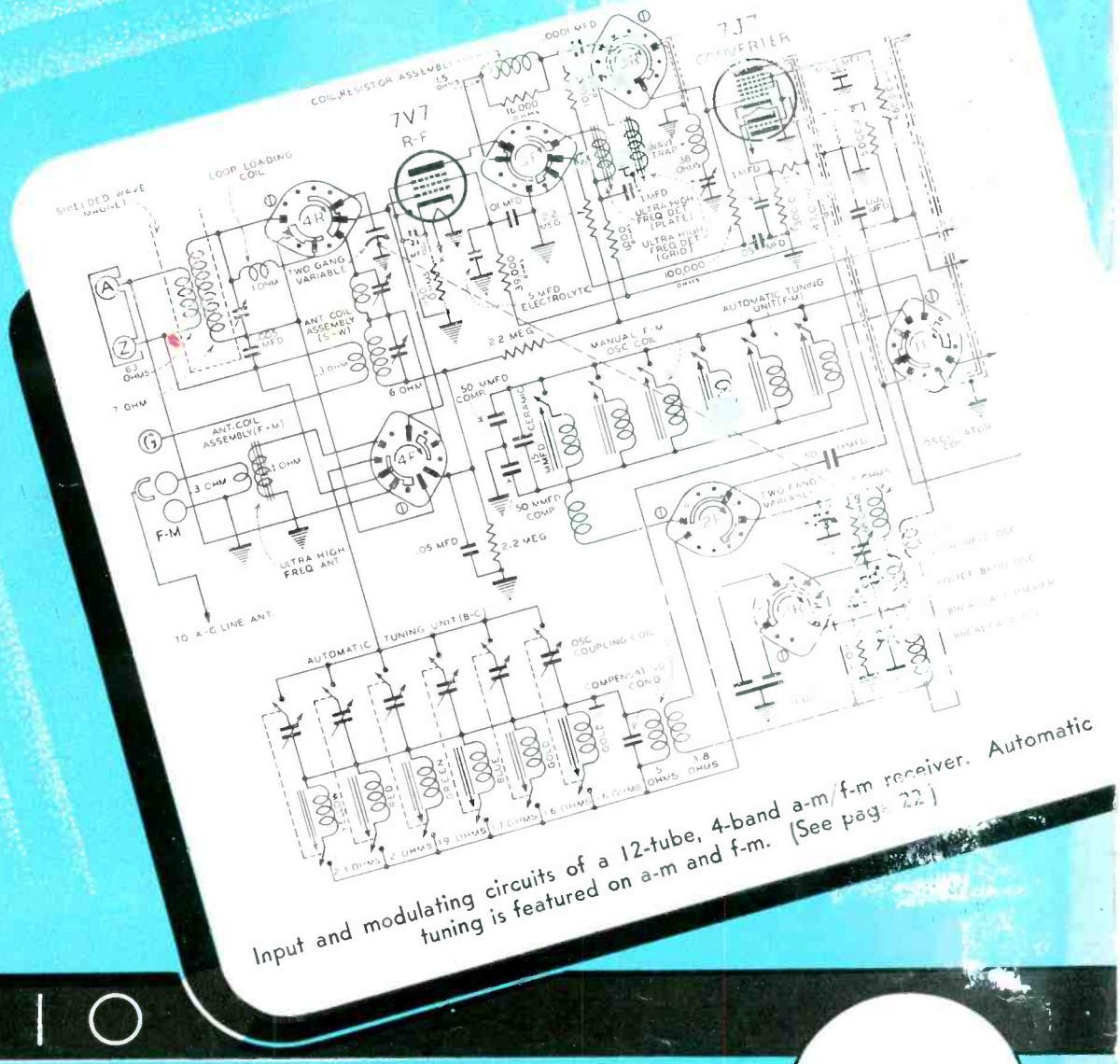
SERVICE

A MONTHLY DIGEST OF RADIO AND ALLIED MAINTENANCE

1/4S



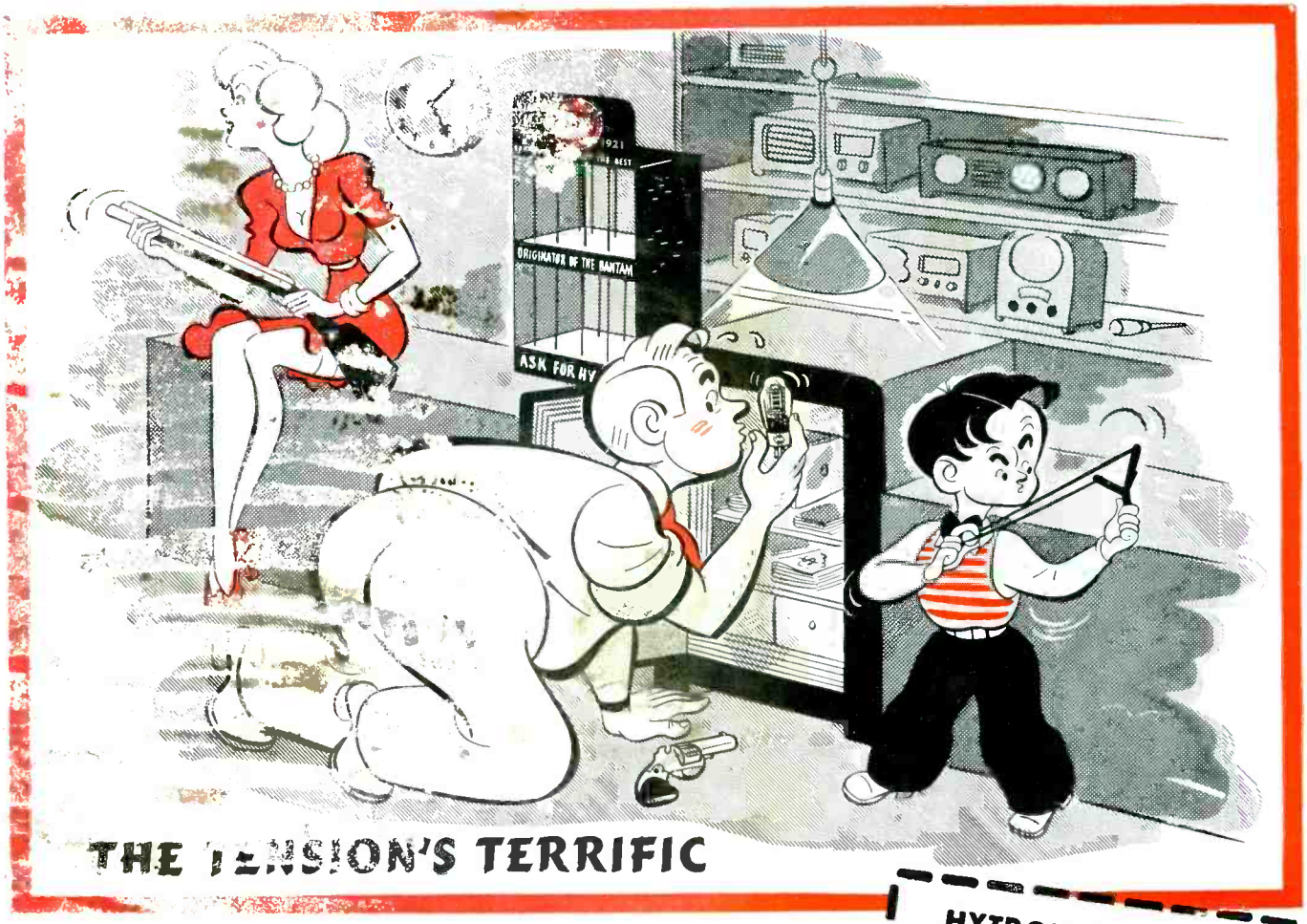
Input and modulating circuits of a 12-tube, 4-band a-m/f-m receiver. Automatic tuning is featured on a-m and f-m. (See page 22)

★ RADIO

★ TELEVISION

★ ELECTRONICS

November
1943



THE TENSION'S TERRIFIC

. . . let's hope it eases soon!

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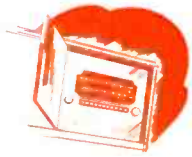
HYTRON HYLIGHTS

The War Production Board, interpreting for Hytron the Limitation Order L-265, has made it clear that any kind of replacement tube covered by the order may be shipped on orders bearing L-265 certifications. Authorized Hytronic distributors have, therefore, been informed that Hytron transmitting and special purpose tubes may be obtained under L-265. Since Hytron is concentrating on these types, good deliveries of them are being made against L-265 orders, because scheduled deliveries against rated priority orders are being maintained by expanded production facilities.



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HYTRON CORPORATION ELECTRONIC AND RADIO TUBES

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to Diagnose, Locate and Repair Receiver Troubles

EASIER • BETTER and FASTER

SPEED... DO MORE WORK... MAKE MORE MONEY...

FACTS

About GHIRARDI'S [illegible] Wartime Service Handbook

"IT'S NAMED WRONG!" says John Davidson

"Ghirardi's RADIO TROUBLE-SHOOTER'S HANDBOOK is named wrong," *writes Serviceman John C. Davidson of Opelousas, La.* "It should be called the Radio Serviceman's Savior!"

"Time saved on only two repair jobs paid for the book. I wouldn't be without it." *Burton V. Selle, Elyria, Ohio.*

"I've learned more in one hour from this book than I have in the last 11 years of my radio career! No radio man will ever go wrong in buying it. It's the best I've ever had!" *Pvt. Evert Halbach, Ft. Benning, Ga.*

Radio service men need all the help they can get these days—and here's the very latest book written by the master servicing expert, Alfred A. Ghirardi, to give you EXACTLY the help you need WHEN YOU NEED IT! Don't waste time in complicated testing of every receiver! Simply turn to the Case History "Trouble" data on that particular model in Ghirardi's new edition **RADIO TROUBLESHOOTER'S HANDBOOK.** Nine times out of ten, you'll find exactly the clue you need to repair it promptly—and without any elaborate testing whatsoever!

GOODBYE TO GUESSWORK—

Don't let work pile up on your bench while you fuss around trying to find a hard-to-get replacement tube or part for a job. Turn to the Data Sections in the **TROUBLESHOOTER'S HANDBOOK**—and you may be pleasantly surprised to learn that some easy-to-get tube or part can be substituted according to the directions that this new Handbook supplies!

STOP WASTING TIME!

In brief, why bother to spend your valuable time figuring out anything for yourself that has already been figured out for you and recorded in easily-found, quickly-understood style in this big new 710-page manual-size book! Smart servicemen everywhere say this big new volume is helping them turn out from 50% to 100% more work in a given time—and make more money accordingly.

NEW—COMPLETELY REVISED

Don't confuse this Handbook with previous editions. This is Ghirardi's big NEW wartime edition—completely revised—bigger than ever—more helpful—CONTAINING NINE MORE SECTIONS OF VITAL [illegible] PRIAL—and giving complete data on 75 subjects absolutely essential to your every day service work.

HOW TO TEST A RADIO IN 2 MINUTES OR LESS!

You don't have to spend long hours of study before this big new book starts working for you. It isn't a "study" book. You simply refer to the Case History or other required data section every time a set comes in for repair. It will pay for itself the time saved the first couple of times you use it—then continue to pay you big dividends for years to come.

HERE'S WHAT YOU GET!

Features of the Handbook include a valuable 404-page Case History compilation—the most comprehensive and authoritative ever published—giving the common trouble Symptoms, their Causes and Remedies for over 4000 receiver models! In addition, it gives the most complete and genuinely helpful tube chart you've ever seen; dozens of tips on interchanging [illegible] condensers, controls, and other parts; I-F alignment peaks for over 20,000 superhets; a big section on A.F. transformer troubles—and numerous graphs, charts, helpful hints, and servicing data compilations that will help you do every job better—and, generally, in a small fraction of the time you would normally take!

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EDITORIAL

AN intriguing assortment of figures showing the amazing strides of f-m were revealed at a General Electric luncheon a few weeks ago by W. R. David. He said that the potential market of f-m receivers is approximately 12,500,000, not including second receivers and car sets. This is based on the assumption that but *one* out of *four* will buy an f-m set in the major areas served by f-m where the population is some 50,000,000. And there will be plenty of f-m stations to listen to, too. Five years after the war, Mr. David predicted that we will have 500 f-m stations.

And by the way, television was also on Mr. David's prediction list. There will be at least 100 television stations five years after the war, he said. Television also received a boost from Thomas F. Joyce, of RCA. Speaking before a joint meeting of the American Television Society and the Advertising Club of New York, he said that we will be having $200 television receivers. In the interim postwar period we will have, of course, the steady rise of receivers and stations to the predicted peaks.

Looks as if f-m and television are growing up and mighty fast, at a streamlined pace!

THE a-r system has certainly become an important factor in the war effort. In plant, office, at the front and on the sea, p-a has proved its mettle. Even a number of major war books have cited the great work of p-a. Take, for instance, Lieutenant John Mason Brown's book "To All Hands" recently published. In this book the p-a system is really the hero. For Lieutenant Brown was a "battle announcer" on the flagship of the Atlantic Fleet Amphibious Force. It was his job to keep the men informed of up-to-the-minute developments in the air and on the shore, by a series of news broadcasts over the ship's p-a system.

A salute to p-a!

OUR efforts to conserve paper continue. The December issue of SERVICE will have a new trim size of 7⅝" x 10⅝". In October the weight of paper was further decreased to 40-pound stock.

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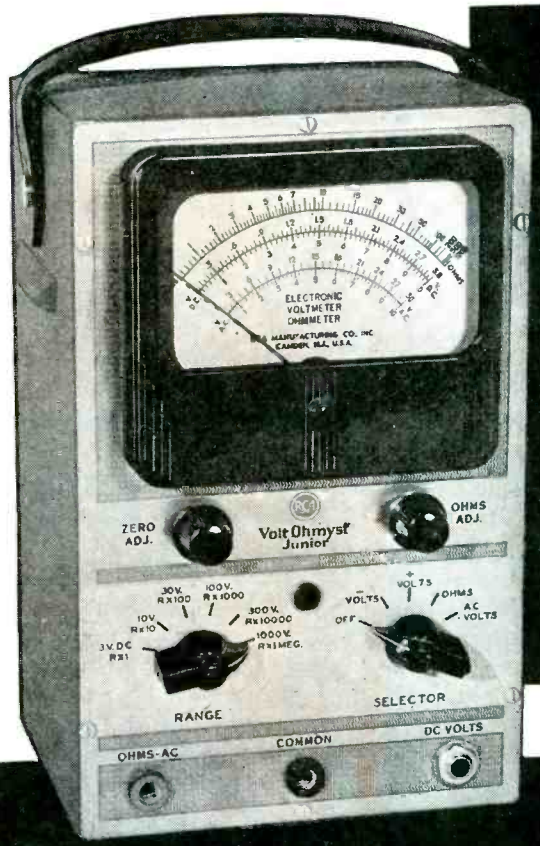

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SERVICE
A Monthly Digest of Radio and Allied Maintenance

WARTIME SERVICING OF I-F TRANSFORMERS

By ALFRED A. GHIRARDI
Advisory Editor

MANY receivers that have defective i-f transformers can be maintained in operation by a little ingenuity or expediency on the part of the Service Man, even though exact replacement transformers are not available. The purpose of this article is to offer pertinent suggestions for accomplishing this. Practical remedies and *tricks of the trade* for the various types of troubles that may be encountered will be discussed, as well as the subsequent adjustments that may be required for good performance.

Faulty Compensator Condensers

If one section of a dual-unit i-f compensator condenser is faulty it should be disconnected entirely from the circuit and an external single condenser installed under the chassis pan and connected in its place. Another procedure is to tighten the coupling between the coils by sliding them closer together and then leaving the *primary* untuned, as indicated in Fig 1. The good condenser is used to tune the secondary.

One method of adjusting the position of the coils in a wax-coated, dowel-mounted transformer is to heat the coil over a soldering iron, with a metal can or shield around them to act as an oven. This should soften the wax in about ten minutes, permitting movement of at least one of the coils. If the coils are lacquered it may be necessary to soak them in a lacquer thinner. Considerable care is sometimes required to prevent the collapsing of the coils. Small potted i-f units may be repaired by heating and removing the iron-core pots.

Stripped compensator screws used in trimmers may be repaired by soldering a nut to the brass insert of the trimmer. If no insert is used and the base is of ceramac material or bakelite, cement a nut under the base for the adjusting screw.

Simple Repair of Open I-F Coil

When confronted with an open i-f coil and no prospect of obtaining a replacement unit, some Service Men proceed at once to unwind up to 10 or 20 per cent of the turns and try to spot the open and effect a repair. If too much wire is unwound, the coupling will be reduced, with a consequent loss of gain, and it also may be quite a job to tune the transformer. The addition of shunt fixed condensers may be required to tune the transformer up to the normal i-f, and peaking will be difficult. One alternative is to bring an iron slug to the rescue to build up the inductance to the former value by using it as a core. Another is to slide the coils a little closer together on the coil form, first loosening them by the method previously explained.

Unwinding turns from *both* of the i-f coils may be necessary where the compensators are wide open and do not peak properly. The lower inductance will then permit the compensa-

Fig. 2. At (a) normal circuit of standard 2-coil i-f; (b) using a transformer with open primary; (c) using a transformer with open secondary.

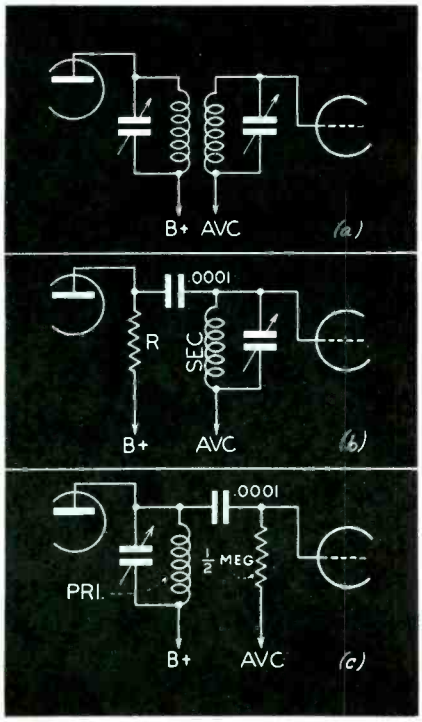


Fig. 1. Tightening coupling between coils when one section of dual-unit i-f compensator condenser is faulty.

