a rectifier, and when A.C. is applied to

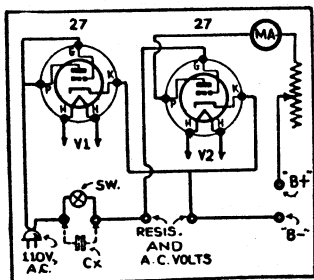


FIG. 4—Low-capacity condenser tester.

it, a varying voltage will be applied in turn to the grid of V2. This voltage will vary in accordance with the size of the condenser being tested. By closing the switch, resistance or A.C. volts may be read at the proper binding posts. Inductance can also be measured. Calibration is made by comparison with known values.

(See Fig. 4.)

### “NEON” CONDENSER TESTER

By Alfred Kafoury

THE diagram Fig. 5, shows how the Service Man may construct a condenser tester using a neon tube, that is suitable for testing all types of condensers.

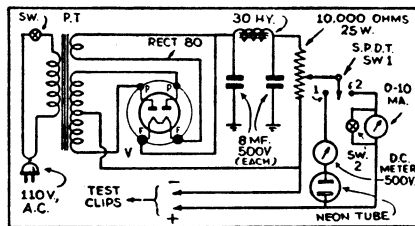


FIG. 5—A Neon-Tube condenser tester.

A S.P.D.T. switch, Sw. 1, is placed in position 1 when testing paper condensers, and in position 2 when testing electrolytics. The latter must be tested according to polarity. Switch Sw. 2 is closed when first testing electrolytics, for protection of the meter, then opened and a reading taken. If the condenser passes more than 1/2-ma. per microfarad, it should be discarded.

In testing paper condensers, with Sw. 1 in position 1, the voltage can be regulated to the working voltage of the unit being tested. The 500 V. D.C. meter is for this purpose, and while not absolutely necessary, it is very handy.

### A SIMPLE WATTMETER

By Eugene Kingrey

HERE is a simple method of constructing a wattmeter, which is as accurate as needed for ordinary measurements. The device may be calibrated

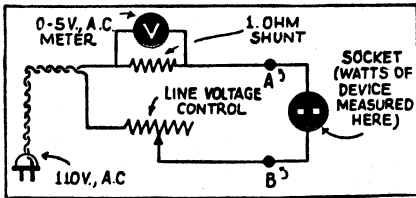


FIG. 6—Circuit of a simple wattmeter.

by the use of bulbs, electric irons, or any other apparatus of **known** (note the emphasis) drain.

There is only one precaution to observe—have the meter shunt fastened in place firmly so that it cannot be removed unintentionally, as removal while the apparatus is in operation will ruin the meter. Incidentally, various ranges may be had by using different sizes of shunts for the meter, but the switch used to change the range must be of the shorting type.

The line voltage across A-B should always be adjusted to read 100 V. before taking a measurement of watts drain.

Initial calibration should be made with a 50-W. lamp. Then other appliances may be connected to the output socket, and meter readings noted until enough are obtained to make a calibration chart.

I believe Service Men will find this apparatus of some use.

See Fig. 6.

## ELECTRICAL MICROMETER

By Bell Labs. Record

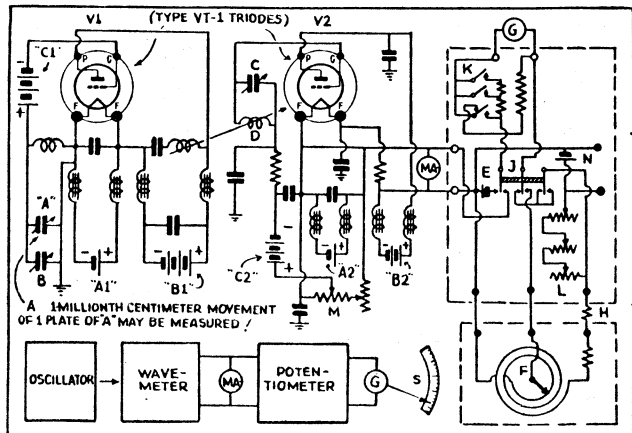
MANY requests have been received for a circuit of an "electrical micrometer." Figure 7 shows such a circuit, while Fig. 8 gives a detail of the micrometer "head." The arrangement consists of 2 oscillators, one of which is fixed. The variable oscillator is connected to, and tuned by, the plates of the micrometer. Moving the top plate and thus changing the capacity, changes the frequency of oscillator V1, this change causing galvanometer G to move. This particular equipment works on 2,000 kc. No constants are given since the technician will doubtless have his own ideas about them.

The principle is that which is common to all ultra-micrometers—the various types differing only in their method of measuring the change of frequency produced by the displacement.

By making the spacing between the plates very small the frequency change will be relatively large for small plate displacement. By substituting this frequency change for a displacement change, the instrument gains greatly in sensitivity.

The potentiometer F must be set so that the galvanometer reads on-scale, and for large displacements the potentiometer must be constantly adjusted, while for very small displacements, the change can be watched on the meter.

FIG. 7—Circuit of Electrical Ultra-Micrometer.



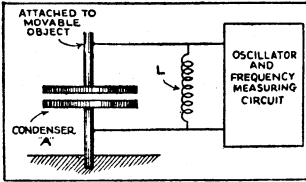


FIG. 8—Ultra-Micrometer head.

It must be emphasized that the apparatus here is of the highest precision type, but the principle is very interesting, and might be put to use by the home mechanic.

**INCREASE THE METER'S RANGE**

By John J. Nothelfer

MANY good Weston or Jewell meters, designed for the old RCA battery-model receivers, can now be bought very cheap in some of the salvage stores. The fan who cannot afford to buy a new voltmeter, or milliammeter, can make use of an old instrument by a few changes and convert it into a volt-ammeter of all ranges with great saving to his purse, since these meters can be bought for around a dollar to a dollar and a half.

As Fig. 9C shows, the case is removed from the meter and a small piece of insulated stranded wire is soldered to the resistance terminal which leads to the armature at the bottom of the meter. (Care should be taken not to solder to the terminal that leads to the terminals of the meter). A small hole is drilled in the bakelite back, and the wire is drawn through. (Fig. 9A.) The case is then replaced, and the meter is ready to be mounted on a small box.

Various meters have different internal resistances and draw more or less ohms per volts, so the correct resistance values cannot be given. However, the manufacturers of most instruments will be willing to give the rated resistance, upon request. The Jewell and Weston meters mentioned, however, have a resistance of 125 ohms per volt. So, for each volt to be added, a resistance of 125 ohms should be used. (Fig. 9B.)

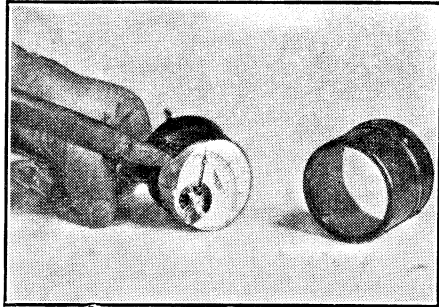


FIG. 9C—A voltmeter, with its case removed, undergoing the operation described by Mr. Nothelfer, which gives access to the basic milliammeter unit.

The meter has already a 5-volt scale, with a 625-ohm resistance built in. To increase the voltage of this meter to 50, a total resistance is required of  $50 \times 125 = 6250$ . The meter already has 625 ohms resistance; subtract this from 6250, and the additional resistance required is found to be 5625 ohms. A fixed resistor of this size is quite hard to obtain; and a good substitute is one of variable type, with 6000 ohms maximum, adjusted to the required length.

To obtain milliampere readings from the meter, the wire which was soldered to the armature is used with the terminal of the meter which connects directly to the other winding of the armature. Resistance wire from old, heavy rheostats will answer nicely as a shunt.

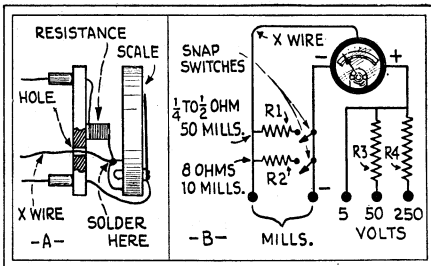


FIG. 9—Connections to the meter illustrated in Fig. 9C. With the action used, R3 is 5625 ohms; R4, 61,875.

**UTILIZING A GALVANOMETER IN TESTING WORK**

ELECTRICAL meters are the eyes of the radio experimenter and Service Man, for spotting trouble, and I am a close adherent and zealous user of these valuable electrical devices. I know of

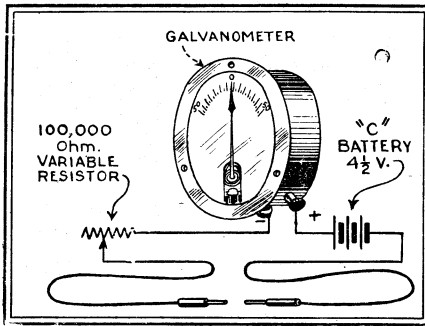


FIG. 10—A galvanometer (or milliammeter) takes the guesswork out of servicing. All data sheets are based on the assumption that the Service Man has means of measurement.

many a Service Man who still depends upon guesswork, a pair of phones with a battery, or 110-volt line with a lamp in series, as the only means of locating faults, disregarding other factors and ignoring the actual cause of the trouble. For most Service Men are interested only in shorts and breaks in the wiring; and anything else is immaterial to them.

A continuity test is all that is required in most cases, but there are instances where partial breaks or shorts occur and a phone or lamp test yields very little information, if any.

A galvanometer (or a low-reading milliammeter—which is practically the same instrument, in principle) is the ideal device for testing; and very valuable information may be gained through its use. See Fig. 10.

With a small "C" battery and a variable high resistor in series with the instrument a number of different tests may be performed.

This combination is exceedingly helpful for testing windings in audio-frequency transformers and, by taking readings, we may determine the approximate transformation-ratio of the windings and establish the identity of the primary and secondary when these are not marked. Other comparative tests of resistance may be performed as one becomes more familiar with the possibilities of this valuable instrument for radio testing.

Care should be taken, when making the necessary connections to the instrument, that the resistance is at a maximum and of a value of at least 100,000

ohms, when first closing the circuit with the battery in series. These instruments are very sensitive and delicate, and may be damaged even with a small run down battery.

By varying the resistor, we may readily adjust the pointer to any desirable place on the scale, and the instrument is then ready for use. The same procedure as in the case of phone testing is followed; but instead of hearing clicks we watch the deflection of the pointer.

### ADDITIONAL METER SCALES

By J. Christine

THE trend in service equipment, for the man who "rolls his own," is to use one instrument for a multiplicity of purposes. If a single meter is to be used as a voltmeter, ammeter, milliammeter, ohmmeter, capacity meter, etc., the numerous scales that are necessary complicate the reading of the meter to such an extent as to make the instrument impractical. If separate scales are to be used, then we are faced with the problem of removing the glass from the meter every time a change in the scale is to be effected. The novel scheme illustrated in Fig. 11 overcomes this difficulty.

The zero and top mark lines of the meter scale are drawn on the second scale to facilitate lining it up when it is placed on the instrument. The meter is then calibrated and the markings placed on the new scale.

With this arrangement it is possible

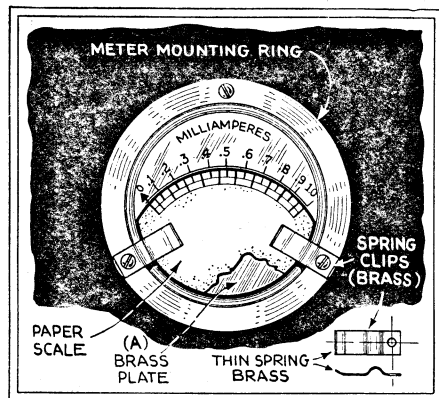


FIG. 11—The desired paper scale is pasted over a removable non-magnetic plate (A).

to use as many extra scales as is desired, without, at the same time, opening the actual instrument itself.

### EXTENDING RANGE OF A.C. VOLTMETERS

By D. V. Chambers

**SERVICE** Men who have old-style A.C. voltmeters with very low voltage, full-scale, such as 0-3 volts or 0-4 volts, find very little use for them in present day A.C. receivers. However, by the addition of a shop-made transformer, they may be made to read low, medium or high voltages. Such a transformer is herewith described and is sufficiently accurate for all set measurements, even up to 1,000 volts or more by the use of series resistors. See Fig. 12.

Take an old audio transformer (those in the RCA catacombs of old, are a good size), the smaller the better. Remove all old windings and use original

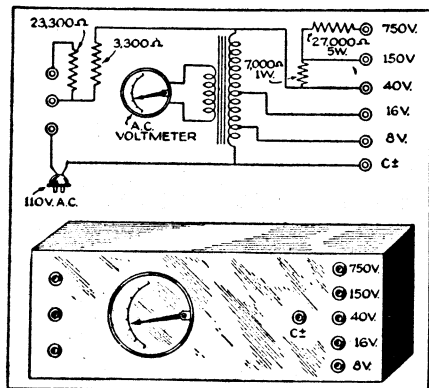


FIG. 12—Circuit for extending range of low-voltage A.C. voltmeters, as used in instrument pictured.

cardboard core, with side pieces cut to fit, and cemented in place to just fit inside window of laminations.

If a 3-V. A.C. Weston 476 is used, which I have, the primary will require about No. 24 or No. 26 enameled wire, 45 turns, and 4-volt—60 turns. (Core cross-section squared and divided by 6, gives volts-per-turn available for your particular laminations. If it is  $\frac{3}{4}$ -in. wide and  $\frac{3}{4}$ -in. thick, then  $\frac{3}{4} \times \frac{3}{4} \div 6 =$  between 10 and 11 turns-per-volt. 10 is OK, for it isn't used for any great length of time, and so will not overheat.)

Several layers of tape, varnished

cloth or heavy brown paper are shel-lacked in place, for insulation. Then, start winding the secondary, which is continuous and tapped. For the 1st section, 8 volts, wind 120 turns in even layers, using about No. 28 enameled wire; for the next tap, wind 120 more turns (for the 16-V. tap), using No. 32 E. wire; then, 360 turns of about No. 34 for the 40-volt winding. If there is sufficient room and you want to include a 150- or 160-volt tap, then (for a 150-volt tap) add 1,650 turns of very fine wire, such as No. 38 or No. 40 enameled, in layers with a thin sheet of paper between each layer.

Having finished the coil, shellac and immediately wind several layers of tape or paper around and shellac. Put the laminations in place and, if a small metal box such as coil shield with lugs for mounting is handy, place in can and fill with pitch or wax; this makes a neat job.

Having only wound to 40 volts, I used resistors (1-watt carbons), for higher voltages, namely, 150 and 750. Use several 1-watt resistors in series for 750-volt reading, as it should be about a 5-watt resistor to drop this 600 volts. It requires about 5,200 ohms for the 150-volt reading and about 21,000 ohms, 5-watt, for the 750-V. reading.

This whole affair can be put in a small box size about 4 x 7 ins., and 3 to 4 inches deep. An aluminum panel makes for an attractive-looking product. This arrangement, to avoid shocks or fireworks, must be well insulated! By the simple addition of a right-size resistor to make the meter read full-scale with 110 V. circuit, condensers can be checked, chokes measured, etc. It is the next handiest thing to the ohmmeter, which in my case it matches in size and shape.

### TUBE TESTER AS V.T. VOLTMETER

By William Wilson

ALMOST any emission-type tube tester may be used as a fairly accurate vacuum-tube voltmeter. With the use of a 1,000-ohm potentiometer and a  $4\frac{1}{2}$  V. "C" battery, a wide variety of different tube types may be used. An adapter is made for the tube to be used

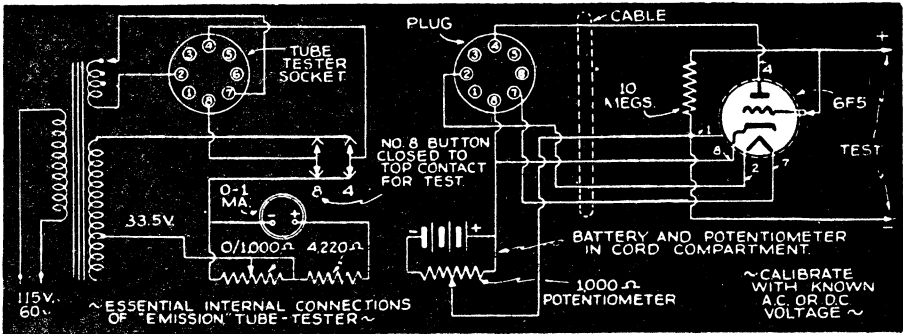


FIG. 13—Any emission-type tube tester may be used as a vacuum-tube voltmeter.

with the grid circuit left open. If grid connects to top cap, no adapter is needed. I used a type 6F5 since it has a top cap which can be used as a probe and the socket can be connected to a plug and cable for high-frequency measurements. My instrument is a Supreme 89D and the circuit is shown in the diagram of Fig. 13. Calibration curves can be made to suit the instrument used.

### VERSATILE V.T. VOLTMETER

By William Chaney

I WISH to present an A.C.-operated, flexible, vacuum-tube voltmeter of entirely original design, simplicity and proven worth. I use this meter in service work, and it was used as an output meter "on the line" in one of the local radio manufacturing companies, comparing favorably with the specialized equipment used for this purpose. The 6J7 metal tube is used because the response is linear from 2 to 5 ma. (with circuit constants used) so that the measured voltages may be read directly from the meter scale. The ranges are 10, 100, 500 and 1,000 V. A.C. and 0-13 V. D.C. (with use of the 9 meg. potentiometer, the D.C. range may be extended much higher and still have linear response). Frequency error is small up to 200 or 300 kc. I have used it to measure output of an all-wave oscillator. Some of the uses of this meter are: measuring A.C. voltages from transformer; A.V.C. voltages; bias on audio tubes at the grid, and when tapped high-resistance voltage dividers are used; output meter (from plate to

ground or across voice coil); gain in final stages of a receiver; etc. In some cases an A.C. operated V.-T. voltmeter will induce a terrific hum in a receiver when A.V.C. voltages are being measured. There are a number of things which can be done to cure this: (1) change the power transformer of the V.T. voltmeter (which may have leakage or too high a capacity between primary and secondary, etc.); (2) insulate all grounds from the chassis, including insulated mounting of the filter condensers of V.T. voltmeter; (3) insert a resistance and capacity filter in the ground lead of the D.C. section of the V.T. voltmeter (see diagram); (4) reverse line plug; (5) remove external ground from receiver and line bypass condenser (if there is one). See Fig. 14.

