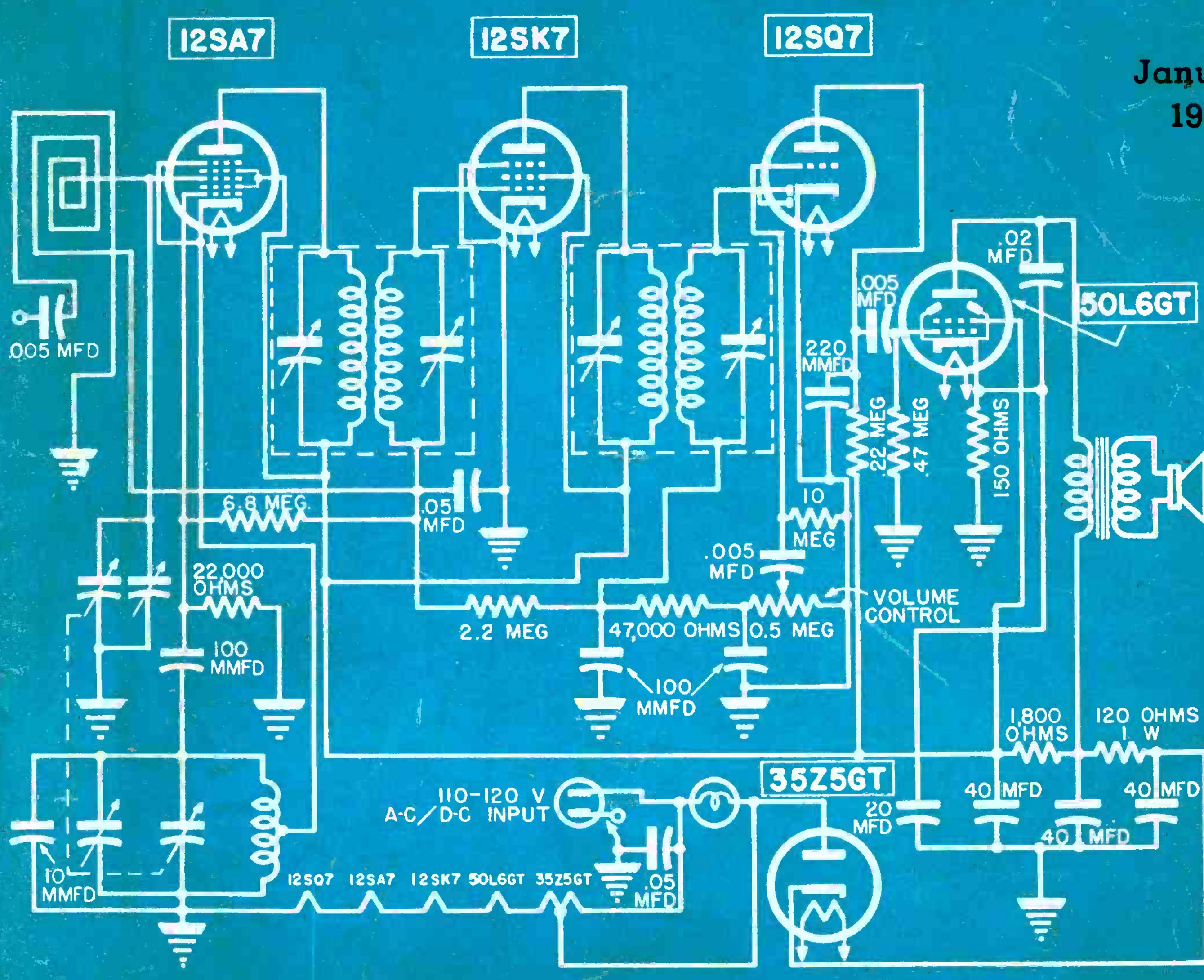
RADIO · TELEVISION · ELECTRONIC

SERVICE

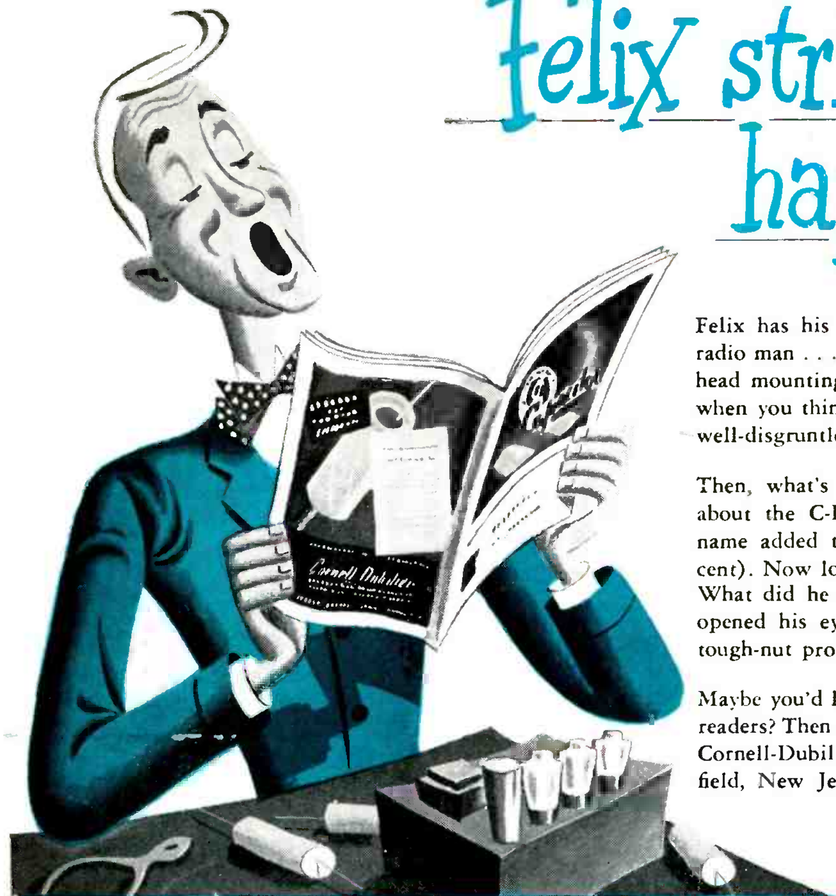
January
1946



Postwar 5-tube a-c/d-c superhet featuring a 2-stage resistance filter and high-Q i-f transformers. (See page 47.)

A MONTHLY DIGEST OF RADIO AND ALLIED MAINTENANCE

Felix strikes a happy note-



Felix has his share of worries, just like every other radio man . . . work piling up, parts hard to get; overhead mounting, hours shrinking into minutes. In fact, when you think about it, this should be a picture of a well-disgruntled service man.

Then, what's the smile for? Last month Felix read about the C-D Capacitor and straight 'way had his name added to our mailing list. (Didn't cost him a cent). Now look at him, after reading only one issue! What did he discover? A practical service story that opened his eyes to a quick, easy way of cracking a tough-nut problem. What a break!

Maybe you'd like to join our happy family of Capacitor readers? Then do as he did. Write to "The Capacitor", Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey.

COLOR-CODE CHARTS FOR YOU!

Another C-D help. These charts are available in two useful sizes; one for your wall and one for your pocket. Both include Army-Navy coding and RMA standards. Ask your local jobber for a set.

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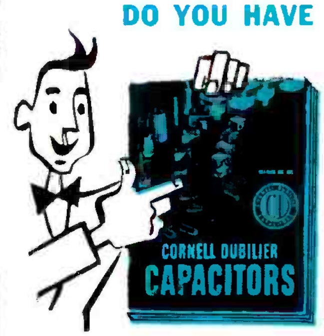

Here at your fingertips is all the information you need on capacitors. Smart servicer's remember only one line . . . one name for their capacitor needs: Cornell-Dubilier. Send for Catalog #195.