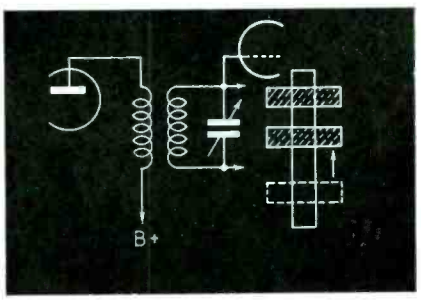
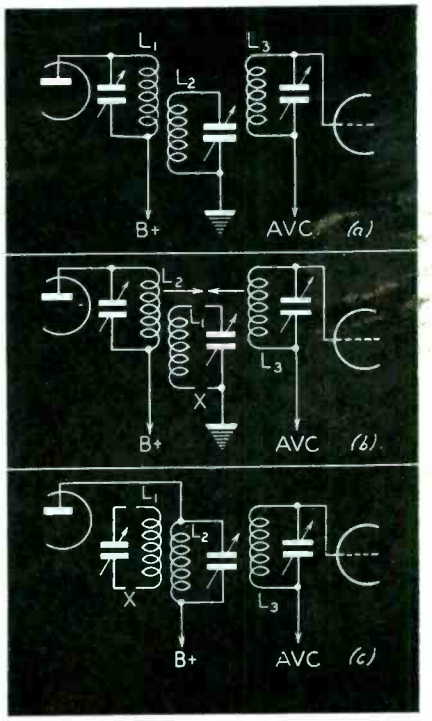


Fig. 3. At (a) normal circuit of 3-coil i-f transformer; (b) making use of transformer if intermediate coil is open; (c) making use of transformer if primary coil is open.



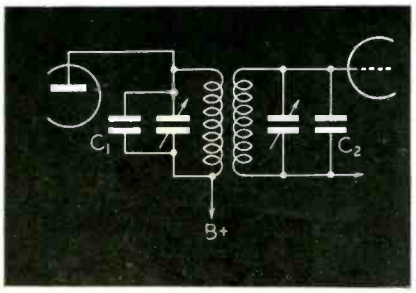


Fig. 4. Shunting fixed mica capacitors in a 455-kc transformer, being used as a substitute for a defective lower frequency transformer.

tors to tune correctly and will also aid stability. A certain amount of capacity is required in the circuit to overcome misalignment caused by changed circuit capacitances resulting from changing the tubes, etc.

Maintaining Operation When I-F Coil Opens

We will consider first the most popular type of i-f transformer, the dual-coil tuned transformer, which is normally wired as illustrated in Fig. 2. If one of the coils becomes open-circuited, temporary repairs may be made as illustrated in Fig. 2a or 2b by the addition of a simple resistor and coupling condenser. When the primary is open, a plate resistor of suitable value between about 50,000 and 250,000 ohms is inserted as a plate load and a small mica capacitor couples the plate to the tuned grid of the following stage. Realignment of the single tuned circuit is very important, as the circuit constants will have changed considerably (Note Fig. 2a). When the secondary is open, a similar procedure is used but the grid resistor used should ordinarily be of higher resistance value than the plate resistor of the former case. The arrangement illustrated in Fig. 2b will permit operation in this case.

Let us now consider the triple-tuned type transformer of Fig. 3a, which is used in many high-quality receivers. When one of the coils is open the transformer can be made to function as a dual transformer, as in Fig. 2a. If the intermediate winding L_2 is open, it will be necessary to increase the coupling between L_1 and L_3 to maintain sufficient gain in the amplifier. This is indicated in Fig. 3a. The intermediate circuit should be made completely open-circuited to minimize its effect on the active coils. The method of increasing coupling will be discussed later. If L_1 is open, winding L_2 may be used as the primary as indicated in Fig. 3b. If L_3 is open, winding L_2 may be used as the secondary in the same way.

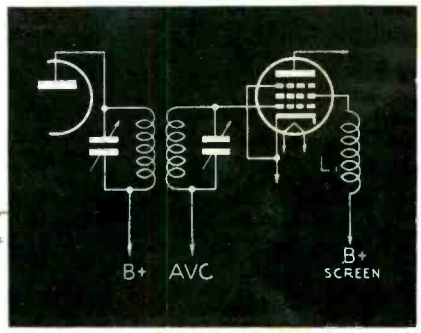


Fig. 6. How to increase gain.

Substituting a Transormer of Higher I-F

I-f transformers for 175 or 262 kc are more likely to open than 455 kc units because of the finer wire used in their coils. In an emergency, a 455-kc transformer may be used to replace a lower frequency transformer by shunting fixed mica condensers across the two windings, as C_1 and C_2 in Fig. 4. The pass band will be widened and the gain reduced, but the performance will be adequate in many cases. Use this remedy with caution in loop sets. Some of the lost gain may be recaptured by employing one of the tricks to follow.

Fig. 7. Another gain-increasing method.

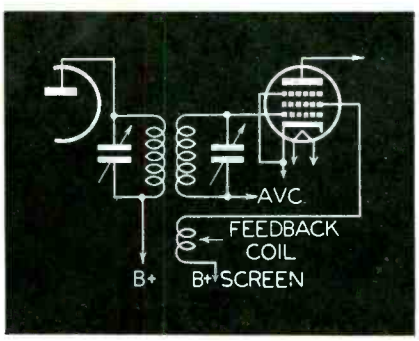
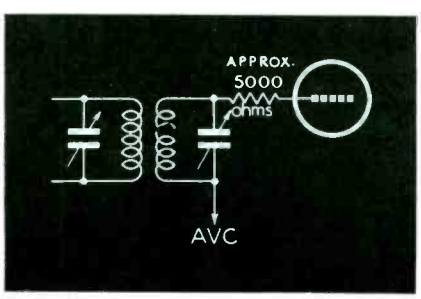


Fig. 8. A method of stopping i-f oscillation is shown here.



Increasing I-F Gain

Since the use of most of the wartime i-f transformer repair expedients results in reduction of the i-f amplification, it behooves us to investigate practical methods of *increasing* the i-f gain in order to compensate for the reduction, and thus permit their use.

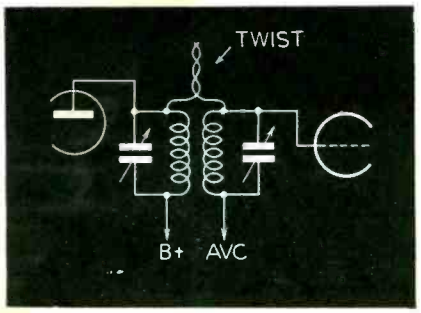


Fig. 5. Twisting insulated-wire leads connected to hot sides of primary and secondary coils to obtain the capacitive regeneration.

The arrangement shown in Fig. 5 indicates one method of obtaining capacitive regeneration by simply twisting together two insulated-wire leads connected to the *hot* sides of the primary and secondary coils. This will usually improve the gain when the transformer is repeaked. Where a single-ended type i-f tube is used, a short wire soldered to the plate terminal may be twisted around the control-grid lead right at the socket and regeneration may be thus obtained and controlled. If oscillation occurs, shorten the coupling wire.

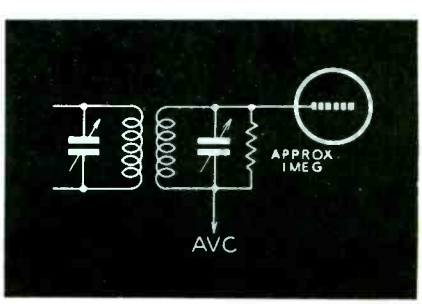
Fig. 6 shows another method of increasing gain by inserting a choke in the screen-grid lead. This choke (L_1) may be a coil salvaged from a defective i-f transformer. Turns may be peeled off until the right amount of feedback is obtained. Still another method is illustrated in Fig. 7 where direct magnetic feedback is employed in the transformer by means of a *tickler* or *feedback* coil connected in the screen circuit. A little experimenting is again required to find the optimum number of turns for the feedback coil; 10 or 20 will do in many cases. And don't forget that the polarity of the tickler coil, or direction of winding, is most important—otherwise degeneration instead of regeneration will result.

Decreasing I-F Gain

In some repair jobs, installation of a new i-f transformer will cause oscillation. There are probably a lot more ways to kill gain than to bolster it. It

(*Continued on page 21*)

Fig. 9. An effective method of stopping i-f oscillation (reducing gain) is illustrated here.



SERVICING HELPS

A SPARE-PART TESTER

By HARRY F. LEEPER

ONE vacuum tube and a few resistors and condensers connected as shown in Fig. 1, provide an economical and efficient tester for radio defects.

Instead of hit and miss testing, the trouble may be quickly localized to the defective stage.

In operation the terminal *B* is connected to the receiver chassis and terminal *A* with the plates of various tubes. After adjusting the potentiometer for volume desired in the phones, the signal from a station may be listened to at various stages in the receiver.

Standard flashlight cells are used for the tube filament voltage. The plate voltage is secured from an old *B* eliminator and connected to two terminals mounted in the rear of the instrument case.

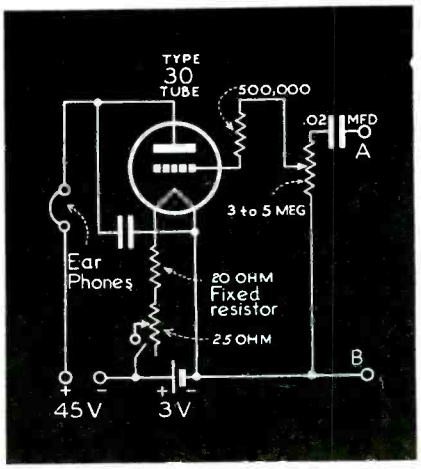


Fig. 1. The test unit designed by Mr. Leeper.

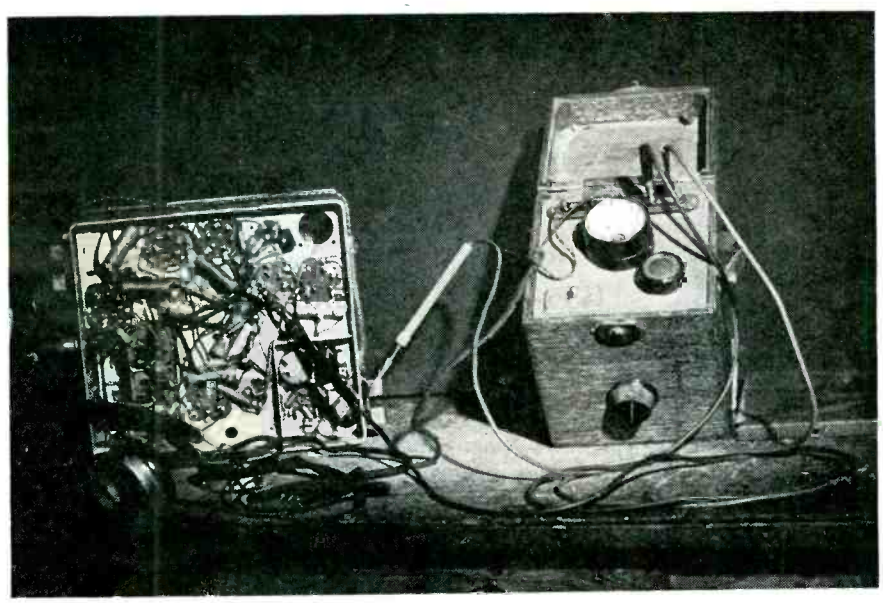


Fig. 2. The tester ready for operation.

In checking a receiver for distortion, noise, etc., the signal can be checked by starting at the plate of the audio tube and working backward toward the input of the receiver.

The signal will become weaker as this progession is followed. By advancing the potentiometer and tuning in a strong signal, sufficient volume is usually obtained from the tubes ahead of the first detector circuit, for checking purposes.

Tests can be conducted, by starting at the audio section too.

Having localized the trouble, each part in it may be checked with an ohmmeter for the defective part.

A recent application with this unit involved a distortion test of a Philco 60.

The usual voltage tests at the plate of the 75 detector and at the grid and plate of the 42 output tube did not indicate the trouble. The coupling condenser was also good.

The tester was then connected at the plate of the 75 detector tube. The signal was found to be clear, thus eliminating all the preceding sections.

Connection was then made at the plate of the 42 output tube, where distortion was present. This narrowed the search down to two condensers and three resistors between these tubes.

Further tests proved that a .5-mfd condenser connected in the plate circuit of the 75 tube had a leakage of several thousand ohms to ground, which was causing the trouble.

A "B" ELIMINATOR WELDER

By BURTON V. SELLE
and
CORPORAL HUBERT W. MEREDITH*

WE know that copper is a vital war material, and conservation is of vital importance. In experimenting with ways of accelerating repairs, we ran across a welding method of repair that not only speeds up repair work, but saves copper wire too.

Sometimes it has been possible to repair an open audio transformer or speaker field by inducing an extremely high voltage. Too often, though, we found that it is a trick that is not very practical, because the voltage was too low or too high. A perfect weld was not assured either, for we had no way of knowing when a perfect weld had taken place. The use of a *B* eliminator seems to have solved the problem.

The procedure is as follows: First set up on your work bench a small sensitive radio. Tune the radio to some point on the dial where man-made static ordinarily comes in loudest.

Now set up a high voltage *B* eliminator (100 to 250 volts) with a variable control. Turn the *B* eliminator off. Then connect a pair of leads with clips from the *B* eliminator across, let us say, an open coil. Make sure that the variable control on the *B* eliminator is set at its lowest point.

Now plug in the *B* eliminator and listen for an arcing sound in the radio. Keep increasing the *B* voltage until you pick up this arcing sound in the radio. As soon as the broken wires in the coil have solidly welded themselves together, the arcing sound in the radio will cease. When this sound ceases, shut off the *B* eliminator immediately. If the high voltage is left on after the weld has taken place, the coil may burn out.

The radio used in this procedure is actually your welding eye.

*This paper does not reflect the opinion of, or constitute a verification by the U. S. Army

PECULIARITIES OF ELECTRONIC CIRCUITS

By S. J. MURCEK

CIRCUITS incorporated into electronic devices differ, to some extent, from the circuits of radio receiving or public address equipment. These circuit deviations require careful consideration.

Most industrial electronic systems are characterized by the absence of radio frequency currents and voltages, with the possible exception of induction welding and heating equipment. In such systems, the frequencies applied are within the limits of the audio frequency spectrum. Electronic circuits, then, may be considered as a special form of the conventional audio frequency amplifier, altered to meet specific needs.

The audio frequency system concept may be more clearly visualized if we remember that reactions occurring in the electronic system result from the *real movement* which is under its control. For example, the photocontrol responds to the passage of an object between a phototube and a light source. An appreciable period of time is required for this travel by the scanned object, resulting in a response of like rate by the photocontrol system. From this, it is clear that the functional period of the photocontrol lies somewhere in the lower audio frequency spectrum.

Despite the basic audio frequency character of the electronic control, certain electrical system variations occur to place such a system in a classification somewhat removed from the usual audio frequency system. Where, in conventional audio frequency systems, dynamic coupling, usually of the resistance-capacitance or transformer type, is employed, the electronic system conventionally utilizes direct coupling. The necessity for this particular deviation lies in the fact that direct coupling lends itself admirably to the high voltage negative biasing required for thyratron tube grid control.

Two forms of direct coupling often utilized in electronic systems are shown in the schematic circuits of Fig. 1. The coupling system in Fig. 1a has been subject to considerable discussion, and is normally utilized in the conventional electronic circuit system. With this type of coupling, the thyraton *2* grid is variable with *respect* to the cathode. That is, if the control grid of the pentode *1* is positive with respect to its cathode, the thyratron grid is negative with respect to its cathode.

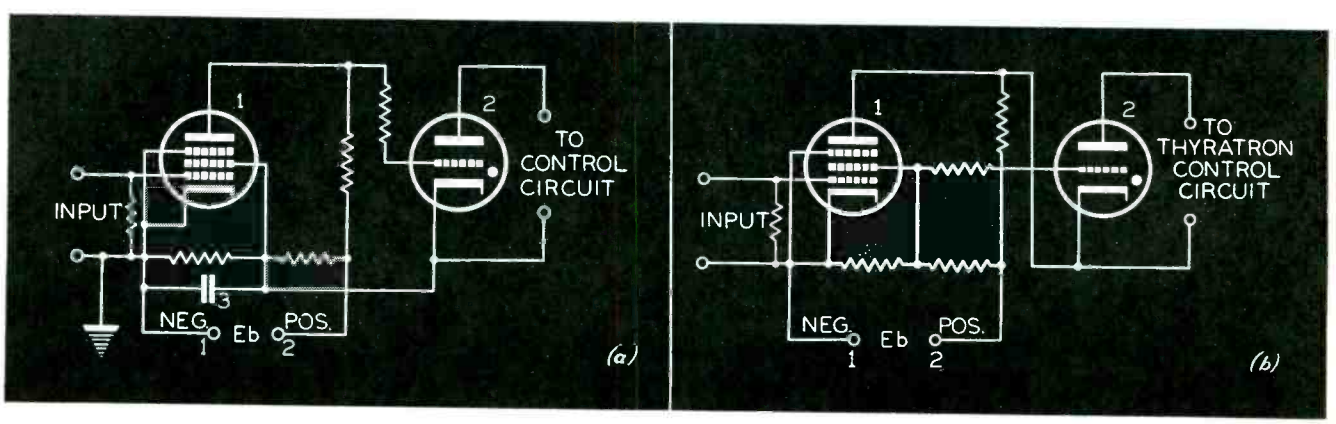
In the instance of Fig. 1b, however, the cathode of thyratron *2* is variable with respect to the grid, the latter electrode being electrically constant. Here, if the control grid of pentode *1* is positive with respect to its cathode, the *cathode* of thyratron *2* is *negative* with respect to the *grid*, or, the grid is *positive* with respect to the cathode. This is the exact opposite of the operation provided by the circuit in Fig. 1a.

In the circuits of Fig. 1, E_b is the pentode circuit plate supply voltage. It should be observed that this voltage, through the operation of the pentode circuits, provides the high negative grid-to-cathode bias required to maintain the thyratron *dark*, or non-conductive.

Further, the circuit of Fig. 1b is rarely applied in modern electronic systems, because of the difficulties encountered in providing adequate circuit shielding against external disturbances. This arises from the fact that the *cathode is the sensitive electrode* of the thyratron. The cathode of the thyratron is normally heated by power applied to its heater terminals from a transformer winding. Thus, leakages, resistive or electrostatic, occurring between this winding and others located on the same transformer core leg, are introduced in series with the pentode plate circuit, since the plate circuit power for this pentode is also supplied by the same transformer. Resistive leakage introduces an a-c ripple voltage into the thyratron grid circuit in this manner. External disturbance voltages are introduced here electrostatically. In direct contrast, the cathode of the thyratron in Fig. 1a is returned to no-voltage, or *ground* level through the relatively low resistance of the voltage divider.

Dynamically-coupled circuits in electronic systems, differ from those usually employed in radio and public address systems in that tube grid bias voltages are often avoided. The tube under consideration is operated in a normally *saturated* manner. An example of such operation is given in the circuit and graph of Fig. 2. In Fig. 2a, the control grid of the pentode *2* is normally at zero volts with respect to the cathode. Under these conditions,

Fig. 1. Here we see two forms of direct coupling often utilized in electronic systems. The system shown in (a) is normally used in the conventional electronic system. In the system shown in (b) we achieve an effect directly opposite to that of the circuit shown in (a). This system is rarely used because of the difficulties found in shielding such a circuit.