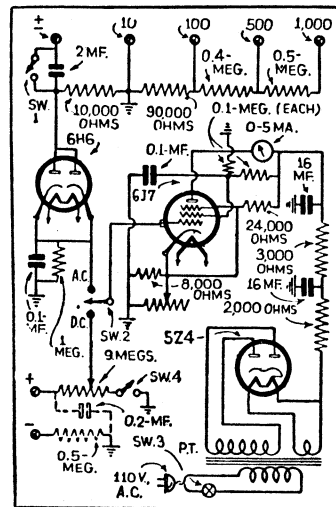


FIG. 14—A Versatile V.T. Voltmeter.

### A DYNATRON VACUUM-TUBE VOLTMETER

By C. W. Melotte

IN Fig. 15 is shown the wiring diagram of a vacuum-tube voltmeter I use. Its advantage is that very small voltages can be measured with it without the use of an ultra-sensitive meter.

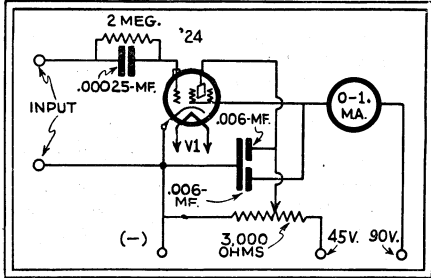


FIG. 15—Circuit of a Dynatron V.T. Voltmeter.

An ordinary 0-1. milliammeter is sensitive enough to measure such small voltages as would not operate an ordinary V.T. voltmeter using the more standard three-element tube. An input of 0.05-volt gives a reading of approximately 0.2-ma.

The potentiometer is used to accurately adjust the plate voltage to the correct operating point.

### "MAGIC EYE" LEAKAGE TESTER

By Ray Jefferson

I RECENTLY finished building a "Magic Eye Leakage Tester" and have found it can be made very useful by making the additional changes as indicated in the diagram, Fig. 16.

As an output meter it is very sensitive, as it will operate on a signal which is barely audible. This is a great help in aligning sets with A.V.C. and sets

with poor L.F. gain. This sensitivity can be controlled by the 0.5-meg. potentiometer.

As may be noted in the diagram, the 6.3 V. filament circuit is used to test the capacity of small condensers.

I used only one filter condenser, as an input condenser was found unnecessary; it raised the voltage too high.

A 50,000-ohm variable cathode resistor was found to be too large, as all of the action took place on one end. A 10,000-ohm tapered unit was found to be satisfactory. (Switch Sw. 6 is of the "skip" type in order to prevent shorting the "B" units.)

The 6 input terminals are connected as follows:

- 1 and 2— to voice coil of speaker.
- 3 and 5— to plate of output tube.
- 4 and 5— to test leakage (open Sw. 1).
- 4 and 6— small condenser capacity test (open Sw. 1).
- 4 and 5—A.V.C. line (open Sw. 2).

### SIMPLE OUTPUT METER

By Andrew Frevert

A SMALL output meter, that is made up to use in conjunction with a service oscillator, is shown in the sketch. (Fig. 17.)

The combination (of jacks A, B, C, D; switches S1, S2; and transformer T) makes a variable input to meter M and detector CD which forms the output indicator; depending on types of sets.

With connections to set on jacks A and B and switches in No. 2 position, primary of transformer is in series with speaker; secondary in series with meter and detector. With switches in No. 1 position, input with primary in parallel is fed direct to meter and crystal.

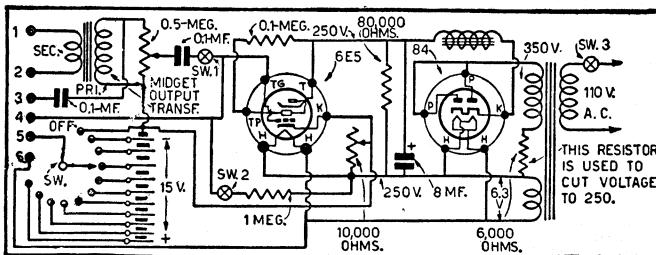


FIG. 16—Here is an improved version of the "Magic Eye" leakage tester described in March, 1936, Radio-Craft. Several features have been added, which make the apparatus much more adaptable.



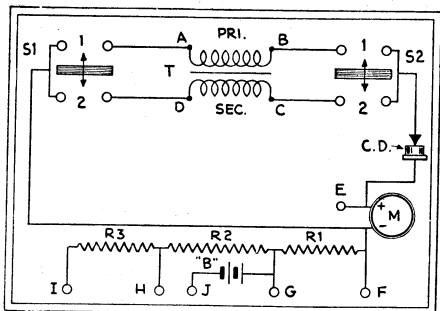


FIG. 17—This set-up is flexible for measurements on various sets; and also for continuity tests.

With input leads in jacks C and D and switches in No. 1 position, secondary is in series with input, primary feeding to meter. With switches in No. 2 position, input is in parallel with secondary and feeding to meter.

With input leads in A and C jacks, S1 on No. 1 position and S2 on No. 2 position, meter is connected direct to input signal.

For use as voltmeter: Jack E plus, G minus 5 volts; Jack E plus, H minus 25 volts; Jack E plus, I minus 100 volts.

Jacks E and J are for continuity testing or, if scale is calibrated, for use as ohmmeter.

### A.C.-D.C. VISUAL OUTPUT INDICATOR

By P. J. Donneau

A VISUAL output indicator can be made with nothing more than a 6E5 visual tuning indicator tube and socket, a 30-watt electric light bulb and socket, a line plug, a 0.1-mf. fixed condenser, some wire, a 1-megohm fixed resistor, and 3 battery clips. The 6-prong socket and the ten-cent-store light socket may be screwed to a small baseboard.

The connections (see Fig. 18) are as follows:—One side of the line plug is connected to the filament and cathode prongs of the tube socket; the other side to one terminal of the light socket and the plate prong of the tube socket. The remaining terminal of the light socket connects to the other filament prong of the tube socket. A large battery clip for grounding the unit is connected to the cathode through the fixed condenser; 2 small battery clips are

directly connected to the control-grid and cathode terminals of the socket. These two clips connect to the output transformer of the receiver, in place of the voice coil. The tube is placed in its socket and the 30-watt bulb (preferably painted black to avoid glare) is screwed-in, and the unit is ready to operate. In some cases it works better if a 1-meg, resistor is externally connected between the plate and target prongs of the socket.

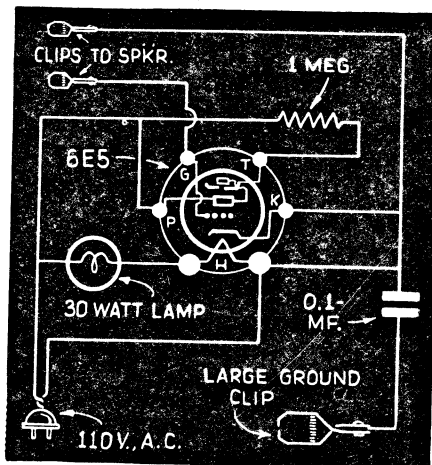


FIG. 18—Efficient output meter, improvised from a 6E5 tube and parts found around any workshop.

The unit may be used on A.C. or D.C., and if care is taken to make sure the cathode side of the plug is always on the grounded side of the line, the fixed condenser may be omitted.

### MEASURING A.V.C. VOLTAGES

By Willard Moody

**FUNDAMENTAL Circuit:** (See Fig. 19A.) When opposing voltages are equal there is a zero current and therefore infinite resistance; the voltage as read on V. is then equal to the source being measured. In the diagram (Fig. 19A) T are the terminals for the voltage to be measured; J is the jack for headphones or micro-ammeter and B the battery supplying the bucking voltage.

**Practical Circuit:** (See Fig. 19B.)

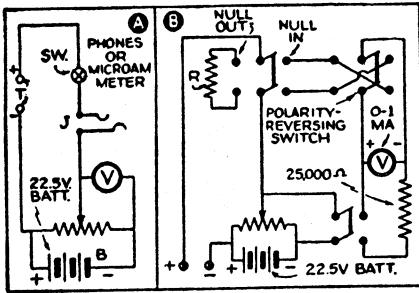


FIG. 19—Measures A.V.C. circuits accurately.

Important: Proper polarity must be observed in connecting the infinite resistance voltmeter in the circuit under test.

### A PHONOGRAPH-CASE OSCILLATOR

By R. Douglas Clerk

THIS novel and useful oscillator, totally shielded and fitting into a portable phonograph case, is an audio-modulated R.F. oscillator covering the broadcast band. The R.F. coil used in this job was taken from an Atwater Kent "Model 35" receiver; coupled to this coil L1 is a 10-turn winding L2 in variable inductive relation. This pick-up coil is connected to the antenna and ground binding posts of the receiver under test.

It is shown by diagram in Fig. 20.

The electrical characteristics of an average antenna are simulated in the electrical values of a "dummy antenna" arrangement of the complete input connections to the radio set being test-

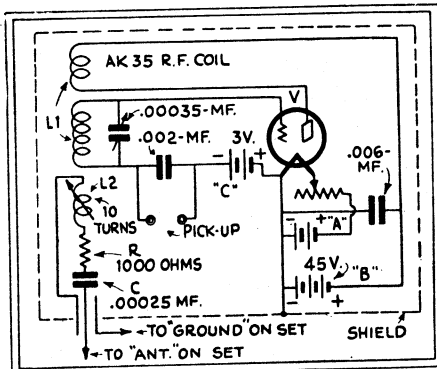


FIG. 20—The "portable broadcaster" is a very compact oscillator, built into a portable phonograph which gives modulation.

ed; its components being L2, R, and C.

The entire set-up is shielded, as indicated in the diagram, and the phonograph turntable motor and the phonograph pick-up are grounded to this shield. In this particular unit, tube V was a Northern Electric "peanut" tube (which has a 1.1-volt filament), and the pick-up was a Canadian Marconi unit of the high-impedance type; although, of course, any make of apparatus having equivalent characteristics may be used without the least bit of trouble.

### AN A.C.-OPERATED SERVICE OSCILLATOR

By W. R. Wheatley

NO doubt, every radio experimenter and Service Man has many times wished for a small portable generator of signals of various frequencies, either modulated or unmodulated. I have constructed one which is exceptionally compact, obtains its power supply by simply plugging into the light socket,

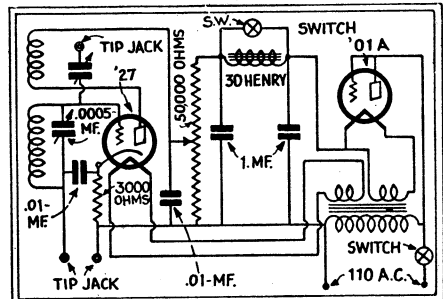


FIG. 21—This oscillator, with home-made power transformer, is an extremely-compact and convenient device, modulated by the A.C. hum of the light line. A jumper is put across the lower tip jacks when the meter is not in circuit.

and covers a wide range of frequencies with three plug-in coils. It comprises a '27 tube used as an oscillator, in the conventional tuned-grid circuit, and an '01A tube with grid and plate tied together as rectifier. (See Fig. 21.)

One 30-henry choke is used in the filter circuit, which is conventional; the voltage divider is a 50,000-ohm potentiometer, with the plate of the '27 connected to the slider, so that a variable voltage is provided for the plate of the oscillator. The filament supply of the two tubes is from a transformer, and

the plate voltage is taken direct from the 110-volt A.C. line; as this supplies voltage high enough for the purpose after it is rectified. Tip jacks are provided in the grid-return circuit, so that a meter may be plugged in to be used in lining up gang condenser or testing the resonance of circuits. A small variable condenser is provided, with one side connected to the grid and the other to a tip jack; so that the oscillator is easily coupled to other circuits.

This oscillator is very handy for lining up gang condensers and neutralizing sets; I have used it as the oscillator in a superhet. An ordinary set can be converted to a super by connecting the grid of the first tube to an external tuned circuit coupled to the oscillator. Although a very slight A.C. ripple remains in the voltage supply of the oscillator, when the signal of the oscillator is tuned in on a sensitive receiver it appears about the same as the A.C. hum in ordinary receivers.

In order to modulate the signal sufficiently, so that it may be heard distinctly, a switch is connected across the 30-henry choke. When closed, this modulates the signal with the 60-cycle hum which is very distinct. The schematic diagram shows all details.

However, when I looked for a filament transformer I was unable to find one small enough; so I constructed one. I used the core iron from a 30-henry choke, and also the form on which the wire was wound; on this I wound 1200 turns of No. 28 enameled wire for the primary. Over this were 28 turns of No. 18 D.C.C. wire for the 2½-volt secondary, and over this 55 turns of No. 20 D.C.C. wire for the 5-volt secondary. Although this transformer becomes warm when in operation, I have operated several hours without undue heating.

To illustrate the compactness of this oscillator, the panel is 7 inches wide by 9 inches long, and the entire apparatus is housed in a box 3½ inches deep.

### A BRIDGE-TYPE TESTER

By Lowell Slack

THIS unit, which operates on the

principle of a simplified Wheatstone bridge, is very useful for Service Men and experimenters in testing for resistance, capacity, plate resistance of vacuum tubes, ratio of transformer windings and a comparison of inductive reactance.

The unit consists of a type 56 or 27 triode tube and a 3-to-1 A.F. transformer connected as an audio oscillator, feeding a potentiometer which is equipped with a scale calibrated in equal parts (of the resistance of the pot. See Fig. 22A).

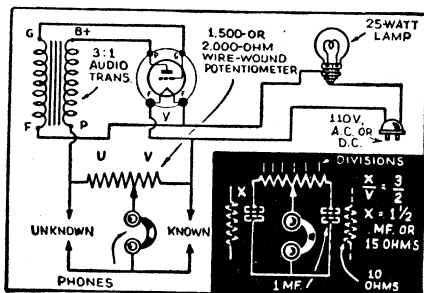


FIG. 22A—Simplified A.C. Bridge unit. B, method of calculation at lower right.

In operation, for resistances, condensers, and inductances, the unknown unit is connected to one side of the bridge and a corresponding unit of known value is connected in the other branch. Then the potentiometer is shifted for minimum tone from the oscillator and the ratio of units on the scale of the potentiometer will give the ratio of unknown to known. In the example shown in Fig. 22B the unknown capacity is 3/2 of the known capacity which equals 1½ mf.; and, in the instance of checking an unknown resistance, when compared to a 10-ohm resistor it is 15 ohms.

To arrive at the plate resistance of a tube, the tube should be connected with "A," "B" and "C" batteries of correct size for the particular tube operation desired and the negative lead from the "B" battery to cathode should be opened and connected to the "unknown" terminals of the bridge. Then by inserting a suitable known value of resistance in the "known" side, the ratio of plate resistance to known resistance can be determined.

In the comparison of inductive reactances, an inductance having a known reactance is inserted in the "known" side of the bridge and the unknown inductance in the "unknown" side. The bridge is then balanced and the reactances are thus compared on the potentiometer scale.

## IMPROVING THE OHMMETER

By J. E. Kitchin

THE ordinary method of measuring resistances with a 4,500-ohm resistor and 0-1-scale milliammeter will not go below 50 ohms with a shunt; and the slide-wire bridge is not suitable for carrying around.

A better idea can be incorporated in many set testers by adding one binding post to the existing circuit, as shown. The writer used two positions on his Weston bi-polar switch; instead of adding a D.P.-D.T. switch. (See Fig. 23.)

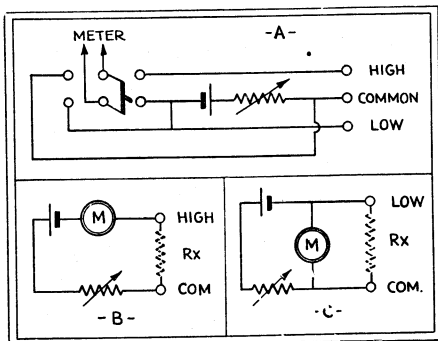


FIG. 23—In this ohmmeter the D.P.D.T. switch may be part of a larger unit.

To operate it, close the meter switch on the low side, and adjust the current to one milliamper. Then, if the unknown resistor  $R_x$  is of high value, switch the meter to the high side, and connect  $R_x$  across H and C (as at B). The higher the resistance, the less will be the current indicated by the meter, as is well known.

If  $R_x$  has a low value, leave the meter on low, and connect  $R_x$  across terminals L and C (as at C). The meter reading will be low in proportion as the value of  $R_x$  is low; for  $R_x$  is a shunt around the meter.

Calibration, by means of Ohm's Law, is performed in the usual way; the low scale should be calibrated with known resistance values, since the internal resistance of the meter must be taken into consideration.

## A RESISTANCE-CAPACITY BOX

By E. A. Marchant

I GIVE a diagram of what I term one of the handiest pieces of equipment around our shop. As can be seen from the diagram any resistance value from 200 ohms to 2 megs. may be had by merely operating the switch; but in addition to this, any one of these values may be varied to any desired value by the use of the variable control in the negative leg of the circuit. The 3 decks make it possible to name a deck for low values of resistance, a deck for high values, and a deck for condensers; which means that the whole thing is in one box, with only one switch. See Fig. 24.

A neat, 3 scale dial plate can be drawn for the switch and the volume controls may be calibrated or the regular plates purchased for them.

When repairing a set I manipulate my condenser switch for different values of condensers at different points of the receiver. You will be surprised at how much improvement you can make in the receiver with a few extra condensers.

Another place where the condenser resistor box saves time is in cases of open high-value resistors. If you are in doubt about a resistor of high value

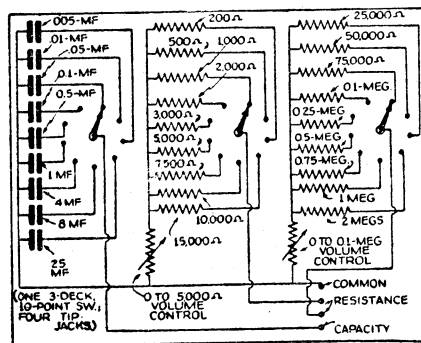


FIG. 24—A resistance-capacity box which saves time.

and your ohmmeter will not measure that high, then set your resistor switch to the value needed and go directly across the resistor in doubt, and also sometimes you will find an open resistor which is not color-coded and the service manuals do not give the value. From your tube characteristics chart or other data determine what voltage or current you should have, connect a volt or current meter to the circuit and place the test leads from your condenser resistor box across the open resistor and vary the resistor switch until you find a resistor that gives nearly the voltage or current wanted, if necessary you may cut in the volume control and bring the exact amount of resistance in. Also you can experiment with resistors in load circuits and greatly improve a receiver.

You will find many additional uses for this condenser-resistor box.

### CONSTRUCTING A RESISTANCE METER

By Malvern H. Berry

ALMOST every radio and electrical experimenter has need of an efficient and reliable resistance meter. With this he can design his own resistors, choke coils, and many other things. The instrument mentioned in this article was constructed from a potentiometer, a galvanometer, two binding posts, one dial, and a small box (Fig. 25).

