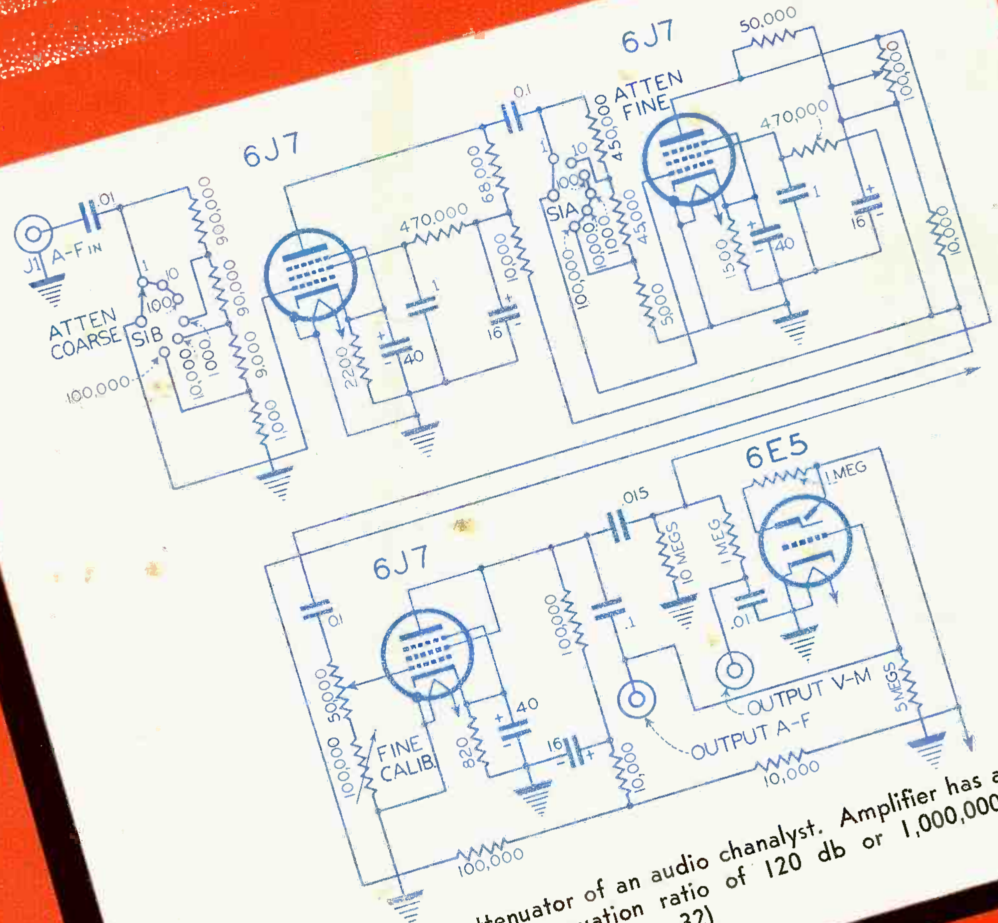
SERVICE

A MONTHLY DIGEST OF RADIO AND ALLIED MAINTENANCE



A high-gain amplifier and attenuator of an audio chanalyst. Amplifier has a sensitivity of 173 microvolts and attenuation ratio of 120 db or 1,000,000 to 1.
(See page 32)

★ RADIO
★ TELEVISION
★ ELECTRONICS

October
1943

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EDITORIAL

FEW phases of the industry have had such spectacular professional support, recently, as *television*. Specialist after specialist has gone "all out" in praise of the future of this video art. If only a few of these enthusiastic predictions come true, there will be mighty busy days ahead for the Service Man.

Commenting on the future of television, James Lawrence Fly, FCC chairman, said before several hundred radio executives at a meeting in Boston, "Wartime research has provided us with great improvements for this industry and we will have a 'durn sight' better television after the war. . . . And as soon as the war is over, we are 'going to town' with television."

In Hollywood, at the recent SMPE Convention, Klaus Landsberg, director of television at Paramount Pictures, pointed out that television will be a tremendous industry after the war. He said we are all ready for it and await only the cessation of hostilities to begin television activity on a giant scale.

This time it appears as if television means business!

THE shortage of materials has made it difficult to maintain prewar quality in all types of batteries. Thus battery life has not been up to par in many instances. In some cases this decrease in life was caused by the use of inferior solder due to an inadequate supply of tin. This condition existed for some months. In another case, it was necessary to use a substitute for acetylene carbon (used to extend the life of batteries), since the material is used in military batteries. Fortunately some of the problems have been ironed out and as war conditions improve, other solutions will appear, too. Incidentally, the WPB advises now that the production of batteries has been increased to accommodate the estimated 3,200,000 battery sets in non-electrified farm areas.

THE National War Fund Drive is on. Funds will be directed to *all* the relief agencies of *all* the United Nations. So give *all possible* to this vital cause!

SERVICE

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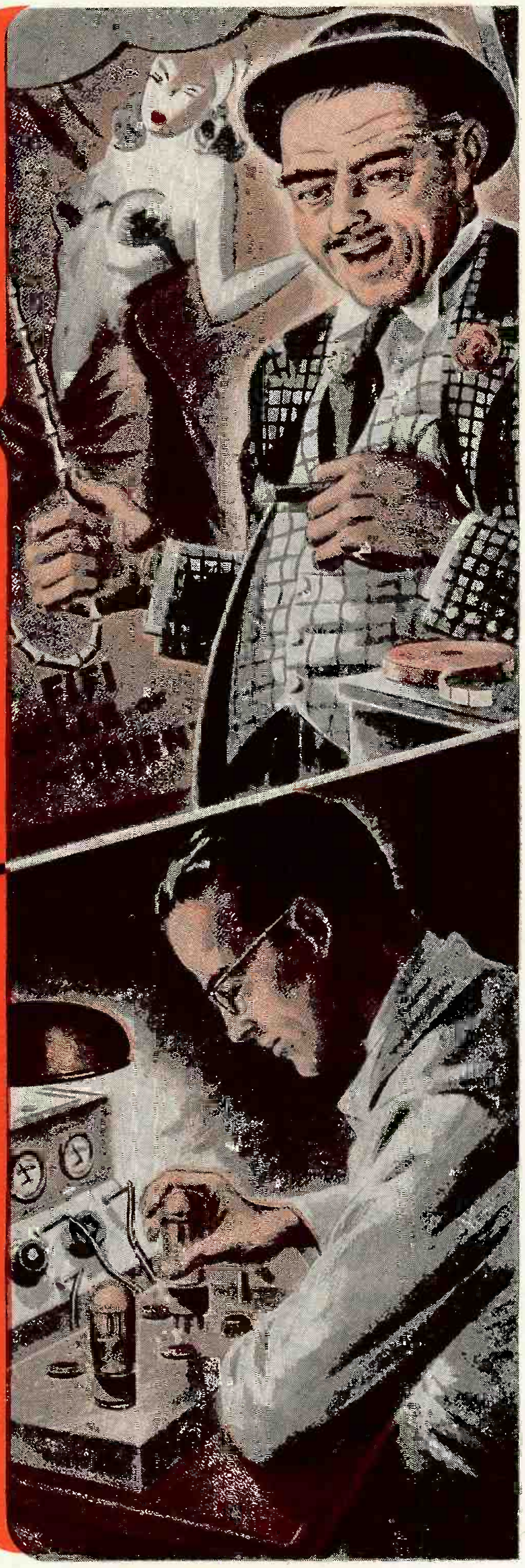

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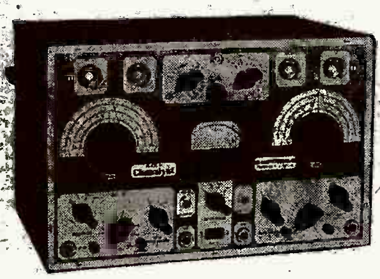

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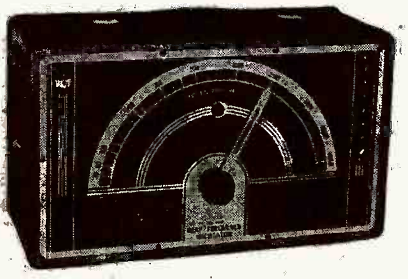

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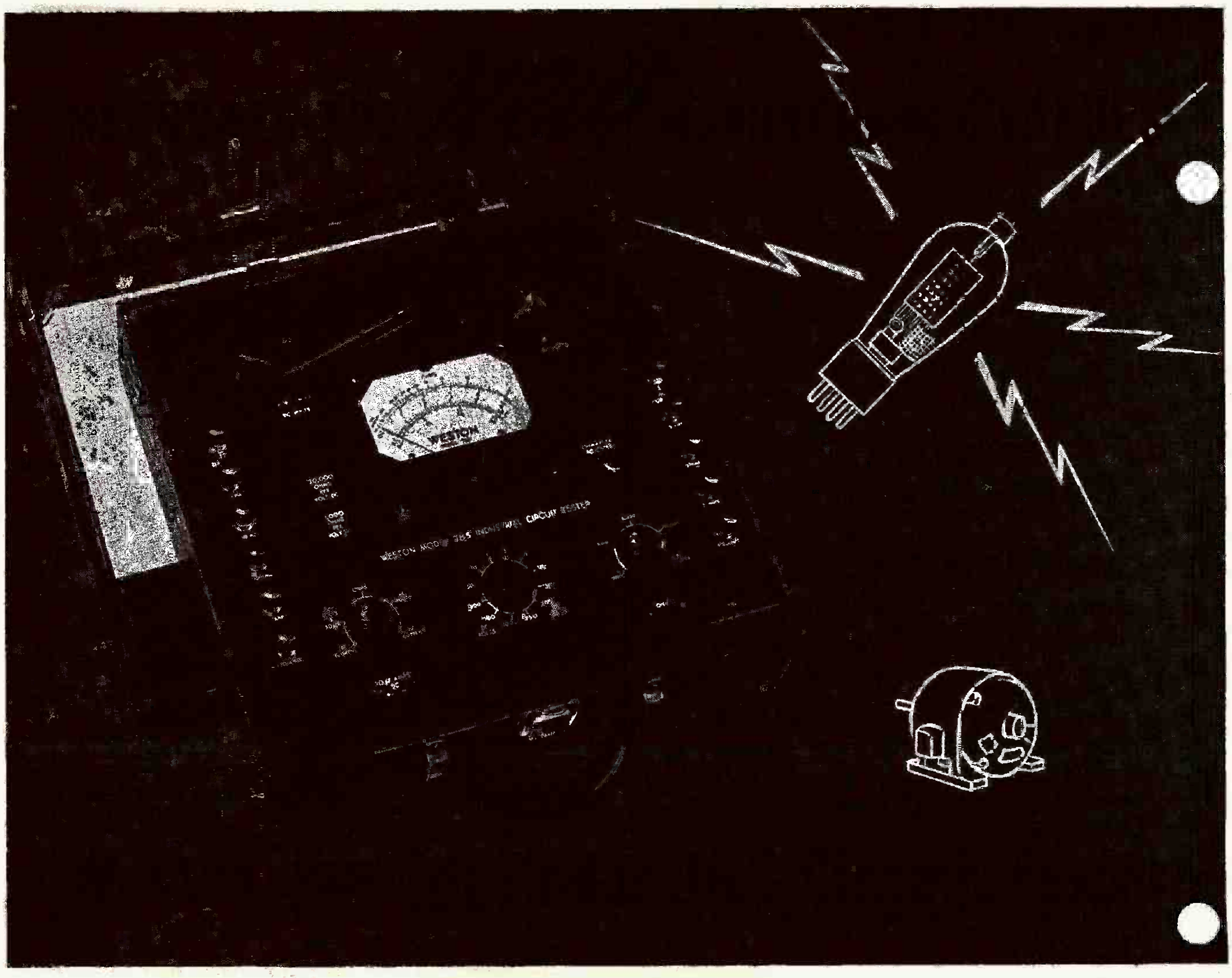

RANGES

D-C Voltage—*Measurements from 10 millivolts to 1000 volts (20,000 ohms per volt) in full scale ranges of: 1/10/50/200/500/1000 volts. (Up to 5000 volts with very compact external multiplier.)*

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SERVICE
A Monthly Digest of Radio and Allied Maintenance

A VERSATILE POWER SUPPLY

By M. E. HELLER

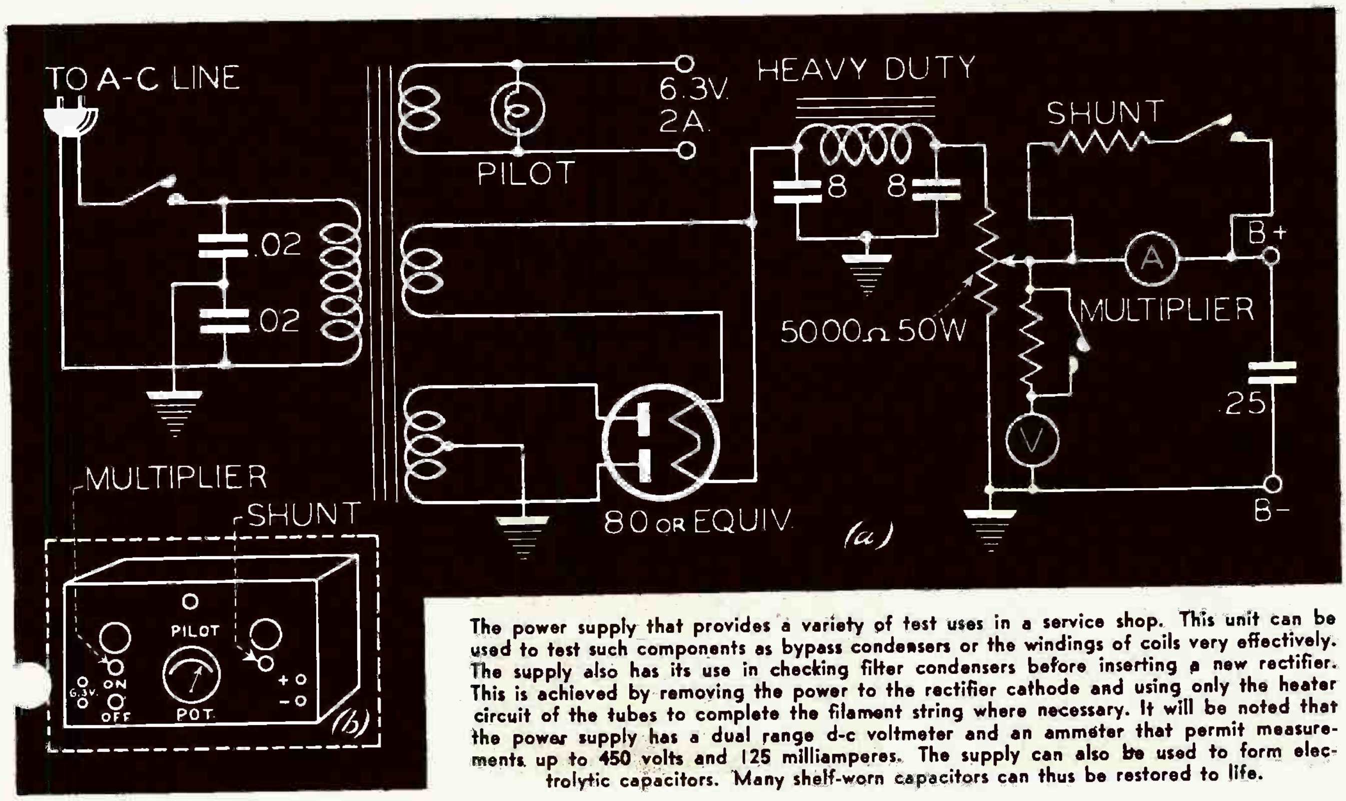
A POWER supply can serve many purposes in addition to supplying power. With oversized transformers and chokes as used in the unit shown in Fig. 1, the number of applications are increased manifold. A dual range d-c voltmeter and ammeter permit measurements over a range up to 450 volts and 125 ma.

The unit is valuable in connection with receivers and amplifiers and may also be used with test equipment of many types, electronic hook-ups, especially of the quick, breadboard style, oscillators, phototube circuits, vacuum tube voltmeters, etc. In receivers, it will, of course, serve as a *B* supply. But it is much more useful. How many times have you had an intermittent set which defied diagnosing or one that popped occasionally but would not give up? It would probably have surrendered with an application of voltage. This power unit would serve very well to replace the receiver's *B* supply for this purpose. Caution must be observed in holding the overvoltage to reasonable limits so as not to ruin components which may not be involved. For example, if a suspected bypass condenser or primary coil in an intermittent set refuses to break down at the maximum rated voltage of the electrolytic filter condensers, either the condensers should be disconnected or the high voltage should be applied only to the parts suspected before increasing the voltage.

In replacing a burned-out rectifier tube in a universal portable or a-c/d-c receiver, it is a good policy to check the filter condensers before inserting a new tube because these rectifiers can't take it when a short circuit occurs. They may be damaged if not blown out. By removing the *B* supply from the rectifier cathode and using only the heater circuit of the tube to complete the filament string where necessary, this unit may be connected as a supply to determine the defective condenser. It may be similarly substituted in auto receivers when trouble exists somewhere in the vibrator circuit. With the set operating properly, the entire filter system is cleared of suspicion, leaving only the power transformer, buffer and filter condensers on the 6-volt side. These may then be checked individually.

The supply is also ideal for forming electrolytic condensers of any rating, the progress being determined by the current taken. In general, Service Men are lax in reforming condensers which have rested on the shelf for years. The heavy current that may occur in placing them immediately into service will probably ruin them prematurely.

Another use for the unit is the checking of high wattage resistors; measuring the actual wattage and resistance under various operating conditions. It may similarly be used for determining the minimum or optimum field conditions in electro-dynamic speakers. Some speakers sound squawky when the field is operated too low. A small increase may considerably improve the quality. It's easy to find out!



The power supply that provides a variety of test uses in a service shop. This unit can be used to test such components as bypass condensers or the windings of coils very effectively. The supply also has its use in checking filter condensers before inserting a new rectifier. This is achieved by removing the power to the rectifier cathode and using only the heater circuit of the tubes to complete the filament string where necessary. It will be noted that the power supply has a dual range d-c voltmeter and an ammeter that permit measurements up to 450 volts and 125 milliamperes. The supply can also be used to form electrolytic capacitors. Many shelf-worn capacitors can thus be restored to life.

CONTROLLED RECTIFIERS

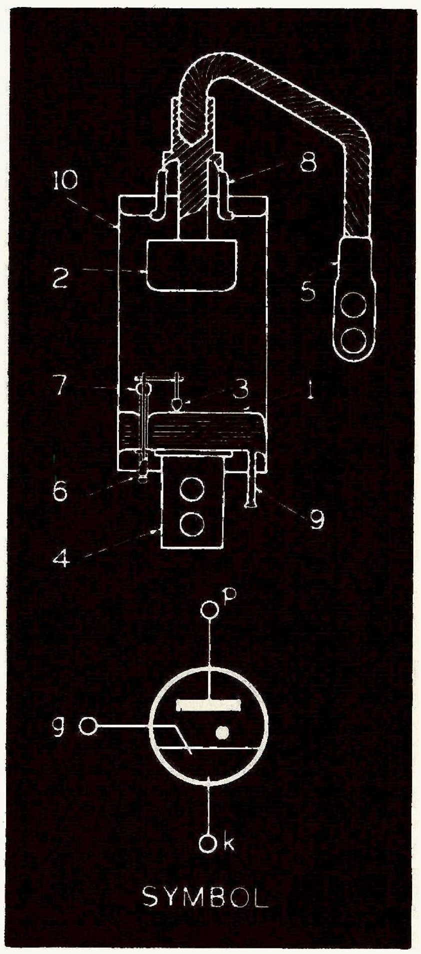
By S. J. MURCEK

SINCE, by reason of applied economics, commercial electrical energy is delivered in a-c form, it is to be expected that certain problems will arise in the application of such energy. Alternating current energy is not directly suitable for a great number of applications.

Among electrical power applications of high commercial importance are electro-plating, drive motor speed regulation, generator output voltage regulation, and radio transmitter power supplies. Each of these applications requires d-c energy, of varying degrees of freedom from modulation.

Prior to the evolution of the electronic art, d-c energy for the above cited applications was derived from a-c power sources with dynamo-electrical machinery,. We refer to motor-generator sets, rotary converters, and synchronous mechanical rectifiers. These devices were usually bulky and cumbersome, high in initial and maintenance costs.

Fig. 1. The internal construction of an ignitron—the cold cathode rectifier tube.



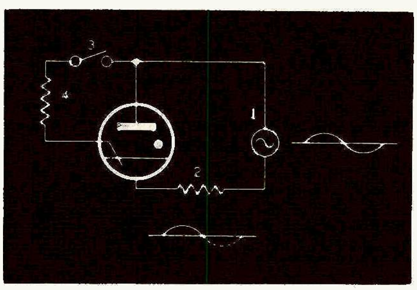
With the rise of the electronic art, the controlled electronic rectifier made its appearance. This rectifier is low in initial cost, and requires only a comparatively nominal amount of maintenance. Its general acceptance for application to various uses has resulted in the sale and installation of great numbers of such units, in various forms. Power handling capacities of these rectifiers range from a few watts to power levels approaching street railway supply demands.