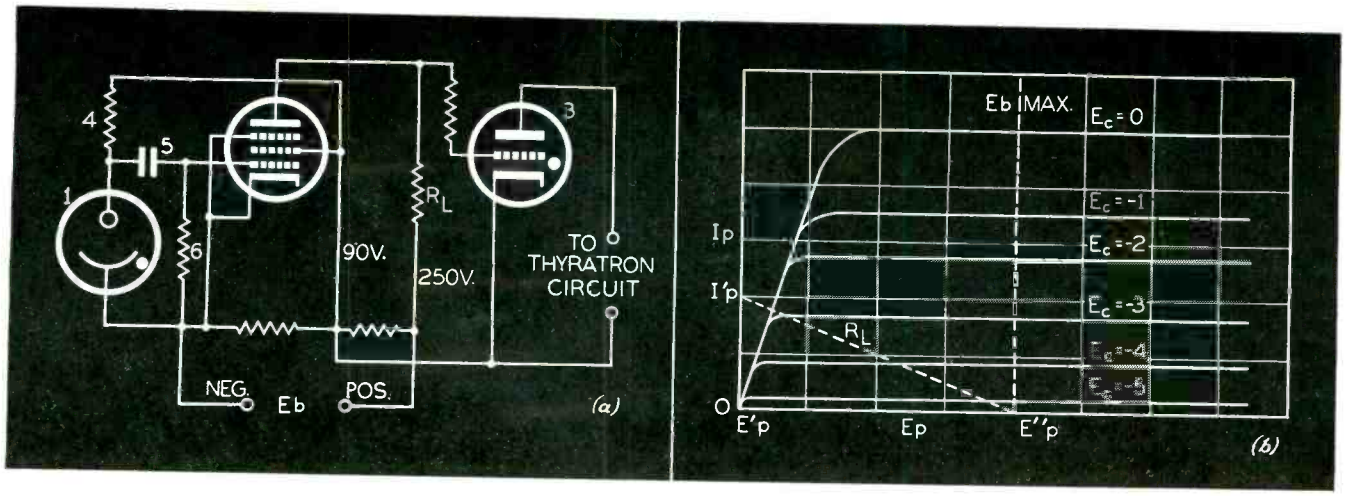


Fig. 2. At (a) a schematic of a dynamically-coupled circuit used in electronic systems. At (b) we have a graph showing operating characteristics of system.

from the family of tube plate curves, in Fig. 2b, it is seen that the pentode plate current I_p is at a maximum, since the grid voltage E_c is at zero volts with respect to the cathode. Further, this maximum or *saturation* plate current is limited to a safe value I'_p by the plate resistor R_L, the voltage across the tube plate and cathode, E'_p, being relatively small. From this, also, it may be observed that the grid of thyratron *3* in Fig. 2a is normally negative with respect to its cathode, this tube remaining *dark*.

An increase in the illumination level on phototube *1* decreases the voltage across this tube. The control grid of pentode *2* swings negative with respect to its cathode, since capacitor, *5*, discharges in series with the phototube and grid resistor *6*. In addition, the decrease in voltage across the phototube is usually in excess of ten volts, since the phototube loading resistor *4* is very high in resistance.

From the graph of Fig. 2b, it is obvious that a negative grid voltage of ten volts is sufficient to cut off conduction by the pentode. The voltage between the anode and cathode, E'_p, is now at a maximum. In the circuit of Fig. 2a, such a reaction places the grid of thyratron *3* positive with respect to the cathode, this tube now being conductive. Once capacitor *5* discharges completely, however, the pentode grid bias voltage is once again at zero volts, and saturation, with thyratron non-conduction, re-establishes the normal state. Obviously, pentode *2* of Fig. 2a does not necessarily require a fixed negative bias between the grid and cathode.

Although the circuit of Fig. 2a is shown specifically connected with a phototube, it is common to find an amplifier stage of this type immediately succeeding a negatively based impulsed stage. The high potential negative pulse obtained from the plate circuit of the negatively biased stage would suffice, here, to swing the control grid of the zero biased tube sufficiently negative to cut off its plate current completely, thus satisfying the conditions imposed by the use of such an amplifier stage. This type of dynamically coupled voltage amplifier stage may be readily recognized as a *class B* resistance coupled amplifier stage, wherein the control grid of the amplifier tube usually swings positive with respect to the cathode, except that the negative grid voltage swing in the electronic variant performs the desired function. Single ended class *B* amplifier stages are readily applicable to electronic control circuits in that only one of the alternations of each cycle amplified by such a stage is used in controlling the operation of a thyratron tube.

Thus, a dynamically coupled stage of the zero bias type, resistance coupled in the grid variable manner to the control grid of a succeeding thyratron, will provide thyratron conduction only during the negative portions of the a-c wave train connected into the input grid circuit of the zero bias stage.

Where the electronic device is applied in the control of relatively slow moving equipment, and the accompanying reactions lie in the low frequency end of the audio spectrum, the amplifier and coupling systems incorporated into the device are quite similar to early audio frequency amplifier systems. The fidelity and frequency response of amplifying and coupling equipment in this classification, operating at low frequencies, need only suffice to provide sufficient voltage gain to effect adequate control of the thyratron stage. However, where great precision or extreme rapidity of operation is desired, it is conventional to detail the coupling and amplifying system more closely.

In the practical application of modern electronics, it is customary to subdivide a given wave, or wave shape, into its several basic components. That is, a given wave is considered to be a system of several fundamental waves. From the illustration of Fig. 3a, depicting a reversed sawtooth impulse, it may be observed that the initial rise of the impulse has a much steeper slope than the impulse decline. If the initial velocity of the steep wave front is continued algebraically, the result is a peaked wave of very high frequency. Conversely, the continuation of the lower velocity in the impulse decline gives rise to a peaked wave of much lower frequency. Thus, in order that the amplifier and the coupling system be capable of transmitting the impulse faithfully, it is necessary to insure transmission of the two fundamental frequencies, or *periods*, contained in the impulse. Further, if the wave front has an extremely steep slope, the electronic system must be capable of amplifying and coupling at radio, as well as at audio frequencies:

Systems of this type, when designed for transmission of such a wide band of frequencies, are capable of providing electronic controls having a precision of several thousandths of one per cent. This accuracy is attained by proper compensation of the integral amplifier system, with specific attention to the transmission of the higher frequencies. In practice, a portion of the amplifier stage plate impedance is provided by means of a radio frequency *choke* of the proper value. Fidelity in wave shape is attained through avoidance of tube characteristic curvatures, through the application of suitable tubes to the system under consideration.

The square wave of Fig. 3b offers the greatest obstacles in its amplification and transmission, since the wave front and the wave decline are in the radio frequency portion of the spectrum. Direct coupled amplifiers, when

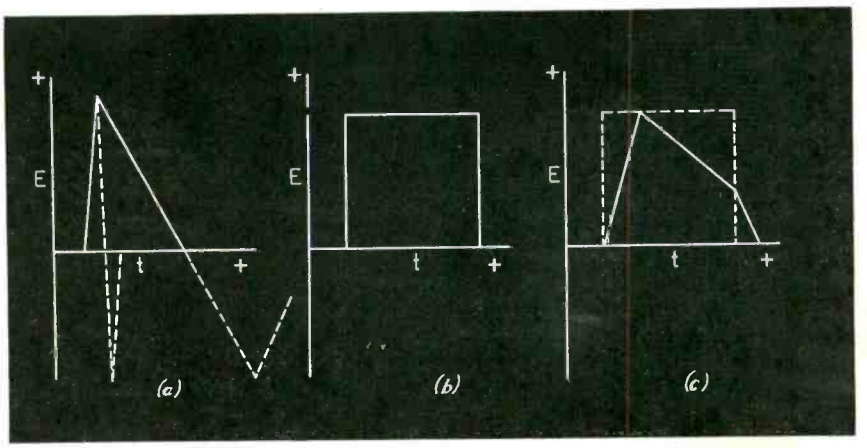


Fig. 3. Sub-division of wave shapes. At (a), a reversed sawtooth impulse; (b), square wave; (c), distortion of square wave.

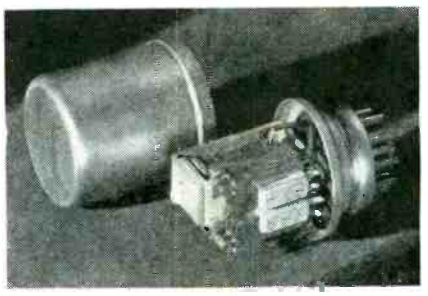
plate and grid circuits are properly compensated for transmission of the high frequencies, will reproduce the wave most faithfully, though never perfectly. A cathode-ray oscilloscope of the television type, is essential in the service and maintenance testing of an amplifier system of this type, since the circuits of the oscilloscope must also be capable of reproducing such square-wave shapes.

In the instance of a dynamically-coupled amplifier system, the square wave is a difficult wave-form to transmit properly. It may undergo considerable distortion, as is shown in the broken lines of Fig. 3c, due to various limitations imposed by the circuit constants of the amplifier and coupling stage. Inability of the stage to amplify radio frequencies in the same number as the lower audio frequencies, results in a positively sloping wave front, instead of one which is perpendicular. Again, if the coupling capacitor and resistor are not properly chosen, with respect to the input circuit or source impedance, the top of the wave will fall off to a marked degree. This is also true if a coupling capacitor has a low dielectric resistance. Finally, the high frequency limitation again appears in the positive slope of the wave decline.

It is well to observe here that if the amplifier stage is to provide a reasonable degree of fidelity, the control grid circuit resistance must be maintained as low as possible. This arrangement precludes the possibility of wave attenuation through the high resistance loading of the grid circuit at radio frequencies.

Further, a wide frequency response range may be secured only through proper circuit bypassing. Thus, the cathode resistor, if any, must be shunted by a large capacity to pass low frequency currents without appreciable drop, and high quality r-f bypass capacitors to bypass radio frequency currents.

It will be found, from an inspection of the grid to plate transconductance characteristic for a given pentode, that some unavoidable distortion of wave form may occur by reason of curvatures in this characteristic. Here, inverse feedback may be used to advantage, thus tending to reduce the effects of such curvatures. In the practical dynamically-coupled amplifier stage intended for incorporation into electronic devices, it is conventional to introduce this feedback by omission of the cathode bias capacitor. This introduces a portion of the plate voltage variation, which now appears across the cathode biasing resistor in series with the signal voltage applied to the grid. In some instances, only a section of the cathode resistor may be bypassed as a means of controlling or limiting the magnitude of the feedback voltage.



(*Courtesy, Automatic Electric Co.*)

Fig. 5. A d-c end relay.

A prime requisite to good fidelity and frequency response from any wide-range amplifier is a well-regulated plate voltage supply. This regulator serves to maintain the amplifier plate and screen voltages constant despite the current demand from the tubes involved. However, in the majority of applications, satisfactory fidelity and frequency response may be obtained from the amplifier with an unregulated power supply.

Amplifier plate power supplies which are peculiar to electronic devices and are at the same time unique, are those which employ the dry-disc or barrier rectifier unit. Use of this type of rectifier provides full wave rectification without transformer center tapping. Voltage-doubling power supply systems incorporating this rectifier are simple to the extreme, and are convenient to apply.

The power supply of Fig. 4a employs four small barrier rectifier units in a full-wave bridge. In this rectifier, when the upper terminal of transformer secondary winding *1* is positive, rectifiers *4* and *5* conduct capacitor *6* charge current, and the current drawn by bleeder resistor *7*. The voltage across capacitor *6* rises to equal the peak of the a-c value impressed across the rectifier terminals. On the other hand, when the upper terminal of the transformer secondary winding is negative, rectifiers *2* and *3* conduct the capacitor and bleed resistor currents. Thus, the rectifier operates in a full-wave mode.

In the voltage doubling power supply of Fig. 4b, capacitors *4* and *5* are charged alternately, and discharged in series. Thus, when the upper terminal of transformer secondary winding *1* is positive, current conduction is through rectifier *2* and capacitor *4*.

On the negative alternation, when the upper lead of the transformer secondary winding is negative, rectifier *3* conducts the current through capacitor

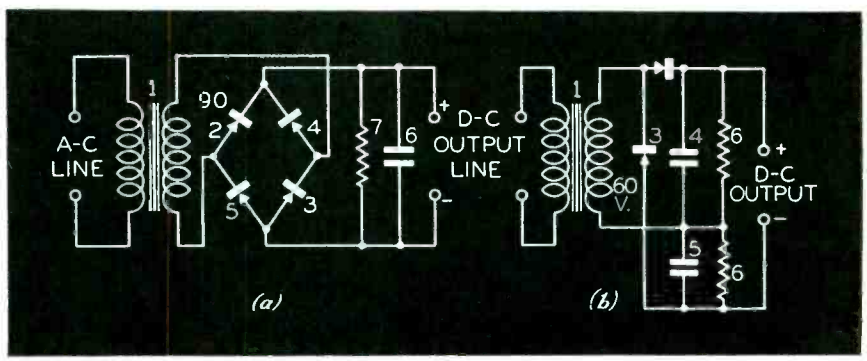


Fig. 4. A power supply using four small barrier rectifier units in a full-wave bridge.

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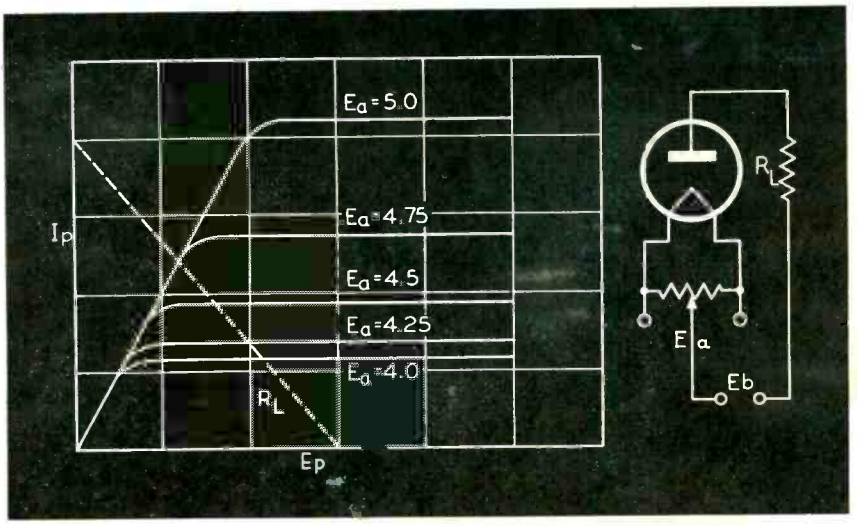


Fig. 7. Characteristics of two-element rectifier tubes.

5. On the positive alternation of the a-c voltage wave, capacitor *4* is charged, and on the negative, capacitor 5 receives the charge. The capacitors discharge in series through resistor *6* and the load, the total discharge voltage being twice that of the peak a-c transformer voltage. It is well to observe that, during the discharge of the series capacitors, either of the capacitors, depending on the a-c supply frequency, is being charged during the discharge. The voltage doubler is a full-wave device.

The electronic system amplifier is usually terminated in a thyratron tube system, rather than a power audio tube. In turn, the thyratron circuit is terminated in an end relay or small contactor.

End relays for electronic uses are designed for rapid operation, the smaller types completing the opening and closing operation in several hundredths of a second. End relays of the latter type, commonly employed in small electronic systems are shown in the illustrations of Fig. 5 and Fig. 9.

The end-relay operating coil is usually connected in series with the plate circuit of the end thyratron. Since the thyratron acts as a rectifier, the current through the relay magnet coil is half-wave rectified a-c. Periodic cessation of the coil current has a tendency to cause the relay armature to chatter, or vibrate. To overcome this objection, the magnet core is appropriately *shaded* with a short-circuited coil, consisting of a single turn of copper strip. The function of this auxiliary coil is the delay of the magnetic field collapse, which tends to keep the relay armature attracted to the pole piece, for the short intervals during which the thyratron ceases to conduct.

Fig. 8. This diagram illustrates the manner in which the degenerative feedback effects electronic damping.

A conventional circuit, in which a d-c relay is used in the plate circuit of a thyratron, is shown in the circuit diagram given in Fig. 6. Here, when

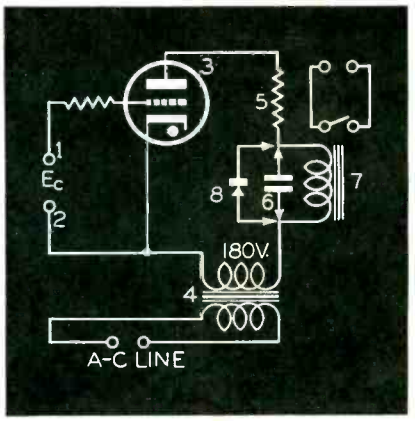
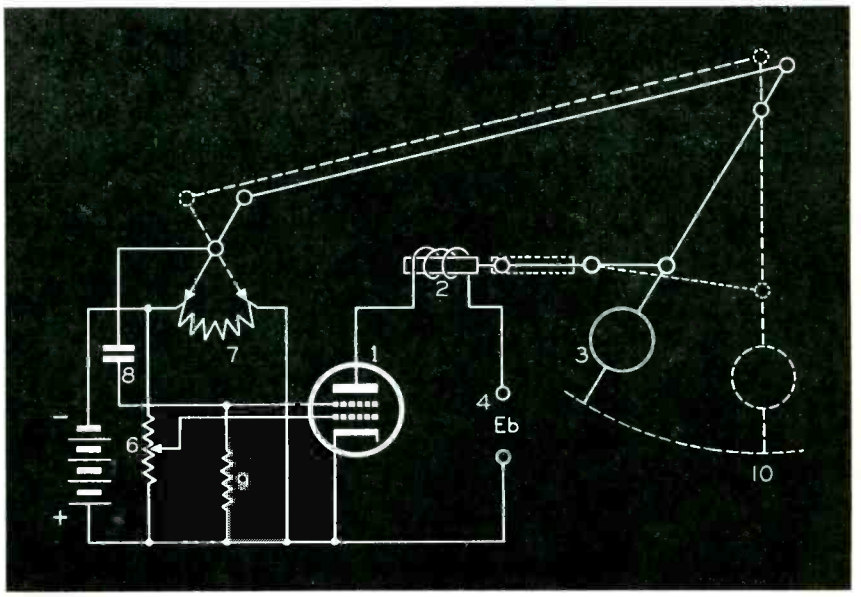


Fig. 6. A conventional circuit using a d-c relay in plate circuit of thyratron.

thyratron *3* conducts, capacitor *6* accumulates a charge, the peak charging current being limited by resistor *5*. The coil of relay *7* is energized at the same time, causing the relay to seal. Now, during the negative half-cycle intervals, when the thyratron does not conduct, the capacitor charge serves to keep the relay armature attracted to the pole piece, thus eliminating chattering or vibration of the armature.

Capacitor *6* of Fig. 6 may be replaced with a barrier rectifier unit *8*, as indicated in Fig. 6. In this instance, cessation of thyratron conduction is accompanied by the collapse of the relay magnet field flux, giving rise to a counter, or self-induced voltage. This voltage is always of such polarity as to oppose the decline of the current initially present in the coil. Accordingly, rectifier *8* is so connected across the coil of the relay as to provide a short circuit path for the self-induced current. The resulting current momentarily sustains the coil field flux, keeping the relay sealed against vibration and chattering. Rectifier *8* does not, of course, conduct the thyratron current.