Assemble and wire in accordance with the diagrams; Fig. 25A is the schematic circuit. The potentiometer R should be one of about 1000 ohms. The galvanometer G may be replaced by a high-range milliammeter and the results will be the same. The battery B is just a two-cell flashlight battery, which can be purchased from the ten-cent store.

After everything is assembled comes the calibration of the potentiometer R. This can be done with a Wheatstone bridge. (If the constructor does not have a Wheatstone bridge, one may be had for the asking at your local high school. In the event that the constructor is not familiar with the Wheatstone bridge, the physics instructor at the high school would be glad to explain it.) If you can use the bridge, proceed

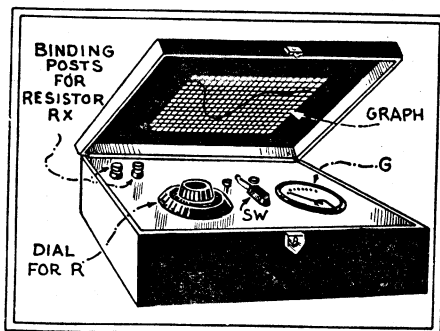


FIG. 25—Layout of resistance meter; the graph in the lid is the reference calibration.

as follows: attach to the potentiometer a dial, (vernier preferred) and adjust the potentiometer for a reading of 5 on the dial. With this fractional part of the potentiometer in the circuit, connect it to the Wheatstone bridge and find what the resistance of that part is. Get a piece of "graph" squared paper and graph the resistance in ohms, for every five marks or degrees on the dial, across the paper; and graph the reading or degrees on the dial up and down. Where the two intersect on the graph page, place a dot. After the resistances have been calibrated from zero to the full value of the dial for every five degrees, draw a line through all of the dots. This will be your calibrated curve for the resistance meter.

To operate the meter, place an unknown resistance  $R_x$  across at the binding posts, and note the reading of the galvanometer G when the unknown resistance is placed in the circuit. Switch on to the calibrated potentiometer R and adjust until the galvanometer reads the same as before. The value is then

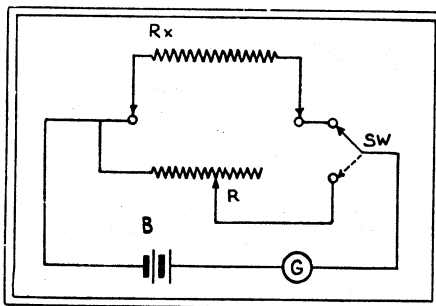


FIG. 25A—A good wire-wound potentiometer, a galvanometer, some calibrated resistance standards, and a few odds and ends, compose this handy instrument.

the same in both resistances. Take the reading of the dial in degrees and look that reading up on the graph, and the value of the unknown resistance can be read direct from there.

By ganging several variable resistors of assorted ranges at R, and tapping them to a selector switch, the resistance range may thus be greatly increased.

## BUILDING A RESISTANCE CALCULATOR

By S. H. Burns

FEW experimenters are fortunate enough to have an ohmmeter or other instrument for the measurement of resistance. There is no end to the occasions that call for the use of some such device, even while carrying on the simplest of experiments.

With the current and the voltage known, the resistance can be calculated by applying the formula for resistance in Ohm's Law. A voltmeter and a milliammeter, when used in connection with a battery, will give these values. The disadvantage of this method is in having a voltage supply that is constant while the current that must flow through the resistance being measured, is drawn from it. Then too, a considerable variation in the voltage must be available to accommodate the measurement of greatly different resistance values with any degree of accuracy. For a low resistance measurement, it is not possible to use a high voltage; on the other hand, when dealing with higher values the voltage should be increased

Where the work can be done quickly

batteries are satisfactory, but oftentimes the voltage required for accuracy may be as high as 100 volts. In these days of battery eliminators, it is somewhat of a problem to secure this battery voltage.

### A Reliable Voltage Source

Various schemes were tried out while searching for something that would supply any reasonable voltage for as long a time as was necessary to complete the work at hand. It was decided that 100 volts would be sufficient for all requirements. The A.C. lighting circuit seemed to offer an unfailing source of energy. Now to convert this into the direct current required. After discarding several ideas as altogether too complicated, the scheme illustrated in Fig. 26A was adopted.

The only things needed are tube for rectifying and a variable resistance to regulate the voltage output supply. Several tubes were tried and a '26 was selected since the rectified voltage was plenty high enough and the current output sufficient. Then also, most experimenters will have several of these tubes not in use since they have been replaced by other types.

The 110-volt line has one side tied to the grid and plate terminals of the tube while the other side of the line is not connected to the rectifying tube directly. A variable resistance of 25,000 ohms is in series with the tube filament and the other side of the line. The 2-mf. condenser shown across this resistance levels out the rectified voltage just as in any rectifying circuit. It can be of the low-voltage bypass type since the voltage is not great.

The filament of a '26 operates on 1.5 volts and consumes 1.05 amps. An idle filament transformer having such a winding can be used for this; or, if one is not handy and the device is to be made more or less permanent, a heater transformer can be quickly made. For the core, remove the laminations from a burned-out audio transformer. That portion of the core inside the coil is in most cases about 1/2-in. square.

If the dismantled transformer had a bobbin in which its coil was wound, remove the wire and use the bobbin for

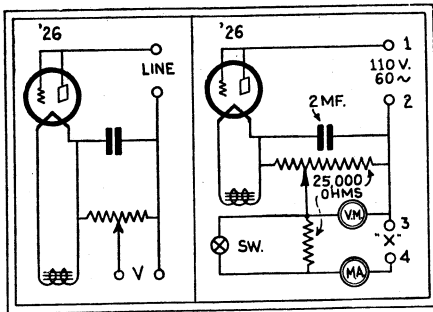


FIG. 26A, left—Theoretical circuit of the resistance calculator.

FIG. 26B, right—Final circuit diagram of the calculator.

the new coil. Otherwise, a form can be easily made of cardboard. The total current is low, therefore a primary wound with No. 32 B&S wire will carry it. Using this wire with enamel insulation, or better still, enamel and silk, wind 1800 turns on the coil and insulate it with tape. As the wire is quite thin, flexible leads had best be soldered to the start and finish of this primary. The 1.5-volt winding consists of 24 turns of No. 20 B&S enameled wire. Cover the coil with tape to protect the wire. The laminations should now be put back in place in the new coil. To eliminate any tendency to hum, dip the transformer into a pot of melted wax; this when cool will hold everything firmly.

#### The Variable Voltage Feature

In Fig. 26B, the parts are shown connected diagrammatically. It is the connection from the movable arm on the 25,000-ohm resistor that gives the voltage and current used for our purpose. With the arm at the end nearest the filament connection, the voltage obtained will be 100 volts when the maximum of 10 ma. is being used. The drain through the resistance will be about 4 ma., making the total less than 15 ma. at maximum.

The meter connections are shown in this figure also. The voltmeter should have a 0-100-volt scale and preferably marked in 10-volt divisions. The 25000 ohm resistance in series with the milliammeter is only used when measuring low resistance, and can be cut in or out of the circuit at will, with the single pole switch shown.

#### The Resistance Curve

To eliminate the necessity of working out each resistance problem, the curve given in Fig. 26C is used. Along the lower edge appear the current values in milliamperes. The resistance in ohms is at the left, vertically. This curve gives the resistance value directly when the voltage used in measuring is 10.

To make a measurement, proceed as follows: referring again to Fig. 26B the unknown resistance is connected to the terminals at 3 and 4. There is no need for haste in taking the readings as the current used will have no effect what-

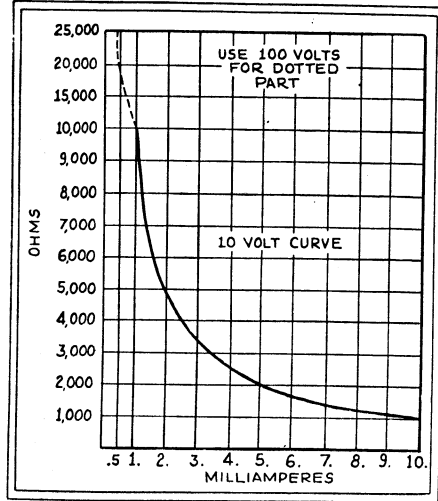


FIG. 26C—The 10-volt calibration curve. The dotted portion is for an applied voltage of 100.

ever upon the voltage. Assuming that the resistance is not known, have the switch at the left open thus cutting the 25000-ohm resistance into the circuit. Move the pot. arm to the right as far as possible, thus decreasing the voltage to a minimum. Plug into the 110-volt lighting circuit. Next move the voltage adjustment to the left until the voltmeter indicates 10 volts. If the reading on the milliammeter is low, close the switch and forget about the 25000 ohms. The most accurate conclusions are arrived at when using that part of the curve between 2 and 5 ma. Therefore, should the meter show less than 2 ma., move the voltage up until it comes within these limits.

Assume that it requires a potential of, say, 40 volts to produce the desired current flow, and again for purpose of explanation, assume that this current is 3 ma. Following the vertical 3-ma. line to the point where it intersects the curve, and looking left along the horizontal line also intersected at this point, it is found that the resistance value lies between 3000 and 4000 ohms. And as each horizontal line represents 1000 ohms, the exact value is 3,330. This would be true if the voltage used was 10; however, as 40 volts were used simply multiply the result by 4, giving 13,320 ohms as the resistance.

In this manner, one curve is used for any multiple of 10 volts by simply multiplying the result by the multiple used. Using 50 volts, multiply by 5; or using 90 volts, multiply by 9. Any value can be measured with 10 volts between 1000 and 10,000 ohms and taken directly from the curve.

### TIME-DELAY CIRCUIT

By J. E. Templier

MANY experimenters want a means of delaying the closing of a circuit by an accurately predetermined length of time; this would be useful in the construction of robots, selector systems, burglar alarms, etc. The following description of one may prove useful (See Fig. 27) Unit L1-L2 is a 2-coil relay; L1 has a high impedance, to match the input signal, and L2, which is wound over L1, a low impedance. The signal applied to L1 closes switch S1 and completes the secondary circuit of the filament transformer T, which includes L2. The coil L2 holds the circuit closed until the cathode becomes heated and current flows through L3; this closes switch S2 and, a fraction of a second, later opens S3 and cuts off the current from L2; this releases S1 and the circuit is again ready for operation, as soon as the cathode has cooled.

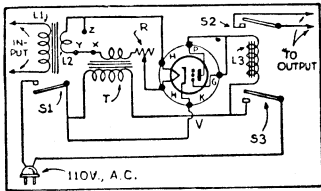


FIG. 27—A V-T type time-delay relay circuit which is variable from 10 to 60 seconds.

By using the older, type 27 tube and normal filament voltage, about 30 sec. is required to close S2. However, by using a transformer, T, with a 5-V. secondary, and a rheostat, R, of about 7 ohms, the time may be adjusted from 10 to 60 seconds. By using the filament-type tube, this time may be greatly decreased.

Details for relays L1-L2 and L3, are not given; as most experimenters have relays on hand or know how to build

them. Note that L2 **must** have a low resistance. The arm of S2 should be about one-half the length and weight of that of S3, so that it will close sooner and have time to operate the output relay (not shown).

Notice that S2 is closed only momentarily, so that another relay must be added to keep the circuit closed; also that only a momentary signal need be applied to L1. However, by changing the transformer connection, from X—Y to X—Z, S2 will remain closed as long as the signal is applied to L1.

### FORD CUT-OUTS MAKE RELAYS FOR BURGLAR ALARMS

By J. Theriault

RADIO Service Men who are called upon to install burglar alarm systems can oftentimes get a used 110 V. A.C. telephone signal bell and with the addition of two old Ford cut-outs, make the required relays as shown in Fig. 28.

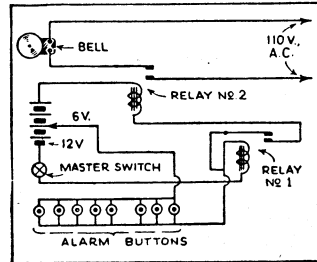


FIG. 28—Burglar alarm system using Ford cut-outs.

Remove the heavy outside windings from both cut-outs. For relay No. 2 be sure to remove the first layer, next to the core. This can be easily done by catching the outside turn, next to the core, and pulling it out.

When any of the alarm buttons have once made contact, the bell will keep on ringing until the master switch is opened, as the two relays form a "locking" circuit.

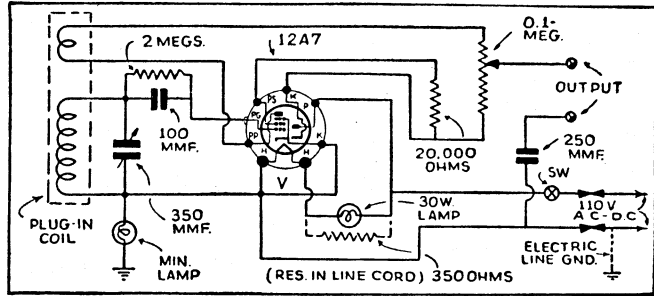
### LOW-COST TEST OSCILLATOR

By Louis B. Sklar

THIS simple instrument will give good results on either A.C. or D.C. Since it is intended for such universal



FIG. 29—Here is a simple A.C.-D.C. test oscillator with several novel features.



use, the 5-W miniature lamp is used as shown in Fig. 29. If the lamp lights when the plug is put in the socket, the plug should be reversed. Of course, a ground is needed on the oscillator for this test. This test should always be made; since if the plug is not inserted in the correct manner, the tuning condenser and some of the other parts of the unit will be "hot" and unless shielded may cause injury or damage. The rest of the circuit is very simple and may be followed from the diagram. Either a line cord resistor or a 30-W. lamp may be used as the series resist-

ance to feed the heater of the 12A7. Standard plug-in coils of the desired band ranges are used for tuning.

The use of the line cord resistance will enable the builder to construct a more compact unit, while the 30-W. lamp will be cheaper and will likely be easy to obtain. The cord should have a resistance of 350 ohms. The calibration chart may be fastened to the cover of the box, and the extra plug-in coils may be mounted there also. This oscillator is so simple that it cannot get out of order and it will be found extremely convenient to use.



## CHAPTER V

### VACUUM TUBES AND CIRCUITS

#### A PHOTO-TUBE RELAY FOR UNIVERSAL OPERATION

By C. H. W. Nason

ONE of the writer's friends is a stage designer. He builds pretty models of stage sets with trick lighting effects. The other night he suggested that a photo-electric relay would be a nice adjunct to one of his display sets. The trouble was that the "gadget" had to operate on either A.C. or D.C., regardless.

A few moments of thought followed by a half-hour or more of intensive soldering resulted in the arrangement shown in Fig 1. It will be noted that the triode tube may be of any type that uses a heater voltage of 6.3 V., and draws 0.3 ampere. Types 37, 76, or 6C5 are suitable.

The filament is lighted through a series resistance and the device may thus be operated on either A.C. or D.C. 110-volt supply circuits.

The grid bias is made variable by means of a potentiometer connected between cathode and ground. This should be adjusted so that the relay does not trip under normal light conditions. This permits the room to be illuminated without such indirect illumination of the photo-cell affecting the operation of the device. The relay may be so adjusted as to operate either to turn the controlled circuits on or off with the application of light.

This same device may be used so that automobile head-lamps control the opening of the garage door—so that persons intercepting a beam which normally keeps the relay closed will cause it to open and thus sound an alarm. No long-winded description is necessary,

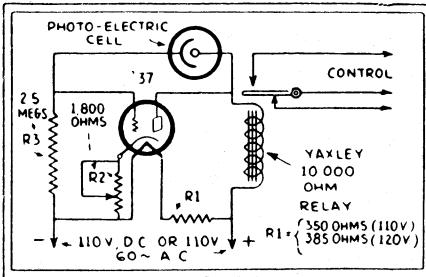


FIG. 1—A P.E. tube relay for A.C. or D.C. mains.

however, for a thousand uses for the device will immediately suggest themselves.

The parts are as follows: R1, 350 ohms, 5 watts; R2, 3500 ohms, Electro-d potentiometer; R3, 1- to 5-meg-ohm grid leak; P.E.C., a caesium type gas-filled photoelectric cell; Relay, Yaxley 10,000-ohm relay or device of similar sensitivity.

### BATTERY TYPE TUBE TESTER

By Floyd M. Glass

THIS tester is designed particularly for the rural Service Man, or anyone who must test tubes without the use of power from the light lines. It will test the most widely-used battery tubes. The equipment may be assembled in a small box, and small-size batteries may be included, if desired, to make the unit entirely self-contained. Socket No. 1

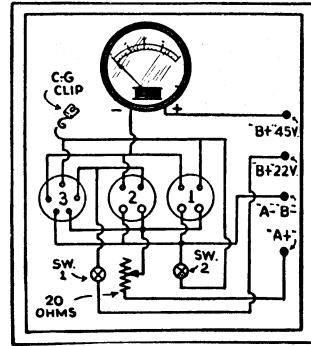


FIG. 2—A self-contained tube tester.

is for 01A, 01AA, 71A, 30, and 31 tubes. Socket No. 2 takes the 32 and 34s, while Socket No. 3 is used for 33s. The tester should be calibrated with new, good tubes. All tubes are tested first with switch Sw. 1 closed and Sw. 2 open. A good tube will show a fluctuation upon opening and closing Sw. 1. The screen-grids are tested the same way—but by opening and closing Sw. 2 (See Fig. 2.)

### MATCHING PUSH-PULL TUBES

By E. J. Christians

PUSH-PULL tubes must be matched, in order to obtain good quality, lack of hum, and plenty of pep. A perfect

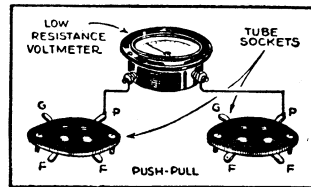


FIG. 3—Illustrating procedure for matching push-pull tubes.

match will be shown by zero reading when the voltmeter is connected between the plate prongs of the output tubes. If meter reads backwards, reverse the connections. A reading of more than one volt indicates that a new tube should be put in. (Fig. 3.)

**A TUBE SHORT TESTER**

By A. E. Ellison

THIS is a worthy addition to any tube testing equipment, and is very simple to make and use. As may be seen from Fig. 4, the switch is the heart of the tester and will have to be homemade. Any 7-point switch will serve, but the arm must be replaced with a 7-contact fan, as shown. The seventh arm is of bakelite, with a contact on the end, which is connected to the circuit with a flexible lead.

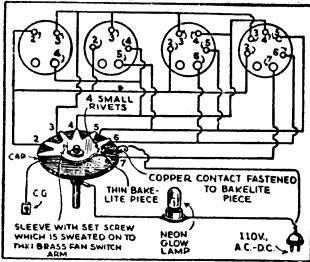


FIG. 4—A tube-short tester.