The operational theory of these controlled rectifiers is similar for each device, regardless of its power capacity. Deviations from the basic theory which may occur are due entirely to certain specific requirements of a few special applications. Generally, however, the underlying control circuits are the same, even in these special cases, as those of the simpler rectifiers.

Rectification, in the electronic rectifier, is dependent on the operation of a single component device, the electronic rectifier tube. This tube, itself, may vary to some extent in constructional and operational detail. Thus, it may be a simple vacuum triode, a thyratron, or even a cold cathode controlled rectifier tube. An example of the latter type is the ignitron.

Essentially, the ignitron is a cold-cathode rectifier tube which is capable of operation at relatively low voltages. The internal construction of the tube is shown in the pictorial diagram of Fig. 1. The tube envelope *10,* instead of being blown from hard glass, is fabricated from metal. In the bottom of the envelope is the cathode *1,* which is a pool of mercury. The envelope, being in contact with the pool, functions as a cathode shield. Suspended above the pool is a large graphite anode *2.* A third electrode *3* has its tip immersed in the cathode pool. This electrode is termed the ***igniter.*** Mechanical details of the tube include the metal-to-glass shields *7* and *8*; the electrode lugs *4, 5,* and *6*; and the exhaust tubulation *9.* The last mentioned detail corresponds to the glass exhaust tip of the conventional glass-enveloped tube. In practice, the ignitron is clamped in a water-cooled, or air-blast cooled clamp. This additional cooling increases the ability of the tube to dissipate higher current losses.

Fig. 2. The ignitron connected as a rectifier.



In operation as a rectifier, the ignitron is connected in series with the a-c supply *1* (Fig. 2), and the load resistance *2.* When the switch *3* is open, the ignitron does not conduct. Closure of this switch when the anode of the ignitron is positive with respect to the cathode permits a current, limited by the resistor *4,* to flow through the igniter from the cathode pool. Within several microseconds, a sensitive crystal on the surface of the igniter heats to incandescence, vaporizing mercury and liberating free electrons. These electrons are attracted by the positive charge on the anode, thus establishing an initial, or *leader* current which vaporizes still more mercury and liberates greater numbers of free electrons. This is due to the intensified and enlarged surface of the *cathode spot.* This process continues until sufficient mercury is vaporized and ionized to support the conduction of the load current through the tube.

The ignitron tube continues to conduct as long as the anode remains positive with respect to the cathode pool. When the anode swings negative with respect to the pool, the latter becomes the anode. Since this electrode is the *emitter,* the solid anode being incapable of liberating electrons under normal temperatures, the tube will not conduct. It may be seen from the foregoing that the tube functions as a rectifier, in a manner nearly identical with that of the gaseous thyratron tube.

When functioning as a rectifier, it has been shown that the ignitron ceases to conduct during the negative half-cycle of the applied a-c voltage wave. Also, once the tube ceases to conduct, control is reestablished, and the igniter must again be subjected to a voltage impulse to initiate conduction. Thus, the igniter must receive a voltage impulse at the beginning of each positive half-cycle. Otherwise, the tube functions, and may be controlled through application of circuits

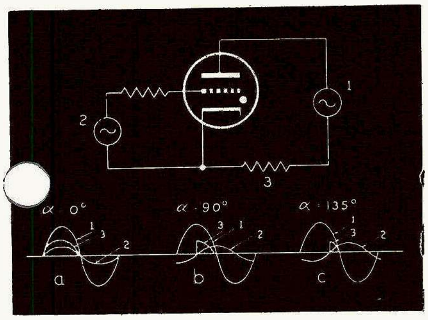


Fig. 3. Graphical representation of phase relationship under control conditions.

similar to those used in conjunction with thyratron tubes.

Commercial rectifiers, especially where currents of appreciable magnitude are required, utilize thyratrons and ignitrons as the rectifying elements. Various forms of grid control, depending on the rectifier application, are used in these rectifiers, for direct control over the tube conduction.

The most effective form of rectifier tube control involves the application of an a-c voltage wave, between the grid and cathode of the tube, the phase relationship of this voltage wave being variable with respect to the voltage wave impressed between the anode and cathode of the tube. Fig. 3 is a graphical representation of the phenomena present under such control conditions.

In the instance of the ignitron, it has been shown that, in order to cause the tube to conduct a complete half-cycle, it is necessary to fire the tube at the start of each positive a-c half-cycle. Under like conditions this is equally true of the thyratron. In Fig. 3*a*, it is shown that the tube under phase shift control conducts a full half-cycle of the a-c anode to cathode voltage wave *3* when the phase difference between the anode and grid voltage waves is zero electrical degrees.

If, however, the grid voltage lags behind the anode voltage at an angle of 90 electrical degrees, as in Fig. 3*b*, the tube conducts only a portion of the available anode load current *3*. Since the *average* time during which the tube conducts is less than is true of Fig. 3*a*, a further increase in the grid voltage phase lag, as in Fig. 3*c*, causes the tube to conduct over a further reduced period. This reduces the average anode current to a proportionately greater degree. From this it is evident that the average current conducted by a thyratron or other gas tube, is proportional to the period during which the tube conducts, in each half-cycle of the a-c voltage wave.

The current conducted by a thyratron under phase-control is conducted as a series of pulsations. The duration of these pulsations depends on the degree of phase-shift control, and the frequency of the conductions depends on the a-c frequency applied to the tube circuit. Thus, a d'Arsenval ammeter connected in series with the thyratron cathode reads a current value which lies between the peak and zero values of each pulsation. This is termed the *average* value of such a current, the current average varying directly with the degree of phase-shift control applied to the thyratron grid circuit. Where the phase-shift angle is zero with respect to the anode voltage wave, and the a-c wave form applied to the tube circuit is of sine curvature, the average conducted current value is 31.8 per cent of the peak current conducted by the tube.

Further, the average value of the rectified current conducted by a thyratron, as read with a d'Arsenval or moving coil meter, differs from d-c of similar magnitude in that the former is not a measure of the true power being dissipated in the tube circuit. However, the true power value of the average current may be readily compared with d-c of equal magnitude by comparison of the heat-producing characteristics of each, since the power dissipated in a given resistance varies directly as the square of the current conducted by that resistance. Thus

$$P = I^2R, \text{ where}$$

P is the dissipated power in watts, and R is the ohmic value of the resistance. Here it may be seen that the average current required to develop a temperature equal to that produced by d-c current differs to some extent from the d-c value. This new average current value is termed, from mathematical analysis of the problem, the *root mean square* value of the average current. In most instances, the root mean square value of the average current does not deviate appreciably from the average current reading. Therefore, the average value is practical for most rectifier applications, excepting those involving precise control of the developed temperature or delivered power.

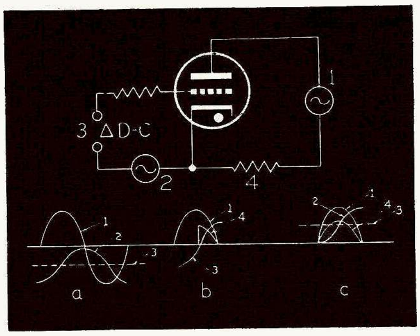


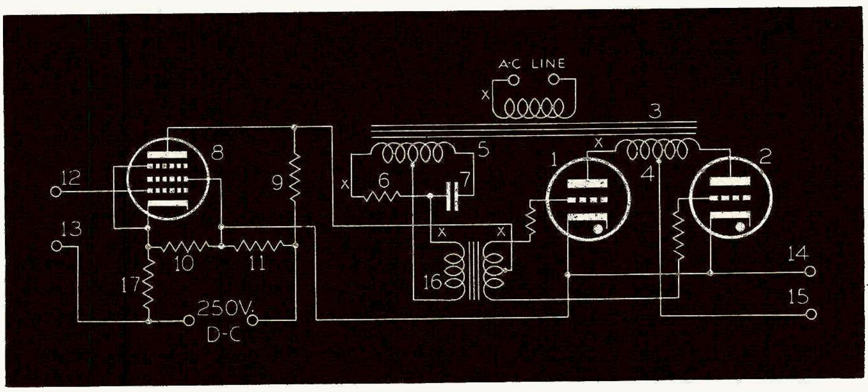
Fig. 4. A practical form of gas tube phase shift control is explained in the graphs . . . a, b, and c.

A more practical form of gas tube phase shift control is shown in the graphs of Fig. 4. In the circuit sketch an a-c voltage is impressed across the thyratron and series load resistor. A second a-c voltage, lagging the anode voltage by ninety electrical degrees, is connected between the cathode and grid of the tube. In series with this second a-c voltage is a variable and reversible d-c voltage. When this d-c voltage *3* of Fig. 4*a* is such that the tube grid is negative with respect to its cathode, and the d-c voltage exceeds the crest amplitude of the a-c series grid voltage *2*, the grid of the tube remains negative with respect to the cathode, and the tube does not conduct.

If, however, the d-c component is zero, as is the case in Fig. 4*b*, the a-c grid voltage *2* drives the tube grid positive 90 degrees late in the positive half-cycle. Therefore, the tube conducts only over half of the positive a-c alternation *1*.

In Fig. 4*c*, where the d-c grid voltage component *3* is positive with respect to the tube cathode, and is greater than the crest amplitude of the a-c grid voltage *2*, the grid of the tube does not swing negative with respect to the cathode. Under these conditions, the tube is conductive over the entire a-c positive alternation.

Fig. 5. A d-c amplifier linked to a rectifier for control purposes.



From the graphs of Fig. 4, and the foregoing discussion, it is evident that the average current conducted by the thyratron is directly dependent on the magnitude and polarity of the d-c grid voltage component. This assumes importance when the rectifier is subjected to control by a suitable d-c amplifier. Such a circuit is given in Fig. 5, in which the output voltage and current of a full-wave rectifier, consisting of thyratron tubes *1* and *2*, vary with the d-c voltage impressed between the control grid and cathode of the pentode amplifier tube *8*.

The voltage which appears between the junction of resistor *6* and condenser *7*, and the center tap of the winding *5* on transformer *3* is late with respect to the line voltage wave. This voltage is in series with the d-c output voltage supplied by the plate circuit and power supply associated with the amplifier tube *8*.

Thus, when the control grid of tube *8* is positive with respect to its cathode, the plate of this tube is negative with respect to its shield grid. As a result, the grids of the thyratron rectifier tubes do not swing positive with respect to their cathodes, and these tubes do not conduct.

Conversely, if the control grid of tube *8* is negative with respect to its cathode, the anode of this tube is then positive with respect to its shield grid. Here, the control grids of the thyratrons are always positive with respect to their cathodes, and the output of the rectifier is at a maximum.

Obviously, from this, the rectifier power output may be varied from zero to maximum, over a continuous range. Further, this effect is secured by the variation of the control grid of the amplifier tube *8* with respect to its cathode, over a range of a few volts. If terminals *12* and *13* in Fig. 5, are connected with a suitable phototube circuit, for example, the d-c output voltage at terminals *14* and *15* could then vary inversely with the illumination on the phototube.

It should be observed, from Fig. 5, that the lagging a-c voltage wave derived from transformer winding *5* is connected to the primary winding of a grid matching transformer *16*. This transformer is of the center-tapped secondary, or *push-pull* type. The *start* and *finish* leads of this winding each connect to a thyratron control grid; i.e., the tube a-c grid components are 180 electrical degrees out of phase with each other, and *each lags its corresponding anode voltage by 90 electrical degrees*. That is, where the rectifier thyratron is to be controlled by a varying d-c voltage, each thyratron concerned must possess, in series with that grid voltage, an a-c voltage component which lags the anode to cathode voltage wave by 90 electrical degrees. This is especially important in polyphase rectifier systems.

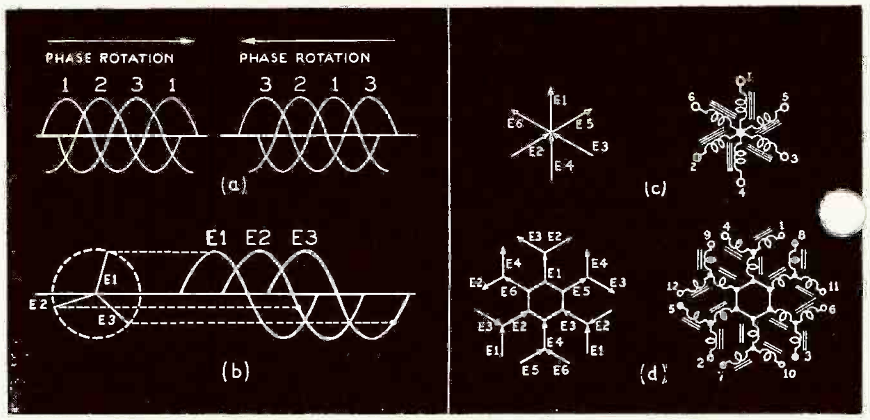
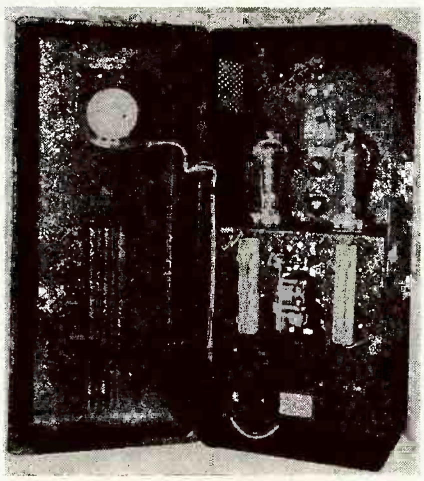


Fig. 8. Symmetrical systems with their phase relationship. Arrangements of 3-, 6- and 12-phase systems are shown here.



(*Courtesy Westinghouse*)
Fig. 7. A phase shift igniter control.

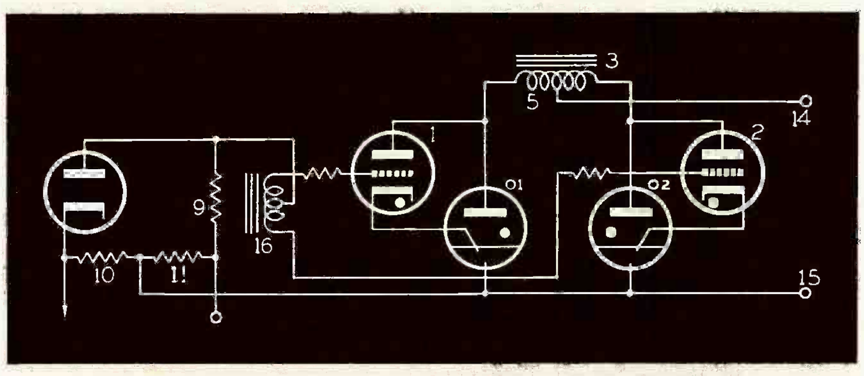


Fig. 6. Thyratron tubes control igniter electrodes of ignitrons in this circuit.

Thyratron tubes *1* and *2* of Fig. 5, instead of supplying actual output power, may be utilized to control the igniter electrodes of a pair of rectifier ignitrons, as is shown in the partial schematic of Fig. 6. In this circuit variation, thyratron *1* is now in series with the igniter of the ignitron *01*. Once the thyratron begins to conduct, the igniter of tube excites it into conduction. When the ignitron conducts, the voltage between its anode and cathode is insufficient to support conduction by the thyratron. Thus the latter ceases to conduct for the balance of that alternation. This is also true of the operation of thyratron *2* and ignitron *02*. A thyratron applied in this manner is often referred to as an igniter control tube.

Fig. *7* illustrates a commercial controller intended for manual phase-shift control of ignitron tubes in combination with igniter control thyratrons.

Electronic rectifiers are produced as controlled poly-phase systems for most applications. In these systems, the load current is commutated from a given tube to a successive tube or tubes, in such a manner that the d-c output voltage does not fall to zero at any time during the operation of the unit. It is conventional to supply power to such a device from a conventional three-phase line.

Commercial three-phase power is supplied through the medium of a three-conductor electrical system. When such a system is in a *balanced* state, the potential or voltage reading across any two of the conductors is equal to that obtainable between these conductors and the remaining one. The frequencies of all three voltages are alike, except that each voltage maximum is succeeded by the next 120 electrical degrees, or two-thirds of a

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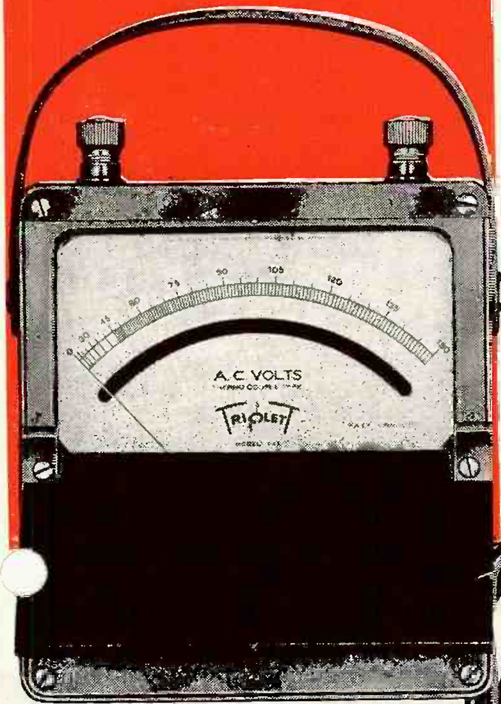

TRIPLETT
MODEL 645 PORTABLE

The hinged cover provides protection to instrument glass during carrying. Especially important when carried with other equipment. Opens flush and provides a smooth case open or closed.

The molded mechanical shield excludes dust, and allows replacement of plug-in thermocouples or rectifiers without exposing sensitive mechanism of instrument. Also, it protects the movement from possible damage when the case is open.

The Plug-in feature permits pre-calibration of thermocouples or rectifiers. Plug-in units are interchangeable. No recalibration of the instrument is required. In case of burn-out of a thermocouple or a rectifier a new one may be secured and replacement effected without returning instrument to factory.

For additional engineering information Model 645 and other instruments of the same case style write for 645 data sheet.

★

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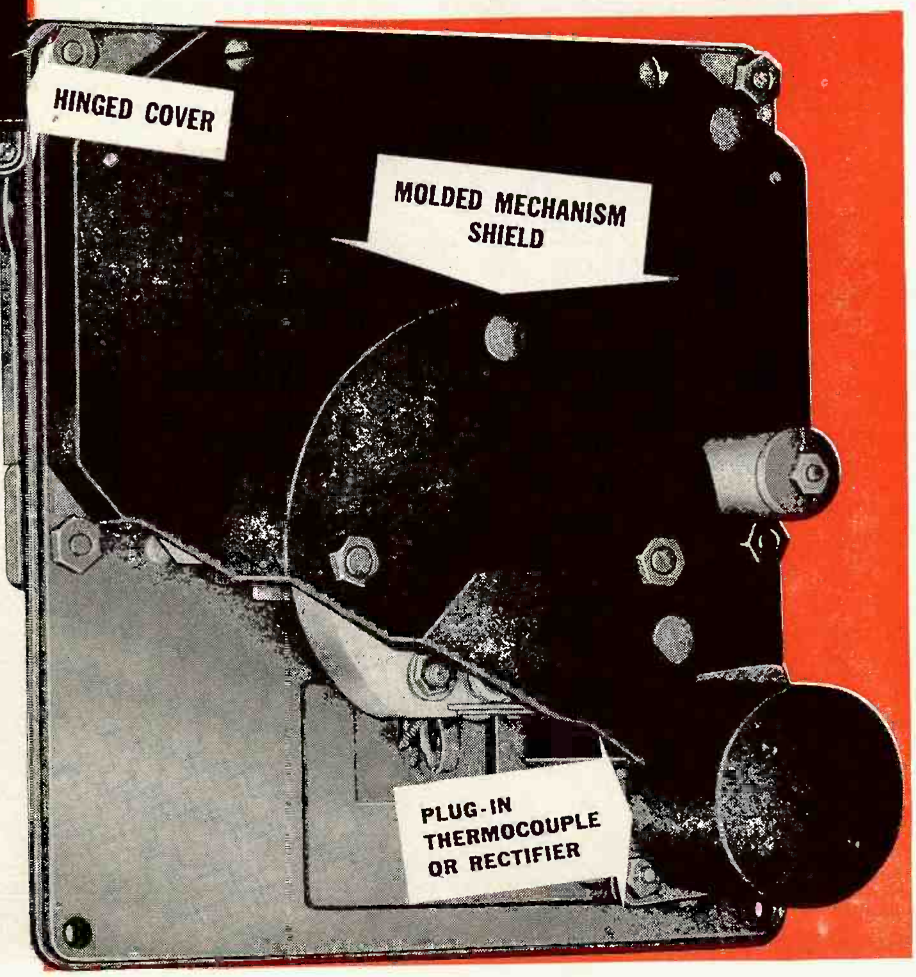


cycle, later. These voltage and frequency relationships are shown graphically in Fig. 8*a*.