Thyratron-end systems are often terminated in devices other than relays, such as motor armatures, solenoid or *pull* coils, or heating units. In any such application, the thyratron system is under grid phase-shift control, this control being applied through the preceding amplifying stages. When grid voltage phase-shift control is applied to a thyratron tube, the tube conducts only over a portion of the positive a-c alternation. This is dependent on the angle of lag between the grid voltage wave and that across the plate and cathode of the tube. Assuredly, conduction of the thyratron over less than full positive a-c alterna-



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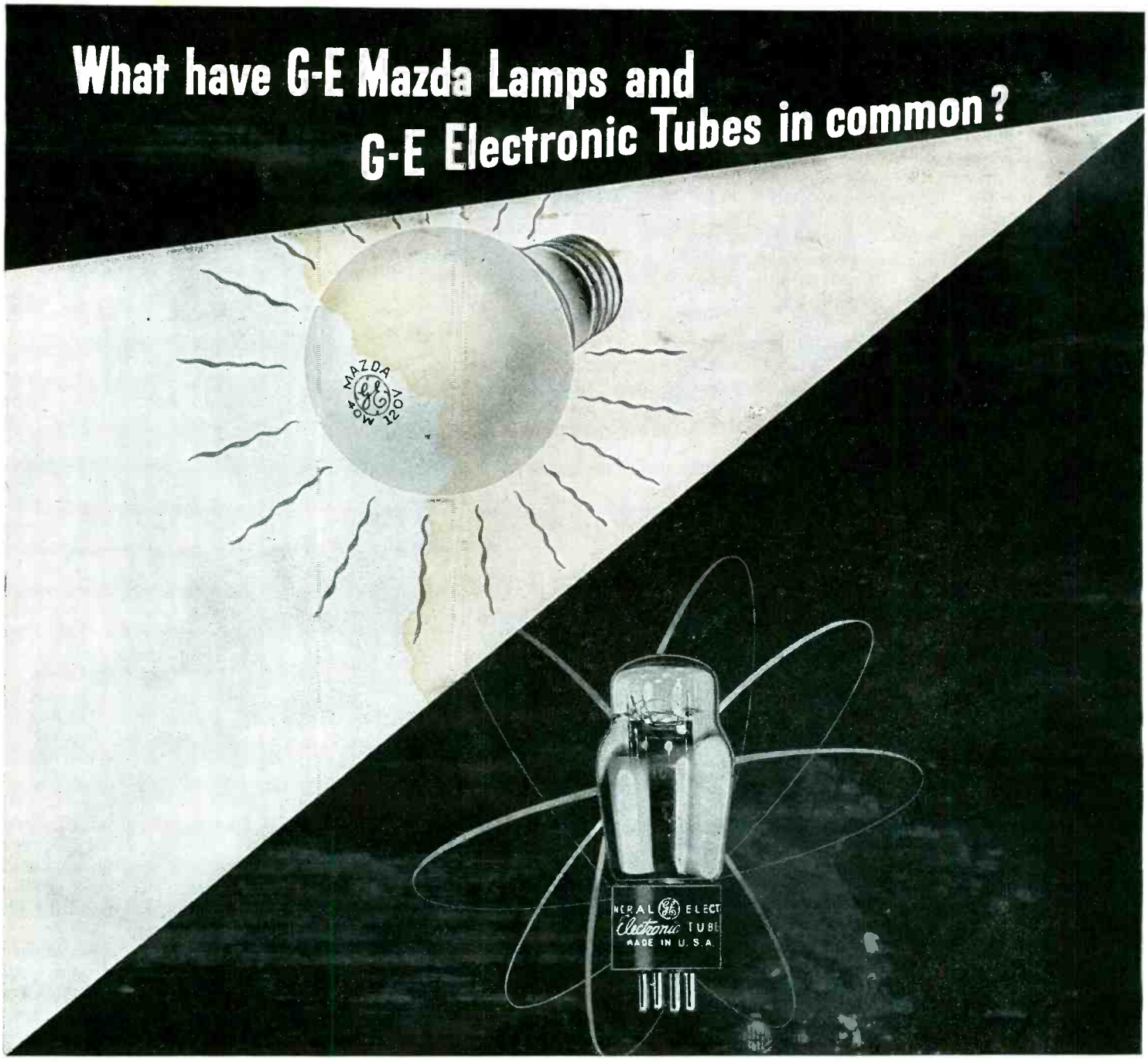

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tions results in the distortion of the conducted wave form. Hence, the true power value of the conducted alternation is altered, this alteration increasing progressively with the increase of the grid voltage wave lag angle.

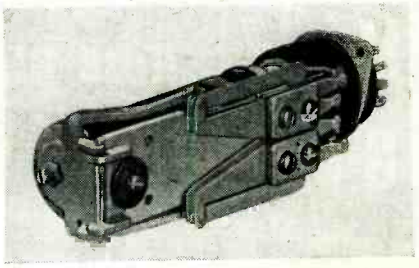
Where the phase-controlled thyratron is in series with a motor armature or heating coil, the horsepower or heat developed is directly proportional to the true power dissipated in that device. Therefore, this power will vary directly with the lag angle of the grid voltage wave.

Power measurement, in these thyraton-end systems, is difficult, unless properly approached. A simple method which would provide measurement of the actual power values involved lies in the amount of heat developed in a resistance by such a current. This heat quantity might then be compared with that developed in the same resistor by d-c. A-c power values are based on such a comparison. Here, it might be recalled that electrical measuring instruments deriving movement from heat developed in their measurement systems include such instruments as the hot wire ammeter, and the thermo-coupled voltmeters and ammeters. These instruments were originally intended for measurement of high frequency a-c power values. However, their accuracy is even higher at lower frequencies. These should prove invaluable in measurements involving asymmetrical wave forms of the type developed by the phase-controlled thyratron.

Where it is desired to electronically regulate the true power developed by a motor, or similar electrical device, hot wires and thermocouples are obviously too cumbersome and too difficult to apply. To avoid the use of these devices, it is conventional to use, in electronic circuits involving true power values, a device known as a saturable diode.

Saturable diodes, such as the Westinghouse R0585, are two element rectifier tubes. These tubes are so designed that the tube plate current varies with the tube filament temperature, and therefore the filament current or voltage. This specific variation is shown in the family of characteristics given in Fig. 7. Here, E_a is the filament terminal voltage, I_p the plate current, and R_L the series load resistance.

Since the tube plate current is proportional to the tube filament temperature, it is proportional to the true value of the voltage or current heating the filament. It follows, therefore, that the voltage developed across the tube plate loading resistor may be directly applied to the control of thyratron or other electronic circuits to provide



(Courtesy, Automatic Electric Co.)

Fig. 9. An end relay for rectified a-c operation.

regulation along the true power characteristic of the controlled device.

An apparent self-contradiction which appears to exist in electronic circuits of this type, as well as nearly all electronic circuits, involves the use of a static as well as a dynamic control voltage. Moreover, these voltages are usually so arranged as to be diametrically opposed, with respect to each other. Such an anomaly indicates the use of degenerative feedback in the circuit so arranged.

The use of degenerative feedback voltages is resorted to, when the electronically controlled device has a mechanically or physically resonant period, or where the device has appreciable inertia, as a means of damping out undesired reactions in the operation of the control system as a whole.

The manner in which degenerative feedback effects electronic damping may be readily understood from the system sketch of Fig. 8. In this system, the position of pendulum *3* is controlled by the position of the slider arm of control potentiometer *6* on its resistance element. Thus, if the sliding contact is moved toward the negative terminal on its resistance element, tube plate current is decreased. The lack of sufficient magnetic attraction now permits pendulum *3* to gravitate to a new position, near point *10*. During the period of travel, the pendulum weight accumulates momentum and this must be expended in some manner. As a consequence, the pendulum passes the position at which it will normally come to rest, swinging a distance from this point which is nearly equal to the original length of the travel arc. Further, once it reaches the limit of this second arc length, it will swing in the direction from which it first moved, and again the point of origin will nearly be attained. Briefly, the pendulum oscillates, or moves in accordance with the laws underlying harmonic motion.

When the pendulum in Fig. 8 first begins to move, however, it causes the sliding contact of feedback potentiometer *7* to move toward the positive end of its resistance element. The voltage across coupling capacitor *8* is then greater than that which appears between the sliding contact and the positive terminal of the feedback potentiometer resistance element. Condenser *8* must then discharge through grid resistor *9*, driving the auxiliary grid of tube *1* positive with respect to its cathode. This sustains the tube plate current and prevents the rapid descent of the pendulum.

The principle of degenerative feedback, as applied in the instance of the pendulum, is especially invaluable in precision voltage and speed regulating devices. In the instance of an electronic voltage regulator, in which the regulator supplies a controlled field current to a d-c generator, the feedback stimulus or voltage may be readily secured from the armature circuit of the generator itself. Due to the inductive delay in the field winding of the generator, the amount of correction applied by the electronic control is not effective immediately. As a result, the electronic control applies an additional correction. The additional correction causes the generator output voltage to rise above the desired value, whence the regulator applies a correction in the opposite direction. Obviously, the entire system is resonant, and oscillates. When the degenerative feedback stimulus is applied to the electronic regulator, voltage rise across the generator armature serves, through the feedback system, to cause the regulator to provide a counter correction. This neutralizes the initial overcorrection and the system quickly stabilizes.

Fundamentally, the same principles applied in conventional radio and sound equipment are also applied to electronic systems. The difference prevails in the final operation which is a physical reaction unlike that of the radio or audio system.

* * *

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Loud hum: The filters with the exception of No. 30, on the diagram checked okeh. Replacing this condenser did not help any. On checking further I found that some of the electrolyte from the condensers No. 30 had seeped through the coiled-wire shield and impregnated a spot on the wire connecting the center tap of the volume control and condenser No. 18. This wire picked up the hum from the shield and fed it to the grid of the 6SQ7 tube. To repair, simply replace wire and dress condenser away from the shield.

Henry D. Morse

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SER-CUITS

By HENRY HOWARD

MANY of later type portable receivers feature design improvements usually found only in larger models. In Admiral's P6-XP6 portable chassis, shown in Fig. 1. for instance, we have a combined 2-gang condenser and permeability tuner. This set has the usual condenser tuned loop and oscillator, but the first detector is tuned with a variable core. This coil is connected in parallel with a .000367-mfd silver mica tuning capacitor in the IN5 r-f stage plate circuit and is coupled to the detector grid through a .00025-mfd condenser and 100,000-ohm grid leak. The IN5 i-f stage has a plate decoupling filter consisting of 5000 ohms and .05-mfd condenser, which makes the plate voltage lower than the screen grid.

The avc system is more complete than in most receivers. A voltage divider of four resistors connects the avc output with the i-f stage filament. The first detector gets the highest control voltage, being tapped down 3 megohms from the high side (with a .01-mfd filter and bypass condenser). The r-f stage is next, being tapped down 5 megohms from the first tap. A .05-mfd condenser is used here. And then comes the i-f control, tapped down another 5 megohms with a .01-mfd bypass. This point is 5 megohms from the filament. Thus the divider totals 18 megohms.

Admiral N6

Another Admiral chasis, N6, a 6-tube a-c phono model with 3 audio stages, is shown in Fig 2. A 6SQ7 second detector-first audio feeds a 6J5 stage with high-current degeneration, due to the 3000-ohm un-bypassed cathode bias resistor. The triode drives a 6K6 output stage with an inversed feedback tap on the output transformer, which delivers degenerative voltage to the first audio cathode and also to the output tube's cathode. The latter is bypassed with a 12-mfd electrolytic, which would effectively kill any attempt at degeneration for the high notes, but is not large enough for the bass notes. This would tend to weaken the bass response.

Fig. 1. Admiral P6-XP6 portable with variable core tuning first detector.

The 1-megohm volume control is tapped at the center for tone control and bass compensation. In phono operation the cathode of the 6SK7 i-f is opened.

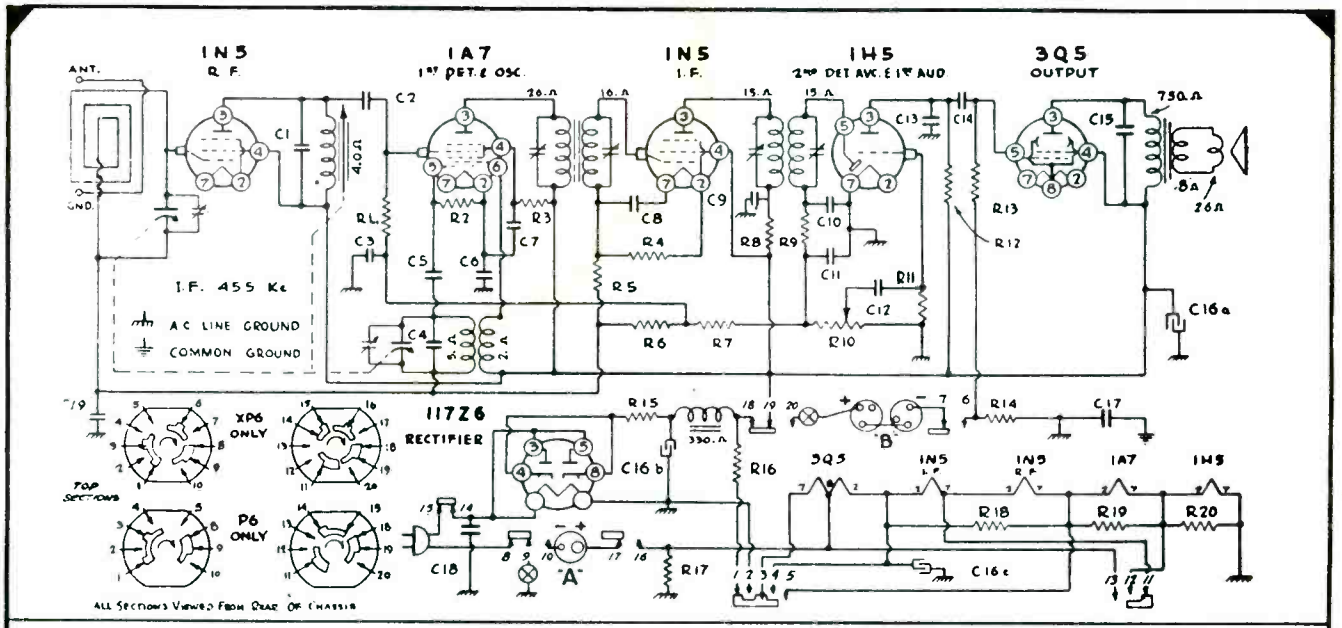
Stromberg-Carlson 925

The 925 receivers of Stromberg-Carlson have 14 tubes with two a-m and one f-m bands. The power transformers have electrostatic shields and all oscillator circuits are temperature compensated for minimizing frequency drift. Five-gang condensers tune the following circuits: a-m antenna, f-m antenna, f-m detector input (in plate of r-f amplifier), a-m oscillator and f-m oscillator.

There are two built-in antennas; a low impedance tapped loop antenna for a-m and a dipole for f-m. Provision is made for an external antenna which is impedance-coupled by a shunt resistor and series coil feeding into the antenna transformer at a low impedance tap.

The first detector is resistance or impedance-coupled on a-m and tuned on f-m. A broadcast band sensitivity switch is provided which changes the plate load resistor of the 6AB7 r-f amplifier from 1,150 to 150 ohms, thus considerably reducing the amplification of the r-f stage.

The 6AC7 converter has an i-f trap



CONDENSERS

No.	Ohms	Watts	No.	Ohms	Watts
R1	100,000	½	R11	15,000,000	½
R2	200,000	½	R12	1,000,000	½
R3	5,000,000	½	R13	2,000,000	½
R4	5,000,000	½	R14	400	½
R5	5,000,000	½	R15	22	½
R6	5,000,000	½	R16	2,150	5
R7	3,000,000	½	R17	3,000	½
R8	5,000	½	R18	500	½
R9	70,000	½	R19	200	½
R10	1,000,000	V.C	R20	110	½

RESISTORS

No.	Capacity (Mfd.)	Volts	No.	Capacity (Mfd.)	Volts
C1	.000367 Silver	Mica	C11	.0001	Mica
C2	.00025	Mica	C12	.01	400
C3	.01	400	C13	.00025	Mica
C4	.000015	Mica	C14	.01	400
C5	.00005	Mica	C15	.002	600
C6	.25	200	C16a	40.	150
C7	.01	400	C16b	30.	150
C8	.01	400	C16c	100.	25
C9	.05	400	C17	.1	400
C10	.00005 In I.F.	Can	C18	.05	400
			C19	.05	200

LOOKING FOR TROUBLE

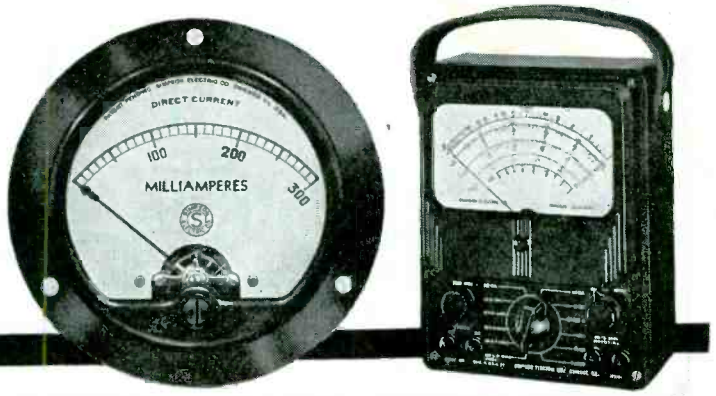
You wouldn't find it much fun, sitting on a hill looking for Japs. That's what this soldier is doing, on a battlefield somewhere in the South Pacific. Every tree, every bush, every slightest movement must be scrutinized carefully. Everything may look peaceful enough, but there's plenty of trouble out there. And the big idea is to track it down, before it finds you.

This young lady, too, is on the lookout for trouble. With a microscope she is examining pivots to be used in Simpson electrical instruments and testing equipment.

From start to finish these pivots have been processed entirely right in the Simpson plant. Rounded on ends in true spherical form . . . specially heat-treated to make them hard for long wear, tough to withstand shocks and vibration . . . ground and lapped to a mirror finish to prevent rusting.

To the naked eye each one is a model of delicate precision. But Simpson doesn't stop there. It is this young lady's job to search out any microscopic flaw that might affect an instrument's accuracy.

The same meticulous care attends every step of manufacture. Why? Because Simpson instruments are going forth to posts of vital importance, on the home front and the fighting fronts alike. Because it is our job not only to make *all* we can, but to make them the *best* we can.