In operation, the switch arm is revolved rapidly over the contacts, a short showing up by a flash of the neon bulb.

**USE FOR OLD TUNING EYE TUBES**

By Roland T. Schaefer

OLD tuning eye tubes that no longer can be used as indicators but in which the triode section still checks O.K. Most Servicemen have a few such tubes in their shops. Types 6E5, 6G5, 6T5 and 6U5 are more common.

These tubes can be used as audio amplifiers with quite a bit of gain. The circuit in Fig. 5A is an example. The

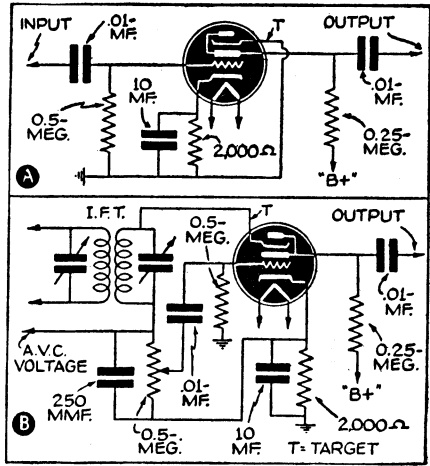


FIG. 5—Uses for old "tuning eye" tubes.

target should be grounded when not used.

Another example, Fig. 5B, is for using the tube as a 2nd-detector in a superhet. In this case the target is used as a diode. This works almost as well as a type 75 tube.

**INDICATOR FOR CONDENSER ANALYZER**

By H. A. Wirsching

I SHOULD like to contribute the following to the Service Men who built or bought the Thordarson Condenser Analyzer as I know that the phone method of minimum hum was, and is, tiresome to use.

I conceived the idea that the "eye" tube (6E5 or 6G5) might take the place of the phones and found that it works very well, and is very compact and light as I use a 25Z5 in a voltage-doubling (transformerless) circuit. I trust that others may find this an easier way to balance the bridge. See Fig. 6.

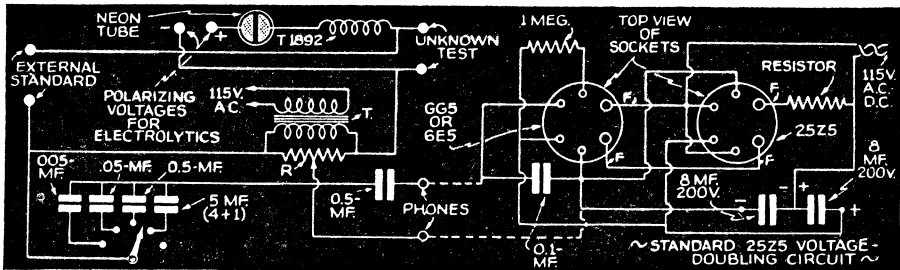


FIG. 6—Circuit for use of "tuning eye" as indicator for condenser analyzer.

## CHAPTER VI

### VOLUME CONTROL METHODS

#### A VOLUME-CONTROL METHOD

By Vincent Campbell

RECENTLY I decided to build a four-tube regenerative receiver which I knew would give me excellent volume and tone. But here arose the problem of obtaining a real volume control. Of course I tried the antenna control and "B" lead control, but all I could obtain was a continuous whistle. After some time, I finally hit upon the method to be described which gives control ranging from the merest whisper to terrific volume.

The section outlined in dotted lines in Fig. 1 is the control. I have used a Centralab 500,000-ohm modulator and a .02-mf. fixed condenser. The positive "A" and negative "B" lead connects to

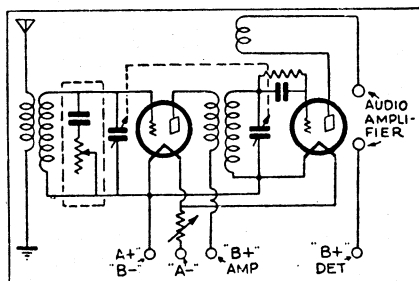


FIG. 1—Design for a good volume control.

the center post of the resistor; the condenser on the end of the resistor to the grid of the R.F. coil, as shown.

You can pass this on to anyone who wants a good volume control. (See Fig. 1.)

#### AN IMPROVED VOLUME CONTROL

By Russell L. Wooley

AUTOMOTIVE radio receivers have, usually, a 50,000-ohm potentiometer, shunted across the 67½-volt section of the "B" supply, to vary the screen-grid

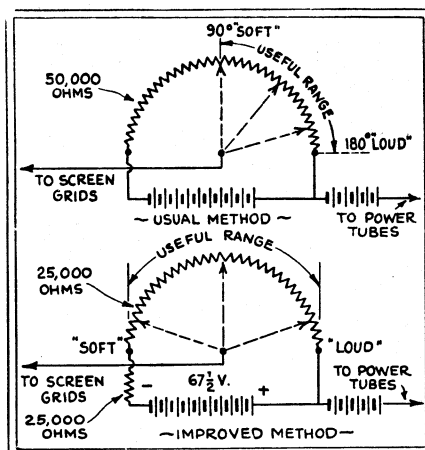


FIG. 2—Just as tuning is spread by adding another condenser, so volume control may be made less critical by a series fixed resistor.

volume. This is a good method of volume control; but the useful range is limited to about half the arc of the slider's movement. The result is that the change in volume from "soft" to "loud" is very abrupt.

This method of volume control may be improved by using a fixed resistor of, say, 25,000 ohms value, connected in series with a variable potentiometer of 25,000 ohms; the useful range is thereby spread over the entire arc.

These particular values do not, of course, hold true in every case; conditions, such as the sensitivity of the receiving set, the field strength of local stations, the number of screen-grid R.F. stages, and the screen-grid voltage, determine the value of the potentiometer. The total resistance, however, should be 50,000 ohms.

Inasmuch as a volume control of this type is shunted directly across the "B" supply, a switch should be included, to disconnect it from one terminal of the "B" battery when it is not being used; for otherwise it wastes current. (See Fig. 2.)

**TONE CONTROL BOX**

THIS may be made as illustrated in Fig. 3. The pictorial schematic indicates a fixed condenser of .02 mf. capacity in series with a variable resistance. This resistance must be noiseless.

Many dynamic loudspeakers sound harsh, due to the presence of very strong high frequencies. The modern dynamics have this tendency the least, as they ordinarily have a high frequency cut-off obtained either mechanically or electrically. The Tone Control Box illustrates one way of doing it electrically when the loudspeaker does not contain such compensation.

The exact dimensions of the completed unit will depend upon the particular parts used.

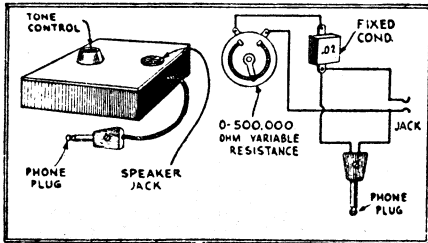


FIG. 3—The circuit of the portable tone-control box.

As the resistance is lowered, the high notes are by-passed more and more, with the final results—very drummy reproduction.

The unit connects between the radio set and the loudspeaker. The loudspeaker plugs into the jack and the Tone Control Box plug is plugged into the jack on the radio set; of course, the plug is not necessary if the receiver has binding post provision for the loudspeaker cord tips. Two binding posts may be used on the Tone Control Box in lieu of a jack.

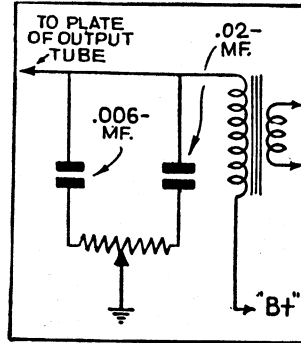


FIG. 4—A novel tone-control circuit.

**NOVEL TONE-CONTROL CIRCUIT**

By Lansing L. Post

FIG. 4 shows a circuit of a variable tone control. The value of the potentiometer is 0.5-meg. while the condenser values can be arrived at by experiment, to suit the builder.

I find that shifting from "highs" to bass is gradual instead of suddenly as with a single condenser and variable resistor in series.

**REMOTE VOLUME CONTROL**

By Quentin Achzehner

IT is very handy to have a remote control for the radio receiver situated at the telephone or any other point, so that the control on the set may be cut out at will and the remote control substituted. This is easily done by

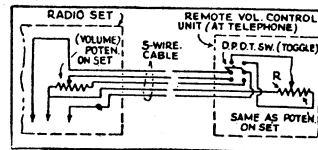


FIG. 5—A remote volume-control arrangement.

the use of the circuit in Fig. 5. A volume control of the same type as that used on the set is needed, as well as a D.P.D.T. switch (to select either volume control).



## CHAPTER VII

### AMPLIFIERS AND PHONOGRAPH REPRODUCERS

#### EMERGENCY CLASS AB TRANSFORMER

By Lando K. Meyer

THE power transformer from almost any make of old "B" eliminator, will serve as a very efficient input transformer for a class AB amplifier. The transformer must, of course, be one that has

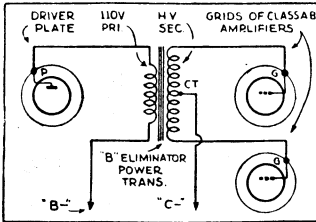


FIG. 1—Emergency transformer for Class AB amplifiers.

a center-tapped high-voltage secondary. Those taken from a Majestic Super "B" work very well. The secondary has ample carrying capacity for the grid current on positive peaks. (See Fig. 1.)

#### A MOVIE ADDRESS SYSTEM

By Russell L. Woolley

A "TALKIE" operator uses the method shown herewith, to make short an-

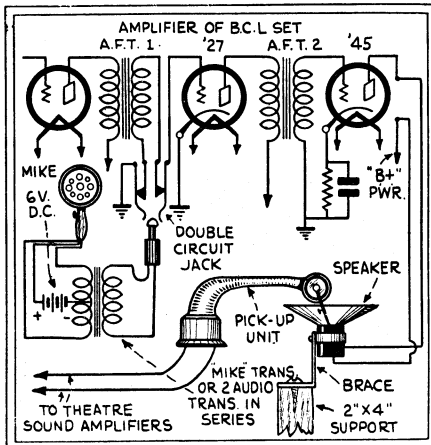


FIG. 2—The mechanical coupling of a pickup to a magnetic speaker gives an input for an audio amplifier.

nouncements over his Western Electric sound equipment. All that is needed to do this is a portable broadcast set, with a double-circuit jack connected across the grid-circuit of the first audio stage of the receiver; a good "mike," a center-tapped transformer; and four dry-cell batteries. Two old audio transformers, with their windings connected in series, may be used in place of the microphone transformer. The broadcast receiver acts as a speech amplifier; the speaker—a magnetic one—is mounted near the pick-up unit of the "talkie" system. When it is desired to make an announcement, the needle of the pick-up is centered on the diaphragm of the speaker unit. (Fig. 2.)

#### A RADIO-PHONOGRAPH KINK

By Louis B. Sklar

HERE is a very novel scheme of playing the radio and phonograph simultaneously. Anyone having an electric pick-up and a phonograph can perform this stunt without difficulty, as shown above. (Fig. 3.)

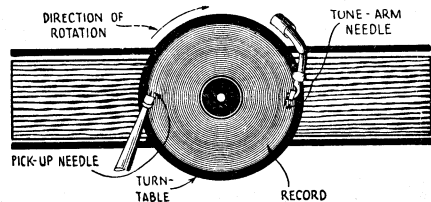


FIG. 3—This use of the same disc for radio and phonograph at once is not only amusing, but a test of quality.

Looking at the layout, you see that the pick-up needle is at one side of the record; while the tone-arm needle is exactly opposite. When the record starts to rotate, music will be heard coming from the phonograph as well as from the radio speaker. The music from the two speakers will be slightly out of synchronism, because the two needles are not on the same point of the record; even though they are placed in the same groove. This produces an effect as if one instrument were playing and the other accompanying it.

**A LOW-COST MIXER**

By C. M. Dibrell

BY this means, several sources of input may be mixed and any may be varied without disturbing the others. Ordinary 0.5-meg. potentiometers are used for the individual volume controls. The cost of the extra tubes and associated equipment is less than that of the expensive, constant-impedance type mixers that are ordinarily used. (See Fig. 4.)

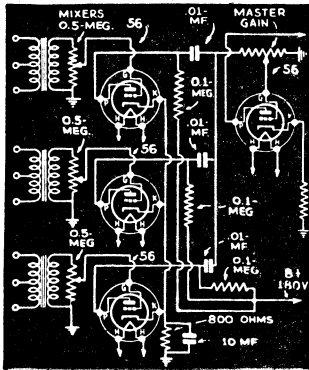


FIG. 4—Circuit of the low-cost mixer.

**HOME-MADE PANEL RACK**

By Robert Duncan

IN building some radio equipment I had need for a relay rack. As commercial racks were so expensive, I decided to build my own.

Two old bed rails were obtained from the junk yard and cut to the desired lengths. They can either be bolted or welded together in the form of a rack. The finished product makes a very sturdy and efficient rack.

The general idea is illustrated in Fig. 5.

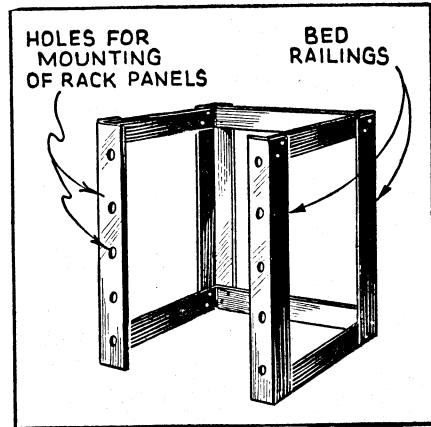


FIG. 5—A trip to the junkyard, and the use of this kink, saves dollars.



**CHAPTER VIII**

**POWER SUPPLY EQUIPMENT**

**AN EMERGENCY BATTERY**

By John J. Nothelfer

RECENTLY, the writer was called out of town to service a battery-model console radio set. Upon arriving, a day ahead of the promised date, I found that the storage battery had been taken away to be recharged, and it would be returned early the next day. The idea of coming back the next day over the rough country road was unpleasant; and that of using the car battery seemed the solution.

Upon trying to loosen the clamps on the battery, it was found that they were too tight; the pliers would never loosen them, and the required wrench had been left home. Having a roll of No. 14 rubber covered lead-in wire, I drove the car as close as possible to the window nearest the set; and the wires were connected to the battery terminals. In this manner six-volt direct current was obtained, and the set was tested and repaired in the usual manner.

### EDISON "B" BATTERIES

By Chester Rector, W9BFW

REBUILDING a storage "B" battery of the Edison type has several advantages: first, the investment is small; second, no destructive acid to spill; third, the nickel steel elements are non-sulphating and last indefinitely; and, fourth, the Edison type is lighter than most others. These batteries hold the charge for a long time when not in use. If one is not at hand, it can be obtained from a radio store very cheap; and can be made to give very good service by the following method:

Carefully remove all of the elements and test tubes from the rack, and clean thoroughly. After they are completely cleaned, lay them out to dry. From the drug store purchase two pounds of potassium hydroxide, 5 lbs. distilled water, and 1 oz. mineral oil.

Mix in an earthenware or glass bowl the distilled water and potassium hydroxide until there is a reading of 1,250 in a clean hydrometer, one that has not been used for testing acid batteries. At this stage the solution will become quite warm; so it should sit until cool, being tested again for correct reading. If the reading is higher or lower than 1,250, distilled water or potassium hydroxide should be added as required. Leave the solution to settle, and then filter.

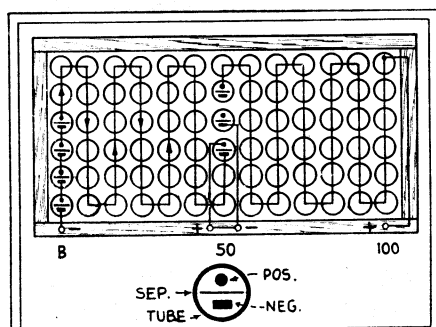


FIG. 1—The storage "B" battery is much favored in Europe still. Many old ones may be picked up here.

Next assemble the battery, as in Fig. 1. Fill each cell to within one inch of the top, by using the hydrometer. The plates will soak up some of the solution; so the process should be repeat-

ed. With a clean medicine dropper, place about three to four drops of the mineral oil (liquid paraffin) upon the top of the solution in each cell.

The charging can be done from a 110-volt A.C. line, by the use of a trickle charger. However, if a 32-volt D.C. lighting system is available, the battery can be charged this way, after it is divided into 25-volt sections; of course, no rectifier is necessary.

The battery must be tested with a voltmeter since the specific gravity remains the same whether it is charged or discharged. The solution should be changed about once every year when in use; and the level should be kept up by adding distilled water.

Two of these units make a very good plate supply for the beginner's amateur transmitter. Also, this type of battery works very well on any radio receiver.

### A 6-VOLT BATTERY FOR 2-VOLT TUBES

By Audie Roberson

NO doubt the best way to furnish power for the 2-volt tubes is by using the Air-Cell battery, but a great many people have an old 6-volt storage battery and are reluctant to throw it away. They may easily be converted to 2-volt batteries and I believe that it is economical to do so.

The first operation is to saw the connecting bars, as shown in Fig. 2. The center cell is then raised and its position reversed; when placed back, it will

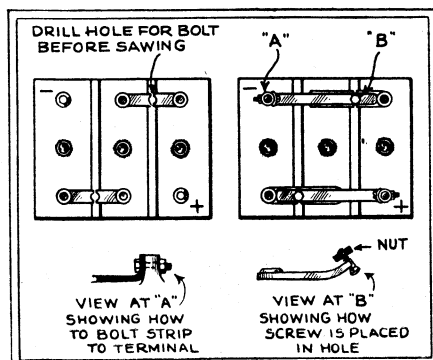


FIG. 2—A conversion that certainly makes for economy. Old 6-volt storage batteries may be rebuilt as described, for use with new 2-volt battery tubes.



appear as shown. Now procure two strips of lead connectors that will just reach across the battery and bend one end so that it will fit as shown. A hole is then drilled through the connector and the battery post so they may be securely fastened.

Now as near as possible to the ends of each cut connector bars, drill a hole. The bars are then bent upward until a bolt can be inserted and then bent down with the end of the connector bar fastened to the battery post as shown in the sketch. Two more holes are drilled to correspond with the holes in the cut connectors which are then bolted securely as shown. It is well to sand-paper each connection before tightening so that the very best connections can be obtained.

### HOME-MADE BATTERY CABLE

By M. W. Johnson

MOST battery sets employ for the battery leads a cable, one end of which is soldered to the receiver. This arrangement therefore presents several disadvantages.

For one thing, it is not convenient to move the set to a position beyond the limit of the cable's slack, without first removing all the battery connections. Also, it is inconvenient to make tests on the receiver without the battery potentials, unless it is desired to remove battery connections.