Fig. 8*b* illustrates that these voltages, and their electrical, or *phase* relationships, may be shown vectorially.

Mathematically, the systems of Fig. 8 are known as *symmetrical systems,* since the reactions present at any instant, in such a system, are symmetrically related with each other. Since any symmetrical system may be subdivided into its basic components, it follows that these, or portions of these subdivisions, may be reassembled in any desired manner, provided the final system bears a distinct relationship to the original system. Thus, the original three-phase system of Fig. 8*a* may be rearranged into the six-phase system of Fig. 8*c* or the twelve-phase system of Fig. 8*d*. These vectorial rearrangements are also shown in the actual electrical form, the actual origin of each winding voltage being indicated in each system.

Rectifier systems employing six or more phases are common in industrial applications. In the average radio broadcast or commercial installation, gas diodes, such as the RCA 872 are used, instead of thyratrons or ignitrons, since no control over a rectifier is needed. However, commercial industrial rectifiers require close regulation, necessitating the use of thyratrons as the control medium.

It has been shown that the grid voltage a-c component, in a thyratron rectifier under d-c phase-shift control, must lag the anode voltage by an electrical angle of 90 degrees. This requirement saddles the single-phase type of rectifier with the need of a reactive phase-shifting or *phase-splitting* system, such as has been discussed for the circuit of Fig. 5. In the instance of the polyphase system, however, the 90-degree lagging voltage is readily secured through the addition of suitable secondary windings to the anode transformer. These additional, or *grid*, windings are so selected that their vectorial sum is a voltage having a 90-degree lag with respect to the anode winding.

An arrangement of this nature results in a compact, but intricate, rectifier control and power system. Despite the numerous windings which are to be found in the transformer for such a rectifier, the identification of each winding lead is relatively simple. The reliable manufacturer provid[illegible]n such transformers, leads with [illegible]r coded markings or numbered tags. Even without such markings, however, identification is possible by visual diagnosis. The heaviest leads are those of the primary system (any other large size being the anode leads), and the smallest in diameter are the grid coil leads. Further, each lead may be traced directly to the origin, this being the coil from which it protrudes. Now, since the coil position is known, as is also the *start* or *finish* nature of the particular lead being identified, it follows that the location of the lead in the system is established, and may be so marked. This procedure is especially useful in transformer replacement operations, serving as a standard against errors in manufacture.

A study of Fig. 9 will facilitate polyphase rectifier trouble and repair diagnoses. This diagram illustrates the manner in which the anode and grid circuits of a three-phase full-wave rectifier system are wired, and the manner in which the 90-degree lagging grid voltage is produced. It should also be observed, from Fi[illegible] that all tubes shown are thyrat[illegible]. This factor is of importance in recti-

(*Continued on page* 28)

Fig. 9A. The transformer primary circuit of a 3-phase line used in conjunction with the circuit shown below.

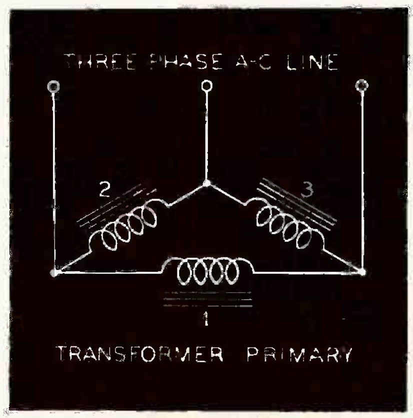
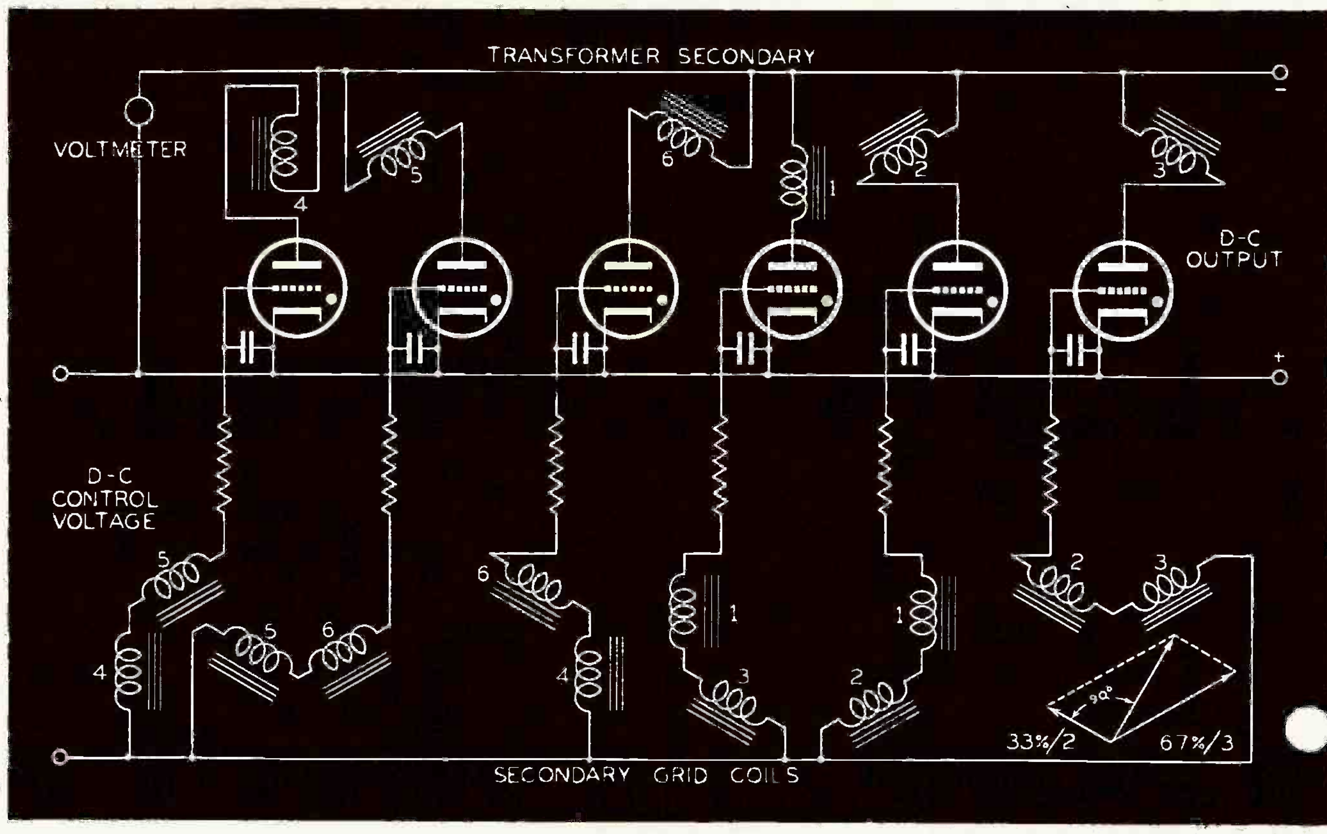


Fig. 9. A 3-phase full-wave rectifier system using thyratrons.



"FIRST AID" TO TEST INSTRUMENTS

By ALFRED A. GHIRARDI

Advisory Editor

PART III. MAINTENANCE AND FACTORY REPAIR

SERVICE Men often suspect their indicating instruments of having developed large errors and then, not having available accurate standard instruments with which to compare them, they proceed to check their accuracy by makeshift methods that lead to incorrect conclusions. Such tests are usually misleading. As a result of them, Service Men often make unjust complaints to instrument manufacturers about the accuracy of their instruments — complaints which indicate incomplete knowledge of instrument characteristics and instrument accuracy.

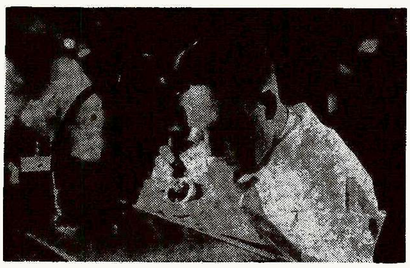
A favorite such complaint (see Fig. 1) is that though a 110-volt house or shop supply is used to test all a-c voltage ranges of the instrument, a different reading is obtained on each range; therefore, the instrument is not accurate.

Why is it possible to obtain a different reading on each range of a perfectly good, accurate a-c/d-c voltmeter, even though the applied voltage is exactly the same each time?

Assume that the instrument, with ranges of, say, 0/7/35/140/350/700/1,400 volts, has the usual 2% accuracy for d-c voltage measurements and 5% for a-c measurements. Since a 110-volt *a-c* line is being used as the voltage source for checking, the 5% accuracy figure is the one to be considered. Remember that the manufacturer's guarantee that the instrument is accurate within 5% on a-c means that on each range it is accurate to within ±5% of the full-scale value *of that range*. On the 7-volt range, for instance, this would mean that the instrument was accurate to within plus or minus 0.35 volt (5/100 × 7) at any point on the scale; the tolerance on the 35-volt range would be plus or minus 1.75 volts (5/100 × 35), etc.

The permissible reading variation limits for the remaining ranges, for 5% tolerance, have been calculated and tabulated:

RANGE	READING LIMITS (Voltage Tolerance 5% plus or minus)
7 V.	± 0.35 V.
35 V.	± 1.75 V.
140 V.	± 7.00 V.
350 V.	±17.5 V.
700 V.	±35.0 V.
1,400 V.	±70.0 V.

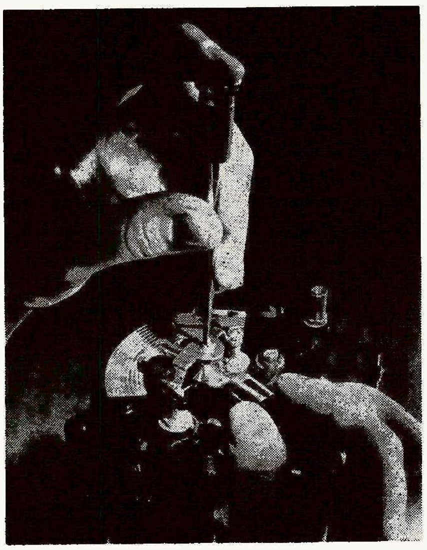


(*Courtesy General Electric*)

Miniature instruments under inspection at a factory.

Since the instrument is accurate to within 5%, when the 140-volt range is connected to the 110-volt a-c supply, it may properly indicate any voltage between 103 and 117 (110 minus 7 volts, and 110 plus 7 volts). If the 350-volt range is connected to the same 110-volt source, the reading may properly be anything between 92.5 and 127.5 volts (110 minus 17.5 volts, and 110 plus 17.5 volts). On the 700-volt range, the indication could properly be any voltage from 75 to 145 volts and still be within the proper tolerance. If any such readings were obtained during the test, the instrument could not properly be considered as being below its specified accuracy. If the Service Man does complain that such an instrument is excessively inaccurate, *the fault lies not with the instrument*, but with himself. He is not allowing for the fact that the higher the instrument range employed, the larger is the permissible difference between the true value of the voltage being measured and the voltage *indication* or *reading* obtained.

Jeweled bearings being adjusted for an a-c ammeter by a factory specialist.
(*Courtesy General Electric*)



When comparing the reading obtained on one range with that obtained on a second range, the Service Man should also remember that the scale error on one range may be plus, while that on the other range may be minus. Thus, if the errors oppose each other, the difference between the readings obtained on the two scales will be equal to the *sum* of the two errors.

Also, whenever the instrument readings obtained by checking the same circuit of a radio receiver on two or more different ranges of the instrument are compared, it should be remembered that additional apparent discrepancies may be introduced by the fact that each range places a different amount of loading upon the receiver circuit being measured. For example, due to the fact that the series multiplier resistor in the 500-volt range circuit of a voltmeter has much higher-resistance than that in the 150-volt range circuit, the voltmeter draws more current from the receiver circuit under measurement when the 150-volt range is used, than if the 500-volt range is used to measure the same voltage. Therefore, any error caused by the *loading* effect of the voltmeter would be greater when the lower range is used.

With these important facts in mind, it is easy to understand the fallacy of checking the accuracy of several ranges of a multi-range instrument by connecting them, in turn, to one voltage source and expecting the reading to be the same on each range.

Incorrect to Check One Instrument Against Another of Equal or Lower Accuracy Rating

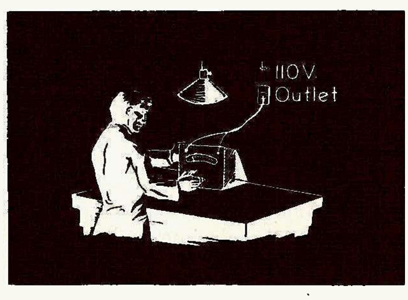
Another incorrect method of checking an instrument, practised by some Service Men, is illustrated in Fig. 2. The reading on the instrument to be checked (*a*), is compared with that on *another instrument* (*b*) *which has no better accuracy rating than the indicating instrument under test*. First, the ranges on the so-called comparison indicating instrument used may be quite dissimilar to those of the instrument tested; this, of course, can cause wide differences in the readings of the two instruments. Even if the ranges are similar, the readings will probably differ because the two instrument inaccuracies are not similar at various scale points. For instance, if the error at the 2-volt point on the scale of one instrument is 0.1 volt, there is not reason to believe that exactly the same error exists at the 2-volt point on the other instrument; it may be *more*—or *less* even though both instruments have the same accuracy rating. The differences may be as much as 50% or 60% of the reading if it is taken on the more-or-less inaccurate lower end of the scale. The percentage accuracy rating of an instrument does not tell exactly what the error *is* at each point on the scale—it tells only that the error *does not exceed* a certain amount. Therefore, since *both* instruments have inaccuracies, one should not be compared with the other nor judged by the other.

Checking one instrument against another is a reliable accuracy test only when the *comparison* instrument is *known* to have a *higher manufacturer's accuracy rating* than the one being checked, and when *inaccuracies* of the *comparison* instrument *are known at every point on every range.* This is the way instruments are calibrated at the factory—but a very accurate *precision standard* instrument is used for the purpose!

In your community it is likely that some organization has *standard* voltmeters and ammeters, of precision greater than your own, against which you can check the calibration of your equipment when necessary. A fact not generally known is that arrangements can often be made with the electrical or radio departments of local schools or colleges for such a check, at little or no cost to the Service Man. The instructor who has charge of the school's instruments, or a student who has access to such equipment, will usually cooperate. Likewise, the signals from your local broadcast stations can easily be utilized to check the calibration of your signal generators, etc.

It is well to remember that the reading of a d-c instrument will usually decrease when the instrument is mounted on a steel panel. The amount of decrease depends upon the particular instrument and the thickness of the panel. If the instrument is to be used on a steel panel it is well to check the accuracy while it is mounted on this same panel.

Fig. 1. Do not check the accuracy of your test voltmeter by comparing the readings on different ranges.



Incorrect to Check Instrument Accuracy by Checking on an Operative Radio Against Manufacturer's Charts

Another instrument checking method which leads Service Men to reach incorrect conclusions is that of checking the accuray of their test instruments by making voltage-current-resistance tube-socket analysis on new standard receivers just arrived from the factory. They compare the readings obtained with their test instruments against the value of the voltage-current-resistance charts supplied by the receiver manufacturer (see Fig. 3). There are several reasons why this

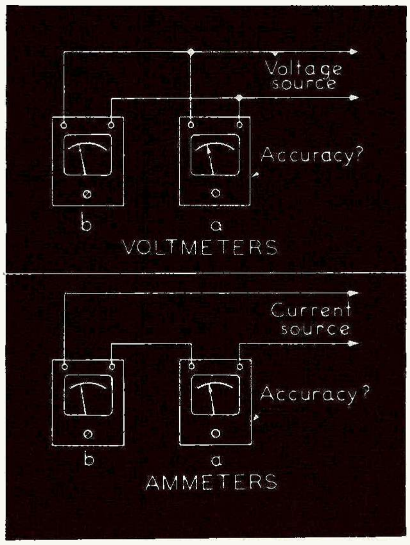


Fig. 2. Do not check the accuracy of an instrument (a) by comparing its readings with those of another instrument (b) of similar or unknown accuracy.

method will lead to incorrect conclusions:

(1)—The line voltage may not be of the exact correct value specified for the receiver.

(2)—Voltage, current and resistance check-valves supplied by receiver manufacturers for their sets are always specified with the understanding that a tolerance of *at least plus or minus* 10% should be allowed. Often, the allowable tolerance is as much as *plus or minus 20%!* How can such values be called standards by which to check an instrument having a rated accuracy of 2%?

(3)—When checking the voltage values, the instrument readings may not correspond with the values specified by the manufacturer, simply because the resistance of the voltmeter range used by the Service Man is not the same as that which was used

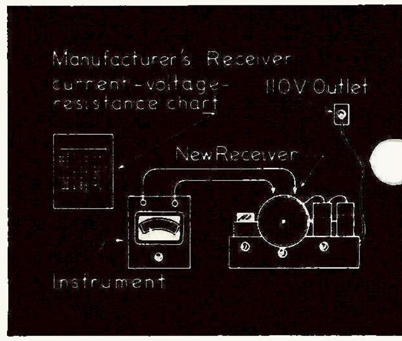


Fig. 3. Do not check the accuracy by comparing meter readings with those specified on manufacturers' analysis charts.

by the manufacturer when he made the initial test. The Service Man's voltmeter may load the circuit more (or less) than did the manufacturer's voltmeter—thereby changing both the current of the circuit and the voltage readings.

Factory Repair of Instruments

On the whole, it is probable that almost 50% of the repairs required by test instruments are within the ability of careful, competent radio Service Men to make. However, it is not always possible, nor desirable, for a radio Service Man to repair his own instruments. In such cases, they must be shipped to an authorized service station, or the original manufacturer for repairs.

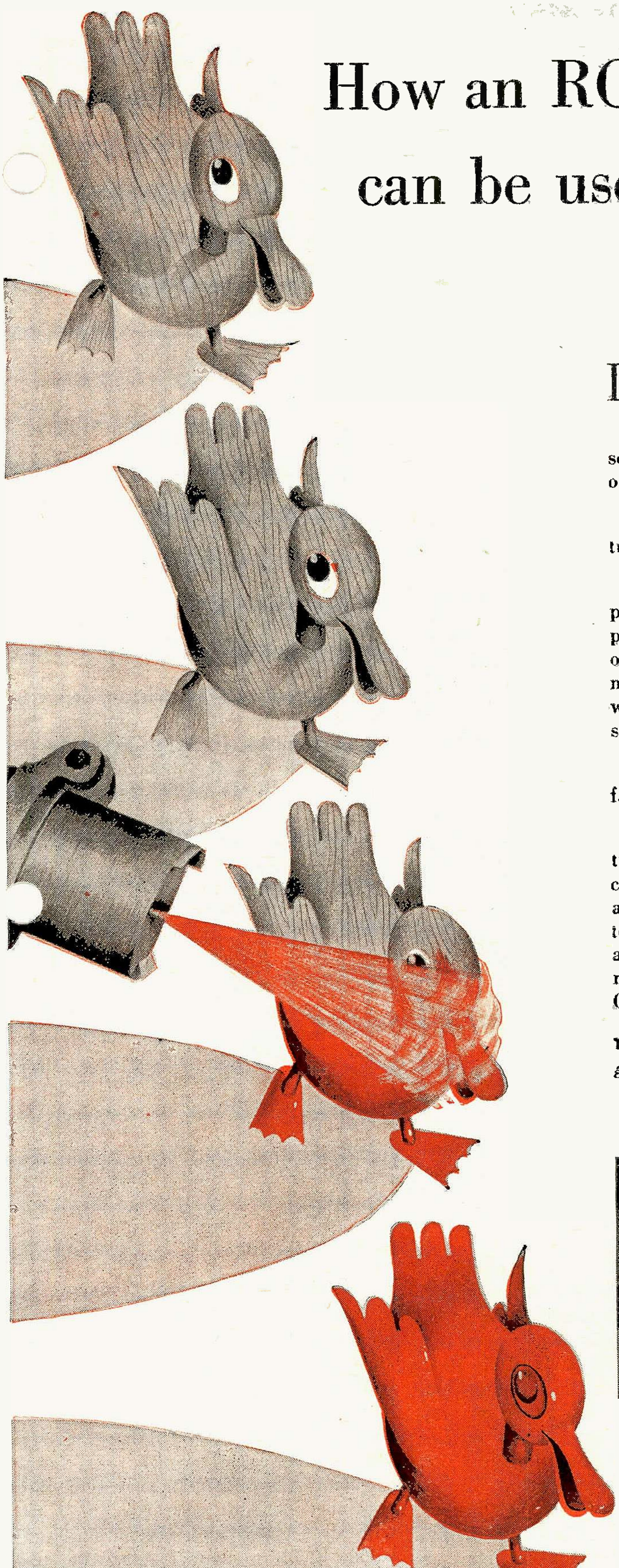
If instruments are to be shipped for repair or reconditioning the time consumed in handling the job will be greatly reduced if the procedure outlined herein is carefully followed.