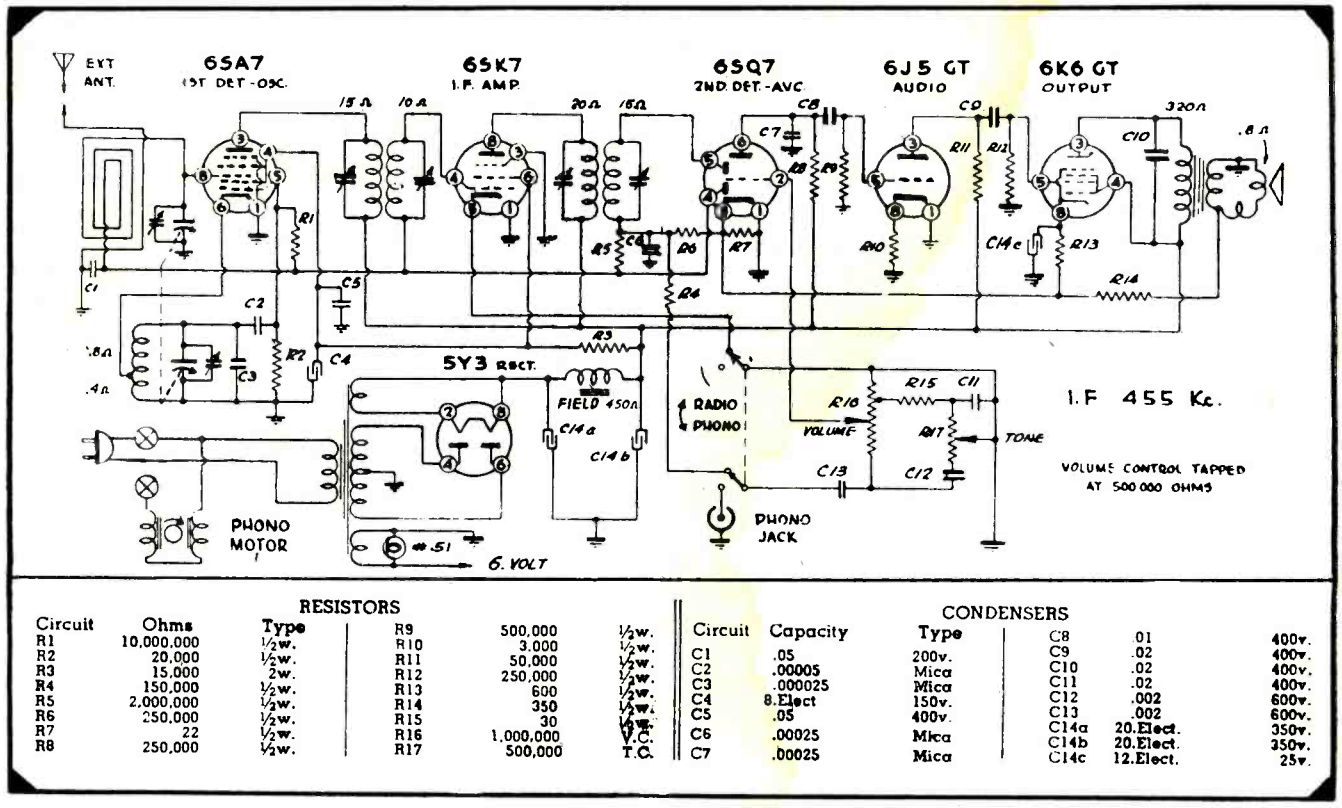


SIMPSON ELECTRIC COMPANY
5200-5218 Kinzie St., Chicago 44, Illinois

Simpson

INSTRUMENTS THAT STAY ACCURATE

Buy War Bonds and Stamps for Victory



RESISTORS

Circuit	Ohms	Type	Circuit	Ohms	Type
R1	10,000,000	½w.	R9	500,000	½w.
R2	20,000	½w.	R10	3,000	½w.
R3	15,000	2w.	R11	50,000	½w.
R4	150,000	½w.	R12	250,000	½w.
R5	2,000,000	½w.	R13	600	½w.
R6	250,000	½w.	R14	350	½w.
R7	22	½w.	R15	30	½w.
R8	250,000	½w.	R16	1,000,000	V.C.
			R17	500,000	T.C.

CONDENSERS

Circuit	Capacity	Type	Circuit	Capacity	
C1	.05	200v.	C8	.01	400v.
C2	.00005	Mica	C9	.02	400v.
C3	.000025	Mica	C10	.02	400v.
C4	8.Elect	150v.	C11	.02	400v.
C5	.05	400v.	C12	.002	600v.
C6	.00025	Mica	C13	.002	600v.
C7	.00025	Mica	C14a	20.Elect.	350v.
			C14b	20.Elect.	350v.
			C14c	12.Elect.	25v.

at the input and feeds into a combination a-m and f-m i-f transformer, the plate being switched to one primary or the other by the waveband switch.

A separate oscillator tube is used.

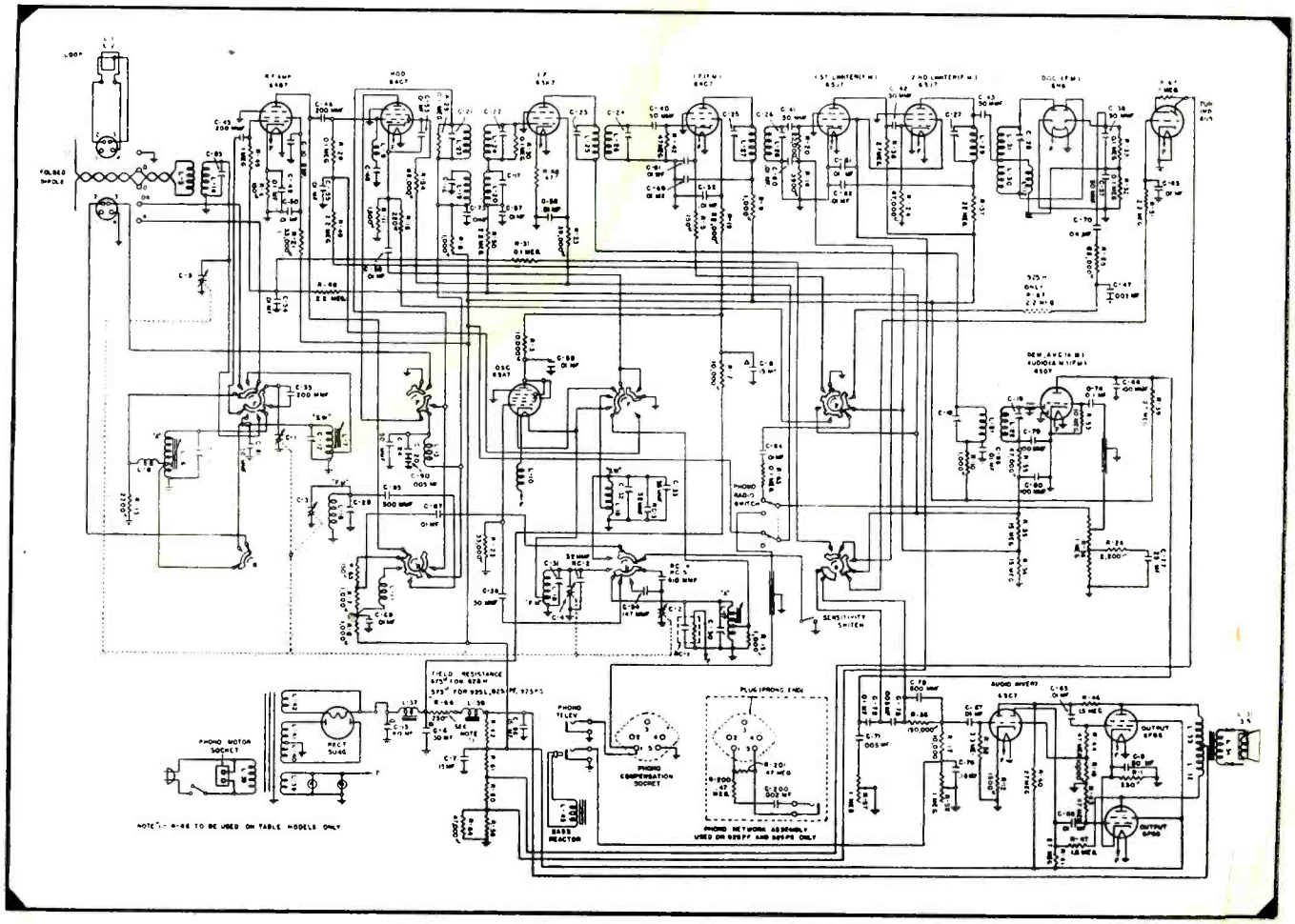
Fig. 2 (above). Admiral N6, 6-tube phono model with three stages of audio.

•

Fig. 3 (below). Stromberg-Carlson 925 a-m/f-m receiver.

It is an unusual type, a 6SA7, used as a triode with grids 2, 3 and 4 tied to the plate. An r-f choke is used in the ungrounded leg of the heater to pre-

(*Continued on page 28*)



SPRAGUE TRADING POST

A FREE Buy-Exchange-Sell Service for Radio Men

WANTED FOR CASH — Supreme Audiolyzer in good condition. Thurber's Radio Service, 112 West Main St., Bay Shore, L. I., N. Y.

CASH FOR TUBE TESTER—Must test all types. Describe fully. John E. Rice, Thompson Ave., East Keansburg, N. J.

SELL OR TRADE — Dumont #148 oscillograph. Will trade for RCA-Rider chanalyst, or sell to highest bidder. A-1 condition. Rexall Radio Stores, 205 Pearl St., Utica, N. Y.

V-O-M FOR SALE—Dayrad series #58 complete in case with new batteries. Also 25 speakers, 5", 6", and 8" PM and field dynamic. Some need cones, some need O.P. transformers. Have many types of transformers (new) for sale. Best offer takes speakers. $30 for V-O-M. Radio Electronic Labs., Hudson, Wis.

FOR SALE—Hallicrafter SX4 communication receiver with crystal and speaker, used only about 60 days. Cost over $125, will take $50 cash. Dean Brooks, 4764 Santa Monica Ave., San Diego 7, Calif.

WANTED — Late model 40 or 42 Supreme combination tube and set tester in good condition. Frank A. Shull, Box 1274, Freer, Texas.

WANTED—Ecophone model EC-1 radio at reasonable price. Rolen P. Woods CEM, 69th Batt. Co. A, Plat. 1, Fleet Postoffice, New York, N. Y.

FOR SALE OR TRADE—225 radio tubes, volume controls, resistors, test equipment, and misc. parts. Clean stock. Will sell for cash or trade for recorder, slide rule, or movie camera. Wm. Hansen, Route 3, Niles, Mich.

WANTED — A Sprayberry radio course. Have a Weston AC meter #478; a Triplett tube checker meter #221; a N.R.A. course; power transformers, and many tubes for trade only. Austin Radio Service, 1309 Jefferson Ave., Houston 3, Texas.

FOR SALE OR SWAP—One phono motor for RCA U-44, #P84564-2, 50 cycles. Will swap for 60-cycle motor, sell for cash, or trade. Like new. Shadyside Electric, 5508 Walnut St., Pittsburgh, Pa.

FOR SALE—Jewell 0-15 Volts AC bakelite meter, new. Want Supreme late models 504A port. lab., and 571 oscillator, or 599 tube and set tester in A-1 condition for cash. Robert R. Rossi, 429 Moore St., Philadelphia 48, Pa.

WILL SELL OR TRADE—Set of accounting books (6 vol.) $10 or trade for pocket V-O-M, ohmmeter, slide rule, or radio equipment. Joseph Miller, 515 Melish Ave., Apt. 20, Cincinnati 29, Ohio.

FOR SALE—Parts for Atwater Kent radios. Hundreds of coils, R-F, I-F, Osc., power trans., chokes, audio-input and output, volume controls, spec. controls, etc. All new. Send for list. C. Demeter, 933 Emma St., Elizabeth 4, N. J.

FOR SALE OR TRADE — Model QC Solar condenser quick check with flange for panel mounting; Superior X-rayometer; Westinghouse Rectox trickle charger DC output ½ amp. 6 volts; used tubes and speakers. Will trade for .38 cal. special revolver with 5" barrel or longer. Joseph K. Peffer, Box 66, Mt. Holly Springs, Penna.

WANTED AT ONCE by ex-service man recently discharged from army and anxious to get started in radio work: Jr. Voltohymst, Hickok voltohmmeter #202, Precision 844P, 856P, Simpson 260, or Weston 301 or what have you in a high-sensitivity instrument. Melton R. Parle, 72 West End Ave., Brooklyn, N. Y.

TELEVISION RECEIVER WANTED — Prefer large screen. Give full details, price, and serial number. Jack's Radio Service, 296 Wainwright St., Newark, N. J.

WANTED—Two 100 milliammeter panel meters, Triplett preferred. Frank J. Polinski, Warren, N. Y.

FOR SALE — Audax relayed-frequency microdyne pickup, studio type head, model RF-1. For use with records and transcriptions up to 12". Overall length 11¼"; radial sweep, 8½". Output imp. 200 ohms balanced line. In excellent condition. First $17.50 takes it. George E. Beggs, Jr., c/o Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.

WANTED — One 71A, 210 or 10, 76, 117Z6GT, two 117L7 tubes; also one 3-gang 350 mfd. condenser; one 1-gang ditto, and one 6" magnetic speaker. Cash. James Monsos, 4837 Harriet Ave., So. Minneapolis 9, Minn.

WANTED — One radio combination RCA model V215. Will trade Zenith 10S-668 latest model. Quote difference wanted. Must be new. W. C. Charles, Radio Shop, 727 S. Potomac St., Hagerstown, Md.

WANTED—Good capacitor analyzer; vols. 2, 4, and 5 Rider's manuals; 1 set Brush crystal type earphones; and a set of hollow shaft hex wrenches. S. T. Matthews, 1106 Decker St., Monongahela, Pa.

TRADE OR SELL—Clough Brengle model O-M-A signal generator. Four freq. ranges, motor driven frequency sweep. Want V-T-V-M, RCA Jr. voltohmyst preferred. C. E. Bell, 3805 Barwick St., Columbia 39, S. C.

FOR SALE—Two PA trumpets, 9 lb. PM units, 1 steel, one aluminum, University L.H. reflex horns. 25" bell, 21" long. Acoustic length 4½'. Rubber rims. 1 crowfoot bracket, 1 "U" bracket. 16 ohm V.C. Used very little, new condition. 1 extra voice coil and diapraghm assembly. 1 extra crowfoot bracket. $95. M. A. Porter, 1713 Larrabee St., Chicago, Ill.

WANTED — Will pay cash for used Echophone EC-1 in good condition. Must be reasonable. Sgt. Phillip B. Hendricks, 244th Sig. Opn. Co., Hq. Com Z C-Ama APO #180, % Postmaster, Los Angeles, Calif.

WANTED—Howard type 610 power pack. L. J. Stauffer, Priest River, Idaho.

URGENTLY NEEDED — 0-3 milliammeter or 0-200 microammeter in good condition to put vac. tube VOM back into service. Cash. Paul P. Banks, Box B, Anamosa, Iowa.

WANTED—Recording turntable with motor and pick-up less oscillator and cabinet. Cash. Sgt. S. T. English, Hq. & Hq. Company S. C., Warrenton, Va.

FOR SALE — One 6-volt Pioneer motor generator delivering 300 volts at 60 mils. Used very little. $20 takes it. Mike Wilson, Toledo, Ill.

FOR SALE—About 1000 adapters to enable you to replace the scarce 12SA7 with a 7A8 without rewiring socket. Also available an adapter to replace 43 tubes with 25A6, etc. 60c ea. Sidney Kaplan, 262 Sumner Ave., Brooklyn 21, N. Y.

TUBES FOR SALE — 12 - 1A7GT; 12 - LA7GT; 12 - 1H5GT; 12 - 1N5-GT; 12 - 1LC6; 12 - 1LN5; 12 - 1L-H4; 12 - 12A8GT; 12 - 12SK7GT; 12 - 12SA7GT; 25 - 12SQ7GT; 12 - 25L6GT; 12 - 25Z6GT; 12 - 35A5; 20 - 35L6GT; 25 - 35Z3; 25 - 35Z5GT; 25 - 50L6GT; 25 - 117Z6GT; and 12 - 7A8. All brand new in original sealed cartons. Std. brands. Make offer for entire lot. Ed. J. Yoerger, 841 Clouet St., New Orleans, La.

WANTED — Amplifier projectors 16mm or 35mm, also want films sound in both sizes. Want radio parts or will buy service shop for cash. U. S. Radio Shop, Box 117, Passaic, N. J.

WILL TRADE — 3 new Wheelock relays, 120 volt, 60 cycles, 10 amp. cont., Type A-7-34, D.P.S.T.; two Struthers-Dunn relays 115-v, 60 cycles, shunt coil, type 29XAX, S.P.D.T.; one Eby relay 10m, type ER-12; 1 Stancor P.P. interstage trans. #A-4772. What have you? Want for cash Precision tube and set tester #920C, also one small receiver. Chas. H. Wallace, 532 Foster Rd., Staten Island 12, N. Y.

WILL TRADE—35-50 watt amplifier, brand new condition. Inputs: 4-mikes, 2-phonos. Two tone controls. Would like RCA 3" 155A oscillograph or other good test eqpt. James Minamoto, 2912C, McGehee, Ark.

RECORDING EQPT. WANTED—10-12 or 16" single or dual speeds, any make. Condition of amp. units immaterial as long as they are in working order. Cash. Give full details. Speak-O-Phone Recording & Eqpt. Co., 23 W. 60th St., New York, N. Y.

FOR SALE—Various UTC-LS transformers, except outputs, and UTC varitones. What do you need? M. P. Schaefer, 280 Wadsworth Ave., New York 33, N. Y.

CASH WAITING

for your unused parts and equipment

Going into the Army or Navy? Giving up your service work for a war job? Or, even if you have remained in servicing work and have unused parts and equipment lying around, you can still render a patriotic service by advertising these for sale through the Sprague Trading Post. We'll gladly run your ad free.

Radio equipment of all types is badly needed today—and the Trading Post will help you dispose of it quickly. It is a golden opportunity to do your bit in keeping radios working on the home front and, at the same time, turn unused materials into cash, and avoid the possibility of obsolescence when the war is won and new, up-to-the-minute equipment is again available.