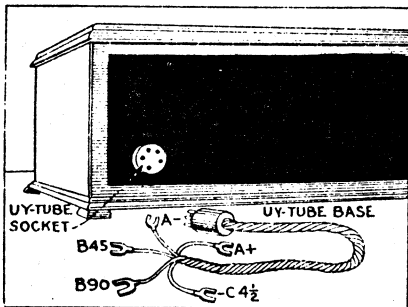


FIG. 3—The set builder who is working over an old battery set can use the connecting method shown to provide a 5-lead cable which will facilitate connecting and disconnecting.

Electric sets and the more expensive battery sets overcome this situation by arranging the current-supply cable to plug into a receptacle on the receiver.

This idea may be applied to any re-

ceiver requiring not more than five leads in a single cable, as shown by Fig. 3. A 5-prong UY socket is mounted on the rear of the set cabinet, and the cabinet ends are soldered to the prongs; while the battery cable is connected to those of the old tube-base. The cable may be held in place with sealing wax poured into the ex-base. If desired, another plug and socket may be "rigged up" for the opposite end of the cable.

### CONNECTIONS FOR 110 V., D.C.

By Oscar Block

IN those districts where the "Ham" is accursed with D.C. mains and at the same time uses all .25 or all .3-amp. type tubes, either one of two methods of connecting the filaments may be used, as shown at A and B, Fig. 4.

Circuit A has the advantage of low current consumption, but has the disadvantage that the "B" battery potential on each tube will be low. It is also not adaptable to push-pull circuits since this type of hookup requires a parallel connection of the filaments in order to use conventional push-pull transformers.

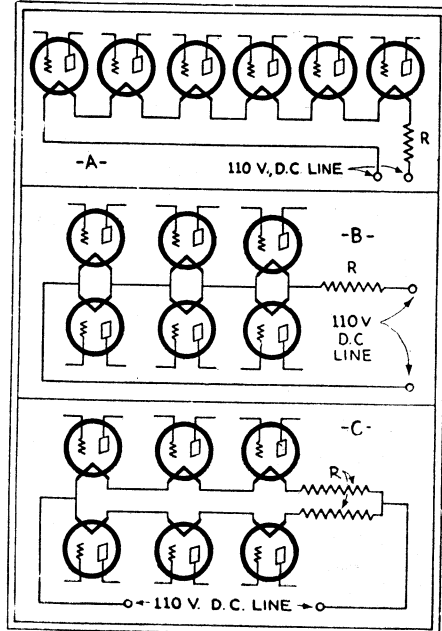


FIG. 4—"DC"-tube filament connections. Circuit A consumes little filament current, but "B" potential is low; that of B, results in high "A" current and "B" potential, and; C, a safer arrangement.

Circuit B illustrates a series-parallel connection of filaments. This mode of connection has none of the disadvantages inherent in the connections of Fig. 4A, although the current drain is greater. It has the distinct disadvantage that if one of the tubes is removed, the increase of current through the tube with which it is in parallel is apt to burn it out. Figure 4C shows a circuit that eliminates this latter difficulty and at the same time retains all of the advantages offered by the connections of Fig. 4B.

In this case, since each branch of the filament circuit and its regulating resistance is independent of the other branch, any fluctuation in one will not manifest itself in the other. A suggested layout for the power unit of a D.C. set is depicted in Fig. 5. This layout is designed for .25-amp. tubes and is intended for those of '71A type. The pilot light should consume 25-ampere at 2.5 V.

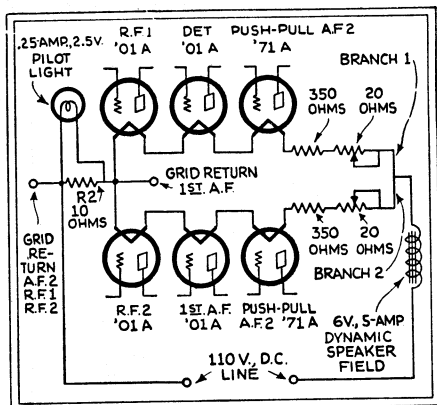


FIG. 5—Final connection of the series-parallel circuit C, Fig. 4.

If tubes are used with characteristics other than those assumed, then the values of R1, R3, and the grid returns of the various tubes, must be changed. The variable 20 ohm resistors are placed in the circuit to compensate for line voltage irregularities. They are to be adjusted until the voltage across the tubes is at its rated value.

It would be interesting to determine just how the various values of resistance used in this connection are determined.

First, it is known that the line voltage is 110, and second, that the terminal voltage of each tube is 5.0. The pilot lamp requires 2.5 volts for operation. Each branch of the circuit has three tubes in series, and since each tube requires 5.0 volts, the three tubes must have 15 volts. This voltage, when added to the 2.5 volts of the pilot lamp, gives a total of 17.5 volts, which, when subtracted from the 110 volts of the supply line, leaves a remainder of 92.5 volts across both R1 and R3.

Now the current through either branch 1 or 2 is the filament current of the tubes, which in this case is .25-ampere. The resistance of both R1 and R3 is then computed from the formula

$$R = \frac{E}{I} = \frac{92.5}{.25} = 370 \text{ ohms.}$$

In order

to provide a means of adjusting the filament voltage, 350 of the 370 ohms are made fixed and the remaining 20 ohms variable. The computation is exactly the same for either branch.

### "MODERNIZING" WITH A TRICKLE CHARGER

By John J. Nothelfer

YOU may be interested to learn how I adapted the transformer of an old Philco trickle charger as the filament supply unit for a type 45 power tube. Naturally, any tube having a 2½-volt filament may be heated in the same manner; and, by changing the number of secondary turns, a 1½- or 5-volt filament.

The case is removed from the transformer and the laminations pulled out. The secondary windings are then removed, and the core rewound with No. 16 S.C.C. wire (As different makes of transformers vary in wattage output it is difficult to state the exact number of turns to be wound.)

A simple test of correct number of secondary turns is as follows: after winding what is thought to be the correct number of turns for the secondary, (perhaps 10 to 15 turns, for a 2½-volt winding; other sizes in the roughly approximate ratio of 5 turns per volt), replace the laminations and connect the transformer primary to the 110-volt

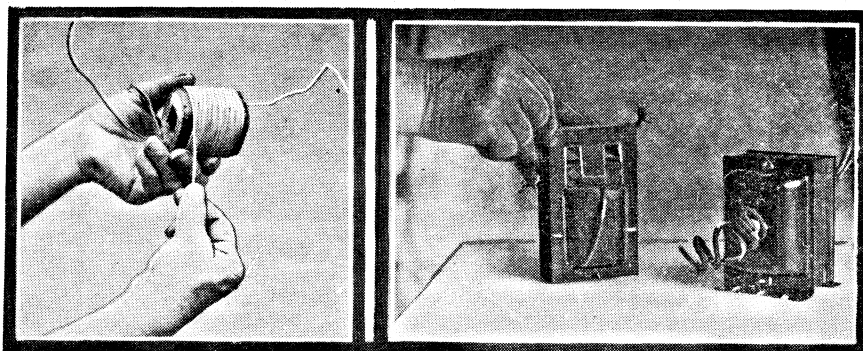


FIG. 6A and 6B—Left, rewinding a power transformer. Right, first replacing the laminations and finally, the completed instrument, looking as good as new.

A.C., line. Now, connect an A.C. voltmeter across the new secondary, and note the output.

If an A.C. voltmeter is not available, an old '99-type tube may be brought into service as a visual indicator of the approximate output of the supposed 2½-volt secondary. If it glows dull red when shunted across the secondary leads, add turns; if very bright, remove turns. The '45 tube filament burns with a dull red glow on 2½ volts.

Before connecting the transformer into the operating circuit, check both primary and secondary for shorts and, more particularly, grounds to each other and to the core. The latter should be insulated from the secondaries and grounded.

Three of the stages, winding the secondary, replacing the laminations, and the finished assembly, are illustrated in Figs. 6A and 6B.

### D.C. FROM YOUR AUTO

By Joseph Riley

A RECENT news item stated that a young man interested in radio had married a young woman also interested in radio. They made a special five-tube set, for use during their honey-moon, to be operated by the storage "A" battery in the automobile they owned.

Anyone can operate their receiver this way by following the idea illustrated in Fig. 7. Any burnt-out "bayonet-base" lamp may be used. The glass part is broken out and two leads are soldered to the contact points. There

are two types of base; single-contact and double-contact; use one which properly fits the particular outlet you want to take the six-volt supply from.

**Caution:** Examine one of the auto lamps and make certain that the D.C. supply is not 12 volts.

A wooden handle is fastened to the lamp shell; this makes it easy to remove the current tap and replace the lamp. It is usually most convenient to tap the current at the instrument board.

The amount of current consumed by the average five-tube set in an hour is about one and one-half amperes; the automobile lamps probably consume three to ten amperes. So, the compari-

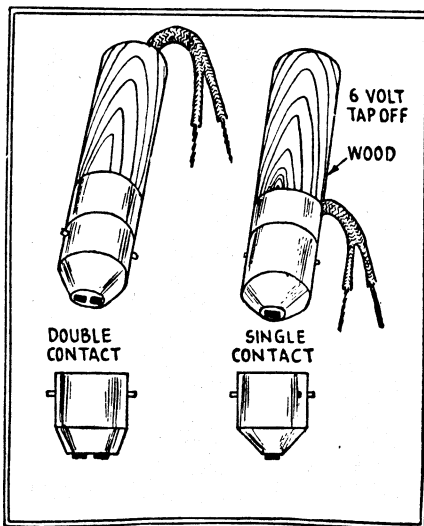


FIG. 7—A simple tap to the automobile storage battery will operate a receiver efficiently.

son indicates, there is no objection on the score of undue battery drain. In fact, the starting motor will probably draw as high as 300 amperes (instantaneous value) for the few seconds it is on during starting.

If a two-color cord is used for connecting, it will be easy to distinguish "A" positive from "A" negative, by using a red lead for the former and a black wire for the latter.

Of course, it is necessary to have the right connection when the plug is made up; but, as the sockets will probably all be connected the same way, the "A" polarities to the set will not be reversed if another socket should be tapped at another time. Usually, the shell of the single-contact base will be negative and the contact positive; a simple test for the double-contact base is to connect the plug "A" leads to the set. If it works, the connections are correct; if it doesn't, the "A" connections are reversed.

A clever arrangement would be to install a set of "B" batteries in the car and wire them to an outlet on the instrument board, to be tapped with another plug. Be sure these "B" voltages are by-passed inside the set.

### A TEMPORARY FUSE

By J. B. McGirt

THE writer ran across this "kink" when the new Crosley screen-grid models first came out. The sets were equipped with a 1-amp. fuse and frequently, when the radio was first put in use, the fuse would blow; whereas the fuse would hold if the heater-type tubes could be brought up to operating temperature. To keep from blowing so many fuses, I resorted to a tinfoil fuse.

Take a piece of tinfoil on paper (such as you find around chewing gum and

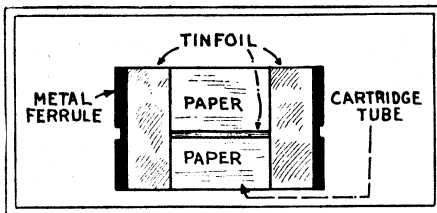


FIG. 8—Emergency repair of old fuse.

cigarettes) and cut it to a size that will just about go around the old fuse tube. Next, cut away a portion of the paper and tinfoil; and your fuse then should look like the one illustrated. (Fig. 8.)

Ordinarily, the least amount of tinfoil that can be used is about right; although it can be made to fuse at higher current levels by making the conducting strip wider.

### CHOICE OF RECTIFIERS

By Edward J. Arnold

HAVING use in the shop for a power-supply unit capable of using either an '80 or a "BH" gaseous rectifier tube, the writer evolved the circuit shown in Fig. 9. It may be of interest to others who can utilize the idea.

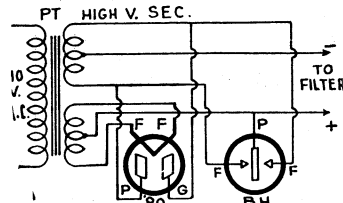


FIG. 9—Two different type of rectifier tubes can be used in this way.

The sockets should be labeled plainly: as it will be exceedingly deleterious to an '80 tube to insert it in the socket intended for the Raytheon.

### A.C.-D.C. "B" POWER SUPPLY

By Oliver H. Smith

"NECESSITY is the mother of invention." A small amount of 90 V. "B" was needed. An inventory of the

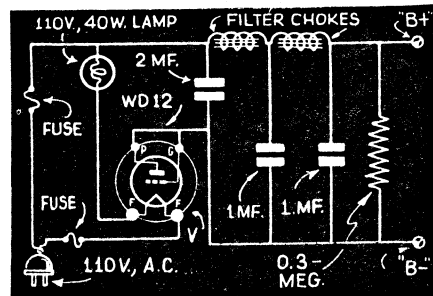


FIG. 10—A novel A.C.-D.C. "B" power supply, using a filament-type tube as rectifier.

available junk box showed no transformers, not even for filaments. The accompanying diagram shows the exact "B" eliminator that was rigged up. An 01A, 71A, or similar tube that draws ¼-A. filament current would give more output. The less said about the efficiency of this circuit the better, but it is simple and served the purpose. (See Fig. 10.)

I have never seen a similar hook-up using a filament-type tube.

### HIGH-VOLTAGE POWER SUPPLY

By Hubert Bussard

"HAMS" and experimenters often want high plate or D.C. voltages. This can be supplied by using ordinary good broadcast-receiver power transformers, wired in a bridge circuit which, in conjunction with 83s or some other mercury-vapor rectifier tube, give a D.C. output nearly equal to the A.C. voltage of the power transformer. Now, to further increase the voltage, wire the high-voltage filament of the bridge rectifier to center-tap of next power transformer. You will then have the voltage of No. 2 added to No. 1. You can make two bridge circuits like No. 1 and get still higher voltages, wiring them in series, of course. All filament windings to rectifiers must be separate. They can be part of the same power transformer, but separate filament transformers would be less likely to have any breakdown trouble. By these circuits the voltages are raised but the transformers are not overloaded. (See Fig. 11.)

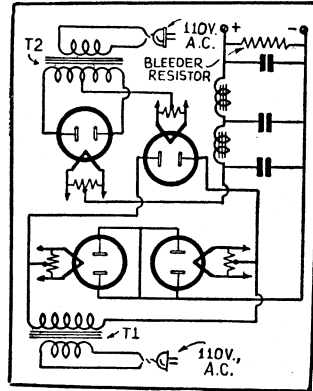


FIG. 11—Circuit of novel high-voltage power supply.

### INCREASING VOLTAGE OF FULL-WAVE RECTIFIER

By Roy Hockin

THE usual full-wave rectifier circuit is shown at Fig. 12A. Occasionally a higher voltage than this affords will be needed while at the same time retaining the advantages of full-wave rectification. This may be accomplished by using the circuit at Fig. 12B, where the original equipment is all used, the changes allowing an increase in voltage of about 90 V. The resistors added should be of at least 5-W. rating, and may have a slightly different resistance value than shown, as for example 10,000 or 15,000 ohms, but both must be of the same value.

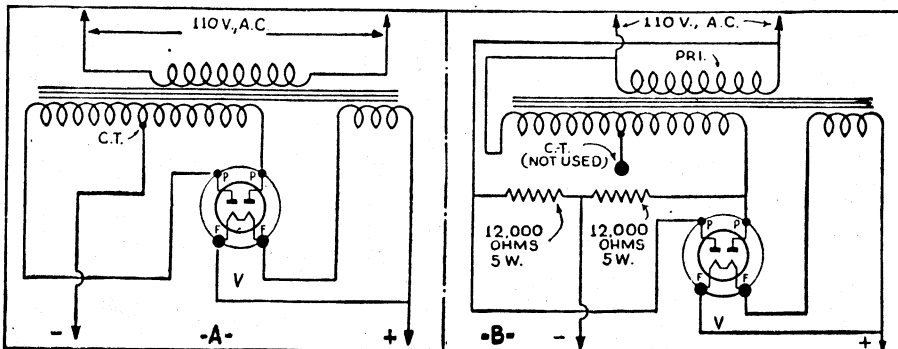


FIG. 12, left—Usual full-wave rectification circuit is at left; improved version at the right.

## CHAPTER IX

### COILS AND TUNING CIRCUITS

#### MEASURING THE FUNDAMENTAL WAVELENGTH OF A COIL OR A COIL AND CONDENSER

By Melvern H. Berry

EVERY Radio Fan has known of a time when he would give a portion of his anatomy to have some means to test the fundamental wavelength of his coils before placing them in his set to see what they would do. Of course, some approximate idea can be obtained from tables and the use of formulas, but for real accurate results it is impossible to obtain the information without some laboratory testing apparatus.

Most every radio fan has an oscillator and a wave meter. If you have a calibrated oscillator, it will be much better.

A neat and accurate galvanometer can be made for a few cents by winding a few turns of fine wire on a form one inch square. Hang this solenoid between the poles of a horseshoe magnet, allowing the ends of the coil to support it.

Place the galvanometer across the ends of the coil to be measured (Fig. 1) and bring the coil in close proximity to the coil of the oscillator. Rotate the dial of the oscillator until there is resonance between the two coils. When the wavelength of the oscillator is the same as that of the coil to be measured a current will be noted to flow in the

galvanometer. The indication may be very slight. The amount of deflection of the galvanometer depends upon its sensitivity and the coupling of the two coils. If your oscillator is calibrated the fundamental wavelength can be read right from the curve.

If your oscillator is not calibrated it will be necessary to employ a wavemeter to get the wavelength of your coil. This can be done by bringing your wavemeter (absorption type) close to the coil to be measured, and when the resonance of the meter is adjusted to coincide with the frequency of the oscillator there will be a second deflection of the galvanometer towards zero. The actual maximum fundamental can be read directly from the meter or from the curve.

When using as a test for the wavelength of a coil and condenser combination, refer to Fig. 2.

It will be necessary to put a radio frequency choke coil in the lead from "B" plus to plate. Otherwise, the battery resistance would probably be so low there would not be sufficient radio frequency voltage drop to cause circuit oscillation. This choke may be of any convenient size. On an ordinary thread spool, 250 turns of 30 to 36 gauge wire with almost any kind of insulation would work well.