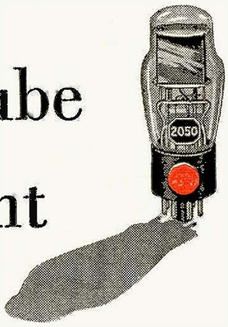
Before shipping an instrument to the factory or service station for any reason whatever, a letter giving *complete* information about its operation should *first* be sent to the Service Department. As many symptoms of the difficulty as possible should be described, including anything that will assist the factory service engineers to understand your problem. It is essential that both the type and serial numbers of the instrument be given so that the manufacturer's records may be checked and the history noted if necessary—also for purposes of identification when the instrument is sent along later. Upon receipt of this letter, if the manufacturer or service station desires you to send the instrument to them they will write you a letter of permission and include instructions concerning the method of return. *Not until these are received should the instrument be shipped!*

Factory Reconditioning of Instruments

Manufacturers and test instrument servicing organizations usually pro-

How an RCA Electron Tube can be used to save paint





IT'S been said that the Electron Tube can do more extraordinary things than any other device yet created by man.

And we don't mean the wild-eyed, sleight-of-hand sort of thing so many people have in mind when they talk about "The World of Tomorrow."

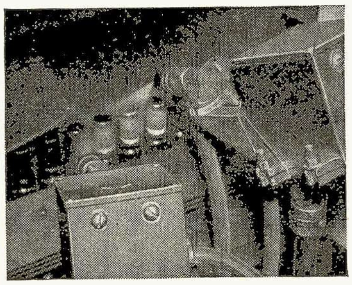
We mean cold, hard, practical things—like saving a manufacturer time and money—*today*, not day-after-tomorrow!

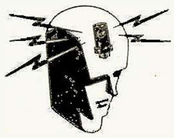
Pictured below, for instance, is a device used by RCA to save paint while spraying metal tubes. A conveyor carries the unpainted tubes in front of two spray guns and on into the baking oven. A control mechanism, built around an electronic switch, makes certain that the guns spray each tube completely but withhold the spray if, as occasionally happens, two or more successive tubes are missing from their sockets.

The principle behind this device can be used by any manufacturer who is interested in paint-spraying economies.

When you Distributors and Servicemen consider the opportunities the Electronic Age can open up for you, keep two points clearly in mind. (*1*) The electronic equipment you may be selling and servicing will use circuits, tubes, and parts largely familiar to you because of your radio experience. (*2*) The Magic Brain of all electronic equipment is a tube—and the fountain-head of modern tube development is RCA. *RCA Victor Division*, RADIO CORPORATION OF AMERICA, *Camden, N. J.*

TUNE IN "WHAT'S NEW?" *Radio Corporation of America's great new show, Saturday nights, 7 to 8, E.W.T., Blue Network.*





The Magic Brain that operates this device (used in spraying RCA metal tubes) is itself an RCA Electron Tube—2050. By seeing to it that a minimum amount of paint was wasted against non-existent tubes, it justified installation costs within a very short time.

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RCA

RCA ELECTRON TUBES

vide instrument reconditioning and recalibration services that are well worth using for test instruments that have seen long, hard usage.

The procedure that is usually followed in reconditioning an instrument is to inspect and clean it thoroughly; check and resolder any connections that may have weakened; replace or repair any component part that has become worn, deteriorated, or damaged; tighten all assembly and mounting screws, clean the panel and polish the cabinet.

It is then given a final test and recalibration. The instrument must pass the same test as a new instrument. If an obsolete type, it is tested under the specifications that were used when it passed through the factory test department originally. Because of the careful and complete reconditioning and accurate testing services provided by some manufacturers, they are able to guarantee a factory reconditioned instrument for one year, which guarantee is identical to that which applied to it when it was originally sold.

Do not send good dollars after bad pennies by having obsolete instruments repaired or reconditioned. Replace them with improved, modern models if you can get them; they make your work easier and more profitable, sometimes at a cost which in the end is considerably lower than that of the repair or reconditioning.

How to Pack and Ship Instruments

Whenever test instruments are to be shipped, they should be packed exceptionally well to avoid damage. Because of possible damage from excessive handling in transit, shipping via freight or overland trucking is not generally recommended. Railway express or parcel post shipment, depending upon the size and weight of the package is preferable, for it provides practically the same assurance for safety as when the instrument is carried by messenger, if it is properly packed.

Now write a *separate* letter to the repair organization or manufacturer; explain what you want done *and authorize them to do it*. It is important that this letter be sent *entirely separately, not* pasted or tied to the package, regardless of whether the package is sent by mail or express. Furthermore, mail it so it will arrive before the shipment. Most manufacturers will not accept instruments unless they have this separate communication advising them of the disposition required —repair—exchange—credit, etc.

Handle and Use Test Instruments Carefully

Electrical indicating instruments are essentially delicate; their operating forces are small, and their accuracy depends upon every part remaining in excellent condition — especially such parts as pivots and jewel bearings, springs, magnets, etc. They should, therefore, be handled carefully, protected from unnecessary vibration, moisture, extremes of temperature, mechanical shocks, etc. The costly types of major repairs that require the facilities or skill of an instrument specialist are almost without exception ones which are the result of carelessness in handling or using the equipment, and which could have been avoided by following the precautions outlined here. In normal times due care of test equipment is distinctly worth while. Under present war emergency conditions, which add to the expense of outside repairs the inconvenience of possibly long delays in having the instruments repaired, such care is doubly important.

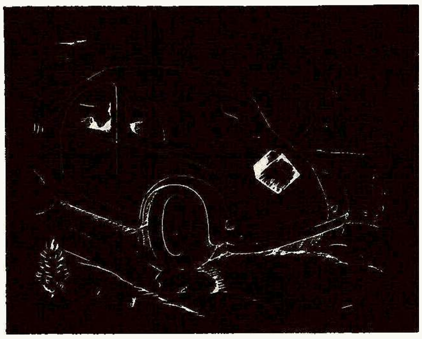


Fig. 4. This kind of a "ride" will damage your test instruments.

The common practice of throwing test equipment into the back of a car or servicing truck, then, as in Fig. 4, driving over rough roads and bumpy railroad crossings will eventually damage even the most rugged instruments. Test instruments are flatly not designed to withstand such severe jolting. Their silent protest is a gradually diminished accuracy. If you habitually treat your test instruments as you would a fine watch, they won't let you down.

When transporting test instruments on service calls, whether in the kit or separately, they will usually ride much more safely on the car seat where the bumps are cushioned, particularly in a passenger car where the seat cushion tilts sharply down toward the rear and will therefore prevent the kit or instruments from slipping off onto the floor in case of a quick stop. In a relatively rough-riding truck some special cushion arrangement utilizing rubber, felt or suspension springs can be worked out. This may seem like going to extremes, but such care is justified, because it is during such transportation that many portable instrument units receive their roughest treatment. A one-mile trip on the floor of car or truck, over rough roads, may subject the instrument to greater strain than months of ordinary bench service.

A second precaution that will prove its worth is to glue patches of sponge rubber on the case of each instrument in such positions that when carried in the kit, or used on the bench, it will be cushioned from strong vibration or mechanical shocks. A couple of short strips of this rubber at the edges of each side, bottom and top of the case will protect it should it tip over on the test bench; in the kit it will always be *floating on rubber*. In a pinch, a 20 cent kneeling pad will provide plenty of "shock absorbing" sponge rubber for several test instruments.

Additional suggestions for maintaining greatest test instrument reading accuracy are:

(*1*)—Always level and check the zero adjustment of the indicating instrument before use.

(*2*)—For accurate work form the habit of tapping the instrument case lightly before taking a reading so as to be sure there is no friction between the pivots and the jewels and that the pointer swings freely in response to current through the movement.

(*3*)—Do not overload the instrument by continuous careless application of a potential of reverse polarity.

(*4*)—Avoid reading the instrument at an angle (parallax).

(*5*)—If possible, choose that range which registers the indication past half-scale. Keep it out of the first 15% of the scale area.

(*6*)—Keep all switch and other contacts clean; do not abuse the instrument by rough handling.

(*7*)—Have your test instruments realigned periodically.

(*8*)—Do not attempt to repair your own indicating instruments unless the repair is a minor one or an emergency exists.

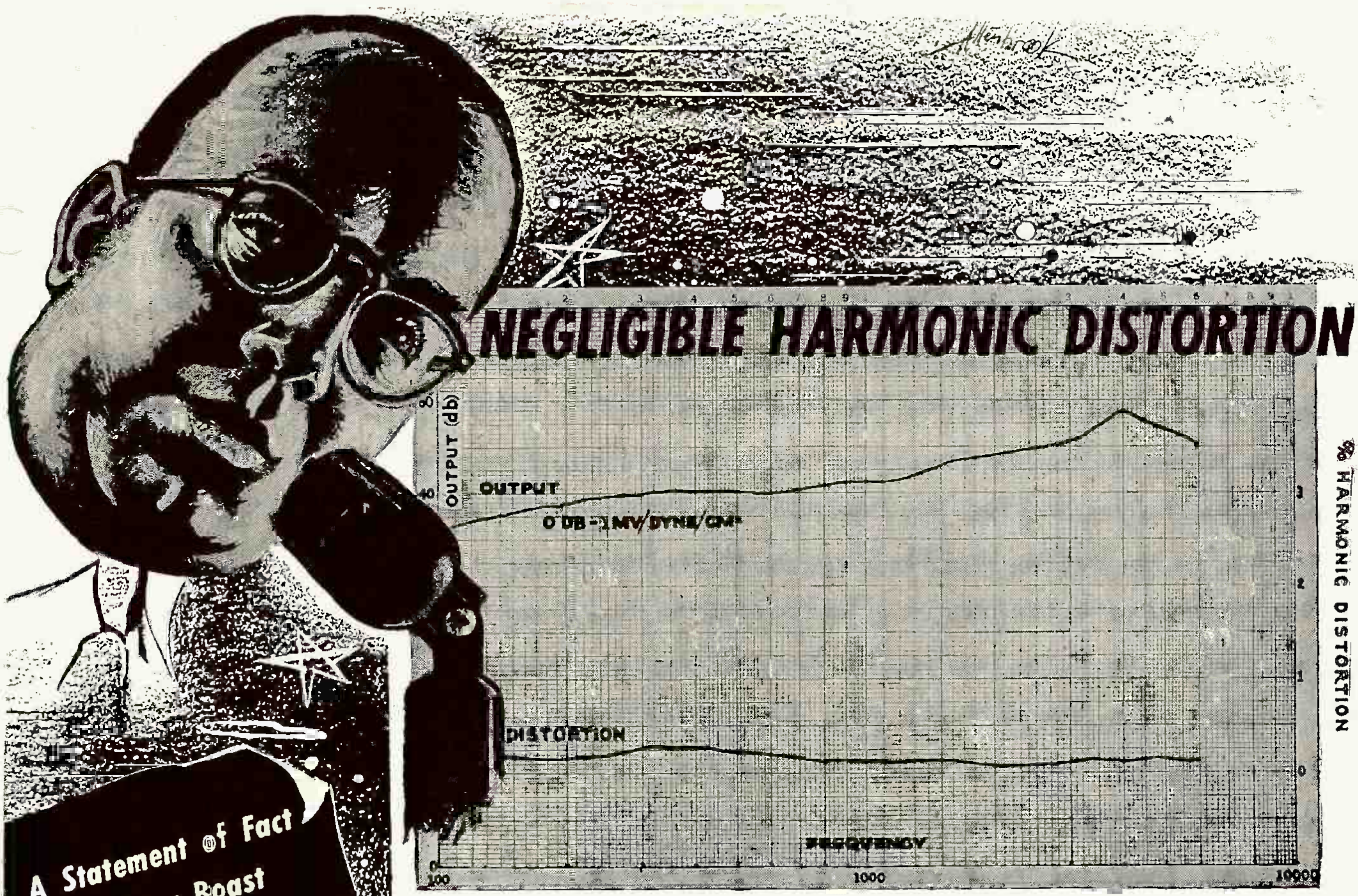
(*9*)—Know your instruments and use them intelligently.

Test Instrument Maintenance

Proper care and maintenance are obviously necessary if best performance and long life are to be obtained from the various test instruments used in radio service work, especially since they are subject to such hard usage. The fine degree of accuracy of many of them is dependent in part upon the continued smooth operation of controls free from excessive wear and backlash, clean contacts, and the exclusion of dust and other foreign matter.

A large part of the charge usually made for factory reconditioning of instruments is for the labor of replacing

(*Continued on page 33*)

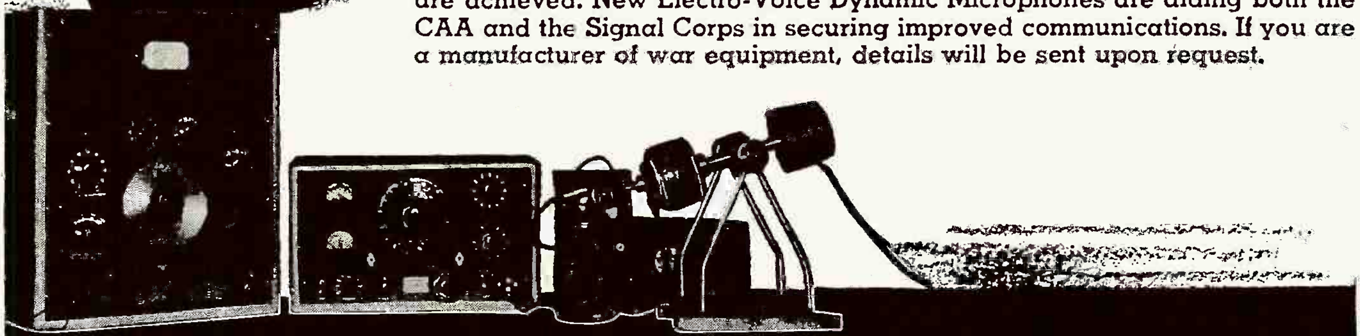


A Statement of Fact —Not a Boast

Every microphone manufactured by Electro-Voice has been designed and developed by our engineers—many in collaboration with the U. S. Army Signal Corps.

Harmonic distortion is the addition of spurious frequencies to the fundamental in definite harmonic relationship. Though the frequency curve may be excellent, harmonic distortion turns up as raspy reproductions, with an unnatural twang, in microphones, amplifiers and speakers. Five percent is considered a satisfactory upper limit for good reproduction, and as much as fifteen percent is allowable for speech communication.

Now come new Electro-Voice Dynamic Microphones with radical innovations in diaphragm fabrication, reducing harmonic distortion to a lower degree than hitherto possible. Cleaner, crisper, more highly intelligible reproductions are achieved. New Electro-Voice Dynamic Microphones are aiding both the CAA and the Signal Corps in securing improved communications. If you are a manufacturer of war equipment, details will be sent upon request.



The Harmonic Wave Analyzer measures the presence of spurious frequencies introduced by microphone distortion. To the ear, such frequencies give the feeling of ragged and false speech quality that may be unintelligible under the stress and strain of battle.

Electro-Voice engineers have found a way to eliminate harmonic distortion in microphone design, as proved by the Wave Analyzer; and the completely natural reproduction from the new Electro-Voice microphones.

Electro-Voice MICROPHONES

ELECTRO-VOICE MANUFACTURING CO., INC. • 1239 SOUTH BEND AVENUE • SOUTH BEND, INDIANA

Export Division: 13 East 40th Street, New York 16, N. Y. — U. S. A. Cables: ARLAB

SER-CUITS

By HENRY HOWARD

MULTI-BAND receivers with provision for a-m/f-m reception and phono operation possess many intriguing engineering features. An excellent example of a-m/f-m phono multi-band design is shown in Fig. 1. This 16-tube receiver has three bands, a push-button unit and a 6-gang variable condenser for tuning. The model, Knight D-360 and 361, uses separate tubes for conversion on the standard and short-wave bands, and f-m bands.

Separate antenna posts are provided for a-m and f-m antennas. An aerial choke provides a low impedance path for d-c and low frequency a-c which attenuates 60-cycle induction hum often experienced on short-wave reception. A 6SG7 tuned r-f stage is used on all bands. A 6SA7 is used for b-c and s-w conversion on a-m while a 6AB7 (1853) television pentode amplifier is used as a converter for the f-m band. A separate 6J5 hot-cathode Hartley oscillator feeds the 6AB7, with cathode to grid injection.

The first i-f transformer has two primaries, one for each converter tube, and a dual tuned secondary for the a-m and f-m i-f circuits. The second transformer has two primaries in series and two separate secondaries which feed two different tubes, a 6Q7 diode, first audio for a-m and a 6SG7 third i-f for f-m. Note the primary tap on the a-m transformer. The third i-f transformer is for f-m only and uses a 60,000-ohm shunt resistor in the primary to widen the response f[illegible] high fidelity. Maximum noise elimination is accomplished when the set is properly tuned, with the magic eye at minimum opening.

Zenith Battery Models

Figs. 2 and 3 show a pair of Zenith battery models; 5G01 and 5G484, the second one being a phono combination. Both receivers are universal portables using the type 117Z6G rectifier in a split half-wave rectifier supply with one cathode for *A* and the other for *B*. The *A* filter has three sections with resistance input; the *B* filter has two sections with resistance input. A headphone jack is provided for high impedance phones. The phones are connected from the output tube's plate to ground through two .05-mfd isolat-

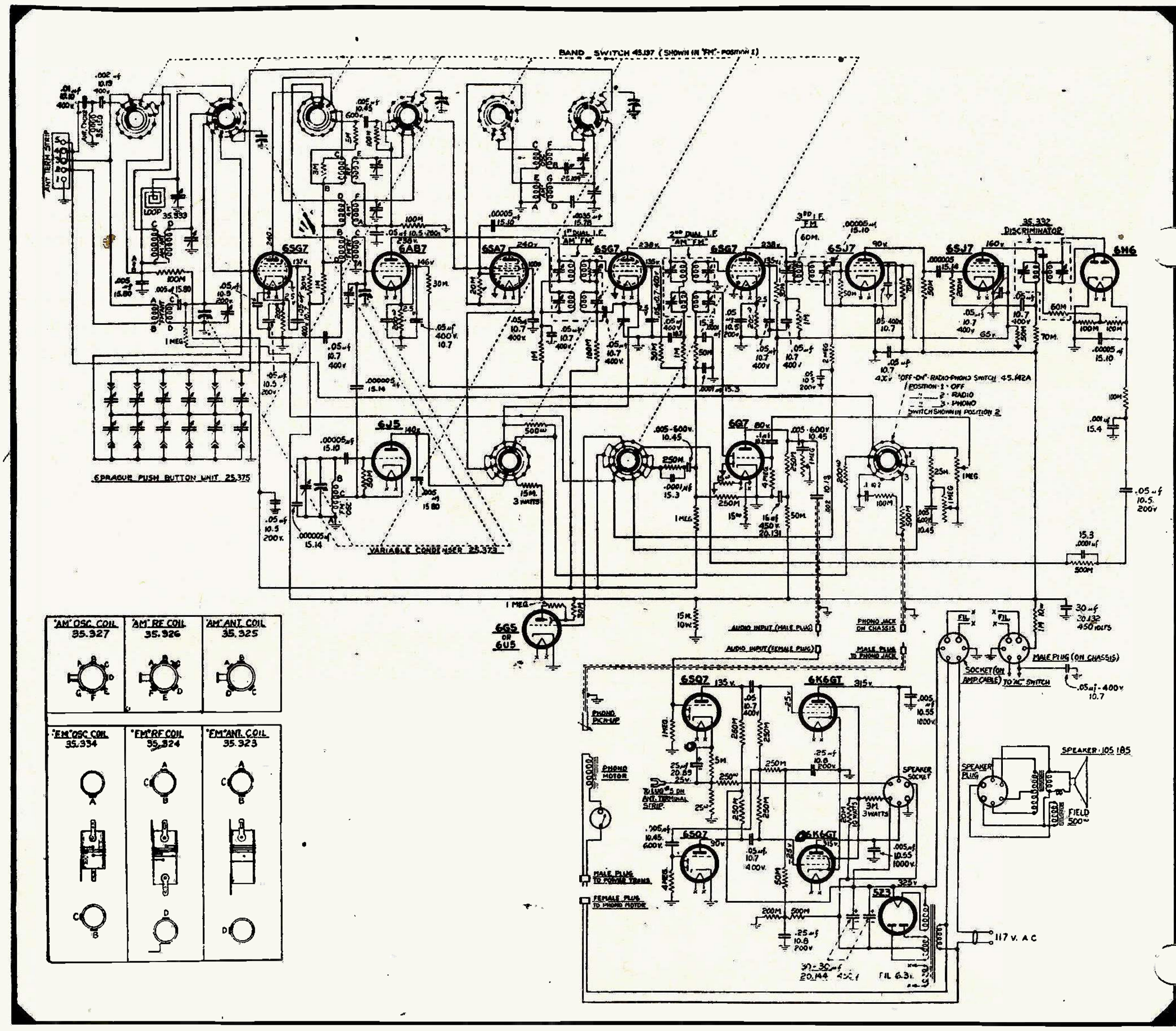


Fig. 1. Knight D-360-361, 16-tube a-m/f-m phono-receiver, with push-button tuning. Dual primaries and secondaries are employed in the second i-f transformer for feeding to different tubes on a-m and f-m.