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Small in physical dimensions; giants in quality. Even when you use them in heat and high humidity, these little Blue Beavers are "all there". They're Johnny-in-the-spot for small space mounting, too. Ask your jobber.

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An army of salesmen is working for *you...*

...when you handle G-E radio tubes

SOUNDS too good to be true, eh? But it's a fact—this is why: . . . Ever stop to think how many homes have one or more G-E lamps, fans, irons, refrigerators, and other appliances, aside from G-E radio sets? *The G-E monogram is everywhere*—famous sign of quality and owner satisfaction. Right in your area, thousands of G-E products, by their dependable performance, are *pre-selling* radio owners on the fact that tubes carrying the G-E monogram are the BEST! . . . As a G-E radio tube dealer, put this army of 24-hour home salesmen to work for *you*—then watch profits increase! Don't delay. Write for information about G-E tube selling rights to:

Electronics Department,
General Electric Company,
Schenectady 5, New York.

Every tube dealer and service man should have G.E.'s handy, fact-filled Tube Characteristics Booklet ETR-15. Write for your free copy today!

GENERAL ELECTRIC

176-E1-8850

EDITORIAL

WHILE polls or surveys have never been taken too seriously by many of the technical group, significant data presented in recent projects appear to have changed these views. For the surveys have proved that they provide an effective guide to not only purchasing requirements, but to important trends and plans.

An enterprising Service Man proved this quite effectively recently. Before expanding his shop, he decided to survey the community to both determine prospective servicing sources and what additional equipment might be necessary for any new servicing efforts.

It was believed that while homes offered a substantial medium for servicing there were other interests that could be served. As a result, offices, schools, hospitals, taxis, garages, hotels, auditoriums and a few public buildings were polled.

While the survey consumed many days and was not too simple to conduct, the results proved the effort well worth while. For this Service Man found that quite a few of the plans he had made and believed quite necessary would have to be completely revised. He found, for instance, that only certain types of receivers were in immediate need of servicing; antennas were a major servicing factor in certain parts of the community; intercommunication systems in plants and offices were in need of repairs and a maintenance service; and the local school system had been in need of repairs for months. In contrast, the Service Man found that taxis would not need a repair service now, because of the possibility of new cab shipments. He had also assumed that the hospital system would require a complete overhauling. He was right, but funds would not be available for at least a year. Many other similar important income-producing facts were disclosed. As a result it was possible to prepare an evaluation of the services that might be offered and equipment that might be needed. The receivers and associated equipment that were to be serviced dictated the purchase of the proper assortment of components, accessories and tubes, and test equipment.

While all surveys are dated, they do serve as a barometer and prevailing conditions can be used as a guide to accuracy.

Whether conducted in an elaborate or simplified procedure, the survey offers basic information that is certainly more useful than that obtained in a guesswork procedure. Try it!

SERVICE

A Monthly Digest of Radio and Allied Maintenance

Reg. U. S. Patent Office

Vol. 15, No. 1 — January, 1946

Page

Published monthly by Bryan Davis Publishing Co., Inc.
52 Vanderbilt Avenue, New York 17, N. Y. Telephone MUrray Hill 4-0170

Bryan S. Davis, President
Paul S Weil, Vice Pres.-Gen. Mgr.
A. Goebel, Circulation Manager
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Entered as second-class matter June 14, 1932, at the Post Office at New York, N. Y., under the Act of March 3, 1879. Subscription price: $2.00 per year in the United States of America and Canada; 25 cents per copy. $3.00 per year in foreign countries; 35 cents per copy.

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Right on your door, every visitor will see this smart, modern decal — and know your shop is operated by Bonded Electronic Technicians. Here, where your profits start, your doorway becomes a sales-aid. And this is only the beginning. Wall banners, displays, job record cards—the Raytheon Bonded Electronic Technician will have plenty of these to help build a substantial, money-making radio service business. See your Raytheon distributor today. Find out how you can qualify to become a Bonded Electronic Technician. Join the practical, responsible business men known to their communities as Bonded Electronic Technicians.