It must be noted that incorrect coupling of the absorption circuit to the cir-

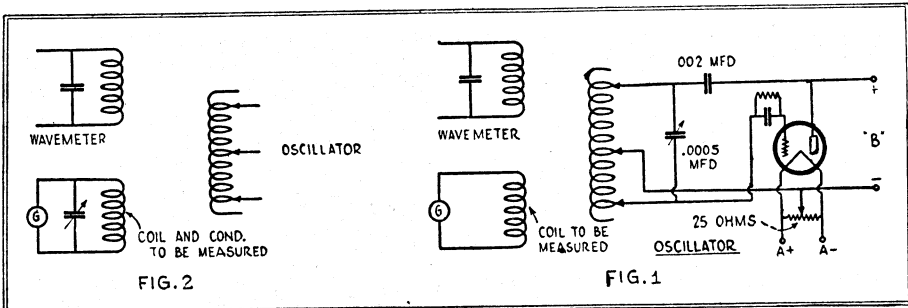


FIG. 1 and 2—The two schematic arrangements above indicate proper connections and coil relations to be observed when determining wavelength range of a particular coil, or coil-and-condenser.

cuit under test will result in double hump resonance,—the indicating device will register at two different wave lengths quite close together. To remedy this it is only necessary to loosen the coupling until the two resonance points merge into one. (It might be of interest to point out that this phenomenon is harnessed to furnish the circuit selectivity of the Hammarlund Hi-Q2 receiver, where the coupling has been reduced to one per cent.)

Instead of the 25-ohm potentiometer diagrammed, it is suggested that a 300- or 400-ohm one be used if a battery type tube is used rather than one of the A.C. type.

Also, the oscillator may work more smoothly if the grid leak connects to filament of the tube. The negative "A" is the correct side for an oscillator.

The .002 mf. fixed condenser must be of high grade as the "B" potential is impressed on it at all times.

It must be remembered that loose coupling must be maintained between coils, if maximum accuracy is to be realized. As it is necessary to have a frequency or wavelength standard from which to work, such a standard must be built or purchased. A simple method for calibrating a home-constructed unit is to use the tuned circuit as an absorption trap in conjunction with a regular radio set, setting the eventual wavemeter so that it "tunes out" the carrier of a broadcast station using crystal control; these stations can be depended upon to be adjusted to their assigned frequency. Once the dial readings for these frequencies have been determined, the rough calibration of a "wavemeter" has been accomplished. Plotting these values on graph paper will supply intermediate values.

### A SEMI-BAND PASS FILTER FOR THE BROAD TUNING RECEIVER

By R. William Tanner

MANY times the Service Man is confronted with the problem of increasing the selectivity of a receiver and, particularly, of one which was manufactured when distance was the main qualification of a set. He, generally, either cuts down the length of the antenna

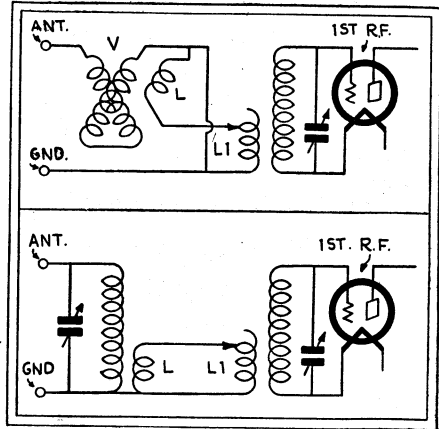


FIG. 3—Two band-pass arrangements which may be applied to give greater selectivity to a receiver.

system or installs a small-capacity condenser in the antenna lead. Both of these methods increase the selectivity but reduce the strength of signals as well.

It was at a time when the writer was working as a Service Man that he devised a rather unique means of increasing selectivity and at the same time, improving the quality. This was applied in the form of a semi-band pass filter. No tiresome mathematics are required to determine inductance and capacity values. The only parts needed are a few feet of No. 26 to 20 cotton-covered wire, a small battery clip, and one of the old style variometers (200 to 600-meter types).

Referring to Fig. 3A, it will be seen that the variometer is connected in series with the antenna and ground. A coil L, coupled to the grounded end of the variometer, and another coil L1 coupled to the filament end of the first R.F. transformer, compose a link circuit through which the antenna currents are applied to the grid of the R.F. or detector tube, whichever the case may be. L consists of 6 turns, fastened in place in any manner which comes to mind. L1 should have 10 turns, tapped every turn down to 3 (less than three turns will result in poor quality due to clipping of side bands). This is what the clip is needed for; to vary the number of turns in order to secure a satisfactory band-pass action. Before

L1 is wound, the regular primary or antenna coil (if one is used) should be removed, to eliminate the losses which would result from the "dead" coil being in close inductive relation to the grid coil.

In operation, the number of turns in L1 is decreased until selectivity is at its best with a good quality of reproduction; always remembering that, the more turns in circuit, the less will be the selectivity and the better the quality; and vice versa. If no shielding is employed in the receiver, the band-pass effect will not be very pronounced.

If the variometer is not available, a coil and a variable condenser similar to those used in the receiver may be employed; this arrangement is depicted in Fig. 3B. A variometer is recommended; as then the tuning is not so critical as with a coil and condenser. However, when tuning, either may be set at minimum and, after the signal has been regularly tuned in, varied for best results.

**A NOVEL COUPLING IDEA**

By Alan Hamilton

THE problem of adding an antenna winding to a single-winding short-wave coil of the "tube-base" type has been "solved" by most amateurs, who do without this coil; with consequent loss of the qualities obtained by this arrangement.

Fig 5.)

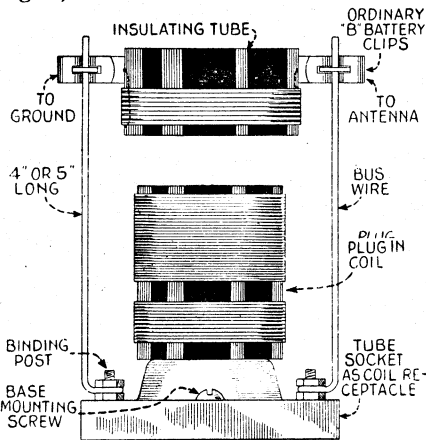


FIG. 4—A tube-base plug-in coil is easily equipped with an adjustable winding in this way.

Another solution of the problem is illustrated in Fig. 4; a coil, larger than the "tube-base" coil, is mounted slidably on two vertical rods, which may be bus bar. The two clips are of the "Fahnestock" type and may be loosened from the rods by pressing; the coil thus being easily adjusted to any position. As the experimenter may desire to use this newly-applied coil as a regenerative (tickler) winding instead of an antenna coil, the desirability of easy adjustment is apparent.

The coil when used as a tickler is wired into circuit with an external control of circuit oscillation.

**TUBE-BASE TICKLER COIL**

By Louis E. Fay

IN winding tube-base coils for 80 meters or above, it is impossible to wind both the secondary and the tickler on the outside. A method that I use puts the tickler on a small tube-base, instead of the usual jumble-wound coil.

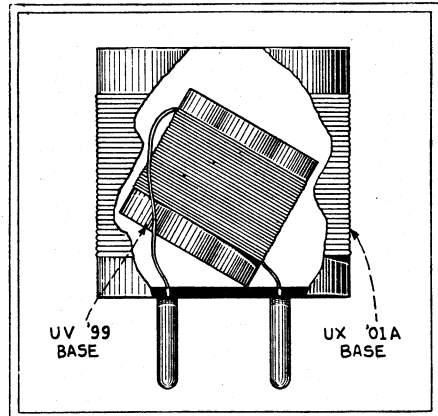


FIG. 5—A tickler for a UX tube-base coil, with fixed coupling, is obtained with a smaller (UV) base.

Wind the secondary on the large tube-base as usual. Then take an old tube, having a smaller diameter base, remove the glass, and contact prongs. This base will fit inside the large base nicely. Wind the approximate number of turns, place inside the large base and solder leads to the prongs of the large base. Vary either the number of turns or coupling until proper regeneration is obtained. Then pour in melted wax to hold tickler in place. (See Fig. 5.)



## HOW TO MAKE FORMS FOR WINDING YOUR OWN COILS

By Charles P. Hansen

THE tyro, the fellow just breaking into the game, can seldom find the information as to just what to do to obtain a certain result, in the best way. It is obtainable only in the "School of Hard Knocks." Occasionally, a bit of data will be found which lightens the work of becoming an experienced technician.

For example, below is described the manner in which the writer fabricates his own coils (generally referred to as being of the "solenoid, low-loss" type). Ten "forms," of various standard sizes, comprise the kit of the author.

### Shaping the Wood

When making coil forms the first requirement is a rectangular piece of wood (Fig. 6). On each end of this block a circle is scribed. Just how much oversize this should be, depends upon the wood-working ability of the constructor; because these two circles determine the resultant size of the form, since the wood is to be worked down to the diameter these circles indicate. Sandpaper the form to the final size. All sharp corners are rounded off with knife and sandpaper.

Dimension A is two inches longer than the desired length of the winding space of the form; and dimension B is, approximately, the desired diameter of the form. Lines C are drawn across one end of the block, to show the smallest thickness of the wedge which will result (as described below); dimension D is the largest thickness of this wedge. Lines E are then drawn; these being the lines to follow with a saw, to produce the wedge. Holes F, for machine screws, are drilled now. At this point, saw, knife and sandpaper are called into use to obtain the shape shown in Fig. 7.

Fig. 8 illustrates the end and side appearance of the finished form. Flat-head machine screws drop flush with the surface, and thread into nuts sunk in the form.

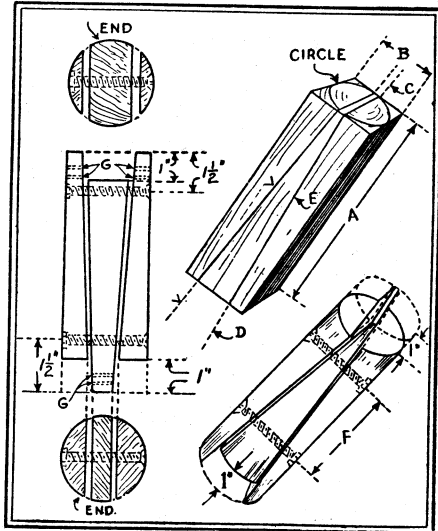


FIG. 6, 7 and 8—The various steps for form making are evident in this drawing.

### Making the Coil

To start the coil, wind a piece of writing paper twice around the form. Hold with rubber bands. Press thumb tacks at desired start and finish points of coil. Fasten wire by threading through holes G, and wind.

When wound, coat with collodion, (being careful not to slop it on the wood form). When dry, remove the two screws, tap wedge with hammer, and disassemble; and finish by gently pulling the writing paper from the inside of the coil.

Coils may be mounted on paraffin-dipped wood strips (w) as illustrated in Fig. 9.

The photograph (Fig. 10) shows an almost-completed space-wound short-wave coil, with holding strips cemented across the outside. One at a time, duplicate strips are cemented to the inside

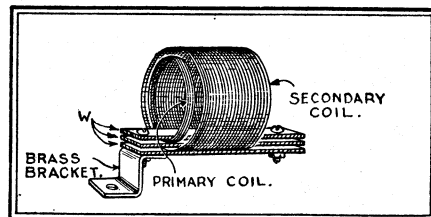


FIG. 9—A convenient way of mounting "low loss" coils constructed with the aid of the forms of Figs. 6-7-8.

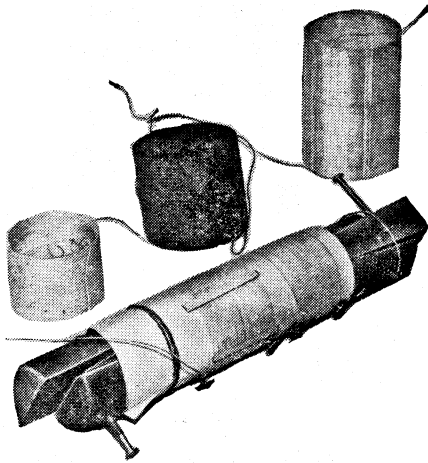


FIG. 10—Coils completed and in the course of construction are illustrated above.

when the coil is removed. Use of too much cement at this time will cause the coil to come apart. The "5-and-10" stores stock tubes of this (transparent) cement.

### A UY PLUG-IN COIL

By W. G. Ruppenthal

PERHAPS this method for constructing a UY plug-in coil will interest other readers.

The base is cut as indicated in Fig. 11 so that it is a tight fit in the fiber tube used for the coil form. A circle with a  $\frac{3}{8}$ -in. radius is drawn in the center. A horizontal diameter is then drawn, and where it intersects each side of the circumference of this circle, a mark is made. From each of these two points, arcs are drawn with  $\frac{3}{8}$ -in. radii in order to intersect the circle above the diameter.

From the center, a vertical line (90) is dropped until it also intersects the

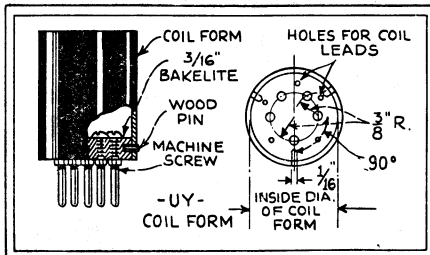


FIG. 11—Mounting coil-tubes to a plug-in base.

circle. These five points of intersection are drilled for either 6/32 or 4/32 machine screws; if 6/32 screws are used, the threads will have to be filed off a little where they go into the socket. The manner of winding the forms is left to the constructor.

Small holes are drilled in the base to let the coil leads out. Holes 1/16-in. in diameter are drilled through the fiber into the base, and wooden pins are then driven in and cut off flush to hold the base and coil rigid if there should be any tendency for them to separate.

### A FORM FOR COILS

WITH a hack-saw, cut lengthwise through a piece of bakelite of the desired diameter, as shown in Fig. 12.

The next step is to wind a piece of stout paper around the (now slotted) tube, and paste it firmly, using care to prevent the paste from sticking the paper to the tube. (The paper should be spaced about 1/2 inches from each end of the tube.)

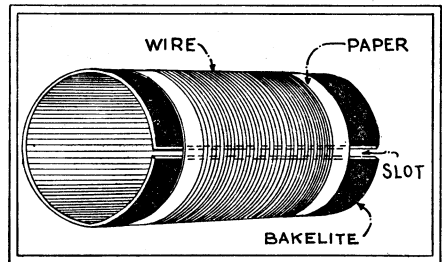


FIG. 12—The method shown makes it possible to prepare coils with lessened dielectric losses.

Wind the wire on the paper, under which is the bakelite tube, being careful not to wind so tightly as to cause the slot in the tube to close completely.

When dry, the coil is easily removed by sliding it off the bakelite tube after pressing the tube until the slot has closed.

The finished coil may be mounted in any convenient manner; the writer usually bolts two strips together, one inside and one out, and then fastens the mounting in the position dictated by the circuit.

**TESTING I.F. TRANSFORMERS**

By H. E. Wessel

SOMETIMES a transformer is suspected of having insufficient tuning range to reach a certain I.F. This may be due to shorted turns or any other cause. Testing such units is very simple if a workable receiver having the same I.F. as the suspected unit is at hand. The doubtful transformer is simply con-

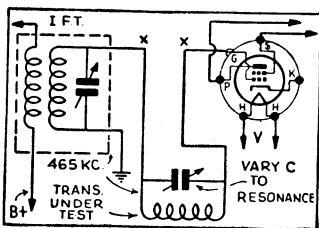


FIG. 13—Determining inductance of I.F. transformers.

nected in the control-grid circuit of the I.F. stage of the receiver as shown in Fig. 13. If the transformer is in good condition a decrease in signal strength will be noted as its trimmer condenser is turned. If no change is noticed, the transformer is not capable of tuning to the desired range, or it is defective.

**NOVEL 3-CIRCUIT TUNER**

By Louis B. Sklar

A DESIGN for a coil of the tuned radio-frequency type and having an adjustable primary to compensate for various lengths of aerials.

That single sentence tells almost the entire story.

For those who want details it may be mentioned that the construction of the coil is extremely simple and it may easily be made from odds and ends about the work-shop. The sketch shows the coil assembly, but it does not show any specific dimensions, as they are not necessary. It is only necessary that the primary coil be small enough in size to slip easily into and out of the secondary.

The number of turns on the secondary depends of course on the size of the tube on which it is wound and the fre-

quencies which it is desired to cover; these data may be obtained from various sources. Usually, with these data for the secondary, the number of turns for the primary is also given where the primary is to be wound on the same tube. In this case, however, the primary is wound on a smaller sized tube and may also be moved away from the secondary, both conditions reducing the inductive coupling between primary and secondary. To offset these conditions it is therefore recommended that about twice as many turns be wound on the primary as would be the case if the primary were wound on the same tube as the secondary. (Fig. 14.)

The primary coil is supported as shown by a piece of ordinary bus-bar, which is bent into the shape of a curve and operates through a binding post of the thumbscrew type. When the primary is moved as far as possible away from the secondary, it is also then at right angles to the secondary, because of the curve in the bus-bar. Thus it is adjustable through the entire range from maximum to minimum coupling, and provides a gradual variation in coupling impossible to obtain with primaries of the tapped variety.

The author worked out this design when winding the secondary on a 2-inch tube for the broadcast frequencies. A coil similar to the primary was mounted on the opposite end of the secondary as a tickler coil, the feedback control being a midget condenser. The result was a home-made 3-circuit tuner which, in tests, proved to be superior to a high priced and well known factory made tuner.

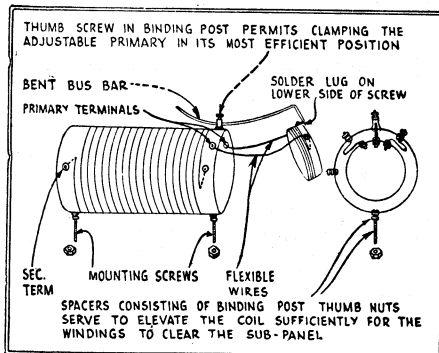


FIG. 14—A novel 3-circuit tuner.

## A SIMPLE WAVETRAP

By C. H. Nason

SERVICE Men at times face the necessity of providing a wavetrapped of simple but effective characteristics. Although in years past many such devices were on the market, they have now ceased to be a standard commodity; and the radio fan or the Service Man must shift for himself in the construction of a suitable circuit arrangement.

"Just anything" will not serve this purpose. It is often desirable to eliminate the signal from a station which is but a few kilocycles removed from a desired carrier. If this is to be done it is essential that the losses in the wavetrapped be small, so that a sharp effect may be obtained. Figure 15 shows the schematic circuit of a simple wavetrapped employing a Hammarlund "MC" Midget condenser in conjunction with suitable coil, the specifications of which are given below. The degree of effectiveness of the device is determined by the tapped connection to which the antenna is connected; it is necessary to find the best arrangement in each case.

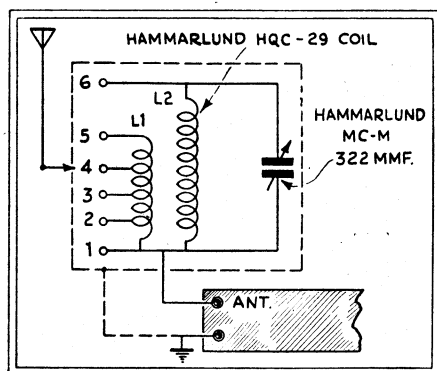


FIG. 15—The combination of low-loss tapped inductance and variable condenser makes this wavetrapped adjustable for varying conditions.