SPRAGUE TRADING POST

A FREE Buy-Exchange-Sell Service for Radio Men

SWAP OR SELL—Have Pilot super-wasp complete; two short-wave radios; plug-in panel type coils (one for ear 'phones, the other for loud speaker); one short wave adapter, and some radio parts. Write for details. G. H. Gerhold, 9307-114th St., Richmond Hill, L. I., N. Y.

WANTED—Signal generator, Hickok 188X or 19X, or any std. make. Give details and price. Andy's, 801 Nebraska St., Vallejo, Calif.

TESTER FOR SALE—Triplett No. 1178 set tester, consisting of Universal V-O-M, No 1150 oscillator, and free point tester, in oak case. In good condition except batteries. Best offer takes it. Orie B. Ball, R. R. No. 3, Connersville, Ind.

URGENTLY NEEDED—V-O-M for AC and DC. Also interested in late model tube tester and other service tools and eqpt. Describe fully and state lowest cash price. Southern Engineer Associates, Ltd., P. O. Box 25, LeMay Station, St. Louis 23, Mo.

WILL PAY CASH for new and used radios, record players, and combinations. What have you? Send full details and name lowest cash price. Smith Music Shoppe, 16 E. North St., Danville, Ill.

WANTED—Broadcast coils for late model AC National SW3. Must be in good condition. State price. J. S. Shino, 412 4th Ave., Tashme, B. C., Canada.

W [illegible]ED—RCP model No. 414 or 66[illegible] multitester; Hickok No. 202 V-O-M; Triplett No. 1200A, C, E, or F tester; Precision series EV-10 tester; Supreme No. 547 multimeter. Must be good. Highest cash price paid. Don Y. Yen, Rockford, Mich.

NATIONAL HRO WANTED—Will pay cash for good HRO and coils. Give full details. Roy Thumm, 53 Academy St., Presque Isle, Me.

WANTED—Will pay cash for a 35Z5 radio tube. J. W. Baker, 1101 Chandler St., Ft. Worth 3, Texas.

FOR SALE—12" P.M. speaker with output trans; input, filament, and power transformers (almost new); also following tubes: RCA 80, four RCA 24A's; Cunningham C327; and C345; also some resistors, condensers, etc. Will sell all for $20. M. Okin, 915 Bryant Ave., Bronx, New York, N. Y.

TUBE TESTER FOR SALE—Triplett No. 1210-A unit in A-1 condition. Will sell for cash, or will swap fo rlate V.O.M.A.M. 25000 O.P.V.—at least 10 meg. Jack's Radio Service, 196 Lincoln St., Millinocket, Me.

WANTED—Speed Control turntable phonograph motor. Also interested in other radio parts. What have you? Joseph Hall, Box 58, Middleton, Mass.

WILL TRADE—Hallicrafters Sky Buddy late model 4-band for good std. signal generator A-C operated, or will consider late tube checker handling "S" series, loctals, etc. Joseph D. Copeland, 66 Clark St., Portland, Me.

FOR SALE OR TRADE—Two Visasig recording units and two tape pullers. Make offer. Leonard F. Dodds, Box 326, Albuquerque, N. M.

NEED TUBES?—write for details to Leonard Baum, 18 Livingstone St., Dorchester, Mass.

TUBE TESTER WANTED—Will pay cash for good unit, late model. Jewell Atwood, Elva, Ky.

WANTED—Any quantity of burned out 12SK, 12SA, 12SQ, 12Q, 12A, 35Z5-6, 35L6, 50L6 tubes. 5¢ each. Write me. F. A. Lanning, Cash & Carry Utica Service-Dealer, 321 Columbia St., Utica 2, N. Y.

WANTED—Used communications receiver and ham transmitter; also, set of Rider Manuals, oscilloscope, and other test eqpt. Michael Bratkowsky, 95 Balsam Ave., Bridgeport, Conn.

SALE OR TRADE—Supreme diagnometer No. 585, like new. Walt's Radio Shop, 11449½ Longbeach Blvd., Lynwood, Calif.

TUBES TO TRADE—Will swap hard-to-get types for any model Hallicrafter receiver. Wright Radio Service, 201 N. 5th St., Leavenworth, Kans.

WILL SELL—Used RCA station allocator, $15 plus postage; used free-point analyzer, cable and plugs, $4. Wanted at once for W.E.R.S., Abbott DK-3 2½-meter transceiver (will pay up to $30); Abbott TR-4 2½-meter transmitter-receiver (will pay up to $50 with tubes); HY-615 and HY-75 tubes. Wm. D. Montgomery, 1290 Coolidge Ave., Cincinnati 30, Ohio.

WANTED—Late model communication receiver! also Voltohmyst. Sgt. Carroll E. Anderson, Troop C—107th Cavalry, Santa Rosa, Calif.

WANTED—Multimeter, signal generator (oscillator) and an emission tube tester. Joe Tyson, 407 K St., N.W., Washington 1, D. C.

WANTED—Will pay cash for Superior signal generator. Halls Radio Service, 6005 W. Fairview Ave., Milwaukee 13, Wisc.

WANTED—Neon sign "Radio Repairs." Give full details first letter. Rose-Bud Radio Service, Ripon, Wisc.

WANTED—Used set of Rider's Reference Manuals Vols. 1-14 incl., also latest model tube tester. John Cogill, 616-6th Pl., S.E., Mason City, Iowa.

SPEAKER WANTED—Jensen No. JH P-52 or Utah co-axial type. Must be in good condition. Packard, 84 Greene St., Pawtucket, R. I.

WANTED—Tube tester for late types, also V-O-M. Richard Griffin, 210 Boyer St., Gallatin, Tenn.

WILL BUY used radio diagrams, books, or radio circuit manuals published within past 3 years. L. A. Verdiales, P. O. Box 5, Vieques, Puerto Rico.

CHANALYST WANTED—In good condition. State price and describe. Edgar N. Jones, Newport, R. I.

WANTED—Recording outfit. Describe fully. John Gil, 160—8th St., Passaic, N. J.

FOR TRADE—Equal value of popular type tubes for late model multi-range tester (Precision preferred). Will consdeir other test equipment. Describe fully. J. B. Abernathy, 667 Ave. D, Boulder City, Nev.

NEW TUBES FOR SALE—1Q5GT; 1A6; 1B5; 1C6; 1D5G; 1D7G; 1F6; 1J6G; 6Q6G; 6W7G; 33, 34, 38, 39/44, 46, 79, 89, 20, 22, 183/483—price 25% under list. Send small deposit and supplier's certificate with order. Also have 4" Kurz-Kasch dial at 30¢; Hammarlund Var. Condenser types MCD, SM-100, and MC-20S at 50¢ ea. N. J. Cooper, 4617 N. Damen Ave., Chicago, Ill.

TO SELL OR SWAP—Weston No. 506 DC 0-1 Ma. permanent magnet moving coil types, new meter. Also have other parts—send for list. Best cash offer or swap for photo eqpt. John J. Vilkas, 1515 So. 48th Court, Cicero, Ill.

WANTED—Two National type ACN dials; two midget tuning condensers, dual, 35 mmf. per section, gangable. Bud No. 913 or equal. Emory A. Cox, 618 S. Roberts, El Reno, Okla.

TUBES FOR SALE—All in original cartons: 4-1C6; 3-2A5; 6-2A6; 6-2A7; 6-2B7; 4-6A4; 1-6A6; 2-6A7; 2-6F7; 2-46; 2-59; 1-49; 2-89; 1-55; 2-56; 2-57; 10-58; 6-2A3; 2-5Z3; 5-10; 5-50; 2-12A; 6-201; 3-226. Mostly special brands. Will sell all or part at lowest net prices. J. C. Thimijan, 715 N. 7th St., Lake City, Minn.

FOR SALE—Weston Model 660. Analyzer cable removed to make handy volt-ohmmeter. Good condition. First $25 takes it. R. H. Schaaf, 394 N. Edison St., Arlington, Va.

WANTED—Good, portable AC operated tube tester for all types. Would like one that reads "Good" and "Bad," but not essential. Randolph McDonald, 1410 Rio Grande St., Austin, Texas.

WANTED—5-tube 110 V. AC or DC table model radio in good working condition. Cash. Alfred L. Mergele, Rt. 1, Box 70, Dilley, Texas.

WANTED—Channel analyzer, also 3" oscilloscope, and capacitor tester. Max Platau, 447 E. 86th St., New York, N. Y.

YOUR OWN AD RUN FREE!

The "Trading Post" is Sprague's way of helping radio servicemen obtain the parts and equipment they need, or dispose of the things they do not need during this period of wartime shortages. Here then are a few hints which may help you benefit from it:

Answer interesting ads while they are "fresh." Don't wait until the magazine is several weeks old. Do not send letters in reply to advertisements to Sprague. Write direct to the advertiser.

Study the "For Sale" ads first to see if what you need is listed *before sending in your "Wanted to Buy" ad*. The Trading Post appears regularly in Radio Retailing-Today, Radio Service-Dealer, Radiocraft, Radio News, and Service.

Please do not specify the magazine in which you would like your ad to appear. We'll do our best to get it in one of the leading publications, but it only complicates matters when a certain publication is specified.

Please don't ask us to run an ad in which you ask more than the normal price for parts or a piece of equipment.

Don't offer to accept C. O. D. telegraphic or telephone replies to your ad. Some individual Trading Post classified advertisements have pulled as many as four and five hundred answers!

Answer ALL inquiries to your advertisement promptly —even though some of them may have arrived too late. This is only common courtesy.

When sending your ad to Sprague, please address it to the department number shown below. This serves as a valuable guide to our advertising department.

Obviously, ads featuring equipment "For Sale or Trade" generally bring better results than those wanting to buy hard-to-get equipment. Preference will thus be given to ads offering parts or equipment for sale.

Write your ad carefully, clearly, and keep it short. Many ads received are unintelligible or hard to decipher —and this causes unnecessary trouble.

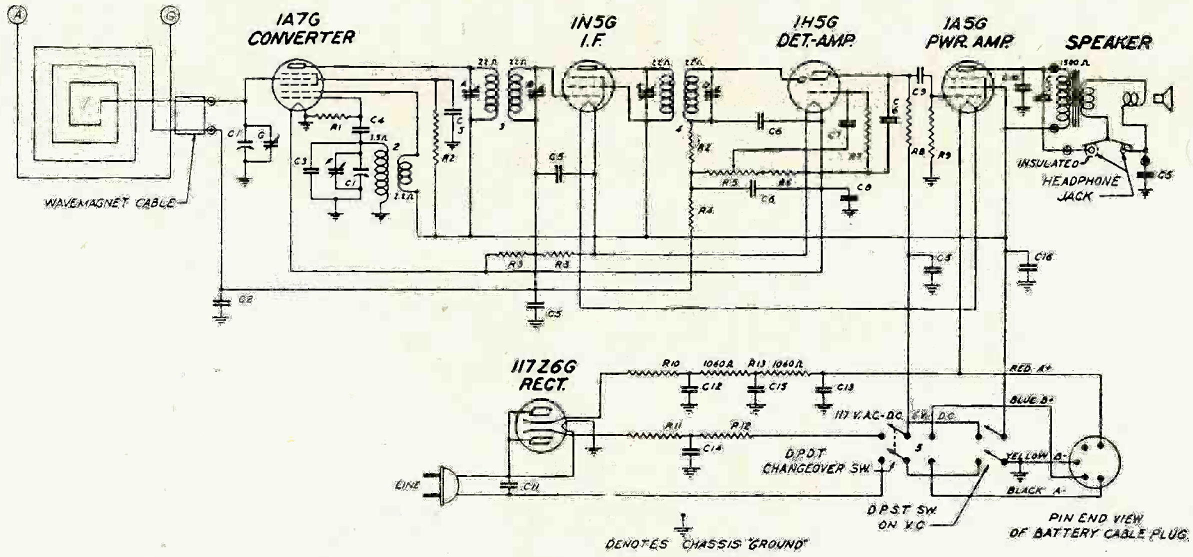
"Emergency Ads" will receive first attention and Sprague, of course, reserves the right to eliminate any ads which do not seem to fit in with the idea behind this special wartime emergency advertising service.

DEPT. S-310

SPRAGUE PRODUCTS CO., *North Adams, Mass.*

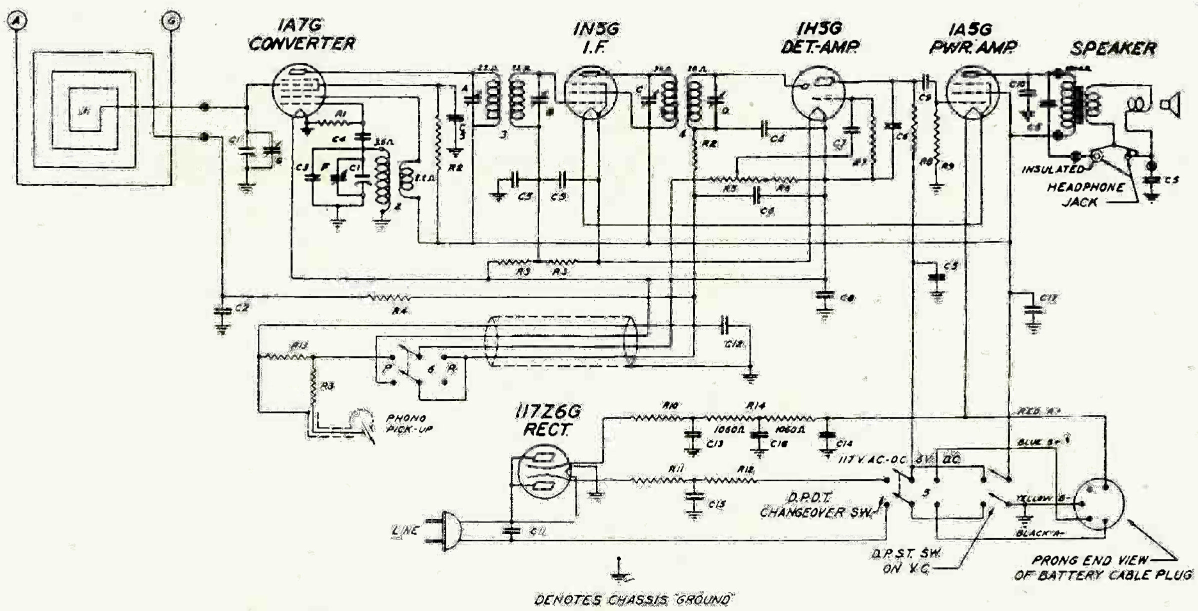
SPRAGUE CONDENSERS
KOOLOHM RESISTORS

Obviously, Sprague cannot assume any responsibility, or guarantee goods, services, etc., which might be exchanged through the above advertisements



DIAG. NO.	PART NO.	DESCRIPTION		DIAG. NO.	PART NO.	DESCRIPTION		DIAG. NO.	PART NO.	DESCRIPTION		DIAG. NO.	PART NO.	DESCRIPTION
C1	22-800	TWO GANG VARIABLE		C14	22-871	20 MFD. ELECTROLYTIC	150V	R8	63-271	1 MEGOHM	1/4 W	5	85-190	POWER SWITCH
C2	22-138	.2 MFD	200V	C15		20 MFD	150V	R9	63-600	2.2 MEGOHM	1/4 W			
C3	22-802	30 MMFD.	600V	C16		20 MFD	150V	R10	63-1022	150 OHM WIREWOUND	1 W			
C4	22-182	.00025 MFD	600V					R11	63-605	1000 OHM	1/2 W			
C5	22-829	.05 MFD	200V					R12	63-803	2200 OHM	1/2 W	A		1st I.F. TRANS PRI.
C6	22-162	.0001 MFD	600V					R13	63-1035	2-SECTION CANDOHM		B		1st IF " SEC
C7	22-826	.01 MFD	200V	R1	63-652	120 M OHM	1/4 W					C		2nd IF " PRI
C8	22-350	.25 MFD	200V	R2	63-593	47 M OHM	1/4 W					D		2nd IF " SEC
C9	22-243	.01 MFD	400V	R3	63-296	220 M OHM	1/4 W					F		BROADCAST OSC (ON GANG)
C10	22-492	.002 MFD	600V	R4	63-669	3.9 MEGOHM	1/4 W	1		WAVEMAGNET ASSEMBLY		G		ANTENNA B'DCAST (")
C11	22-869	.03 MFD	400V	R5	63-1026	VOLUME CONTROL		2	57027	OSC COIL ASSEMBLY				
C12	22-918	40 MFD ELECTROLYTIC	150V	R6	63-507	4700 OHM	1/4 W	3	95-593	1st IF TRANS				
C13		20 MFD "	25V	R7	63-604	10 MEGOHM	1/4 W	4	95-594	2nd IF "				

Fig. 1 (top) and 2 (below). In Fig. 1 appears the Zenith battery model 5G01. This is a universal portable using a 117Z6G rectifier in a split half-wave supply with one cathode for A and the other for B. In Fig. 2, below, appears the Zenith battery model 5G484, which is a phono combination and portable, too. The effective rectification system used in the 5G01 is used in this model. Incidentally, the A filter has three sections with a resistance input and the B filter has two sections with a resistance input.



DIAG. NO.	PART NO.	DESCRIPTION		DIAG. NO.	PART NO.	DESCRIPTION		DIAG. NO.	PART NO.	DESCRIPTION		DIAG. NO.	PART NO.	DESCRIPTION
C1	22-800	TWO-GANG VARIABLE		C15	22-871	20 MFD ELECTROLYTIC	150V	R9	63-600	2.2 MEGOHM	1/4 W	6	85-197	PHONO SWITCH
C2	22-138	.2 MFD.	200V	C16		20 " "	150V	R10	63-1022	150 OHM WIREWOUND	1 W			
C3	22-802	.30 MMFD.	600V	C17		20 " "	150V	R11	63-605	1000 OHM	1/2 W			
C4	22-182	.00025 MFD.	600V					R12	63-803	2200 OHM	1/2 W			
C5	22-829	.05 MFD.	200V					R13	63-591	22 M OHM	1/4 W	A		1st I.F. TRANS. PRI.
C6	22-162	.0001 MFD.	600V					R14	63-1035	2-SECTION CANDOHM		B		1st IF " SEC.
C7	22-826	.01 MFD.	200V	R1	63-652	120 M OHM	1/4 W.					C		2nd IF " PRI.
C8	22-350	.25 MFD.	200V	R2	63-593	47 M OHM	1/4 W.					D		2nd IF " SEC.
C9	22-243	.01 MFD.	400V	R3	63-296	220 M OHM	1/4 W.					F		BROADCAST OSC. (ON GANG)
C10	22-492	.002 MFD.	600V	R4	63-669	3.9 MEGOHM	1/4 W.	1		WAVEMAGNET ASSEMBLY		G		ANTENNA B'DCAST (" ")
C11	22-869	.05 MFD.	400V	R5	63-1026	VOLUME CONTROL		2	57027	OSC. COIL ASSEMBLY				
C12	22-827	.1 MFD.	200V	R6	63-507	4700 OHM	1/4 W.	3	95-593	1st I.F. TRANS.				
C13	22-918	40 MFD. ELECTROLYTIC	150V	R7	63-604	10 MEGOHM	1/4 W.	4	95-594	2nd I.F. "				
C14		20 MFD. "	25V	R8	63-871	1 MEGOHM	1/4 W.	5	85-190	POWER SWITCH				

ing condensers. Both sets have a 4,700-ohm resistor in series with the low side of the volume control which prevents the control being turned down completely, leaving the set dead. This clever feature probably saves many a battery when a receiver is inadvertently left turned on as a bit of noise or static will come through even though no signal is present. An equalizer on the pickup wastes much of the voltage and kills most of the lows as in most portables. A 220,000-ohm series resistor and 22,000-ohm shunt are used. The low side of the pickup is grounded through a .1-mfd condenser.

Zenith 7G605

A short-wave portable receiver with such interesting features as band-spread tuning, *wavered* for short-wave and broadcast reception as well as tuneable short-wave and broadcast band wave-magnets, is shown in Fig. 4.

Alignment forms an important step in the maintenance of this type of receiver. Accordingly we present these data as compiled by Zenith.

After the chassis has been removed by retracting the right end sufficiently to clear the cabinet, the wave-magnet, speaker and battery plugs removed previously to permit removal of the chassis, are reconnected. The receiver should now be ready for alignment on battery power.

In the next step the antenna terminal of the signal generator is connected through a .1-mfd condenser to the converter grid at the junction of the 150,000-ohm resistor and the .02-mfd condenser C11. Then the generator ground lead is connected to the 1LA6 No. 8 filament lead at the standoff insulator. An output meter is then connected across the voice coil (green and black wires of the speaker plug). The i-f trimmers A, B, C and D are then aligned for maximum response.

The oscillator tuned circuit for the broadcast band tracks in the conventional manner, 455 kc *above* the converter frequency. However, band-spread tuning with the oscillator circuit tracking 455 kc *below* the converter frequency has been incorporated on the short-wave bands. The sensitivity at the high frequencies depends on correctly aligning the converter stage at the highest frequency peak (furthest out). The recommended procedure for obtaining the correct peak is to screw the oscillator slugs (*k*) all the way *in* and the converter slugs (*l*) all the way *out*, then aligning for the first peak reached as the oscillator slugs are backed out and the converter slugs are screwed in. The short-wave converter adjustments are broad; therefore, the lowest a-c scale of the output meter is recommended. To prevent false peaks, always keep the signal generator output below the level where the AVC action of the receiver takes effect.