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Excellence in Electronics

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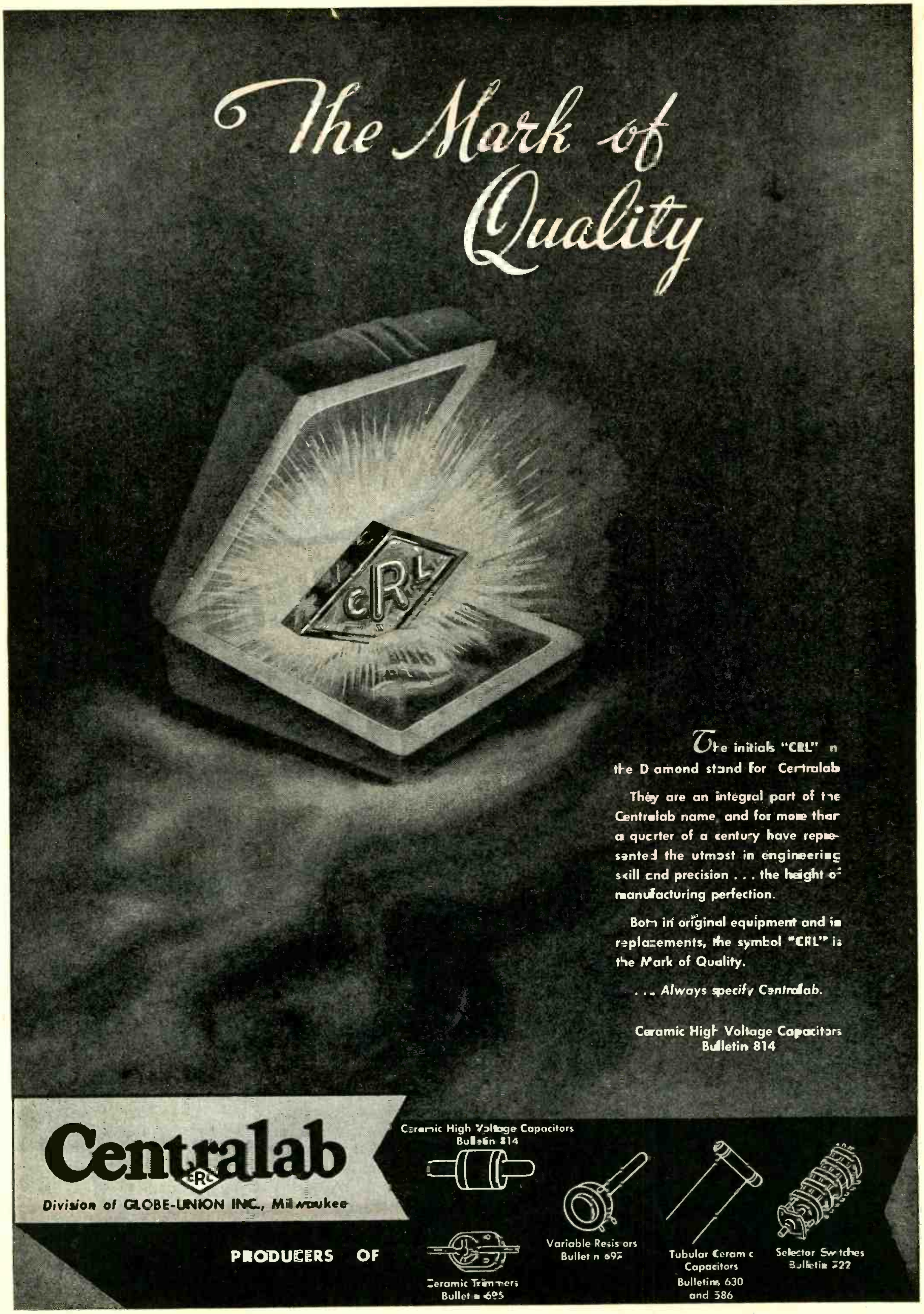

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SOME family trees may boast more branches, but our fruit's all hand-picked. There are no lemons in the Stamford "60" line. Even the smallest are built like giants; you couldn't want a stouter crop of transformers. We designed the 60 transformer types that covered all your replacement needs in quality as well as quantity. Ask to see the Stamford "60"! Give them a try! You'll do a better service job; you'll know real satisfaction in using the finest parts made. For the address of your nearest Stamford "60" jobber and other information, write: Stamford Electria Products Co., Inc., Stamford, Connecticut.