If the entire winding is connected in the circuit, the maximum effect is obtained; but with the possibility of removing the desired signal also, if the interference is from a station on an

adjacent channel. With the antenna connected so that but a small portion of the wavetrapped winding is in series with the antenna lead, the sharpness of the effect is greatly increased; although its magnitude is somewhat reduced. This will allow us to separate stations having dial readings quite close together.

In some localities it may be desirable (to prevent picking up the signals of powerful locals) to shield this wavetrapped; and perhaps ground the shield, as indicated in dotted lines.

When the selector switch is set on tap 1, the wavetrapped is entirely out of the circuit—except for a slight "dead-end" effect (which cannot be detected unless the wavetrapped is in close inductive relation to unshielded coils in the radio set). When the switch is on tap 2, only one turn is in use and the wavetrapped action is very slight; a good condition when trying for "distance," with just a little cross-talk observable between two weak, distant stations.

The maximum effect in the use of the wavetrapped is observed when the switch is placed on tap 6; in which position primary L1 is not in use and has a practically negligible action on the circuit.

Although the coil in Fig. 15 may be used with the old 350-mmf. Hammarlund variable condenser, it may be used to even greater advantage with the more efficient "Type MC-M" 322-mmf. unit recommended. This tuning capacity shunts a coil L2 having 60 turns of No. 22 D.C.C. wire, spaced 36 turns to the inch, on a form 3 in. in diameter; while in inductive relation to it (inside and at the filament end) is the primary winding L1, consisting of 15 turns of No. 24 D.C.C. wire, spaced 39 turns to the inch, on a form of 2-13/16 inches in diameter. The leads are brought from the 1st, 4th, 8th, and 15th turns. (Of course, these coil and condenser proportions may be varied to suit individual preference as to parts or connections).



## CHAPTER X

### SHORT WAVES

#### ADAPTER FOR POLICE BROADCASTS

By P. L. Pennock

MANY set owners have asked me, time again, if it were possible to get the short-wave broadcasts of the local police stations on their present broadcast receivers. This may be done sometimes, when the receiver is very close to the transmitter, which works only a little ways below the broadcast band; but, as a rule, a short-wave converter or adapter will be required. However, the method described here involves practically no cost and very little time; though it is true that the arrangement is not very efficient.

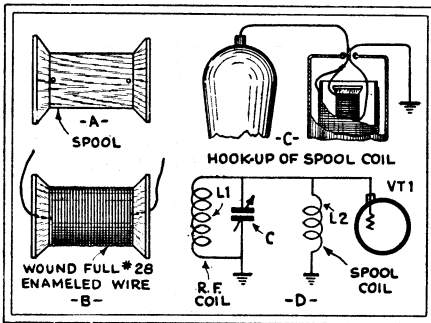


FIG. 1—An additional inductance in shunt across a coil lowers the wavelength, if there is not too much self-capacity.

Procure some empty thread spools (of the ordinary type) and, at each end, drill a small hole to the center, just inside the flange. (Fig. 1A.) Then insert one end of a No. 28 enameled wire through this hole, leaving at least three inches for a lead; and wind a layer completely to the other end, passing the lead through the other hole (as at Fig. 1B). One of these inductors will be needed for each tuned R.F. circuit in the broadcast receiver, whether R.F. or detector; but none for the antenna coupler, if it is untuned.

If the receiver has screen-grid stages, lift the cap of the connecting lead from each tube until you can slip a term-

inal lead, from one of these chokes, under the cap and make an electrical contact with both tube and grid lead. Connect the other lead to some grounded point on the chassis or tube shields (See Fig. 1C) and set the spool on top of the regular coil; do this with each tuned stage. In any stage which does not use a screen-grid tube, the spool is connected between the grid prong of the tube socket and the filament side of the tuned circuit. These terminal wires should be polished with very fine sandpaper, until they will make good metallic contacts.

It will be found, when this has been done, that broadcast stations will tune much higher on the dial; and the short-wave stations on police, amateur and experimental waves will have come up among the lower readings of the scale. On a Crossley "42S" located here (Canton, Ohio), Louisville, Cincinnati, Akron, Cleveland, Richmond, Youngstown, Detroit and Buffalo have been heard. I would suggest that the local ones merely hoped for.

#### A HINT TO SHORT-WAVE FANS

By Wayne Starch

MANY short-wave fans, like myself, may have short-wave sets which tune up about 150 meters. Probably at times, they wished that they could tune a little higher in order that they might receive broadcasts when the short-wave stations are not on the air. In my case, it happened that I wanted

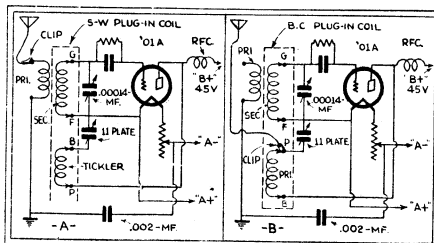


FIG. 2—At A, standard short-wave connection. At B, circuit changes for longer wave reception.

a friend of mine to hear the dynamic speaker that I was using, but was unable to do so in view of the lack of short-wave stations at the time. I decided then and there to fix up my receiver so that I would be able to tune in a few of the higher wave broadcast stations.

Instead of winding a new R.F. coil, I obtained an old one from my junk box (most radio experimenters have junk boxes) and used its secondary as the secondary of a new plug-in coil, and the primary as the tickler. This idea is shown in Fig. 2. I found it necessary to reverse the tickler connections on the new coil in order that regeneration might be secured. The antenna was connected to the "P" terminal of the tickler rather than the antenna coil as shown.

The type of plug-in system to use depends on the type that the short-wave receiver uses, and obviously should be made so as to fit.

With the size tuning condensers as shown and using a standard R.F. coil, the range of the set was extended up to 345 meters.

### A SHORT-WAVE COIL FORM

By Herbert L. DeWolf

HAVING built a number of short-wave coils and giving them a thorough test, the writer is of the opinion that coils made in accordance with the arrangement shown in Fig. 3 work better than any others.

The idea is to hack-saw supporting

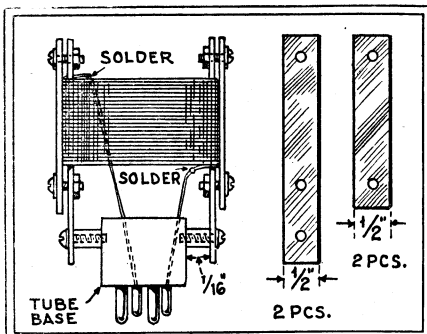


FIG. 3—Another version of the home-made plug-in coil, with low-loss construction.

strips from an old coil; and fasten them with machine-screws to a tube-base, and to the R.F. coil by means of top clamps.

The wire for the tuned coil should be about No. 16 enameled, spaced  $\frac{1}{16}$ -in.; on the regular celluloid-acetone form. The tickler may be wound at the bottom end of the tuned coil; outside of the straps; or formed first and cemented inside the coil.

### SIMPLE CODE-PRACTICE SET

By Richard Grey

TWO people may practice code in the same room using a single buzzer and two separate telegraph keys. No batteries are required. An ordinary bell-ringing transformer is employed.

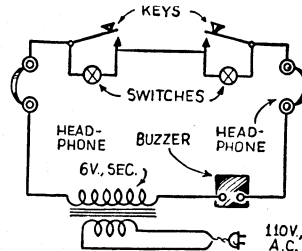


FIG. 4—Simple code-practice set.

When one party is sending, the other party must throw his switch in order to short out his key, and vice versa. Works from the 110 V. 60 cycle house lighting circuits. (See Fig. 4.)

### TUNING IN SHORT WAVES

By John C. Heberger

IF one has a modern broadcast receiver equipped with a power amplifier tube and a short-wave set with at least one stage of audio amplification, foreign short-wave broadcast stations can be tuned in on the loudspeaker of the broadcast receiver if the two receivers are connected together according to the simple diagram shown in Fig. 5.

The writer tunes in daily, by means of this combination, the afternoon programs from G5SW at Chelmsford, England, with volume and quality equal to a local station. Three stages of amplification are none too many because the level of background noise is usually very low on the short waves. Howling caused by mechanical feed-back from

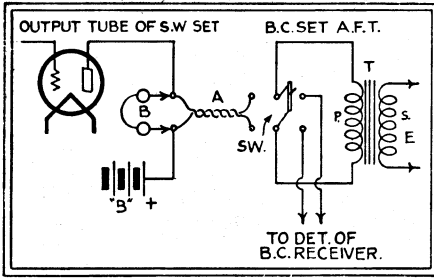


FIG. 5—Short or broadcast waves on the L. S. by switching the S. W. set to the A.F. of the B. C. set.

the speaker may be avoided by using a longer speaker cord or, if necessary, placing the speaker in another room.

Referring to Fig. 5, the lamp cord "A" joining the two receivers can be of any length, and if the sets are located in different rooms the phones "B," which are left connected all the time, can be used to find the station before putting it on the speaker.

The switch SW is placed inside the cabinet of the broadcast receiver in any convenient position. One side of the switch connects the output of the short-wave set to the audio amplifier of the broadcast set; the other side is used for normal operation of the broadcast receiver. Care should be taken in connecting the leads to the switch so that the connections to the transformer are not reversed when reconnected to the detector of the broadcast receiver through the switch.

### INCREASING SHORT-WAVE SET EFFICIENCY

By W. H. Nilsson

THE writer has been using the simple switching circuit illustrated in Fig. 6 for changing from a long aerial to a short one to obtain better results with a short-wave receiver, the long aerial being used only with the broadcast band coil.

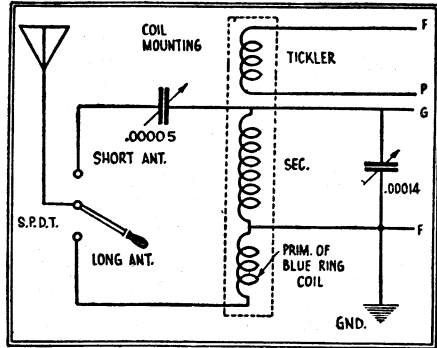


FIG. 6—With a set covering several wavebands, this switch makes it more convenient to change the aerial coupling.

This arrangement has the merit of convenience, and the better performance of the receiver makes it well worth while.

### A MULTIPLE SWITCH

By W. A. Guider

THE arrangement in Figs. 7A and 7B may be made with any number of prongs from 4 to 7, depending upon the number of circuits it is desired to break. The two sockets are the same and are fastened firmly together. The particular unit shown was made for use in a short-wave set, two sets of coils being made available. The 6-prong tube base has every other prong cut off for this use, so that to shift from one circuit to the other it is only necessary to pull the plug out and turn it 1/6th revolution before replacing it. When used simply to break a number of circuits at once, no prong need be cut off.

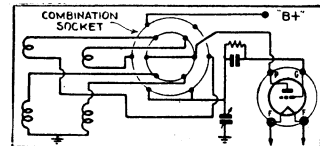
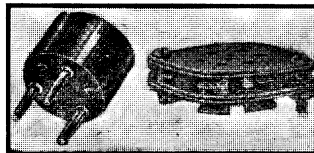
### SELECTOR SWITCH

By T. H. Caserta

THE switch shown in Fig. 8 may be made in any type from 4 to 8 contacts by use of the proper type of socket. The top lamination and the washer are removed from the socket, then the latter is replaced to hold the prongs in

FIG. 7A—Finished appearance of the multiple switch.

FIG. 7B—Schematic of connections for switch shown in Fig. 7A.



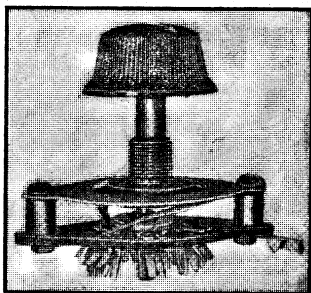


FIG. 8—The novel selector switch made from a wafer socket.

place. The shaft and bearing plate of an old volume control are then bolted onto the socket, using spacers between the two. The contact part of the prongs should be filed slightly in the center to provide a small groove for the arm contact to drop into.

### A MULTI-TAP SWITCH FROM A VOLUME CONTROL

By Fred Boettscher

A GOOD switch may be easily made from an old Frost potentiometer by removing the resistance element and drilling as many circumference holes as needed for taps.

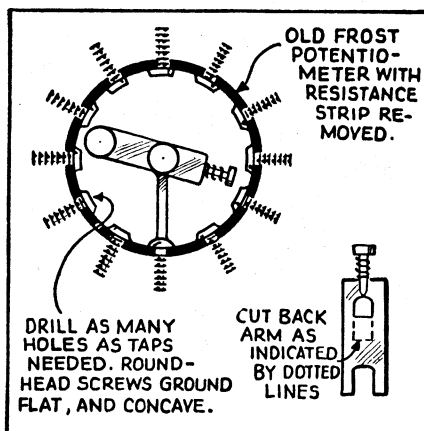


FIG. 9—A selector switch made from a volume control.

Remove the contact arm and cut it back as indicated in the sketch, Fig. 9. This will allow the contact point to slide back further to clear the heads of the screws. Stops may be made by bending the small pieces of metal used in the original control to hold the ends of the resistance element.

Roundhead screws ground flat on the top (and concave if possible) are used as taps.



## CHAPTER XI

### LOUDSPEAKERS AND PHONOGRAPH PICKUPS

#### MULTIPLE SPEAKERS

By Victor Trad

A SIMPLE and economical method of wiring every room for a radio-speaker, illustrated here, obviates drilling holes through the ceiling or floor; because one wire may be taken upstairs or downstairs from the outside of the building. I have used the idea quite successfully in making such in-

stallations in my neighborhood, and they are working quite well. The arrangement shown lessens losses caused by the use of two wires. (Fig. 1.)

A volume control, and a switch also, may be used in each room, if desired by the set owner; convenience outlets are obtainable, or ordinary electrical wall That attached to the receiver's output receptacles may be made to serve. The condensers used are of 2-mf. capacity. That attached to the receiver's output



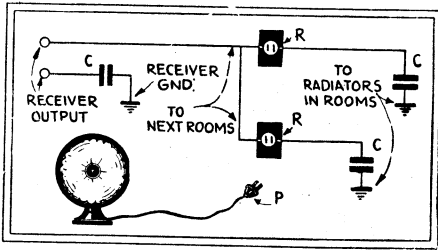


FIG. 1—This method of wiring several speakers to a receiver is not only simple, but profitable.

is connected to the ground post of the set, when the latter runs directly to the radiator.

(The method shown will be of value to many Service Men who are prepared to add a profitable extra to installation work. It is desirable, perhaps, to add a caution that the use of speakers in parallel reduces the impedance and, thereby, the total effective output of the set to all of them. The pentode, particularly, requires a large output impedance. However, if more than two speakers are required, the use of a series-parallel connection will restore the matching of the load to the output tubes. On this subject, it will be of interest to refer to the paragraph "Matching Reproducer Impedance," in the article on page 727 of *Radio-Craft* for June, 1931; while a very large installation is described therein, the principle is the same.—Editor)

### A UNIVERSAL TEST SPEAKER

By R. R. Smith

I FIND this idea useful for auto-radio work.

It eliminates the removal of overhead or separate speaker from the car.

The diagram is self-explanatory. (See Fig. 2.)

The jumpers indicated are equipped with phone tips.

Several 24-in. leads are made up using phone tips on one end and a large or small tube prong on the other to connect speaker to radio set.

Most speaker sockets have large and small holes.

The cable-and-plug shown is used for the '35 and '36 Ford radios. These models predominate in this locality and I use this arrangement to speed up connections.

The long lead with clip is used on the models having the "A" lead connected to speaker plug.

The speaker is a 6-in. auto-radio model with output transformer and is housed in a wooden case, 12 x 8 x 6 ins. wide. The back cover is hinged and all cables, leads and diagrams of speaker sockets are kept inside.

The jacks shown on diagram are mounted in the top of the box at one end. In all cases a lead must be connected between jack marked Gnd. and radio chassis or case.

Servicemen must judge for themselves whether their car-radio service work is sufficient to warrant making this unit.

### REPAIRING SPEAKER CONES

By John J. Nothelfer

HAVING bought several speakers with damaged cones (at a good price and with an idea of reselling at a profit), I learned, much to my chagrin, the prices for new cones! The prices were so high that a loss instead of a profit would result.

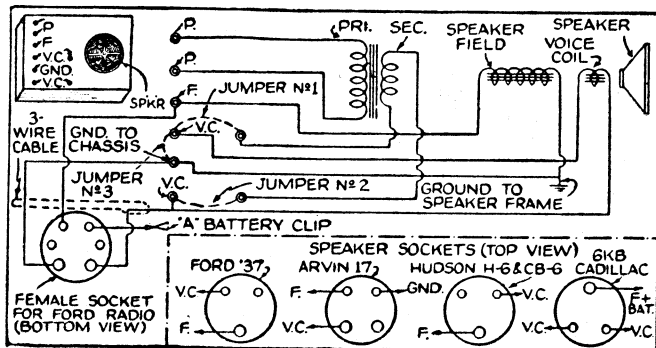


FIG. 2—A universal test speaker circuit and mechanical arrangement.

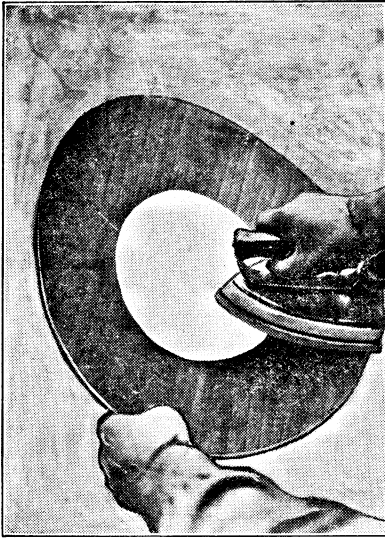


FIG. 3—A repair kink for that busted speaker-cone.

The speakers were damaged at the centering device; this is the case with nearly all damaged cones. I tried repairs, and with good success, after several attempts.

Cutting out the damaged area, I sandpapered the edges of the cut to a rough finish. Cutting a piece of paper from an old cone, I pasted the patch to the damaged area, with white collodion.

It takes a while to dry, and the patch must be held in place all that while, probably an hour. The ordinary hot iron came to the rescue. After raising it to a good, hot "heat," I pressed the iron over the pasted area. In a few minutes the collodion had dried, and it held as firm as if the patches were metal and soldered! To prevent the collodion from getting to the surface of the iron, a piece of paper is laid over the area to be heated.