Oscillation and Hiss

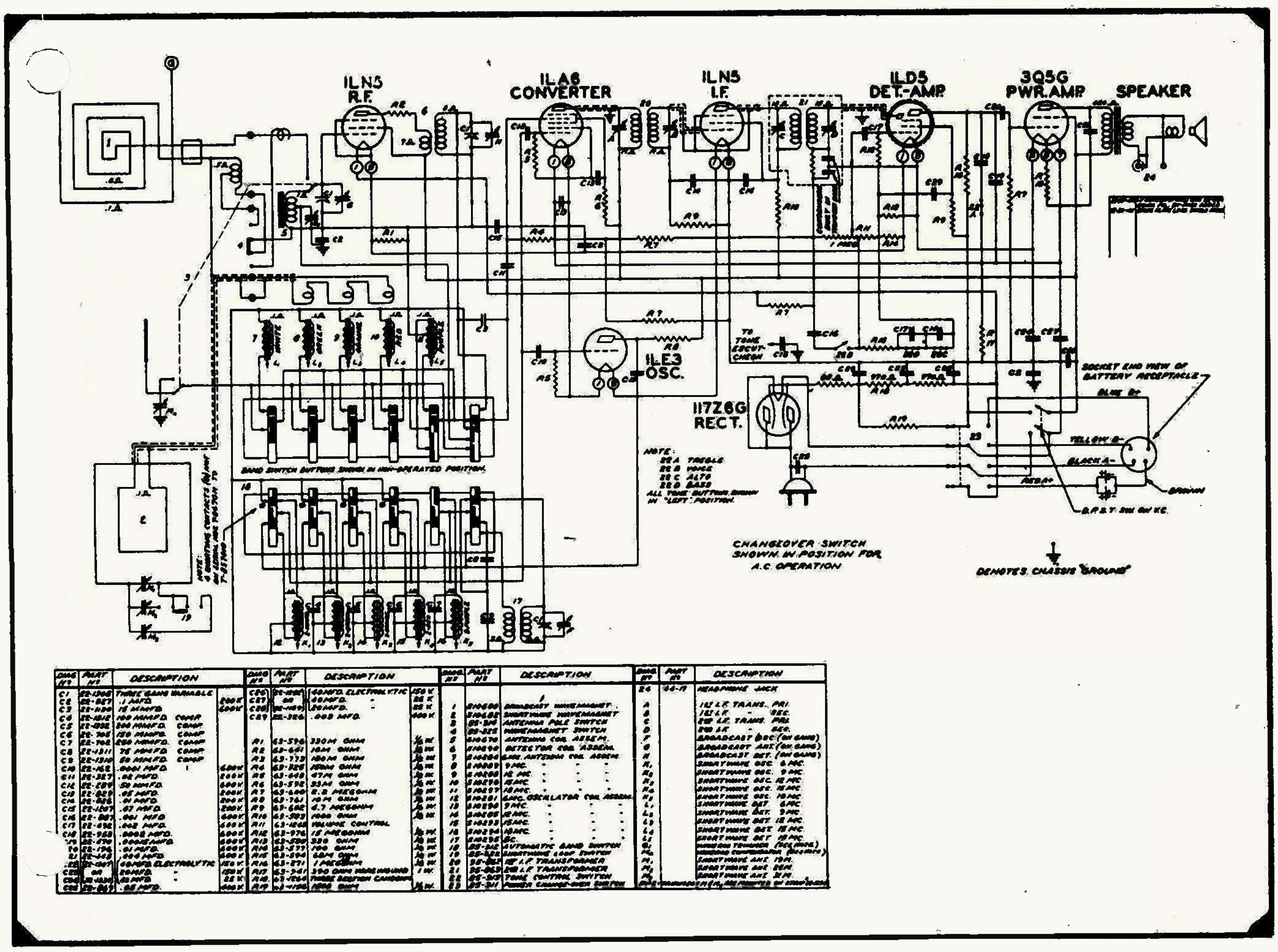
This condition can be caused by excessive gain in the i-f circuit which may be regenerative to a point just below oscillation. Replacing the 1LN5 i-f tube with another that has a lower g-m factor and realigning the i-f transformers will stabilize the circuit.

The inability to attenuate strong local stations is due to the internal capacity coupling between the diode and pentode plates of the 1LD5 tube. Replacement with a new tube will correct this condition.

Care should be exercised when removing or reinserting the wave-mag-

(*Continued on page* 34)

Fig. 4. The Zenith 7G605 portable short-wave receiver with band-spread tuning.



SERVICING HELPS

By BARRY KASSIN

Assistant Editor

TONE CONTROL REPLACEMENTS

IN a large majority of receivers the tone control controls the plate of the output tube. At this point there is developed maximum audio voltage, and the condenser is also subjected to the d-c plate voltage. If this condenser becomes defective in most cases the low end of the control will burn out.

A control used in the plate circuit of the final tube customarily is in the neighborhood of 10,000 to 100,000-ohms. If it should be found difficult to obtain a control of this value, a suggested change as shown in Fig. 1 is recommended. The control value in Fig. 1 would be about 100,000 to 2 megohms; C_1 should be changed to a value of approximately .004 to .006 mfd. In the event that difficulty in obtaining either of these controls is experienced, Fig. 2 demonstrates a further optional recommended change.

Fig. 1. Modifying the plate circuit resistor circuit.

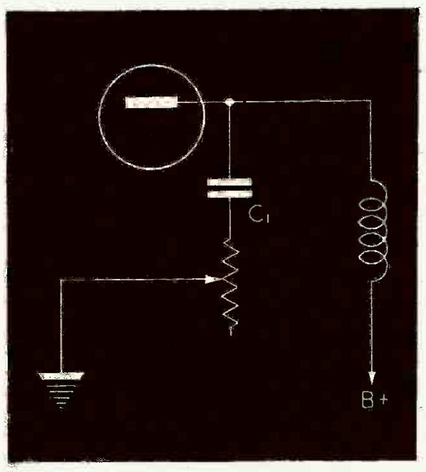


Fig. 2. Another optional change which may be made if there is difficulty in obtaining the required resistance for plate control.

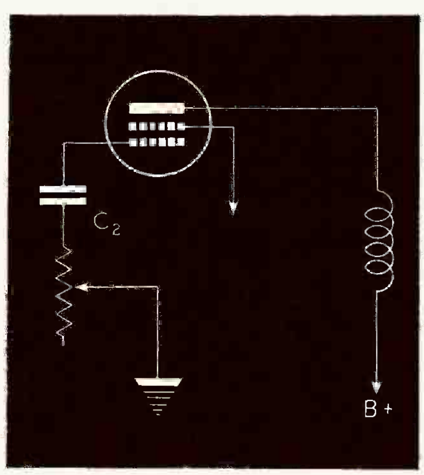


Fig. 3 shows a change using a single pole single throw switch to act as a 2-point tone control. Another alternative is demonstrated by Fig. 4 which uses a multiple tap tone control switch. R_1, R_2, R_3, may be adjusted to suit the desired shading of tone. This same application may be adapted to the plate of the first audio or grid of the second audio stage.

LUBRICATION OF PHONO-MOTORS

IN the maintenance of phono-motors, lubrication is an essential step. Such lubrication must be applied at scheduled periods. In addition selected lubricants must be used.

General Industries K, L and 17

The motor installed in these record changers are governor-controlled, with all gearing enclosed. They are factory lubricated for proper operation. However, the motor should be lubricated at regular intervals with SAE No. 10 oil.

The governor disc engages with a ring of hard felt. This felt is impregnated with a lubricating solution usually sufficient for proper operation for approximately a year under normal conditions. If the motor shows a tendency to chatter or waver, a drop or two of oil applied to this felt ring will eliminate this chatter.

Magnavox (Universal Motor)

The lubrication and speed adjustment is the same for the *universal* motor as for the a-c motor. If the brushes are allowed to become dirty and worn, brush noise will develop. The brushes may be removed by unscrewing the bakelite caps on the motor body and pulling out the brushes by means of the springs. The brushes can be cleaned by sanding them with a fine grade of sand paper or crocus cloth and cleaning the dust from the surface before replacing them. It is important that the brushes be replaced in the same holder and in the same way in which they were originally installed. The brushes when new are 9/16″ long under the springs. When they have worn down to 3/32″ they should be replaced.

Presto Recording J5 Recorder

The motor need not be oiled more than once in three months. Too frequent oiling might cause defects in the windings of the motors. When oiling the motor the entire panel mounting must be raised. The use of *3-in-1* oil is recommended.

RCA Models

RP-139A. After each 1,000 hours of operation, a few drops of light machine oil (SAE 10 or lower) should be applied to the motor oil-hole adjacent to the spindle bearing. The oil hole has a screw plug.

RP-145 and RP-152. These motors generally do not require lubrication in the field. Should it be found necessary, the plastic end cover should be removed and the rotor taken out. Care must be taken not to disturb the center aligned stator laminations. A few drops of light machine oil should be injected into the spindle receptacle.

RP-152 (Motor No. 91706-1). Af-

Fig. 3. A single-pole switch which acts as a two-point tone control.

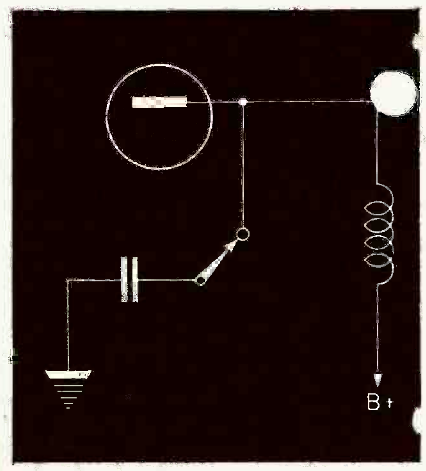
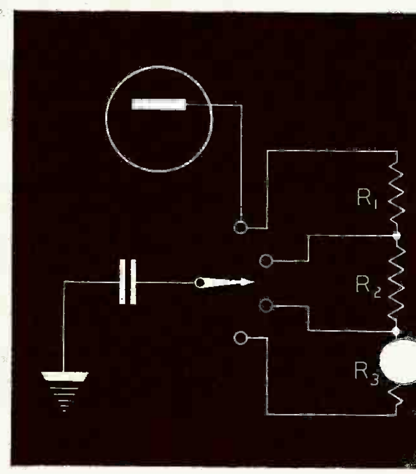
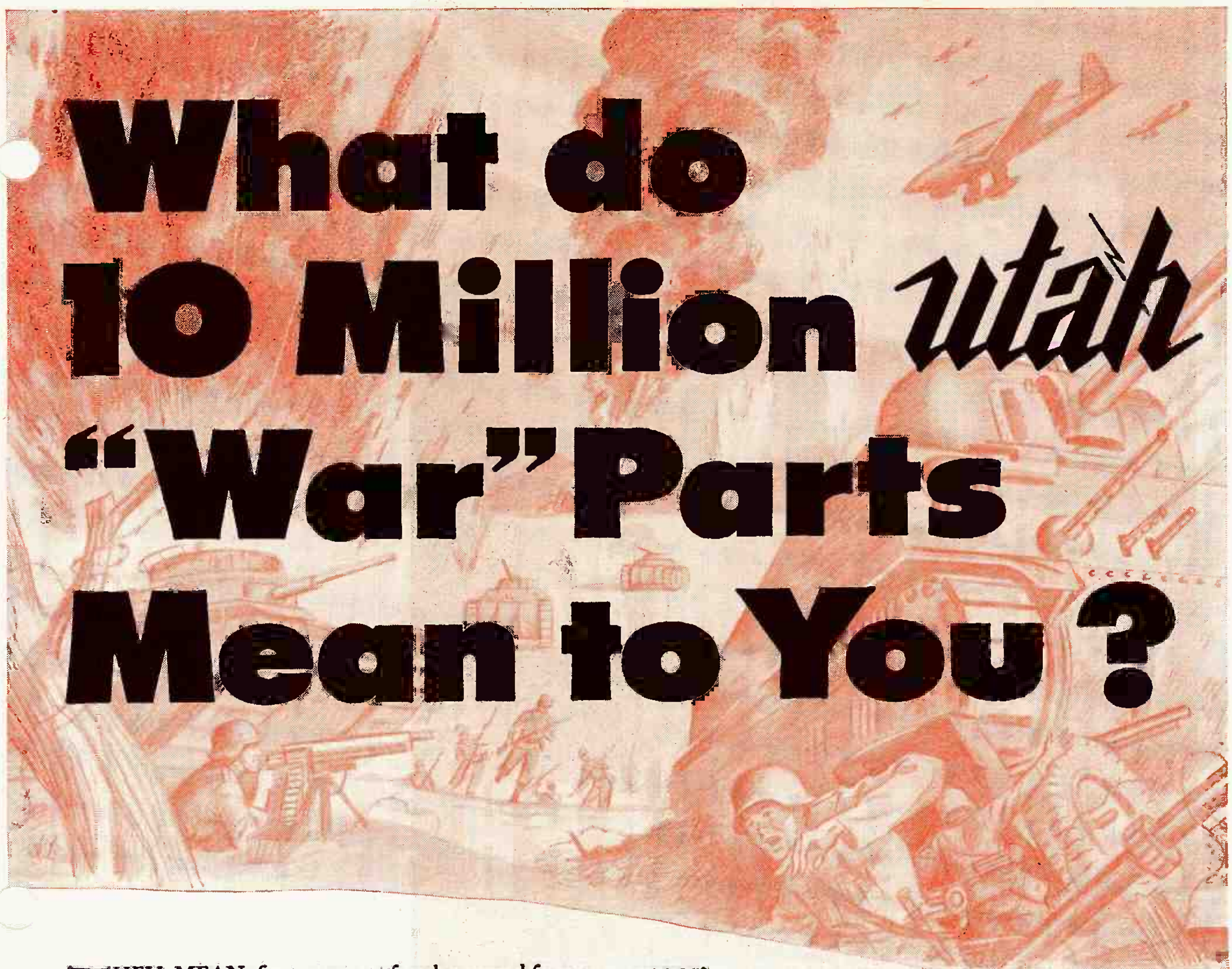


Fig. 4. A multiple tap tone control switch providing tone shading.





What do 10 Million utah "War" Parts Mean to You?

THEY MEAN, first, support for the armed forces . . . support provided in the way we know best how to give it.

They mean the "know how" to keep pace with the radio and electronic developments which are now being used in wartime application—and which will so greatly influence American living "tomorrow."

They mean better products—keyed to "tomorrow's" demand—products you can count on!

UTAH RADIO PRODUCTS COMPANY, 816 Orleans Street, Chicago, Ill. Canadian Office: 560 King Street West, Toronto. In Argentine: UCOA Radio Products Co., S.R.L., Buenos Aires. Cable Address: UTARADIO, Chicago.

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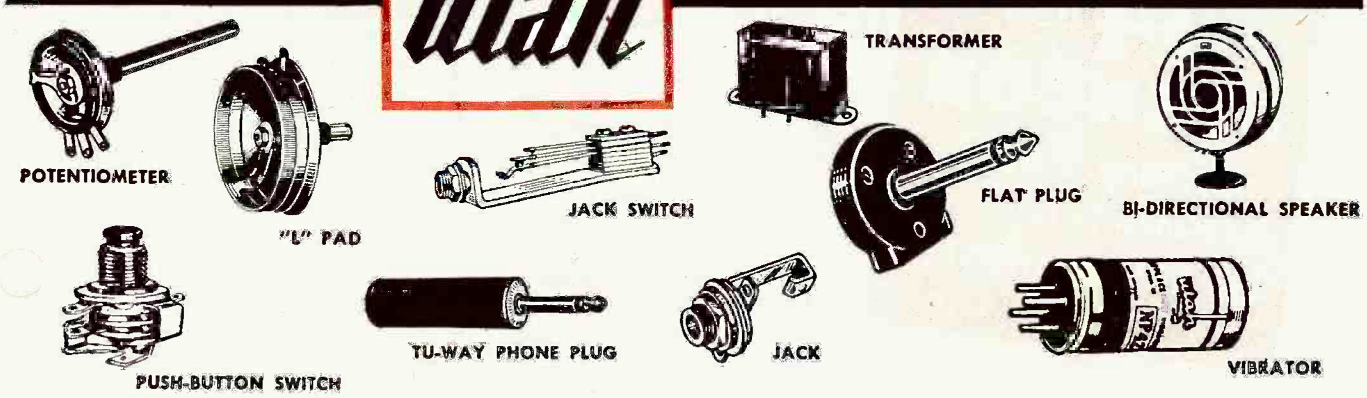


ter each 1,000 hours of operation, the felt washers, on each end of the spindle, should be thoroughly saturated with a light machine oil.

RP-153. If the motor requires oiling, this may be conveniently done by means of two oil holes, one in the black collar surrounding the drive spindle bearing and another at the opposite end of the motor. A light machine oil should be used.

RP-155. After each 1,000 hours of operation, if the motor requires oiling it should be removed from the motorboard. A light machine oil should be used to saturate the felt washer adjacent to the bottom bearing (nearest lead damping weight).

The spout of the oil can may be inserted in one of the holes on the top side, and a few drops injected on the top bearing.

Webster-Chicago Model 11

The changer should be lubricated once a year with about a dozen drops of a good light machine oil at each of the following six points. All points can be reached from above, through holes in the mounting plate, as follows:

(*1*)—Three oil holes on motor gear.

(*2* and *3*)—Housing. Reach all three through two holes marked *A*.

(*4*)—Through hole *B*, drop the oil upon flat surface of cam. It will distribute itself to proper points.

(*5*)—Through holes marked *C*, see felt wick and drop the oil directly upon it.

(*6*)—Through the hole marked *D*, see felt wick, and drop the oil directly upon it.

IMPROVING VIBRATOR OPERATION

THERE are many instances reported wherein new vibrators just taken from stock will not tart when first installed in the radio receiver. It has been found that a frequent cause of this trouble is a slight coating of oxide on the points when kept on a shelf over a period of time.

To correct this condition, it is only necessary to remove this oxide film, after which no further trouble should be encountered. This can be done easily.

It is necessary to first identify the base positions and their symbols. The base symbol (letter or letters) for the vibrator is indicated on the vibrator label and on the carton, or may be determined by checking the numerical listing of the vibrator replacement catalog. After the symbols have been determined, the base diagram

(*Continued on page* 31)

NEWS

CAPACITOR SUBSTITUTION DATA IN SPRAGUE FOLDER

A folder recently issued by the Sprague Products Company, North Adams, Mass., illustrates and describes a *Victory Line* of Sprague atom midget dry electrolytic capacitors and TC tubulars to be supplied through distributors in conformity with wartime limitations on capacitor production for civilian use.

Although the *Victory Line* is necessarily limited to only nine Atom types and nine TC tubulars, these have been carefully selected as to capacities and voltages to enable Service Men to handle practically any replacement job. An article included as part of the folder *How to Use Victory Line Capacitors,* contains many helpful hints on how to substitute the few *Victory* capacitors for the many varieties of standard types. Subjects covered include *Connecting Capacitors in Parallel to Make Capacity Values Not Available in a Single Unit; Replacing Filter Applications Higher Than* 450 *V D-C with Victory Line* 450 *V Capacitors;* and *Replacing Wet Electrolytics with Dry Electrolytics.*

Copies may be obtained direct from the company or through authorized Sprague distributors.

* * *

EDDIE SCHRAMM JOINS CLAROSTAT

Eddie Schramm has joined Clarostat Mfg. Co., Inc., Brooklyn, N. Y., as purchasing agent.

Prior to joining Clarostat he was with War Department as an ANEPA field expediter.

* * *

AT NATIONAL UNION CEREMONIES

Left to right: Marine Corporal Harry Stuhler, Alois Havrilla, Brig. Gen. A. A. Farmer, S. W. Muldowny, Lt. Ralph E. Whitney, Elmer Chamberlin, Vincent J. Murphy (Mayor of City of Newark), and Lt. Col. Kenneth D. Johnson.

* * *

RCA VICTOR WHOLESALERS ATTEND POSTWAR MEETING

About 200 RCA Victor distributors and their executive personnel gathered at the Waldorf-Astoria, New York, recently, to hear officials of RCA Victor discuss mutual problems and current thinking on postwar distribution.

Represented were wholesalers for all RCA products. Similar meetings were held in Chicago, San Francisco, and New Orleans.

H. C. Bonfig, general sales manager, presided. L. W. Teegarden, assistant general sales manager, outlined the part which wholesalers will play in postwar distribution. Vance C. Woodcox, director of commercial research, discussed scientific studies being conducted by RCA.

E. W. Engstrom, director of research of RCA Laboratories, described the consolidation of RCA's extensive research activities at Princeton, N. J.

Thomas F. Joyce, manager of the radio, phonograph and television department, outlined the company's current advertising programs.