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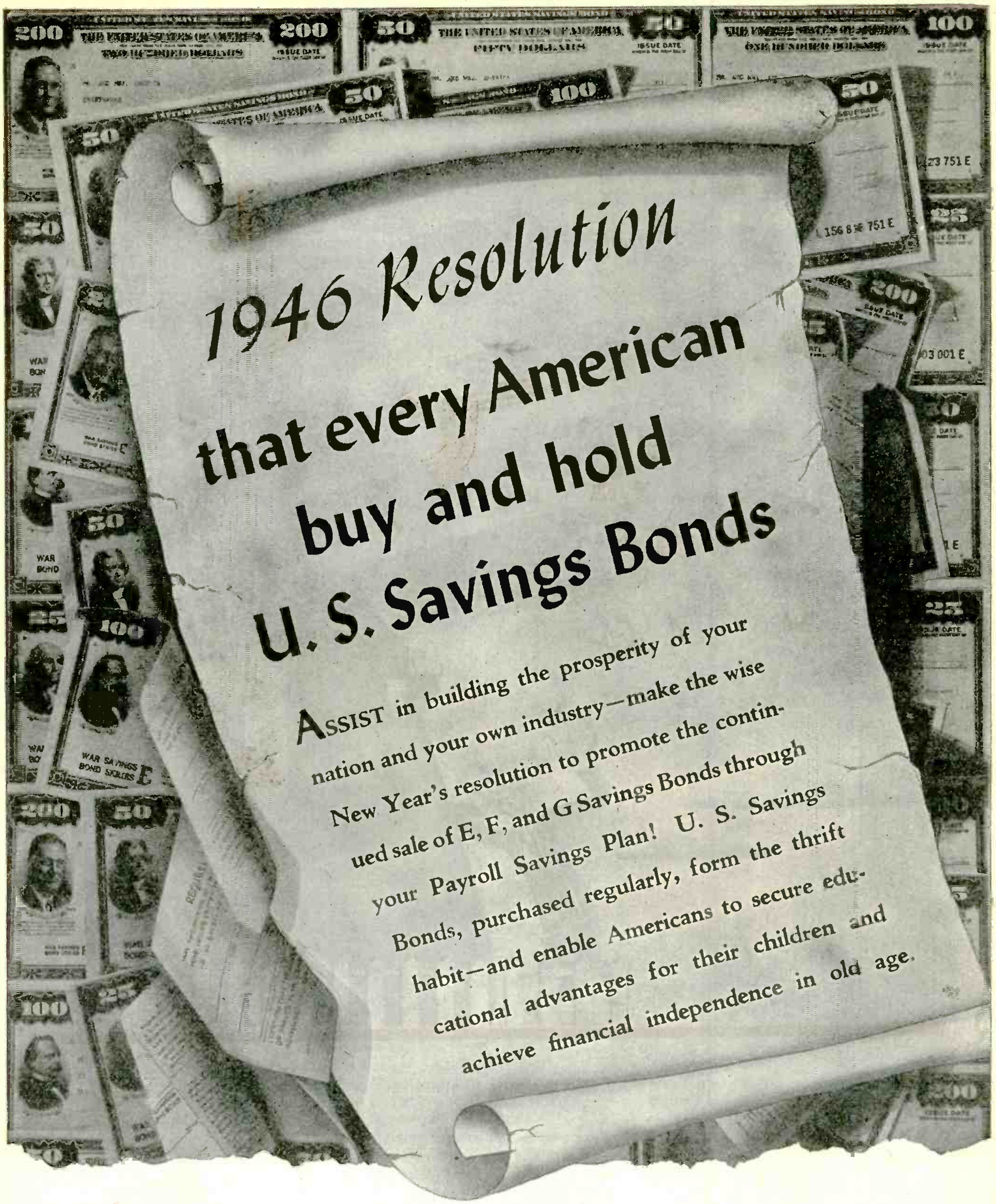
1946 Resolution
that every American
buy and hold
U. S. Savings Bonds
ASSIST in building the prosperity of your nation and your own industry—make the wise New Year's resolution to promote the continued sale of E, F, and G Savings Bonds through your Payroll Savings Plan! U. S. Savings Bonds, purchased regularly, form the thrift habit—and enable Americans to secure educational advantages for their children and achieve financial independence in old age.