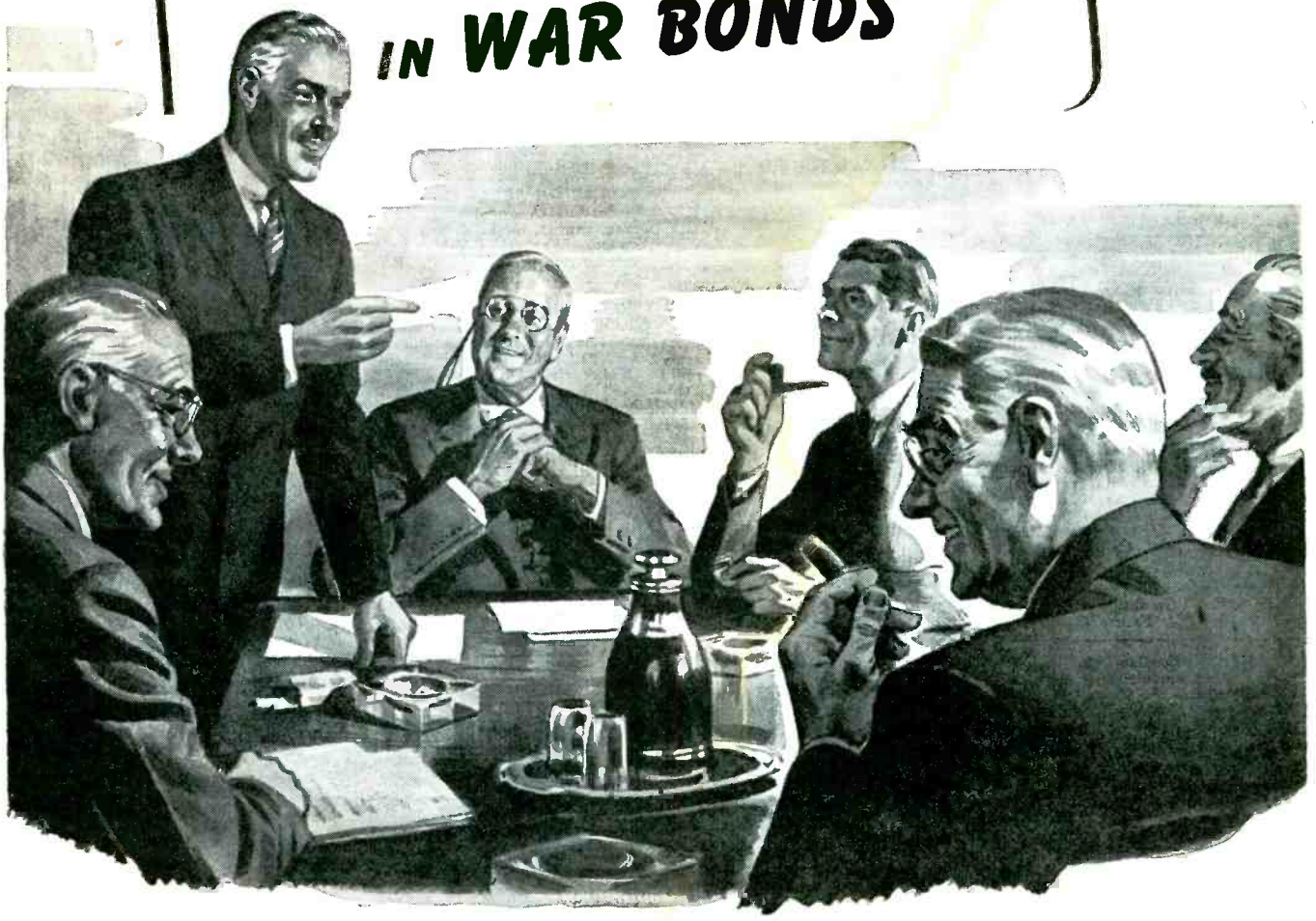
YOUR AD RUN FREE!

Send in your ad today. "Equipment for Sale" and "Equipment Wanted" ads of an emergency nature will receive first attention. Sprague reserves the right to eliminate any ads which do not fit in with the spirit of this special wartime advertising service. Different Trading Post ads appear regularly in Radio Retailing — Today, Radio Service-Dealer, Service, Radio News, and Radio Craft. Please do not specify any certain magazine for your ad. We'll run it in the first available issue.

Dept. S-311, SPRAGUE PRODUCTS CO., North Adams, Mass.

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

"THIS YEAR, LET'S PAY THE BONUS IN WAR BONDS



. . . and drive even harder on the pay-roll savings plan!"

Make War Bonds the Christmas Order of the Day. Urge your workers to make their personal Christmas gifts in the form of War Bonds—and practice what you preach! Make this a 100% War Bond Christmas—to insure future Yuletides of peace and prosperity.

Make up your own posters to spread the "War Bonds for Christmas" story across your plant. Tell the story again and again on bulletin boards, in your plant magazine, and on pay envelope stuffers.

But don't forget your basic, all-important Pay-Roll Savings Plan. How's it going, these days? Perhaps it needs a bit of stoking-up right this very minute, to hold its full head of steam against the competitive demands of the holiday season.

Well, you're the man to stoke it! You can't expect it to keep running indefinitely on last summer's enthusiasm. See to it that your participation percentages, and your deduction percentages, *both* end up the year at new levels.

Every month, now your Pay-Roll Savings ought to run well ahead of the preceding month. *For so many families that formerly depended on the earnings of a single worker, now enjoy the combined earnings of several.* Such *family* incomes are doubled, trebled, even multiplied many times.

Now's the time to turn as much as possible of these increased earnings into War Bonds—War Bonds for Christmas . . . and War Bonds the whole year 'round!

GIVE THE PRESENT WITH A FUTURE—WAR BONDS!

This space contributed by **SERVICE**

This advertisement prepared under the auspices of the United States Treasury Department and the War Advertising Council

WARTIME SERVICING

(*Continued from page 6*)

will be necessary to consider only a few here. The polarity of the regenerative screen grid tickler winding just described (Fig. 7) could, of course, be reversed to provide degeneration. The method to use depends a great deal upon the degree of oscillation present, or the extent of feedback coupling that exists. For mild cases the arrangement illustrated in Fig. 8 offers a simple and effective method. A ¼-watt resistor of approximately 5,000 ohms right at the control-grid terminal can be very effective. Or the Q of the transformer may be lowered a bit by shunting a resistor of high resistance value across the secondary, as shown in Fig. 9.

Where oscillation is caused by coupling in the *B* supply circuit (there is always some degree of this coupling present), the installation of a simple decoupling filter as illustrated in Fig. 10 may be the answer. It would be a very good thing to try anyway, for it is not a loss-type device like the resistor methods previously considered.

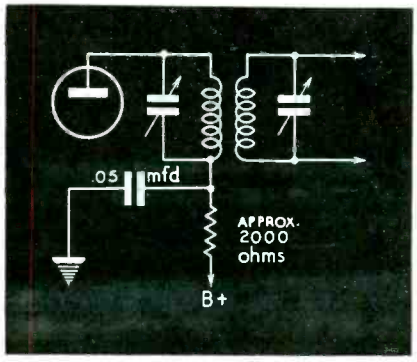


Fig. 10. A method of stopping i-f oscillation is illustrated here.

Another method of attack is to reduce the transconductance of the tube in the i-f amplifier, the proper amount. One simple way to do this is to lower the screen voltage. Proceed as follows. Making sure that there is a bypass condenser from screen to ground (or cathode), insert an ordinary volume control in series with the screen voltage supply and adjust it for optimum conditions. Then measure the portion of the resistance that is in the circuit and substitute a fixed resistor for it.

Salvaging I-F Transformer Parts

Never throw away defective i-f transformer parts as these may usually be used in one way or another. Single i-f coils make excellent r-f chokes, as already indicated. A single i-f coil and trimmer may be used as an i-f wave trap as illustrated in Fig.

11. The coils also serve well for primaries of r-f coils and for vibrator *B* chokes.

A combination f-m/a-m i-f trans-

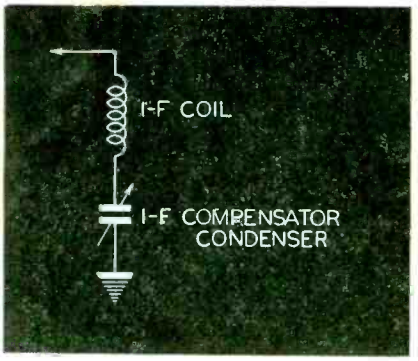


Fig. 11. An i-f wavetrap.

former that is defective in the f-m section may be used for a-m replacement. Zinc cans and copper lined iron cans may substitute for aluminum. Save trimmer condensers that have cracked bases, as the condenser leaves and mica may be used to rebuild a shorted trimmer.

* * *

ZENITH 12A6

(See Front Cover)

INPUT and modulating circuits of Zenith's chassis 12A6, a 12-tube, 4-band am/fm receiver, appear on the cover this month. A shielded loop is used for the broadcast band in conjunction with a loop loading coil. An r-f antenna transformer is used for a-m short-wave and police bands, while a separate input circuit is provided for the f-m channel. This input circuit has two posts, for a doublet antenna and an iron-core transformer. One of the antenna posts is grounded.

The r-f amplifier tube is a 7V7. The converter is a 7J7 triode-heptode, which has good oscillator performance at the high frequencies. The converter input is untuned, the coupling from the r-f amplifier being a combination resistance-choke arrangement on a-m and an aperiodic iron-core transformer for f-m. Note the shielding of the wavetrap grid lead and the plate lead of the converter tube.

This receiver features automatic tuning for both f-m and a-m. The f-m tuning unit operates by tuning the oscillator with shunt iron-core coils. No antenna tuning is used. The broadcast tuning unit is a dual system, with a trimmer condenser for the r-f tuning and shunt iron-core coils for oscillator tuning.

* * *

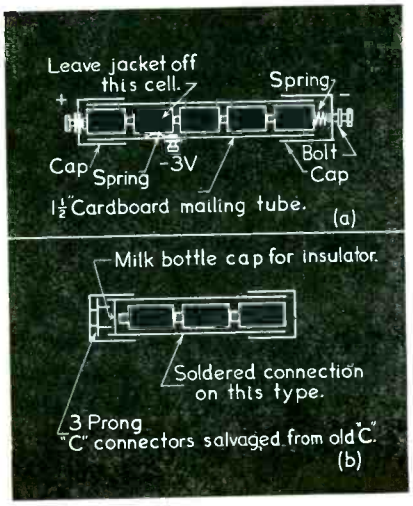
BUY BONDS

SERVICING HELPS

(*See page 7 for Other "Helps"*)

WE are located in an area where batteries are quite essential. Although a few *B* batteries come through, we usually fail to receive *C* batteries to supplement them. To solve this *C* problem, we developed an interesting alternate method, using standard flashlight cells. The method is illustrated in Fig. 1.

Mailing tubes 1½" diameter constitute the housing. Two caps are slipped on for each battery. An 8/32 screw with associated washers and two nuts are located in the center of the positive cap. This with the addition



of a tension spring completes the negative end.

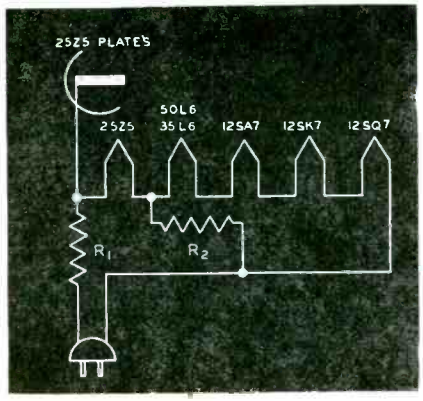
Desired voltage taps are obtained by using a phosphor bronze slip with screw for external connection. Caps should be glued on.

These work out well for such sets as Philco 38 series where 7½ volts are needed with a 3-volt tap. We have also built up some 3-cell 4½-volt batteries using standard C battery connectors sealed in one cap end.

Clark Radio

* * *

Tube Substitutions

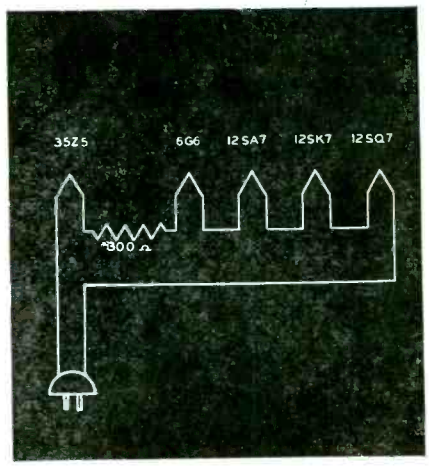


AT left appears a circuit substitution arrangement wherein a 25Z5 is used in place of a 35Z5. R_1 is a 25 ohm resistor. A pilot light should be placed across this unit. R_2 is a 800 to 1000-ohm resistor, depending on whether or not a 35L6 or a 50L6 is being used in the circuit.

At right we have the circuit where a 6G6 is being substituted for a 35L6 or 50L6.

We have used these substitution circuits for quite a while and have found them very satisfactory.

Fairfield Radio Service



SQUARE-WAVE GENERATORS

By JOHN KANE

THE use of square waves in testing audio amplifiers seems to have advantages which will become more important as time goes on. The square-wave type of signal is rich in harmonics, so that selecting a low frequency fundamental permits covering the whole band, and at the same time allows a judgment to be made of the amplitude distortion and phase distortion in the amplifier.

Service Men wanting to experiment with this type of signal without making an expensive investment in square-wave generating equipment may build a small pulse generator apparatus. A suitable circuit is shown in Fig. 1. It is necessary to supply an input sine wave signal. Then, the clipper removes the peaks and gives the square wave output. A regular sine wave audio note from an a-f oscillator, set at a low frequency, can be used. The fundamental should be around 30 or 40 cycles per second.

To see the pattern, an oscilloscope is necessary. The sweep may be set at 4,000 cycles per second approxi-

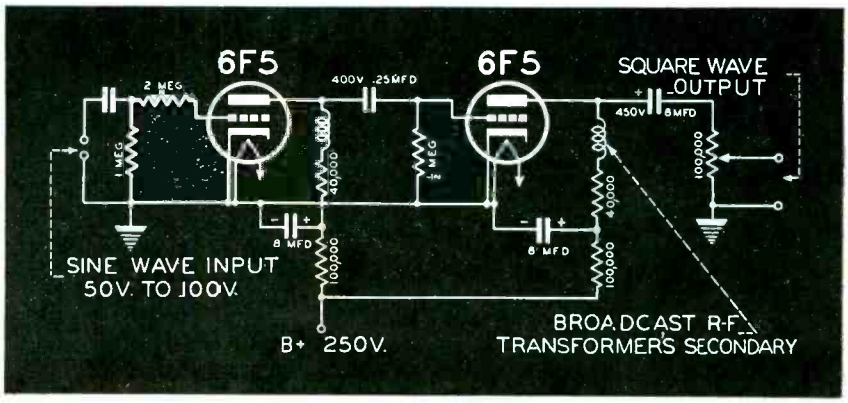
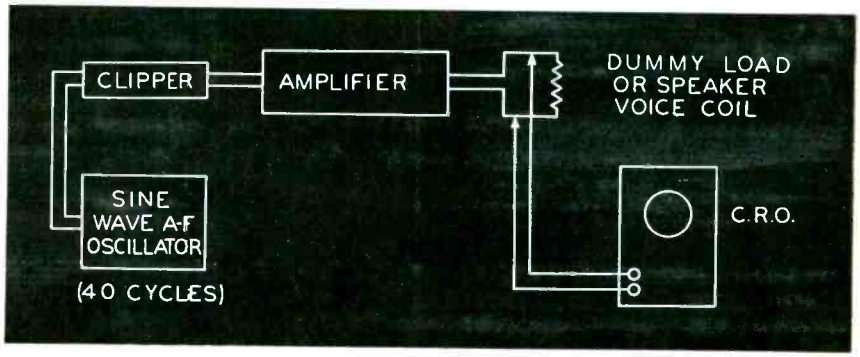


Fig. 1 (above). The square-wave generator circuit diagram.

Fig. 2 (below). A test set-up.



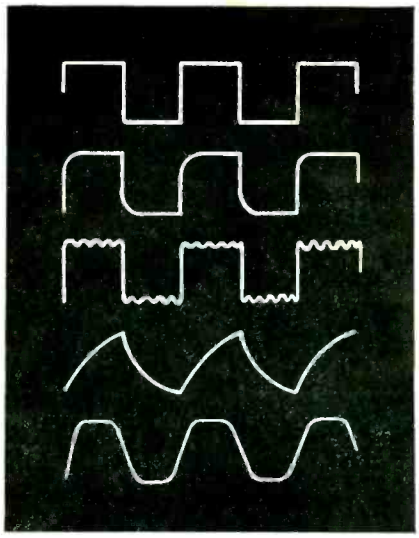


Fig. 3. Patterns obtained with square-wave unit. From top to bottom . . . square wave input; amplitude loss at high frequencies; excessive h-f gain; excessive delay of high-frequencies; loss of amplitude at high frequencies.

mately, and further adjustment of the sawtooth oscillator can be made to secure synchronization, using the fine frequency control on the cathode-ray oscillator panel. The vertical plates of the scope are connected across the voice coil of the receiver's loudspeaker. The square wave is fed to the input of the receiver's audio system, usually across the volume control.

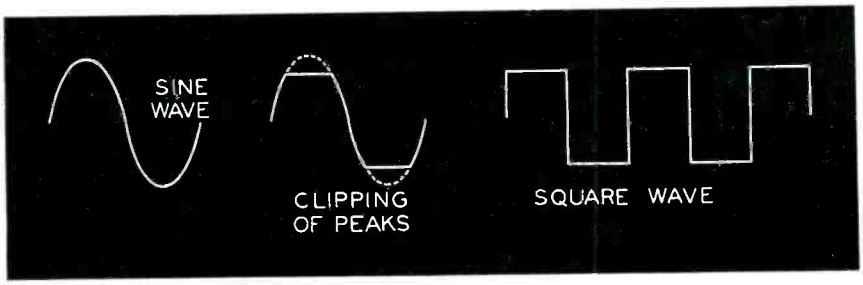
The volume control of the receiver may be set at full volume and the output of the square wave generator adjusted until the trace on the cathode-ray oscilloscope screen departs from its normal square-wave shape. Overloading will be shown by a distortion of the wave.

An advantage of the square wave is that it shows phase shift which may be caused by poor design or defective circuits. Small audio coupling condensers or bypass units in the amplifier, as an example, may cause non-linear amplification over the range. If the amplifier is flat from 400 to 4,000 but has a sharp drop from 30 to 400 and from 4,000 to 10,000, a definite form of pattern will be found on the screen of the oscilloscope, and recognition of the patterns will call for intelligent use of the equipment.

To become familiar with the types of patterns that may be obtained, it is suggested that the Service Man test a receiver or amplifier which is known to be in good condition, and then purposely introduce faults in the set or amplifier, noting the change and the patterns obtained. The condition, such as open filter condenser, shorted grid condenser, too high a plate load impedance, unbalanced push-pull amplifier and so on, can be noted down. Opposite each note can be placed a tracing of the pattern that appeared on the oscilloscope screen. These patterns can be referred to in the future, until the operator of the equip-

(*Continued on page 28*)

Fig. 4. Formation of square wave.



THE AUDIO CHANALYST

Part II—Electronic volt-ohmmeter

THIS section of the RCA audio analyzer is of the same general design as the voltohmyst. The circuit utilizes a push-pull d-c electronic vacuum tube voltmeter, which serves the following purposes in connection with a-f work: measures d-c and a-f voltages, audio output meter, ohmmeter and impedance meter. The polarity changing switch that has proven so useful in the voltohmyst has been retained.

D. C. Voltage Measurements

The voltmeter has eight d-c ranges, 5-10-20-50-100-200-500-1000 volts, with a constant 20-megohm input resistance. The desired range is selected with the multiplier switch and the voltage is read from the corresponding meter scale. Two probes are provided, a *volts probe* which is always applied to the *hot* or *high* side of the source to be measured, and an *A* ground probe which is always connected to the low or grounded side. This probe is the same one used in the *A* channel amplifier described last month.