A new centering device should be installed and the cone replaced on the speaker. The cone is then as good as new, and no fear should be entertained that the pasted patch will come loose. (Fig. 3.)

This idea also works very well with dynamic speakers which have been punctured by accidental means; in this case, ordinary typewriter paper is used.

## NEON BULB USED IN CENTERING SPEAKER CONE

By Samuel H. Beverage

HERE is a kink for centering dynamic speaker cones. It consists of a 110-V. neon bulb in series with the speaker output transformer primary and the A.C. line (see Fig. 4). A low-pitched hum will be reproduced. The centering screws should be loosened and

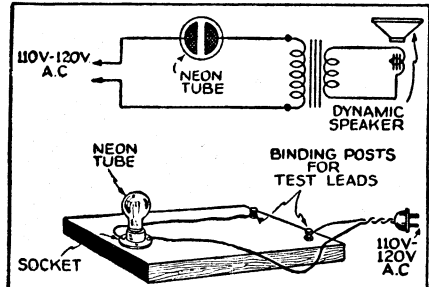


FIG. 4—Using a neon bulb as a help in centering speaker-cones.

then, with the A.C. ripple still being reproduced, the centering screws should be tightened. The voice coil will be perfectly centered. This arrangement is much more convenient than the method of disconnecting filter condensers in the set in order to produce hum.

## SIMPLE EXCITER FOR SPEAKER FIELD

By H. P. Kelly

THIS exciter costs almost nothing to build and is an extremely handy unit to have at hand. The output voltage under load of about 80 ma. will be around 145 V. Only a 40 W. lamp should be used, as this provides the correct voltage drop for the filament of the 25Z5 rectifier. (Fig. 5.)

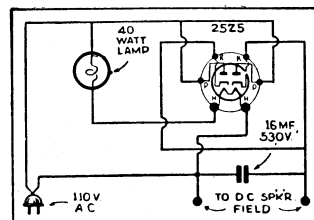


FIG. 5—A.C.—D.C. speaker field exciter.

### REPAIRING PHONOGRAPH PICK-UP

By Ralph Bills

OTHER than actual burn-out, trouble in pick-ups is usually caused by drying up of the rubber armature dampers. Repairs can easily be made with rubber from an inner tube which still has good resiliency, and bits from a (transparent) rubber nursing nipple.

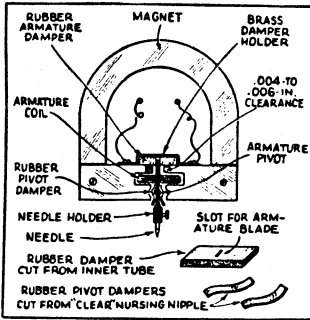


FIG. 6—Illustrating the method of repairing a pickup.

Use care, when taking the assembly apart as the fine wires from the coil break off with the slightest pull. (See Fig. 6.)

### THE RADIO-VIOLIN

By Fess Christiani

RADIO programs may now be received through the medium of the violin. Find the center of a small magnetic speaker disc, and solder a small wood-screw to it at the center. Then

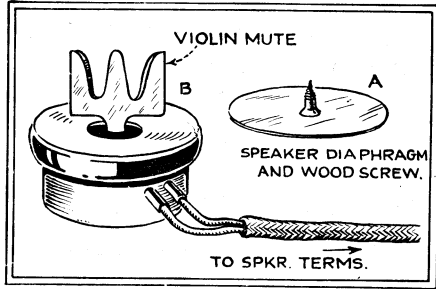


FIG. 7—The home-made "mute" is screwed to magnetic speaker diaphragm, and attached to a violin as in Fig. 8.

cut a wooden violin mute as shown in Fig. 7, and screw it to the speaker diaphragm. The telephone unit is now assembled together with the mute and the entire arrangement attached to the bridge of a violin as shown in Fig. 8.

When a program comes over the radio, one may have the novel experience of walking about the room accompanying it. I play an obligato, and the tone is very clear. There is a great "kick" in it for both listener and player.

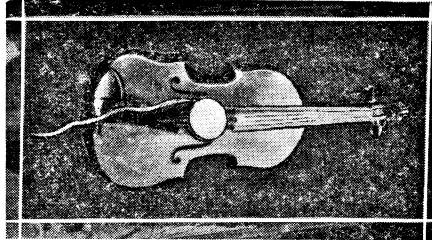


FIG. 8—The radio-violin. The improvised speaker unit, on the violin bridge, facilitates radio accompaniments.



## CHAPTER XII

### TOOLS AND ACCESSORIES

#### A LIGHT BLOW TORCH

By J. E. Kitchin

PROBABLY some of you Service Men with the ever-handy power lines

have never had to solder without a soldering iron. The following, however, may interest those, who, like myself, are sometimes in a district where power is not available.

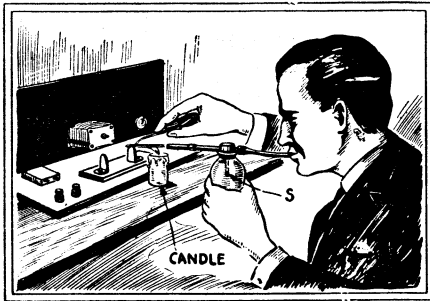


FIG. 1.—Blowpipes are obtainable from laboratory supply houses; but Mr. Kitchin takes this ingenious way to make one of light weight. (The bottle may be retained as a handle!)

Procure an atomizer, of the type used for perfuming, or for spraying the interior of the mouth and nose. Remove the cork, to which are attached the rubber and metal tubes. Cut off the stem, which dips down into the bottle in regular use, and plug this tight with stopper S. Cut the bulb off the rubber tube and, if there is a spray nozzle at the end of the metal tube, remove this. You now have a blowpipe which will direct a flame with needle-like sharpness. Carry this, with a short length of candle, in your kit. (Fig. 1.)

### AN INEXPENSIVE SMALL-PARTS STORAGE CABINET FOR THE AMATEUR

By Lester P. Young

MANY experimenters like to "file" their radio small parts. Stationers often throw away convenient-sized boxes of the type illustrated; and the writer finds them handy for this pur-

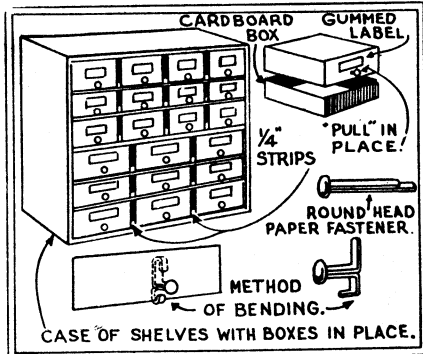


FIG. 2.—The cabinet here shown provides a place for everything; yet it is made of paper boxes, etc., which would otherwise be thrown away. Small wooden strips serve instead of partitions, as shown.

pose. A couple of dozen of these cardboard boxes of varying depth may be fitted into shelves spaced to fit the tiers, as they are placed in a wooden packing case of correct dimensions.

To prevent the boxes from binding, and insure their sliding in the proper place, dividing strips made of  $\frac{1}{4}$ -inch square wood are nailed to each shelf, between each pair of boxes.

Ordinary round-headed brass paper fasteners may be used to make a practical and good-looking "pull" (Fig. 2.)

### CORDLESS SOLDERING IRON

By H. R. Wallin

WHEN one is using an electric soldering iron, especially in wiring radio sets, the cord of the iron is usually in the way; yet at times it is not long enough.

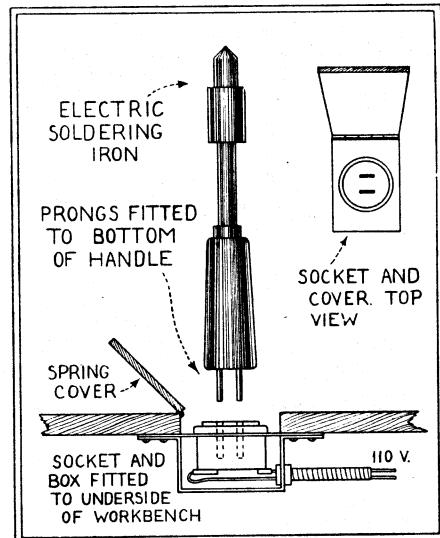


FIG. 3.—By inserting the soldering iron into a fixed socket to keep it hot, it may be used without a cord.

To prevent this annoyance, the connection shown in Fig. 3 was used; it is very simple to rig up. A standard 110-volt socket is set into the top of the bench, by cutting a hole to fit. A flat metal-plate cover is set over this hole, to prevent dirt from falling in; a spring should be used on this cover, so that it will close automatically.

Into the handle of the soldering iron, two prongs are fitted and connected to the terminals of the wires.

For heating, the soldering iron is set upright into the socket; and when needed for use, it is pulled out and brought to the work. Where continuous work is necessary two irons may be used. The heat will be retained in the iron for some time.

### SOLDERING WITH ELECTRIC ARC

By Oscar O. Boucher

THE 5 V.-secondary of a power transformer from an old radio set is used to supply the energy for the "iron" (which, unlike the usual "copper," is made of "carbon"!) illustrated in Fig. 4. One heavy, flexible lead terminates in a heavy alligator clip which is used as the ground connection. The other lead, which terminates in a holder, fastens to an electrode—a piece of carbon rod about 2 ins. long and ¼-in. in diameter. (The type of rod used in arc lamps will do, or it may be taken from a flashlight cell.)

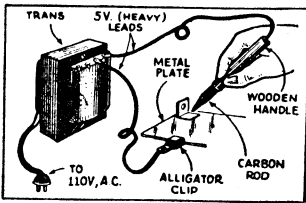


FIG. 4—Set-up of the electric-arc apparatus for soldering.

The clip is fastened to the material to be soldered and the rod placed on the part where soldering is to be done. When the part heats up, solder is applied. The iron is particularly handy, since there is no wait for heating up and it is always ready for use.

### KEEPING THE IRON CLEAN

By Luther C. Welden

KEEPING the soldering iron clean is half the job of doing a solder job; so it is a good idea to keep two handy accessories on the work bench for this purpose.

First, a small sheet of rather fine-grade sandpaper; on which flow a small bit of resin or solder paste and a small amount of solder (Fig. 5A). Next,

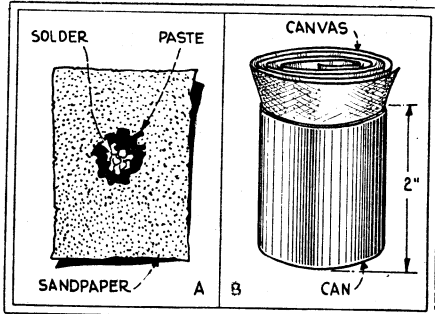


FIG. 5—The two accessories shown make it more convenient to do a good job of soldering.

procure a small round tin can about 2½ inches in diameter and 2 inches deep. Take a strip of canvas 2¼ inches wide, or ¼-inch wider than the can is deep. Roll the canvas in a tight roll until it will fit snugly into the can, with about ¼-inch extending above the edge; "fuzz" this outer edge. (Fig. 5B.)

When the iron is hot, clean the tip by rubbing on the sandpaper; it will be well "tinned" at the same time, because of the paste and solder on the paper. Then clean off the surplus paste by passing it over the canvas pad.

An iron holder made of a strip of tin may be fastened to the can.

### A SOLDERING IRON HOLDER

By Louis Rick

THE idea is merely to connect a 60-watt lamp in series with the soldering iron. When the iron is removed from its holder, the contact K closes, short-circuiting the lamp; the full line

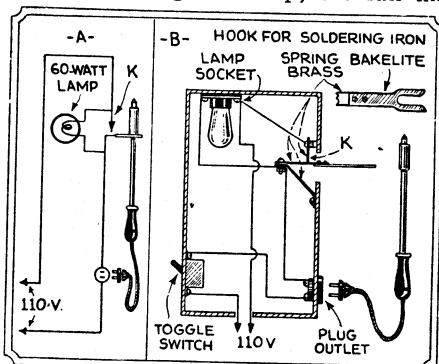


FIG. 6—A novel soldering iron holder. A, its electrical circuit; B, mechanical arrangement.

voltage is then applied to the iron. When not in use the iron is placed on its holder, which opens the contact and connects the lamp in series with the iron; reducing the voltage applied to the iron. With the usual amount of use, the iron is thus kept at a constant temperature.

At A is shown a schematic diagram of the circuit. The arrangement may be housed in a box as illustrated in B, (Fig. 6), and then mounted in any convenient location.

### A HOME-MADE ELECTRIC GLUE POT

By C. M. Parks

SOME time ago a glue pot was needed in a hurry. There was none around, so a serviceable one was made as illustrated.

Resistor R may be any unit having the required value, which must be determined by experiment. If the water is too conductive, too much current may flow for the resistor to carry safely and it will burn out. It is therefore suggested that a lamp bank be used.

The water serves a dual purpose, as the resistor required to develop the requisite heat, and to isolate from direct contact with a localized heat (known as the "water-bath" method) which is a requirement for properly heating glue, sealing wax, paraffin and similar plastics.

The rubber washer is required to insulate the inner metal container from the outer metal can. (Fig. 7)

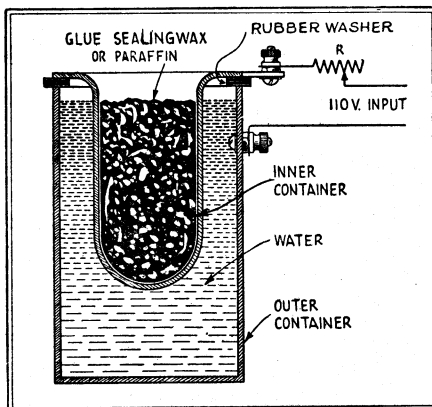


FIG. 7—An easily-constructed glue pot, recommended as an emergency construction design. It may be used regularly for light work.

The outer container is an ordinary metal can of convenient dimensions; the inner one is of proportionate size and the top is slit to form two ears which are bent over to rest on the rubber washer.

### PUNCH AND JIG FOR METAL WORK

By Eugene Douglass

EVERY set-builder and experimenter knows of the difficulty encountered in drilling or cutting holes of large diameter in the metal sheet that he uses for a chassis base. Obtaining neat holes was a problem to me until I had made up the outfit illustrated. The method is as follows:

Two pieces of flat iron (about 30 inches long,  $\frac{1}{4}$ -inch thick, and two or three inches wide) are obtained and clamped together, one above the other; so that, after drilling, the holes in both, pieces will correspond to size and location. Now, drill a  $\frac{3}{8}$ -inch hole, about 1 inches from each end of the iron strips; and also, near the center of the strips, drill holes of the sizes that will later be required in the chassis base. Next, remove the clamp that holds them together, and bolt them together. Use two  $\frac{3}{8}$ -inch bolts for this, and place a  $\frac{3}{32}$ -inch washer at each end, between the iron strips. (See Fig. 8.)

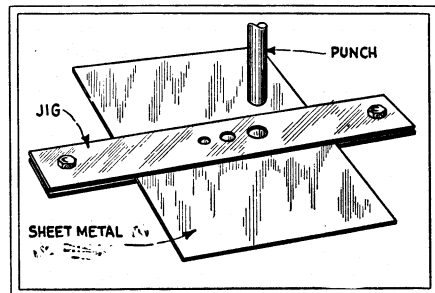


FIG. 8—With a set of jigs and punches of this kind, large, clean holes may be punched in fairly stout sheet metal.

This completes the construction of the jig, but you will need punches, to fit the various holes in it; they are made of round steel and should fit neatly into the holes.

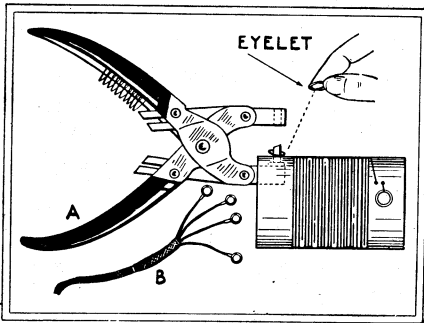


FIG. 9—A, simple eyelet punch used to form terminals on a coil; B, a cable with neat eyeletted terminals.

### A CONVENIENT TERMINAL

By Russell L. Woolley

MORE and more, pressed eyelets are being used in the manufacturing of radio parts. Radio-frequency transformers, R.F. choke coils, connector strips, and the ends of the wires of a cable are all parts of a radio receiver where eyelets may be used to advantage. Perhaps the most notable example of the use of punched eyelets is the A. K. terminal strip.

Now then, the point is that the set builder may also use this comparatively simple manufacturing process, with practically no expense; and at the same time, make a really neat job of his experimental home-made apparatus.

The use of the punch and eyelet kit is illustrated in the accompanying drawing. Here the punch pliers is shown, inserted into a hole drilled in the solenoid coil form. To use, without removing punch from hole, put on the eyelet over the punch—small end down—and close tool. (Fig. 9A.)

A second illustration, suggesting the use of punched eyelets, shows a dynamic speaker's four-wire cable with eyelet terminals. It is apparent that, when these terminals are put on a 6/32 or 8/32 machine-screw binding post, they cannot come loose. (Fig. 9B.)

### RULING PEN HANDY TOOL

By Arthur Bernd

IN putting nuts on bolts in tight corners and down deep in the set, I use a

draughtsman's steel ruling pen, which (as you know) is shaped like a pair of tweezers, with a stud running through to tighten it.

By placing the nut in the ends of the pen and screwing down on the stud, it is easy to set the nut on the bolt; after a few turns the pen is withdrawn and the job finished with a "spin-tite" or wrench.

### REPAIRING SCREEN-GRID TUBES

By Frank C. Atkinson

DON'T throw away a screen-grid tube if the control-grid tip should pull off the top, leaving only the lead sticking up. Clean out the cap, and around the top of the bulb; clean the end of the control-grid wire, and solder to it a short length of fine wire.

Then, procure from a paint store a small amount of litharge (yellow oxide of lead) and a small quantity of gly-

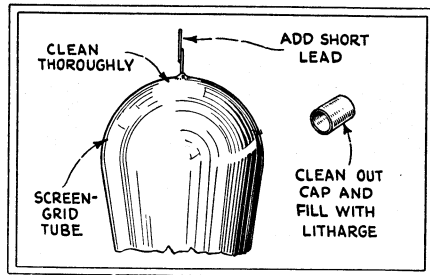


FIG. 10—The loosened cap of a screen-grid tube may be cemented back into place, quite satisfactorily, in the manner shown.

cerine. Mix a small quantity of the litharge into the glycerine, until a stiff paste is formed; pack the grid cap with this, and run the control-grid lead of the tube through the paste and out from the small hole in the cap. Press the cap down upon the glass, clean away the excess paste; and allow this cement to set for twenty-four hours. Then clean the cap, and solder the end of the wire to it; and the job is finished. You will find the tube as good and as strong as new; I have used this method for some time and it has never failed me. (See Fig. 7.)



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