* * *

LT. PRINCE HONORED BY EPEM

The Association of Electronic Parts and Equipment Manufacturers of Chicago, recently honored its executive secretary, Kenneth C. Prince, who attended his last meeting before leaving for Princeton University, where he will begin training as a Lieutenant (jg) in the United States Navy.

Lt. Col. John M. Niehaus, labor officer, United States Army Signal Corps, and Albert A. Epstein, assistant director of the sixth regional War Labor Board, addressed the members.

An election of officers for the ensuing year was also held at this meeting. P. H. Tartak, president of Oxford-Tartak Corporation, Chicago, was elected chairman. E. G. Shalkhauser, president of Radio Manufacturing Engineers, Inc., Peoria, Illinois, was named vice chairman. Helen A. Staniland, vice president of Quam-Nichols Company, Chicago, was re-elected treasurer. Lewis G. Groebe, associated with Lt. Prince in the practice of law, was elected secretary pro tem and will perform the functions of executive secretary.

* * *

RAYTHEON FOURTEEN YEAR EMPLOYEES HOLD MEETING

Employees of Raytheon Manufacturing Company, who have been with the company prior to 1929, held a get-together meeting at Raytheon's Newton, Massachusetts plant. Officers and employees present at the get-together appear in view below.

* * *

BEN MILLER NOW RADIO ESSENTIALS REP

Ben Miller has been appointed manufacturer's representative of Radio Essentials, Inc,. for the Southern Wisconsin and Illinois territory, with headquarters at 149 West Ohio Street, Chicago, Illinois. Mr. Miller was formerly sales manager for Meissner Mfg. Co.

Irving Rosen will represent Radio Essentials in the metropolitan New York area.

Herman Smith is president of Radio Essentials, Inc.

* * *

G. E. WINS SECOND WHITE STAR

The appliance and merchandise division of the General Electric Bridgeport plant has won their second Army-Navy White Star award.

* * *

HOWARD W. BENNETT PROMOTED BY G. E.

Howard W. Bennett has been made manager of the specialty division of the G. E. electronics department.

* * *

E. G. HUBER CITED

Edward G. Huber, former manager of the equipment contract department of National Union Radio Corporation and at present somewhere in the South Pacific, has received a citation for bravery together with two other men of the Marine regiment to which he is attached.

* * *

STAR ADDED TO SOLAR "E" FLAG

Solar Manufacturing Corporation, 285 Madison Avenue, New York City, with plants in Bayonne and West New York, New Jersey and Chicago, has been awarded an additional star for its "E" flag.

* * *

SHEA NOW ECA PRODUCTION MANAGER

H. Gregory Shea has been appointed production manager of Electronic Corporation of America.

IRC VOLUME CONTROL REPAIR BOOKLET

An interesting booklet titled *Here's How*, and devoted to the presentation of ideas on how to make *duration* volume control repairs to home radio sets when normal replacement units may not be readily available, has been publishe[illegible] International Resistance Company, [illegible] N. Broad Street, Philadelphia, Pa. The prize-winning ideas selected by a board of judges from among hundreds submitted by Service Men from all parts of the United States in response to a contest recently sponsored by the International Resistance Company, appear in this booklet.

In addition to the volume control data, involving repair methods both by change of circuit and mechanical changes, the booklet contains information on figuring resistor substitutes; formulas for finding wattage, current and resistance values; a listing of preferred ranges; a standard RMA color code chart and a Resistor Determination Chart.

The booklets are offered free of charge.

* * *

TUBE SUBSTITUTION MANUAL

A 20-page booklet, *Radio Tube Substitution and Change Over Manual* by Robert T. Oelrich, has been published by Oelrich Publications, 1627 S. Keeler Ave., Chicago 23, Ill.

This manual discusses uses which may be made of loctal tubes.

It demonstrates how these tubes may be used in place of the hard-to-get tube numbers, such as 12SA7, 12SK7, 50L6GT, etc., by the use of an adaptor or by changing sockets.

The manual also covers substitutes that may be made without changing the wiring or sockets.

Adaptor construction is also covere[illegible]

Price of the manual is $1.00.

* * *

AERO NEEDLE COUNTER CARD

A 4-color counter card featuring the Aeropoint *111* long-life phonograph needle, is being offered by Aero Needle

Company, 737 North Michigan Ave., Chicago.

The card contains 13 packaged needles. Aeropoint phonograph needles incorporate the shock-absorbing curved spring design engineered by Fred Williamson.

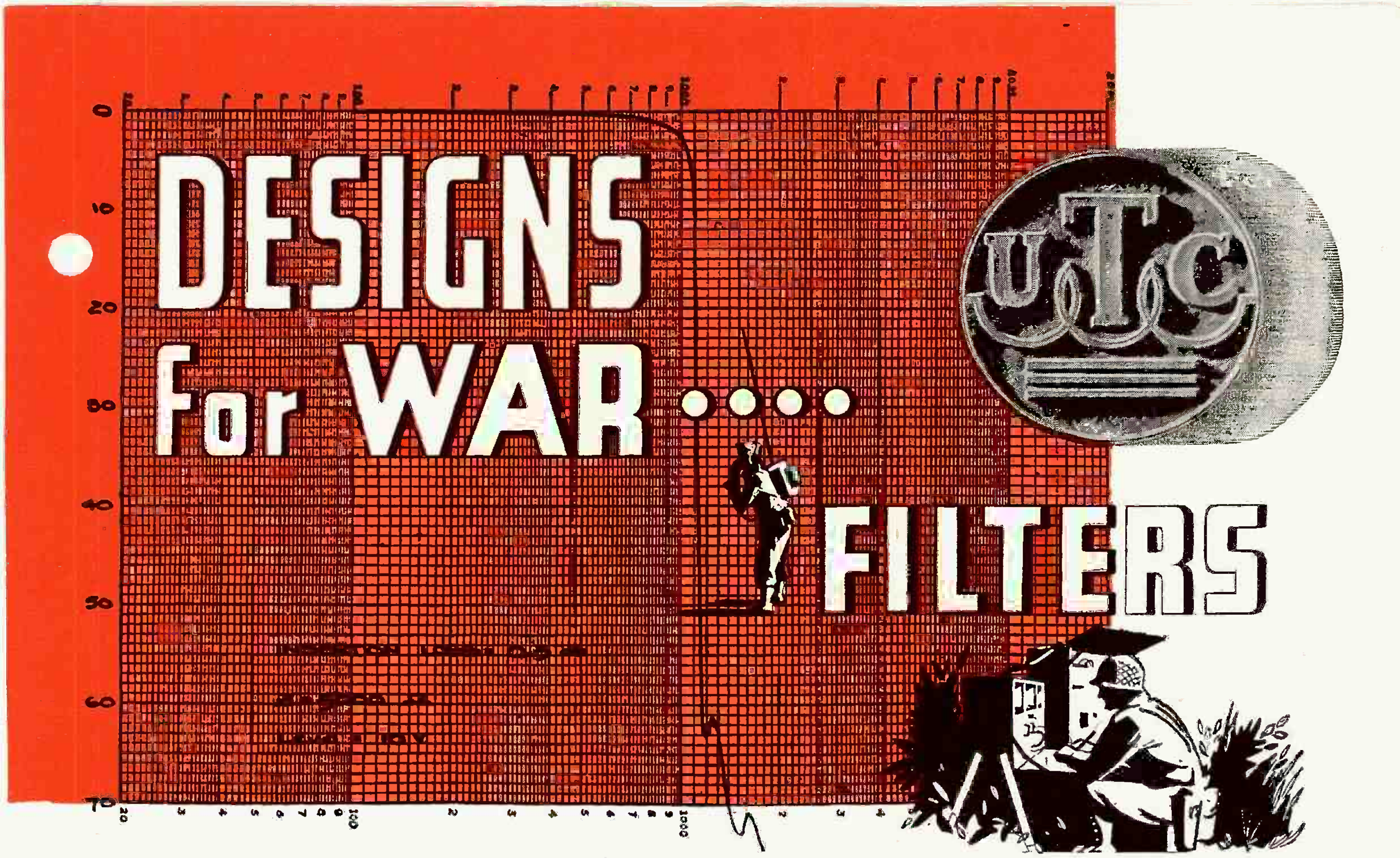
* * *

THROAT MIKE CATALOG

Universal Microphone Co., Inglew[illegible], Cal., has just published catalog 961 [illegible]scribing throat microphones type T-3[illegible].

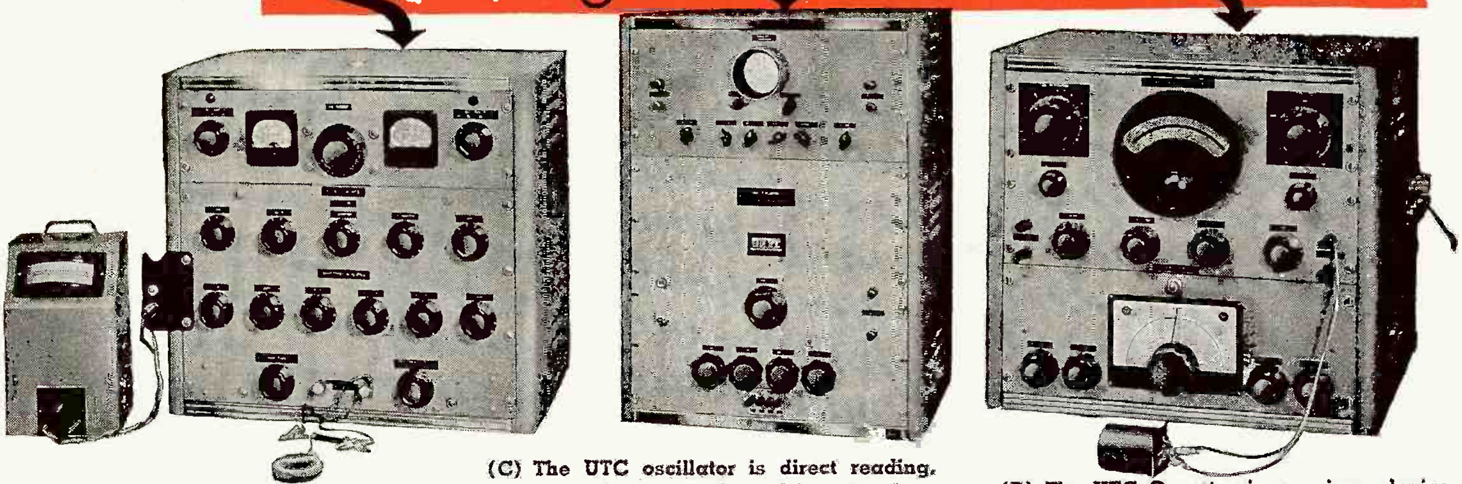
In the catalog are diagrams showing operational circuits and the extension cord assemblies.

DESIGNS For WAR.... FILTERS



(A) Filter performance is dependent upon three major factors, basic design... Q of coil and capacitor elements... and precision of adjustment. The superiority of UTC products in this field has been effected through many years of research and development on core materials and measuring apparatus. We illustrate below a typical filter formula and some of the UTC apparatus used to determine quantitative and qualitative values:

$$\frac{(LC\pi^2 f_\infty - 1)\left(\frac{1}{Q}+1-\left(\frac{f_\infty}{f}\right)^2\right)}{\frac{1}{Q^2}+\left(1-\left(\frac{f_\infty}{f}\right)^2\right)^2} = U_m \text{ (ATTENUATION CONSTANT)}$$



(B) The UTC inductance bridge is capable of four digit accuracy and covers a range from extremely low values to over 100 Hys. The effective resistance and inductance values are direct reading, eliminating the possibility of error in conversion.

(C) The UTC oscillator is direct reading, where the frequency desired is set as in a four digit decade box, and is accurate within 1 cycle at 1,000 cycles. The range is 10 cycles to 100 kc. Accuracy of this type is essential with filters having sharp attenuation characteristics. This instrument is augmented by a UTC harmonic analyzer for the output measuring device.

(D) The UTC Q meter is a unique device which has helped considerably in the development of the special core materials used in our filters. It is also of importance in maintaining uniform quality in our production coils. The Q is read directly and covers the entire range of possible Q factors over the entire audio frequency band.

UNITED TRANSFORMER CO.

150 VARICK STREET • NEW YORK 13, N. Y.

EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y., CABLES: "ARLAB"

CONTROLLED RECTIFIERS

(*Continued from page 12*)

fier trouble investigation, since, for rectifier systems of medium capacity, having an output ranging from twenty-five to 150 amperes, regardless of the voltage output, a greater number of rectifying phases results in the use of a smaller rectifier tube per phase. Polyphase rectifiers in this current range, having a fewer number of rectifier tubes, must invariably resort to the use of ignitrons in each phase.

Thus, at a glance, if the rectifier incorporates many tubes, no ignitrons are involved, and conversely, a small tube complement indicates the presence of ignitron tubes.

Generally, servicing and maintenance of electronic rectifiers is not involved. Under all but the rarest conditions, preliminary trouble diagnosis may be made visually, as is the case with all electronic equipment, and subsequent localization of the defect is then accomplished with the usual radio set servicing instruments.

The type of defect which occurs most frequently is the loss of one, or more, grid voltage a-c components, and is a direct result of rectifier overloading. Rectifier power transformers usually carry the rectifier grid windings in addition to the anode and primary windings. Overheating of the transformer through overload results in winding expansion, the coils or the core expanding to the greatest degree, through rise to the highest temperature. The outermost windings are usually the grid coils, these being wound with wire of small diameter. Expansion of the inner windings thus quickly subjects these grid coils to enough stress to effect a break in the coil wire, open-circuiting the coil, and therefore the grid circuit of the associated thyratron tube.

Where the series a-c coil of a thyratron tube grid circuit is open, that thyratron tube is no longer under grid control. The thyratron then conducts *wide open*, or *runs away*. That is, the tube assumes the greatest portion of the load current, this producing a far brighter glow in the tube than is present in the rest of the tube complement.

Measurement of the a-c grid voltage, in such an instance, is impossible, and the resistance of the grid coils affected is infinite. However, the lack of a voltage across the terminals of the coil is sufficient indication that the coil is defective. This is borne out by the original observation respecting the runaway or overload conduction by the tube affected.

Here, a temporary repair may be effected through the connection of suitable tapped, single-phase transformers, of the type employed in radio transmitter bias supplies, into the system. This must be accomplished in such a manner that the resultant grid voltage across the secondary windings of the two transformers lags the thyratron anode voltage by 90 electrical degrees. It must be of a magnitude similar to that of each grid voltage which is in series with the remaining thyratron grids.

Unless the power transformer consists of several separate, or sectional units, a transformer with a short-circuited winding must be replaced. In the former instance, the defective transformer may be disconnected from the circuit, the balance of the system thus temporarily supplying the load current.

Where operational trouble, such as described here has been caused by overload, it is prudent to examine the protective fusing system. The system should be fused against any such overload, thus insuring the customer against production losses through careless rectifier operation.

Another common rectifier trouble or defect readily diagnosed involves high resistance leakage paths between one of the transformer windings and a grid winding. Here, each of the thyratrons, or ignitrons, will conduct a current differing in magnitude with that of others in the system. Since the tube glow is proportional in brilliance to the current the tube conducts, each of the tubes glows with an intensity differing with that of the balance of the tube complement.

Localization of the defect is approached as with similar troubles in conventional radio receivers. The simplest expedient, here, is the connection of a cathode-ray oscilloscope across the d-c control terminals. Synchronizing the linear oscillator of the 'scope with one of the power phases, the wave viewed on the cathode-ray tube screen may be traced with a soft crayon or pencil. It can be subsequently tried against each of the transformer grid coils until the offending coil voltage wave matches the penciled wave.

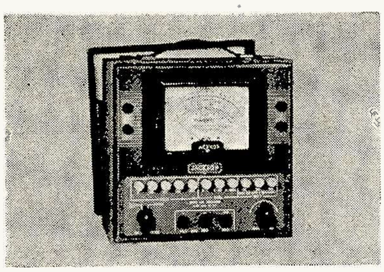
Once the leaky winding has been located in this manner, verification of the localization may be made, through ohmmeter resistance measurements between the terminal of the offending coil and those of other windings.

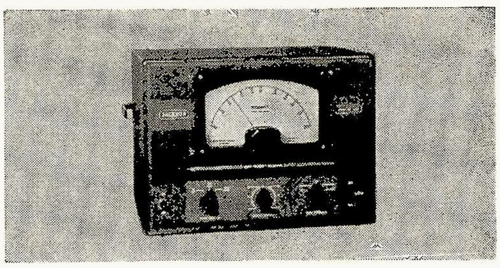
Correction of a fault of this nature is accomplished, as with an open grid winding, through transformer substitution, except that the offending winding must be completely disconnected from the balance of the circuit.

In all of these instances, the initial clue as to the possible defect is available in the glow of the thyratron tubes. This is also true of ignitron rectifiers, since the excitation glow is visible through the Nonex glass anode seal. However, if a defect occurs in the d-c section of the control system, no such indication is available.

The d-c control section troubles are recognizable by the lack of control over the rectifier output. Measurements are the only means by which the possible defect may be analyzed and located. If the rectifier is equipped with a d-c ammeter, which is true in most installations, diagnosis of the trouble is facilitated. Lack of such a d-c ammeter requires that a suitable portable ammeter be connected into the rectifier d-c output system.

If the rectifier output current, as read from the unit name plate, is slightly less than half of the full load current at normal d-c voltage, it being impossible to vary this by means of the d-c control system, it is obvious that the d-c section of the control system is not receiving power from its d-c power supply, and that the thyratrons conduct at 90 degrees. This may be quickly verified by an oscilloscope reading taken across the volt-





meter terminals. The balance of the investigation is carried out in the manner customary with the plate supply section of the conventional radio receiver, resulting in the location of a defective filter capacitor.

Another defect which shows up as abnormally high rectifier output and lack of control by the d-c system may be traced to the controlling amplifier tube, if one is incorporated in the circuit. That latter is probably defective or, more specifically, has an open heater. Another possibility is an open circuited control potentiometer.

Where the rectifier fails to deliver any voltage, it is apparent that the control grid of the control amplifier tube is being held constantly positive, because of a defect in its grid coupling circuit. This causes the tube to draw maximum plate current, with the result that the thyratron grids are biased highly negative. This condition may be readily traced in the circuit diagram of Fig. 5.

If the thyratron grids are controlled from a d-c control potentiometer, it is possible to cause the rectifier to deliver an output current by turning the slider arm shaft toward the positive terminal of the resistance element. In most commercial units, this is accomplished by turning the potentiometer knob clockwise, so as to increase the rectifier output by increasing the positive d-c bias on the control grids of the thyratron rectifier tubes. The rectifier will obviously begin to conduct suddenly at that point on the potentiometer resistance element where the open circuit is to be found. The d-c circuit control potentiometers in the control circuits of commercial rectifiers are usually of the wire-wound variety.

Electronic rectifiers utilizing a-c phase-shifting control systems are rare in industry. However, the general diagnosis procedure here described for d-c controlled system applies, to a great extent, in the analysis of rectifiers in the a-c control classification.

Where a new rectifier is to be installed, it will be found usually, that the a-c and d-c circuit conduits have been placed prior to the arrival of the rectifier cubicle. Before connection of the rectifier to the systems involved, these ducts, or conduits, should be properly connected directly to the cubicle outlets, to insure protection of the wiring against accidental damage.

All connections should be made in accordance with the factory circuit diagram, or blueprint, which is usually supplied with the rectifier. If the cubicle is not equipped with an ammeter, a portable ammeter should be temporarily inserted into the positive output lead of the rectifier. A light output load, selected to conduct only a few amperes, may then be connected across the d-c output terminals in such a manner that the current drawn by this load will be read on the portable or integral ammeter.

Once all connections have been completed and properly insulated, power may be applied to the rectifier. The output ammeter will not read for a period of approximately 300 seconds. The time delay relay which protects the tube cathodes operates during this interval, closing the anode power circuit relay at the end of the timing period. It is a commendable procedure, in the case of a new rectifier, to prevent the operation of this relay for at least twenty minutes. This insures proper *setting* of the tube cathodes. A convenient means of accomplishing s a delay is to turn the rectifier a-c power on, opening and quickly reclosing the a-c power supply switch or breaker at the end of each three-minute period.

When the tube cathodes are at the proper temperature, the d-c load circuit switch may be closed, and the ammeter and the voltmeter readings observed. An attempt should be made to control the d-c output, observation of the control action being possible through the readings of the d-c meters. If the rectifier is a polyphase unit, and it fails to control at this time, the a-c supply *phase rotation* is incorrect. This may be corrected by interchanging any two of the a-c power supply leads at the rectifier a-c terminals. Some of the better rectifier cubicles are equipped with a phase rotation switch and indicator, which provides automatic correction of phase rotation without requiring disconnection of the equipment from the power line. Once the phase rotation has been corrected, the rectifier may be restarted, and control tests again performed. The unit should now operate properly.

...ce in proper operation, the rectifie.. connections may be made permanent, and the normal loading applied. All adjustments must be made at this time, in accordance with the factory instruction book or blueprint. Once these adjustments are made, the unit should be padlocked against tampering.