A sensitive d-c voltmeter has a wide variety of applications in audio work besides the common *B* and *C* voltage measurements. It is ideal for checking bias calls, which may be ruined by a high-drain voltmeter. It is handy for checking leakage and for insulation measurements of transformer windings and paper condensers, particularly for tubulars used for interstage couplings. A small amount of leakage in a coupling condenser (even 100 megohms) will noticeably decrease the negative grid bias and may even make it positive. The distortion and poor performance accompanying a positive grid audio stage are too well known to discuss here.

Another cause of positive grid potentials is a gassy tube. When such a tube is in a volume-controlled stage (like the first audio amplifier in a modern radio set), the volume control may become very noisy in a short time. When noisy controls are found in service, it is important to measure the d-c volts directly at the grid (grid to cathode). If the voltage is positive, look for a gassy tube.

Other applications for a versatile d-c voltmeter will suggest themselves to the alert Service Man. Some amplifiers and modulators utilize electronic control voltage, such as avc bias of volume limiters, compressors and expanders, or just plain audio avc.

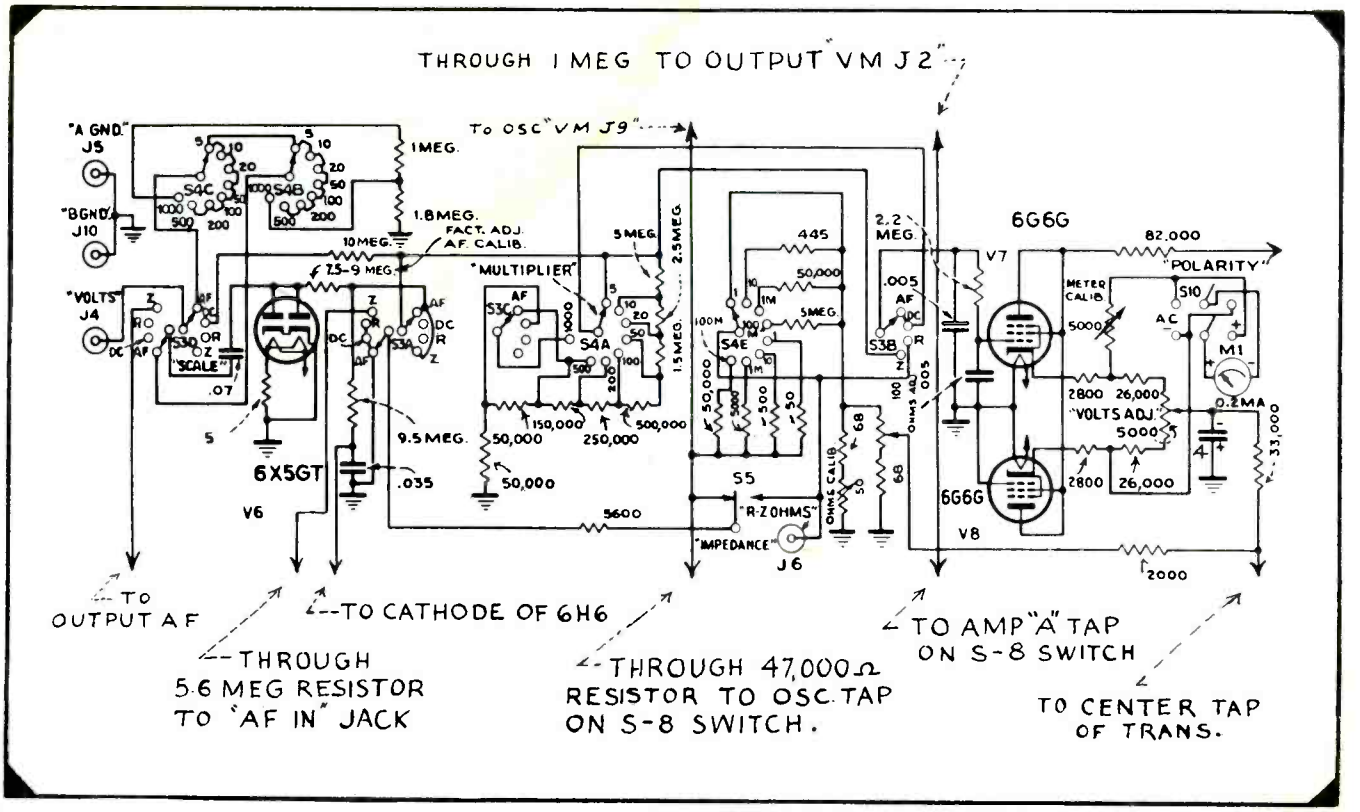
The electronic volt-ohmmeter used in the RCA audio chanalyst. In last month's issue, *Amplifier A* was analyzed.

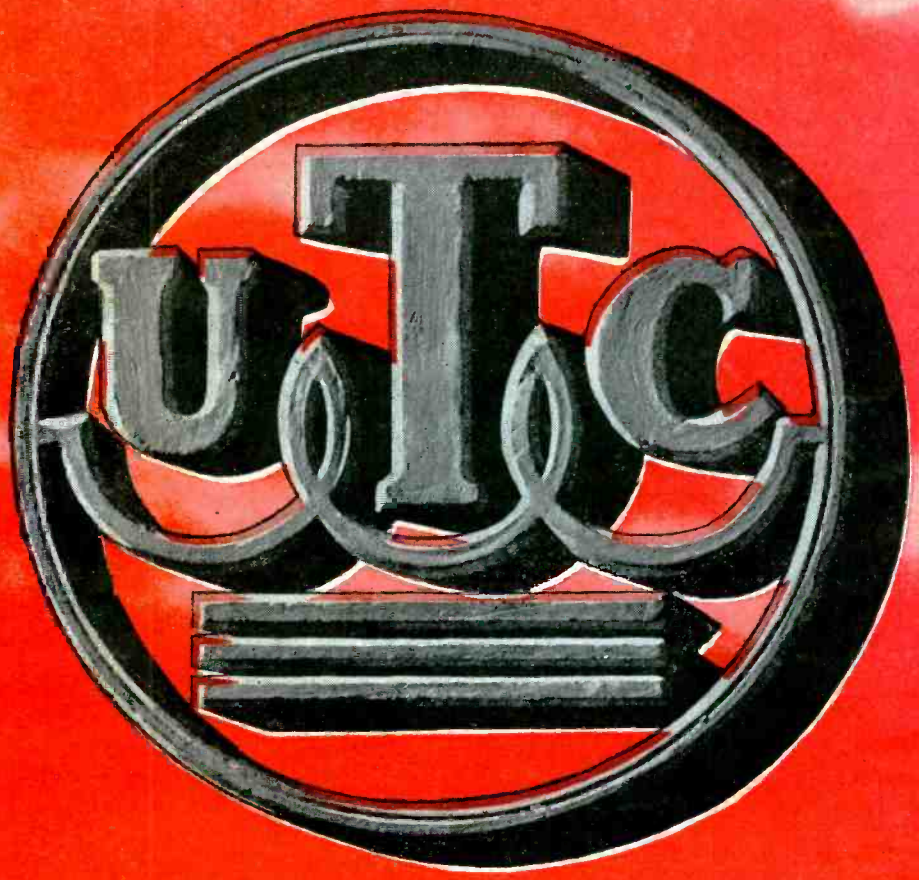
A-F and A-C Measurements

The electronic voltmeter has eight a-f ranges calibrated to read 0.707 of the peak value, which correspond to RMS voltages when measuring sine waves. This is the typical method of calibrating vacuum tube voltmeters for a-c measurements. A 6X5GT with both diodes in parallel rectifies the a-c voltages. The tube impedance is a very small part of the total circuit impendance; hence, changing tubes has very little if any effect on the calibration. The circut is designed to minimize the errors caused by contact potential by balancing out this potential, which usually causes a zero shift with changing line voltage. A 5-ohm resistor is used in the rectifier heater circuit to lower the temperature of the cathode, limiting the contact potential.

The input resistance varies between 1 and 2 megohms for all the voltmeter ranges (the same ranges as for d-c). The meter cannot be wrecked by voltage overloads and the a-f frequency range is essentially flat to 20,000 cycles. Audio frequency voltages can be traced through an amplifier, and the gain of high-level stages can be readily determined by the ratio of output to input voltages (combined with impedance measurements). Because of the wide frequency range of the

(*Continued on page* 31)





Foremost
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SER-CUITS

(*Continued from page* 18)

vent coupling in the 6.3-volt circuit.

The *B* supply is unusual in that five different *B* taps are provided on the voltage divider, the highest tap being taken after the first filter section. This tap supplies the oscillator and second i-f stage screen grid only. All plates and screen grids handling r-f or i-f have individual de-coupling filters.

Push-pull degeneration is used on the output stage with two 1.5 megohms from plate to plate. A 20-mfd cathode bypass reduces odd harmonics. The phono switch disconnects the modulator and first i-f screen grids.

* * *

SQUARE-WAVE GENERATORS

(*Continued from page* 25)

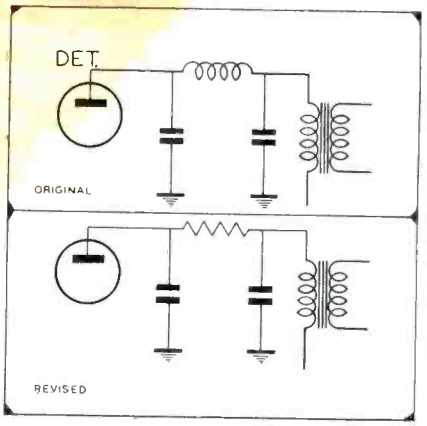
ment becomes thoroughly familiar with them, when he no longer will need the notebook.

Square-wave measurement technique has been used in the laboratory and in television engineering for years, but so far no one has used it widely in audio work and in checking radio circuits such as are known in regular servicing. One reason has been that the equipment is expensive, but the square-wave generator shown in the diagram will serve its purpose very well. In the postwar years it will be used for checking television sets and regular radios as well as public address equipment.

* * *

RESISTOR FOR R-F CHOKE

Some older sets had r-f chokes in the



detector plate circuit. They can be replaced successfully with a 10,000-ohm resistor as indicated.

T. R. Cunningham.

* * *

Start your post-war thinking now — that's important — and keep on buying war bonds — that's even more important.

WHEN YOU CHANGE YOUR ADDRESS

Be sure to notify the Subscription Department of SERVICE at 19 E. Forty-seventh St., New York 17, N. Y., giving the old as well as the new address, and do this at least four weeks in advance. The Post Office Department does not forward magazines unless you pay additional postage, and we cannot duplicate copies mailed to the old address. We ask your cooperation.

NEWS

GHIRARDI SELLS RADIO & TECHNICAL PUBLISHING CO. TO FARRAR & RINEHART

Alfred A. Ghirardi, author of many books on radio theory, maintenance and repair, has sold his Radio & Technical Publishing Company to Farrar & Rinehart, Inc., 232 Madison Avenue, New York City. A subsidiary, the new Radio & Technical

Alfred A. Ghirardi (right) and Stanley Rinehart, Jr., president of Farrar & Rinehart.

Division of Murray Hill Books, Inc., will continue to publish the present Ghirardi radio books as well as new ones.

Mr. Ghirardi will devote all of his time and energies to the writing of new books for the radio-electronic field. He will also serve as Editorial Consultant in radio and electronics for Farrar & Rinehart.

All orders for Ghirardi radio books will hereafter be directed to Radio & Technical Division of Murray Hill Books, Inc., 232 Madison Avenue, New York 16, N. Y.

* * *

SUN RADIO CHANGES NAME

The Sun Radio Co., 212 Fulton St., New York City 7, has modernized its name and will hereafter be known as the Sun Radio & Electronics Co.

* * *

P. I. BURKS VISITS SHURE

P. I. Burks of P. I. Burks and Company, Louisville, Kentucky (right), discussing Shure Brothers jobber bulletin with Jack Berman.

* * *

BUY UNITED STATES WAR SAVINGS BONDS AND STAMPS EVERY PAY DAY

U-H-F REFERENCE GUIDE

A 60-page booklet with biographical sketches of radio's foremost u-h-f and f-m specialists, and detailed listings of authoritative papers on u-h-f and f-m, has been published by Zenith Radio Corporation, 680 North Michigan Avenue, Chicago, 11, Illinois.

The booklet was authored by Elizabeth Kelsey, who last prepared a reference guide to u-h-f.

Copies are available for interested laymen, and for those who have relatives or friends in the communication branches of our armed forces to whom they would like to have us send copies.

Requests for copies of the book, known as *Trail Blazers to Radionics* should be addressed to Miss E. Kelsey.

CLAROSTAT ADDS STAR TO "E" FLAG

A white star has been added to the Army-Navy "E" pennant of the Clarostat Manufacturing Company, Inc., 285 N. 6th St., Brooklyn, N. Y.

* * *

RAYTHEON HOLDS POSTWAR PLANNING MEETING

Postwar activities of Raytheon Production Corporation were discussed at a special meeting held in Chicago, recently. E. S. Riedel, general sales manager, presided. In attendance were A. E. Akeroyd, F. E. Anderson, Fred Simmons and Russ Lund of the postwar planning committee from the Raytheon Newton, Mass., plant.

(*Continued from page 30*)

NEWS

(*Continued from page 29*)

POSTWAR MICROPHONES

Durwood D. Allen, secretary of Universal Microphone Co., Inglewood, Cal., believes that tomorrow's microphones will not show so many changes in technical

design as they will in style of casings, stands and accessories.

* * *

KEN-RAD BONDS BUYING AIDS BOMBER PURCHASE

A new bomber—*Ken-Rad*—will soon take to the skies as a result of the record-shattering bond buying campaign of the employees of Ken-Rad Tube & Lamp Corporation, Owensboro, Kentucky.

Larry O'Brien, director of sales for the Ken-Rad company, was in charge of the

bond sales drive and impresario of the community promotion for Ken-Rad.

One of the features of the Ken-Rad drive was the participation of Ken-Rad men and women dressed in the native costumes and carrying the national flags of United Nations.

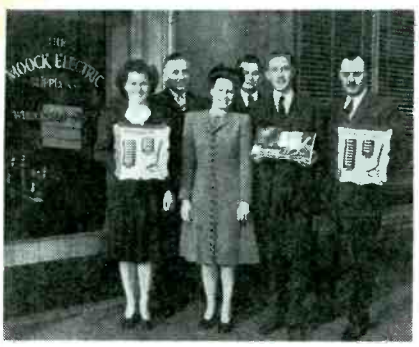
* * *

BELL SOUND CATALOG

A 32-page catalog, No. 38, describing amplifiers and inter-communication systems has been released by Bell Sound Systems, Inc., 1183 Essex Avenue, Columbus, Ohio.

* * *

AEROPOINT DISTRIBUTORS



Charles Conrad (second from left), Manager of the Moock Electric Supply Company, Cleveland, Aeropoint distributors and some of his staff. Left to right: Lynn Landstrom, supervisor of the record department; Mr. Conrad; Dorothy Steven, sales manager of Aeropoint; Dean Gunter, dealer salesman; Howard Elliott, counter salesman, and Earl Dietrich, sales representative for Aeropoint.

REPRESENTATIVES BOOSTER SECTION NAMES CHAIRMEN

At a recent meeting of the Representatives in Long Beach, California, the following committee chairmen were appointed: Carl Stone, chairman of the program and meetings committee; George S. Tivey, chairman of the code of ethics committee; Lou Brittain, chairman of the membership committee, and Don C. Wallace, chairman of the press committee.

Present at this meeting were J. T. Hill, G. S. Tivy, W. C. Hitt, L. W. Howard, D. C. Wallace, C. A. Stone, Charles Silvey, W. B. Knight, and V. T. Rupp, secretary.

* * *

REPS ADD MORE MEMBERS

The California chapter of the Representatives has recently added the following new members living in San Francisco to their roster: L. H. Bushnell, 1355 Market St., S. E.; E. C. Nickerson, 383 Brannan St.; Edward C. Glomb, 1264 Folsom St.; D. J. Rudat, 383 Brannan St.; as well as the following Associate members: H. Kreuger, 530 Gough St., and J. H. Shaw, 1264 Folsom St.

The Los Angeles chapter reports P. P. Wiley, 942 Maple Ave., and M. D. Ealy, 4826 Tyrone Ave., as new members.

The Los Angeles chapter also reports that two of its members, Norman B. Neely and Gerald B. Miller recently became members of the armed forces.

L. Slupin of 1841 E. Washington Lane, Germantown, recently became a member of the Mid-Lantic chapter.

B. L. MacPherson, treasurer of the Hoosier chapter, is now located at 1724 Alabama Ave., Fort Wayne, Ind.

(*Continued on page 34*)

(*Continued from page* 26)

voltmeter, frequency response characteristics may be measured; also the performance of low pass, high pass and band filters in the audio range.

Output Measurements

The meter is furnished with a db scale from —20 to +9.2 db, based upon a zero level of 6 milliwatts in 500 ohms. A range of —20 to +49 db is possible using 7 ranges of the a-f meter with a 20 kc response. Zero db is equal to 1.73 volts, a familiar audio standard equivalent.

The output power of an amplifier may be measured by substituting a resistance load equal to the marked output impedance for the usual inductive load. By measuring the voltage developed across this resistor the power may be readily calculated from the formula:

$$\text{Watts} = \frac{E^2}{R}$$

To measure undistorted power output an oscilloscope should be used across the load to note the point at which distortion begins. For close results a pure sine wave input is usually employed. The output should then also be a pure sine wave.

D-C Resistance Measurements

Connections are made to the ohmmeter through the *scale* and *multiplier* switches. The scale reads up to 4000 ohms, which is multiplied by four ranges—1, 10, 1000 and 100,000—permitting measurements up to approximately 400 megohms. No batteries are required, since the source of voltage is derived from the power supply. Before taking resistance measurements the user is cautioned to see that no voltage exists across the resistance or between the resistance and ground. A rheostat is provided for the resistance range adjustment for balancing out warming-up or aging changes.

Impedance Measurements

The electronic volt-ohmmeter has a Z scale with four ranges . . . 0-400 ohms, 0-4,000 ohms, 0-40,000 ohms and 0-400,000 ohms. The mid-scale points are 1/80 of the range. A frequency of 400 cycles must be used for direct reading; this is one of the spot frequencies available on the local oscillator part of the chanalyst. The meter reads reactive ohms based upon a perfect reactance. A correction may be made for the resistive component by measuring both impedance and reistance and then referring to a chart to obtain a correction factor. No correction is made for a condenser, since it normally has a very small resistive component.

The Circuit

A high input impedance is obtained by the choice of suitable tubes (6G6G) high cathode self-biasing resistors (2800 ohms) and a low plate voltage. No zero adjustment is required when changing ranges, and the calibration is almost entirely independent of line voltage and tube characteristics.

The d-c calibration adjustment is originally set at the factory and does not ordinarily have to be touched until replacing tubes. For recalibration a standard voltage of 5 volts is used. A-c calibration is automatically taken care of when the meter is calibrated for d-c. The 6X5GT rectifier has a negligible affect on calibration, the maximum a-c error being ±7 per cent of full scale reading.

* * *

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."

NEW PRODUCTS

LITTELFUSE EXTRACTOR POST

Fuse extractor posts with anti-vibration side terminals mechanically connected by electrical welding to the metal shell inside the bakelite body and backed up by soft solder have been produced by Littelfuse Incorporated, 4747 Ravenswood Ave., Chicago 40, Illinois. The new welding process makes the terminal connection in

effect one-piece, integral with the metal parts. The terminal is said to be proof against heat and severest vibration.

The new Littelfuse extractor post 1075 for fuses to 15 amps., is used for radios, auto-radios, amplifiers, fractional hp motors, magnets, control circuits, relays, rectifiers, plate circuits, etc. Over-all length is 2½". Length from front to panel 2⅛"; mounting hole ½"; maximum current, 15 amps. It is furnished for screwdriver operation meeting Underwriters' specifications, or for finger operation.

Knob and body are molded of black bakelite. Spacing between live parts gives adequate protection against electrical leakage. The tool-operated types have a red knob.

A fuse grip permits full visual shockproof inspection of fuse; spring-activated cup at the bottom is said to insure positive and continuous electrical contact.

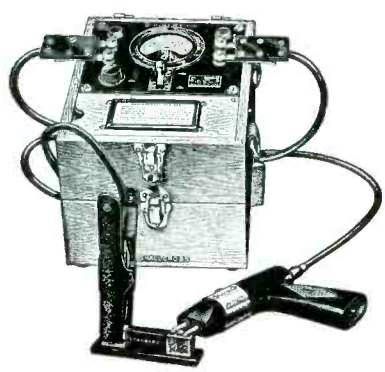
The knob not only pulls the fuse, it holds it. A specifically designed grip prevents the fuse from ever dropping out. The fuse can be taken from the knob only by hand.

* * *

SHALLCROSS LOW-RESISTANCE TEST SETS

Two low-resistance test sets, type 645 and type 653 have been released by Shallcross Mfg. Company, Collingdale, Pa.

The test unit containing the meter, batteries, switches, control, etc., is supported in front of the operator by means of adjustable shoulder straps. Bond or contact resistance measurements as low as .0001 ohm can be made by attaching the fixed clamp to one side of the bonded surface, then touching the hardened points of a pistol grip exploring probe to the other side. Both hands are free at all times to adjust and operate the instrument.



Type 645 is 0.005 and 0.5 ohms full scale; type 653, 0.003 and 0.3 ohms full scale.

* * *

GENERAL ELECTRIC R-F CAPACITOMETER

A radio frequency capacitometer for precision measurements of small capacitance and inductance, has been announced by General Electric.

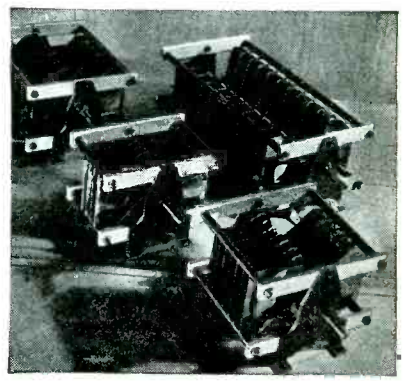
The instrument weighs 55 pounds and is self-contained. Indicating instruments, controls and fuse are mounted on the instrument panel. The front panel and base can be withdrawn from the cabinet as a unit for standard rack mounting.

The capacitometer measures directly at radio instead of audio frequency, with measurements being performed with the aid of an oscilloscope instead of ear phones. The scale on the unit can be read from 0 to 1000 micromicrofarads when measuring capacitance, with inductance measured in the range of 0 to 1000 microhenries.

* * *

VARIABLE CONDENSERS FOR ELECTRONIC HEATING

Heavy-duty variable air condensers designed for electronic heating applications are now being offered by Barker & Williamson, 235 Fairfield Ave., Upper Darby, Pa.

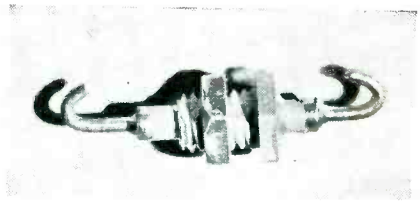


Known as B & W type CX variable condensers, they feature built-in neutralization. Available in almost any required capacity for electronic heating use up to 5 kw, 12,500 volts.

* * *

CENTRALAB BUSHING-MOUNTED CAPACITORS

Bushing-mounted capacitors, type 817, for use in high frequency circuits where a capacity ground to the chassis and a *lead through* is desired, have been released by Centralab, division of Globe-Union, Inc., 900 East Keefe Avenue, Milwaukee, Wisconsin.



* * *

G. E. INDICATOR LAMP

A small molded plastic indicator lamp has been announced by the specialty division of G. E. Special feature is a lock-

on color cap which cannot be shaken loose and will not *freeze* to the base. As many as five circuits can be identified on one panel by the use of five different color caps—amber, red, green, white and blue.

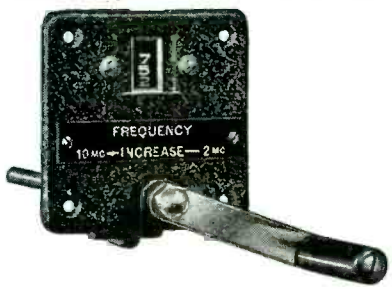
The lamp is supplied ready for mounting. The base is mounted directly to the back of the instrument panel and the color cap is screwed into the base through the panel. A coil spring applies constant pressure to the base of the lamp bulb to maintain a good electrical contact. The lamp takes 6- to 8-volt bulbs.

* * *

BARKER & WILLIAMSON CYCLOMETER TYPE COUNTER ASSEMBLY

A cyclometer type counter unit for registering rotary coil turns is now available from Barker & Williamson, 235 Fairfield Ave., Upper Darby, Pa. It is said to be adaptable to practically any application where a shaft must be turned a predetermined number of times, or set at any pre-determined position. The exact number of turns, down to tenths of a turn, are recorded on the counter.

Standard counters record 10 turns.



Others, also available, record up to 100-1000 turns.

B & W cyclometer counter assemblies have direct shaft drive (1:1 drive shaft to driven unit). Shafts can be any length. A Veeder-Root counter is used. The gear drive is direct. Units weigh 8 ounces. They are available with either right or left hand rotation.

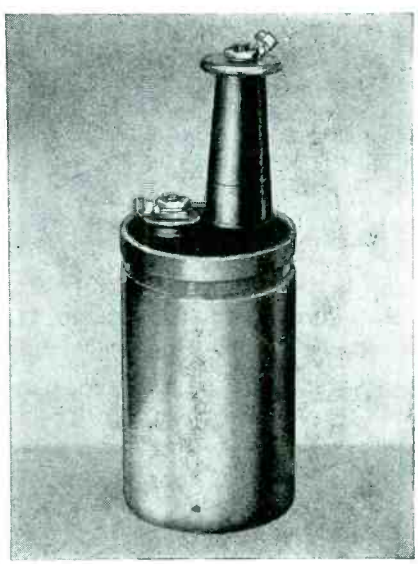
* * *

AEROVOX HIGH-ALTITUDE OIL CAPACITORS

High-altitude oil capacitors for aircraft equipment have been developed by Aerovox Corporation of New Bedford, Mass.

One of these capacitors is similar to the

(*Continued on page* 35)



STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933

Of SERVICE—A Monthly Digest of Radio and Allied Maintenance published monthly at New York, N. Y., for October 1, 1943.

County of New York, } ss.:
State of New York, }

Before me, a Notary Public, in and for the State and county aforesaid, personally appeared B. S. Davis, who, having been duly sworn according to law, deposes and says that he is the Business Manager of SERVICE—A Monthly Digest of Radio and Allied Maintenance, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, managemet, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business manager are: Publisher, Bryan Davis Publishing Co., Inc., 19 East 47th Street, New York, N. Y.; Editor, None; Managing Editor, F. Walen, Union City, N. J.; Business Manager, B. S. Davis, Ghent, N. Y.

2. That the owners are: Bryan Davis Publishing Co., Inc., 19 E. 47th St., New York, N. Y.; B. S. Davis, Ghent, N. Y.; J. C. Munn, Union City, Pa.; A. B. Goodenough, Port Chester, N. Y.; P. S. Weil, Great Neck, L. I., N. Y.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities, are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock, and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

(Signed) B. S. DAVIS, Business Manager.

Sworn to and subscribed before me, this 25th day of September, 1943. (Seal) FRANKLIN B. GOOLD, Notary Public.

Commission expires March, 1944.

NEWS

(*Continued from page 30*)

SYLVANIA TUBE SUBSTITUTION CHARTS

A pamphlet containing charts and all necessary data on radio tube substitutions has been compiled by Sylvania Electric Products, Inc., Emporium, Pa. It is available free of charge from Sylvania distributors or direct.

The pamphlet includes substitution charts for 150 milliampere a-c/d-c receiver tubes, 300 milliampere ac/dc receiver tubes, and battery tube types, carefully edited to conform with the WPB civilian radio tube program. The pamphlet shows the required receiver and modifications necessary for tube substitutions, helps solve difficult tube substitution problems, and gives first and second choices in possible replacements in an easy-to-use check list. The pamphlet fits standard-size loose-leaf binders.

* * *

NEW HIT RELEASES

New record releases under the *Hit* label by the Classic Record Company, 2 W. 46 St., New York, include *If You Please* and *Sunday, Monday, or Always*, by Peter Piper and his orchestra. Recordings titled *Take it from There* and *Put Your Arms Around Me Honey*, by Hal Goodman and orchestra, were also released.

* * *

CENTRALAB CATALOG

A 12-page wartime parts catalog, No. 24, is now being distributed by Centralab, division of Globe-Union, Inc., 900 East Keefe Avenue, Milwaukee 1, Wisconsin.

It is divided into four sections—controls, capacitors, trimmers and switches—and includes all standard items, available to the jobber trade at the present time.

* * *

HALLICRAFTERS WIN SECOND STAR

A second white star for the Army-Navy "E" flag has been awarded to the Hallicrafters Company, 2611 Indiana Avenue, Chicago.

* * *

SYLVANIA ADDS PLANT

Another plant will soon be placed in operation by Sylvania Electric Products, Inc. This is the 18th plant.

WESTINGHOUSE PLANS QUICK CONVERSION TO PEACE PRODUCTION

Complete plans are in readiness at Westinghouse for reconversion to civilian production as soon as war production demands slacken, according to a report disclosed at the company's annual conclave of officers and managers.

Forecasts made at this meeting indicated that while a period of readjustment to peacetime conditions must take place, it should be no more difficult than the adjustment to wartime conditions; the pent-up demands for the goods of peace will be unprecedented; the means of purchasing will exist after the war as never before—in cash, bonds and credit.

* * *

GAROD PLANS FOR POSTWAR

Postwar plans for Garod Radio Corporation were recently announced by Lou Silver, sales manager. Portable midgets, table models, consoles, a-m and f-m, television sets, play-back and record changer combinations will be included in postwar production, said Mr. Silver.

According to Mr. Silver, a national advertising campaign is being prepared and will be released within the near future.

(*Continued on page 35*)

NEW PRODUCTS

(*Continued from page 33*)

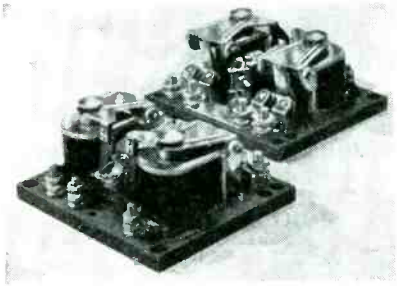
standard type '12 round-can barrier-cap units, except that one terminal is a short screw post. The other is a tall insulator post with corona shield at top. The cover assembly is a one-piece ceramic cap, with the can top spun over a rubber gasket and the cap to provide hermetic sealing.

This aircraft type '12 capacitor utilizes Aerovox hyvol vegetable oil for the impregnant and fill.

* * *

STRUTHERS-DUNN DYNAMIC BREAKING RELAY

Relays that provide instantaneous dynamic-braking with split-series field motors have been developed by Struthers-Dunn, Inc., 1321 Arch Street, Philadelphia, Penna. These relays, types 68HX100 and 67HXX100, are of the Struthers-



Dunn *Nutcracker-construction* in a new, light-weight design. There are no sliding contacts. Positive *memory* contacts select the proper field-winding to give reverse torque for braking. The relays operate in all positions.

* * *

GAROD PERMATONE PHONO NEEDLES

Permatone phono needles that are said to play 1500, 4000, and 7000 recordings, respectively, have been announced by Garod Radio Corporation, 70 Washington Street, Brooklyn 1, New York.

The needles are said to feature a *filter* trap. When the needle rides the groove, shock is said to be absorbed and scratch noise is reduced.

Garod has prepared display cards, approximately 10x15 inches for counter use. In addition, consumer folders, printed in three colors, are also on the list of promotional helps. A quantity of these folders will be supplied, free of charge, with a kit of 4 display cards.

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NEWS

(*Continued from page 34*)

"E" TO ESPEY

The Espey Manufacturing Company, Inc., 305 East 63rd Street, New York City, has won an "E" award.

Lt. Colonel Walter B. Brown, Chief of Employees Relations Section, presented the "E" pennant to Harold Shevers, president of Espey.

* * *

DU MONT ENGINEERS GIVE CATHODE-RAY TUBE TALK

The Radio Club of America inaugurated its fall season program with a paper, *Considerations in the Application of Cathode-Ray Tubes in Equipment*, delivered by Dr. P. S. Christaldi, chief engineer, and I. E. Lempert, cathode-ray tube engineer, of Allen B. Du Mont Laboratories, at Havemeyer Hall, Columbia University.

SPOTS & FLASHES

SEVERAL more radio industry Army-Navy "E" awards for super-production this month . . . congratulations to Amperex Electronic Products, Brooklyn, N. Y.; Reeves Sound Laboratories and Espey Mfg. Co. both of New York City; Bell Sound System, Columbus, Ohio; Erie Resistor Co., Erie, Pa.; Radio Condenser Co., Camden, N. J. . . . Lt. Henry G. Johnson, Sylvania Ad official, on leave, reports from Pacific Theatre of War . . . John "Jack" Ross, former president of Detrola, now head of Aviola Corp., Glendale, Calif. . . . W. Keene Jackson associated with him . . . Fred Goat Co., Brooklyn maker of tube parts, observes 50th anniversary of successful business . . . H. A. Crossland appointed sales manager, General Electric receiver division . . . E. H. Fritschel and H. J. Mandernach named sales managers of G-E tube division . . . Solar Capacitor Sales Corp. appoints J. E. McKinley as representative in Eastern Pennsylvania, Maryland and the District of Columbia . . . headquarters at 401 N. Broad St., Philadelphia . . . we like RCA's *Radio Service News* . . . chockfull of good information for all Service Men . . . better get on the mailing list . . . S. D. Camper appointed by Crosley as Southeastern regional manager with Atlanta headquarters . . . M. F. Klicpera of Houston, Texas, now represents Universal Microphone in Texas, Arkansas, Louisiana and Oklahoma . . . a big pat on the back to Farnsworth employees for remembering fellow-workers in the Services with most complete Christmas packages . . . Fred H. Pinkerton appointed director of public relations by Reeves Sound Labs., Inc. . . . a white star for Army-Navy "E" pennant awarded to Clarostat Mfg. Co. for continued production excellence . . . Fourth War Bond Drive starts in January . . . make your plans to buy as much as you can . . . until then keep purchasing at least 10% of your income . . . plenty $$$'s still urgently needed to get this war over in a hurry . . . Alfred A. Ghirardi joins staff of Farrar & Rinehart, nationally known publishing concern, as Editorial Consultant in the field of radio-electronics . . . Dudley E. Foster and Arthur W. Freese named vice presidents of Majestic Radio and Television Corp. . . . V-mail letters received from men in the Armed Forces prove conclusively that radio is just about the best morale builder in both Army and Navy . . . the same situation exists on the home front . . . it's up to you radio Service Men to keep sets playing despite current shortages of parts.

ADVERTISERS IN THIS ISSUE

SERVICE, NOVEMBER, 1943

WHEN WAR began, among products high on the "critically needed" list were N. U. power tubes. To operate thousands of field and ship transmitters, these tubes were needed in quantities which called for greatly increased facilities *plus some entirely new thinking along mass production lines.*

With a thoroughness that could not miss, National Union engineers went to work on this assignment. Soon they not only had the increased volume required—but in addition we had found the answer which many a tube engineer and production man had long sought, even prayed for . . . the Tube Industry's first automatic exhaust and sealing machines to operate successfully with this type of tube.

Such resourcefulness and engineering capacity have played no small part in making National Union one of the Tube Industry's largest producers of war goods. You will want to remember this achievement when shaping up your post-war plans, and when counsel in electronic applications is needed. *Count on* National Union.

National Union Radio Corporation, Newark, N. J.

Factories at Newark, N. J.; Maplewood, N. J. Lansdale, Penna.; Robesonia, Penna.

NATIONAL UNION

RADIO AND ELECTRONIC TUBES

Transmitting, Cathode Ray, Receiving, Special Purpose Tubes • Condensers • Volume Controls • Photo Electric Cells • Panel Lamps • Flashlight Bulbs

Why Is an RCA Electron Tube Like Sherlock Holmes?

THINGS that were beyond the [illegible] mortals were "elementary" [illegible] fore-and-aft cap.

And why was this?

Simply because Holmes could analyze [illegible] deeply, see more thoroughly into the [illegible] of things, be more observant of little [illegible] else.

A modern Sherlock Holmes [illegible] Tube employed in an electronic device to check tungsten wire leads for radio tubes.

With this difference [illegible] Rock mast[illegible] the crime. The electron tube in this device is a Magic Brain that [illegible] microscopic flaws in wire leads *before* they can cause harm!

For with the aid of this device [illegible] powered with an RCA electron tube, a tiny flaw in a wire can be discovered instantly—and the faulty wire rejected before it finds its way into a completed tube assembly resulting in a leaky tube.

This is electronics in action [illegible] at RCA.

Tomorrow many of you Distributors and Servicemen may be selling, installing, and servicing electronic equipment. The "electronic future" now developing should find you in an enviable position to cash in on your experience and familiarity with radio tubes, circuits, and parts. RCA, too, will be playing a leading part in tomorrow's electronic era—***because 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?"—*RCA's great new show, Saturday nights, 7 to 8, E.W.T., Blue Network.*

To detect flaws in wire leads for RCA tubes, wires are tested by placing them in the magnetic circuit of one of two radio-frequency electronic oscillators. These oscillators are coupled to produce a beat frequency which is dependent on the relative frequencies of the two oscillators. Since a faulty and a perfect wire produce different beat frequencies, as shown by an output meter, an observer watching the meter can instantly detect and reject the faulty piece.

RCA

RADIO CORPORATION OF AMERICA