In general, electronic rectifier units are uncomfortably large in physical size and capacity, dwarfing the usual radio equipment. However, the circuits and circuit elements, aside from their large sizes, should be quite familiar to the radio Service Man, and thus present no deterrent to adequate rectifier servicing and maintenance procedure.

* * *

SERVICING HELPS

(*Continued from page* 24)

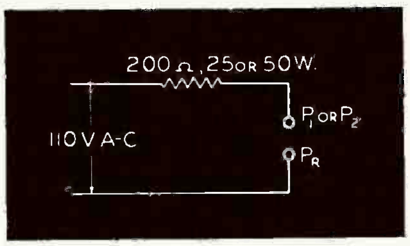
drawings as illustrated in the replacement catalog should be checked.

Connect 110 volts a-c through a 200-ohm, 25 to 50-watt resistor to the reed (P_R) and to either point P_1 or P_2 of the vibrator. Only one of the latter will draw current and actuate the reed. With the vibrator held so that the prongs face you, determine the location of the prongs connected to P_R, P_1, and P_2. It will usually require from one to ten seconds to start the vibrator running and to remove all oxide film from the points. This will not, in any case, damage the vibrator. After this treatment the vibrator will start and function properly in its normal application.

This method may be used to remove oxide film and start any make of shunt-type vibrator. All manufacturers selling a general replacement line employ the shunt-type construction.

(Data, Courtesy Radiart)

A method of removing oxide film from a recitfier is illustrated here.



* * *

Our country is at war. On the home-front, it is your obligation, small enough surely, to keep your industry functioning smoothly "for the duration."

AUDIO CHANALYST

(See Front Cover)

THE RCA Audio Chanalyst, No. 170, for audio systems is contained in a portable case and made up of the following units: a high-gain audio amplifier and attenuator, a low-gain amplifier and attenuator, an audio oscillator and buffer amplifier, a speaker driven by an output stage, a multi-range a-f and d-c vacuum tube voltmeter, power supply and supply of switches for the following operations:

(*1*)—Signal tracing
(*2*)—Gain measurements
(*3*)—Measurements of operating levels
(*4*)—Noise and hum levels
(*5*)—Voltage measurements of a-c, d-c and a-f
(*6*)—Resistance and impedance measurements
(*7*)—Comparison of microphone levels
(*8*)—Supplying spot frequencies with low distortion

The cover diagram, this month, covers the high gain amplifier and attenuator and the 6E5 indicator tube for level measurement. It is called *Amplifier A* and is set at the factory for a sensitivity of 173 microvolts and an attenuation ratio of 120 db or 1,000,000 to 1. The sensitivity is also at minus 80 db with reference to a zero level of 6 milliwatts into 500 ohms. Panel calibration adjustments permit the use of zero levels of 1, 6 or 12 mw with a maximum sensitivity of 71 microvolts.

The amplifier consists of three 6J7 stages, the first two being high gain pentodes and the third operating as a triode. The attenuator consists of two parts, a coarse step-by-step system and a fine potentiometer and rheostat. The coarse switching takes place at the input to the first and second stages while the fine adjustment acts as a standard volume control at the input to the third stage. These will be considered in detail.

The audio input jack, isolated by a .1-mfd condenser is connected to the first attenuator of four resistors. The pentode grid input voltage is not lowered for the 1, 10 and 100 steps. The 1,000-step delivers 1/10 voltage to the grid, the 10,000-step 1/100 voltage, and the 100,000-step only 1/1000 of the input. The tube is operated with conventional cathode bias and uses a rather low plate load resistor, 68,000 ohms, which helps to prevent a drooping gain at the high frequencies due to the miscellaneous capacities to ground. The entire amplifier characteristic is essentially flat up to 10,000 cycles.

The second stage is similar to the first except that the attenuator is the converse of the first, having the 100, 1,000, 10,000 and 100,000 steps tied together while the 1 and 10 steps separate. The entire resistance totals ½ megohm while the input attenuator is 1 megohm. The plate load of this stage consists of a 50,000-ohm resistor shunted by part of a 100,000-ohm potentiometer which serves as a calibration adjustment for gain.

The third stage has a volume control type attenuator plus a variable 100,000 resistor for fine calibration. The calibration of the fine attenuator is from 0 to +20 db with a voltage ratio of 10 to 1. The coarse attenuator in the first and second stage has a ratio of 100,000 to 1 and a range of —80 to +20 db. The bias resistor is 820 ohms, much lower than the pentode stages which have values of 2,200 and 1,500, respectively. All bias resistors are bypassed with 40-mfd condensers. Note the extensive use of plate and screen decoupling filters to aid stability and prevent hum.

The amplifier is calibrated for an undistorted voltage output of .1 volt but will deliver up to 1 volt without overload. Above this value distortion will take place. This will be indicated on the *magic eye* when the eye closes more than half way so all measurements should be taken at less than this level. For other uses, such as signal tr...ing, the *eye* may be used up to a c... 1 position, as overloading to this extent will have no effect on the operation. The output of this amplifier may be used in several ways; as a-f for measurement, a-f to feed a 6SR7 amplifier and speaker, a-f to feed a second channel low gain amplifier (*Amplifier B*) or as rectified a-f for d-c measurement. One of the 6SR7 diodes is used as a rectifier. The output impedance is approximately 100,000 ohms for the a-f and 1 megohm for the voltmeter. Where it is necessary to run a long lead from the audio output jack a low capacity cable must be used to prevent excessive loading.

In connecting the input of this amplifier to a signal source, particular attention must be paid toward having the low potential side of the source connect directly to the ground terminal. Otherwise, when the amplifier is wide open, there will be a considerable amount of hum.

[*Further data on the use of the amplifier will be presented next month.*]

* * *

TEST INSTRUMENTS

(*Continued from page 16*)

...s that have not been properly c...ed for, cleaning contacts, lubricating moving parts, and removing foreign matter such as dust, grit, insects, particles of metal, salts from corrosion, and the like. Much of the inconvenience and expense of returning instruments for repair could be avoided if the user followed a program of periodic inspection and adjustment of his own equipment. Of course, in many cases, operating conditions are such that wear and corrosion are inevitable, but a definite maintenance program will help to minimize deterioration and failures.

The following recommendations for keeping most types of test equipment in proper condition are made by the General Radio Company and are reprinted here through its courtesy. These apply to such units as analyzers, oscillators, testers, etc., which contain various types of switches, wire-wound control resistors, etc.

(*1*)—Follow a definite maintenance program. Many repairs can be eliminated by proper test instrument maintenance.

(*2*)—Switch and relay contacts, ...tact surfaces or wire-wound con...s, slide wires and mechanical contact surfaces of various types can be cleaned by a solution of one-half alcohol and one-half ether.

(*3*)—To remove oxidation or corrosion on large contact surfaces, use crocus cloth. To clean small surfaces, use very fine sandpaper and remove residue with a fine brush for smooth operation. Fine sandpaper can be used for wire-wound controls, key switches, push switches, anti-capacity switches, multi-blade-contact rotary switches, etc.

(*4*)—Electric motors (such as are used in the mechanical visual alignment units in radio manufacturing plants) should be attended to in the usual manner.

(*5*)—Electrical indicating instruments should not be cleaned or adjusted except by one skilled in handling such fine work.

(*6*)—For proper lubrication of any part, first check to see whether oil or grease is used. A fine grade of clock oil, or "Lubrico, Density MD" (manufactured by Master Lubricants Company, Philadelphia, Pennsylvania), should be used on all moving surfaces that require oil. Lubrico is acid-free and adheres to moving parts better than most lubricants. Apply a thin film of oil only. Excess oil catches and retains dust and other foreign matter.

(*7*)—Wire-wound controls, mechanisms, chain drives, gear trains, ball bearings, shafts, vernier drives, etc., can be oiled. Also, push-button switches, condenser bearings, etc.

(*8*)—Tubes and batteries used in test instruments should be checked frequently and replaced if necessary. Proper replacement types shou[illegible] be used.

(*9*)—If an instrument appears to act erratically, inspect for a broken wire or loose soldered or mechanical connection.

(*10*)—Dials, wood cabinets, panels and dust covers (including crackle finish types) can be improved in appearance by oil polish rubbed in well.

(*11*)—Clean slow-motion drives occasionally with a brush and cloth saturated with carbon tetrachloride.

(*12*)—Clean air condensers in oscillators with a pipe cleaner. Do not bend plates. Foreign matter between fixed condenser posts should be removed periodically to prevent electrical leakage.

* * *

SER-CUITS

(*Continued from page 21*)

net plug. Excessive pressure may break the solder bond on the short-wave magnet lug (2nd from bottom), causing raspy noise and fading on short-wave bands. Removing the 1LN5 r-f tube will allow clearanc[illegible] resoldering this bond if it is broke[illegible]

Noisy When Jarred

A short strip of ½" surgical tape applied to the front of the chassis will prevent the speaker from touching the receiver, causing noise when the set is jarred. For microphonism, check the 1LA6 and 1LD5 tubes.

Weak on Short-waves

Lack of sensitivity on the short-wave bands may be attributed to moisture pentrating the trimmer condensers in the high frequency r-f and oscillator circuits. A simple remedy for this condition is to expose the opened back of the receiver to the sun or an electric heating unit. Care should be exercised to avoid excessive heat which will melt the wax impregnation from tubular condensers, coils, etc.

A more thorough inspection will be necessary where salt air has left a film of corrosion at the terminal lugs on the coils and between the plates of the trimmer condensers. The corrosive film may be removed by applying a small brush saturated with carbon-tetrachloride (carbona) to the affe[illegible] parts, then wiping them off wi[illegible] clean cloth. The receiver must be thoroughly dehydrated, as outlined above, before removing the corrosion.

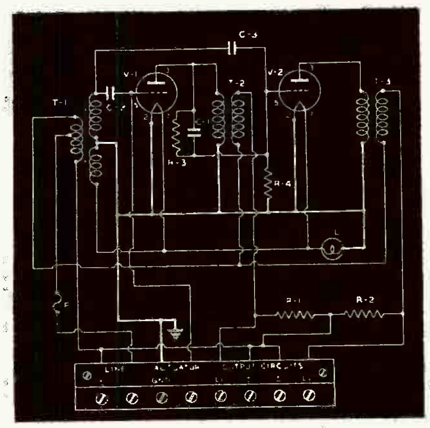
NEW PRODUCTS

THORDARSON FLASHTRON

An electronic package unit known as Flashtron has been announced by Thordarson Electric Manufacturing Company, Chicago.

With Flashtron it is possible to electronically shift control power from one circuit to another and back by the opening and closing of a single pair of electrical contacts.

Flashtron incorporates two grid controlled rectifier tubes. Each of these



tubes controls power to separate output circuits through suitable transformers. The interconnection of the tube elements is such that only one circuit is operating at any given instant and one of the circuits is always functioning (patent 2,208,-235).

In service an actuator or primary sensitive element (bourbon tube, thermostat, etc.) with its electrical contacts is connected to the grid circuit of one of the tubes. The output circuits are connected to a suitable bi-directional motor or other reciprocal control. When the contacts of the actuator approach the closed position, the tube releases power to its output circuit operating the motor or control in a given direction. The change in direction immediately reflects its action to the actuator, opening the contacts and restoring the first tube to a non-operating condition. The second tube then functions, changing the direction of operation and the cycle repeats itself. The valve is constantly re-set to the desired position in exact response to the primary sensitive element which is actuating the Flashtron. Visual observation of the grid control tubes operating many times a second indicates the control obtained with the system.

The Flashtron operates with and supplies to the output terminals, 115-volt, 50-60-cycle current. The potential applied to these contacts does not exceed 15 volts rms, .001 ampere.

The Flashtron is housed in an all-steel box 11½" x 7⅛" x 3⅝".

* * *

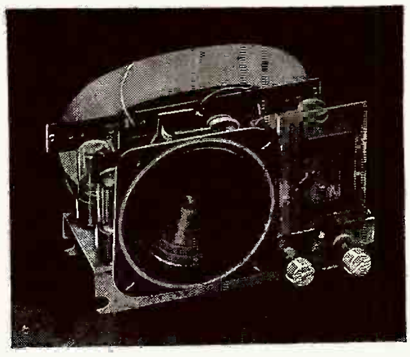
SCHOOL DEMONSTRATOR BOARD

A 5-tube a-c/d-c superhet demonstrator board for training is now available from Lafayette Radio Corporation, 901 West Jackson Boulevard, Chicago 7, Illinois, and 265 Peachtree Street, Atlanta 3, Georgia.

* * *

ALLIED RADIO RECEIVER KIT

A 5-tube a-c/d-c radio receiver kit especially developed for illustrating theory and practices now being covered in basic or preinduction radio training has been produced by Allied Radio Corporation, Educational Division, 833 West Jackson Boulevard, Chicago 7, Illinois.



JOTS & FLASHES

A WHITE STAR has been added to the Army-Navy "E" flag of Solar Mfg. Corp., capacitor manufacturer with plants in Bayonne and West New York, N. J., and in Chicago. . . . General Electric Co., Bridgeport, Conn., earns the coveted white star for the second time as does the Philco Corp. of Philadelphia . . . congratulations. . . . Parker H Ericksen appointed director of sales by Majestic Radio & Television Corp. . . . Regret to report death of Sayre M. Ramsdell, head of Philadelphia Advertising Agency bearing his name . . . was vice-president of Philco for many years. . . . Eddie Schramm, well known in radio service circles, joins Clarostat as purchasing agent. . . . Marshall S. Burlew, son of Roy Burlew of Ken-Rad, graduated from Army Air School as a bombardier and has been commissioned a second-lieutenant. . . . A new plant opened by Ken-Rad in Huntingburg, Ind. . . . General Electric appoints Joseph A. Kerr as tube representative for the Eastern region. . . . Radio Corp. of America wins the third white star for their Army-Navy "E" pennant. . . . White star also earned by Stromberg-Carlson. . . . Scientific Radio Products Co., Council Bluffs, Iowa, awarded the Army-Navy "E" pennant for excellence in production on October 2nd. . . . General Radio Co., Cambridge, Mass., entitled to add the white star to their "E" flag. . . . Are you getting the Aerovox Research worker? . . . chock full of valuable data for all Service Men . . . make sure you are on their list. . . . Emerson-New York, Inc., installs display of tubes and radio parts in showroom at 111 Eighth Ave. . . . Nelson P. Case heads engineering division of Hamilton Radio. . . . Increased production schedules at Radio Receptor Co., New York, and Universal Microphone Co., Inglewood, Cal., has prompted increased manufacturing facilities. . . . T. I. Phillips now heads Pittsburgh divisions of Westinghouse. . . . G. I. Price elected vice-president of same concern. . . . General Electric appoints C. A Priest, manager of transmitter division. . . . Fada of New York issues attractive circular relative to their service facilities. . . . last minute flashes. . . . Army-Navy "E" to the Rola Company, Cleveland speaker manufacturer . . . white star for "E" flag to Sprague Specialties Co. for continued production excellence. . . . Jerome L. Herold joins Emerson Radio & Phono. Corp. as chief purchasing agent. . . . start your post-war thinking NOW . . . that's important . . . and keep on buying war bonds . . . that's even more important.

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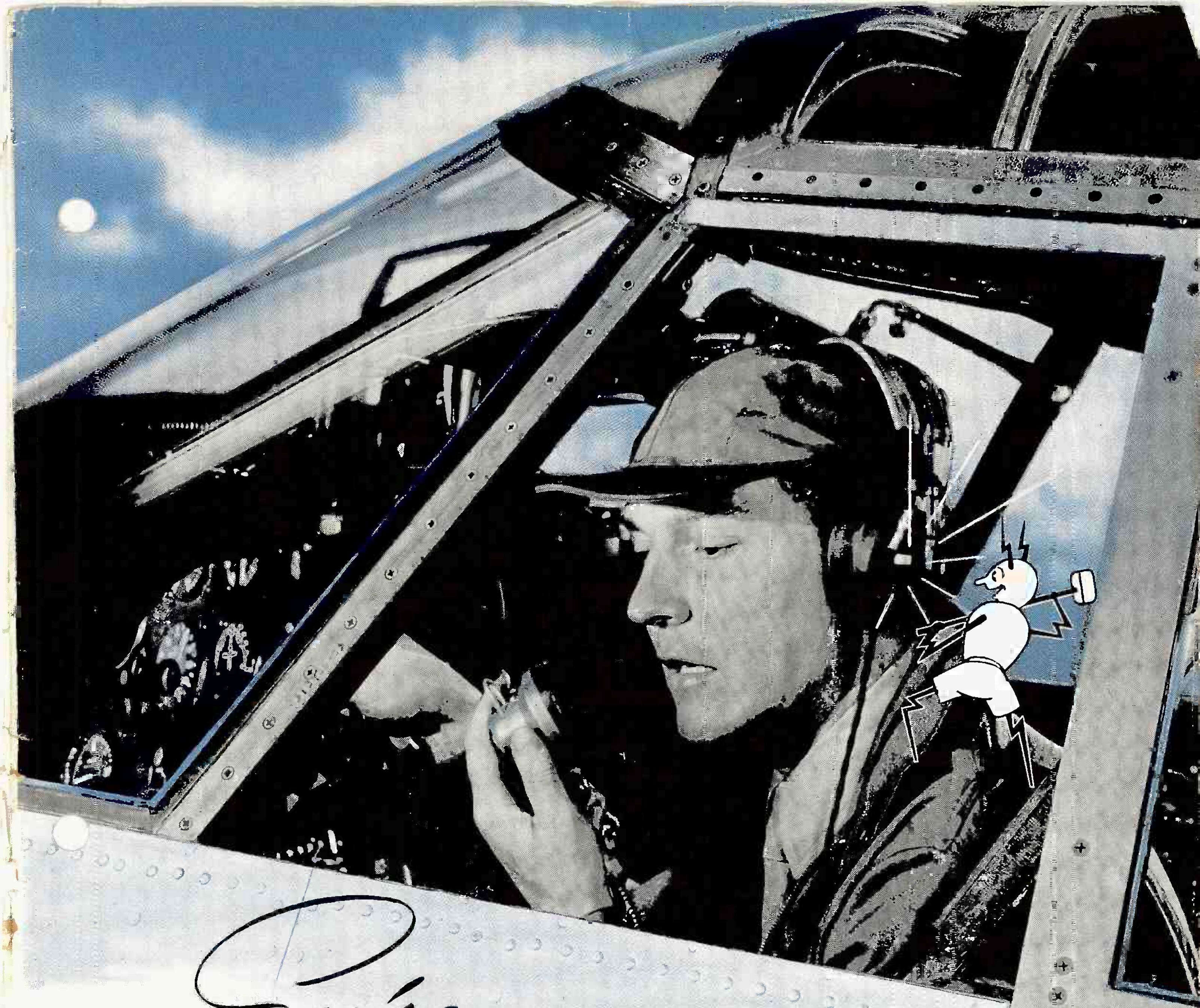
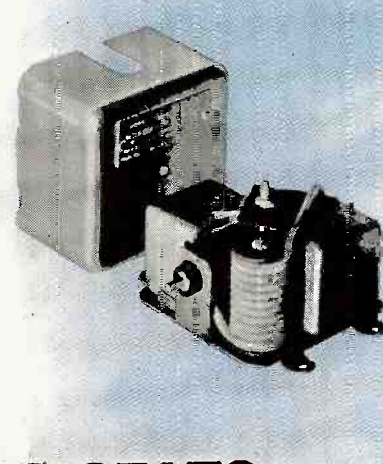


Seeing ...BY EAR

A fighting man must fly blind sometimes, but deaf never. In long range bombers . . . in scrappy pursuit planes . . . whatever the visibility, vital communication channels must be kept clear. Unless the proper suppression filter system is installed, noisy radio interference acts like a pack of demons . . . sabotages communications upon which the safety of men and their military missions depend.

Solar Elim-O-Stats are Communications' Life-savers. They are compact filters which protect against local static, absorbing it *right where it starts*—at generators, motors, contacts, and other sources. Solar Capacitors are reliable components used by practically all leading manufacturers of military radio equipment. From command car to jeep or tank . . . from ship to ship or plane . . . between planes—wherever radio is vital—Solar Capacitors and Elim-O-Stats help keep channels clear, so fighting men can hear.

If you have a problem concerning capacitors or radio noise suppression, call on Solar Manufacturing Corporation, 285 Madison Ave., New York 17, N. Y.



Solar SOLAR — ELIM-O-STATS

CAPACITORS AND RADIO NOISE-SUPPRESSION FILTERS

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WITH SWEAT AND TEARS!

Photo by U. S. Army Air Corps

THE war record of America's radio tube engineers is an impressive one. Yet these able and ingenious men, too, have their "problem children".

In this category are the miniature tubes used by our combat troops in communication radio sets. Admittedly these tubes are tough little "hombres" — especially "tough" for that selected group of engineers whose responsibility is to produce them by the tens of thousands. Only because of the sweat and tears of these men has the flow of miniatures to our armed forces been maintained and steadily expanded month after month.

That National Union is one of the nation's important manufacturers of miniatures is evidence of the success of N.U. engineers in helping to solve one of this Industry's most difficult war production problems. Thus do research and development experiences in wartime build a reservoir for post-war accomplishment.

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