SPRAGUE TRADING POST

A FREE Buy-Exchange-Service for Radio Men

A PERSONAL MESSAGE TO EVERY USER OF THE SPRAGUE TRADING POST

With the gradual reappearance on the market of peacetime radio parts and equipment, it becomes obvious that the four-year-old Sprague Trading Post has outlived its usefulness. Rather than buy old materials, you will want factory-fresh new ones. Instead of trading obsolete equipment, you will now want to avail yourself of the many developments that wartime engineering has produced.

Thus, we are sure that the thousands of radio men, amateurs, experimenters, instructors and those in the nation's armed forces who have benefited through this free buy-trade-sell advertising service will fully understand our reasons for discontinuing it with the December issues of the six leading radio magazines wherein it has appeared.

In closing this chapter of Sprague cooperation with our friends throughout Radio, it is interesting to recapitulate briefly:

During the life of the Sprague Trading Post, approximately 12,000 individual classified advertisements were run absolutely free of charge. As a result, hard-to-get equipment was made rapidly available through those who no longer had need for it. Tubes, test equipment, manuals, receivers, transmitters, and dozens of other items including complete service shops were bought, sold and exchanged in tremendous quantity. So many ads were sent in to us that, on several occasions, we had to increase our advertising budget in order to buy enough magazine space in which to accommodate them all. All told, we invested over $70,000.00 to make this special wartime service as effective as was humanly possible.

What does the Sprague Products Company expect to get out of all of this? Well, the answer to that one is easy. It is simply that we believe that anything we can do to help our friends is good business for us. Now that Sprague Capacitors, *Koolohm Resistors and Test Equipment are again becoming available in complete lines, we believe we can count on the loyal support of every radio man we tried to help when the going was tough. We believe we can count on you to use Sprague materials wherever possible—and if you do, we assure you that you will be getting the best, most dependable units money can buy.

Meanwhile, should any new opportunity for a cooperative service such as the Trading Post present itself, you can count on Sprague to render it to the utmost. Not only this, but I'll personally welcome suggestions and correspondence along this line from all of you who have benefited even a little through the Sprague Trading Post effort during the hectic wartime years.

Harry Kalker
SALES MANAGER

SPRAGUE PRODUCTS CO., NORTH ADAMS, MASS.

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CAPACITORS FOR EVERY SERVICE, AMATEUR AND EXPERIMENTAL NEED

SYLVANIA NEWS
RADIO SERVICE EDITION

JAN. *Published by* SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa. 1946

RADIO SERVICEMEN KNOW THEIR BUSINESS; HAVE COUNTRY'S COMPLETE CONFIDENCE, SURVEY SHOWS

National Research Bureau Reports Findings to Sylvania

A recent nationwide, *independent* survey—conducted by one of America's leading market research organizations—reveals that not only do 93% of the thousands of set owners interviewed firmly believe that the radio serviceman does a good job, but also that 89% say he charges a fair price for his work!

That's a flattering record—since the ground covered was scientifically selected, both from the geographical distribution standpoint and income group.

WHAT THIS MEANS TO YOU

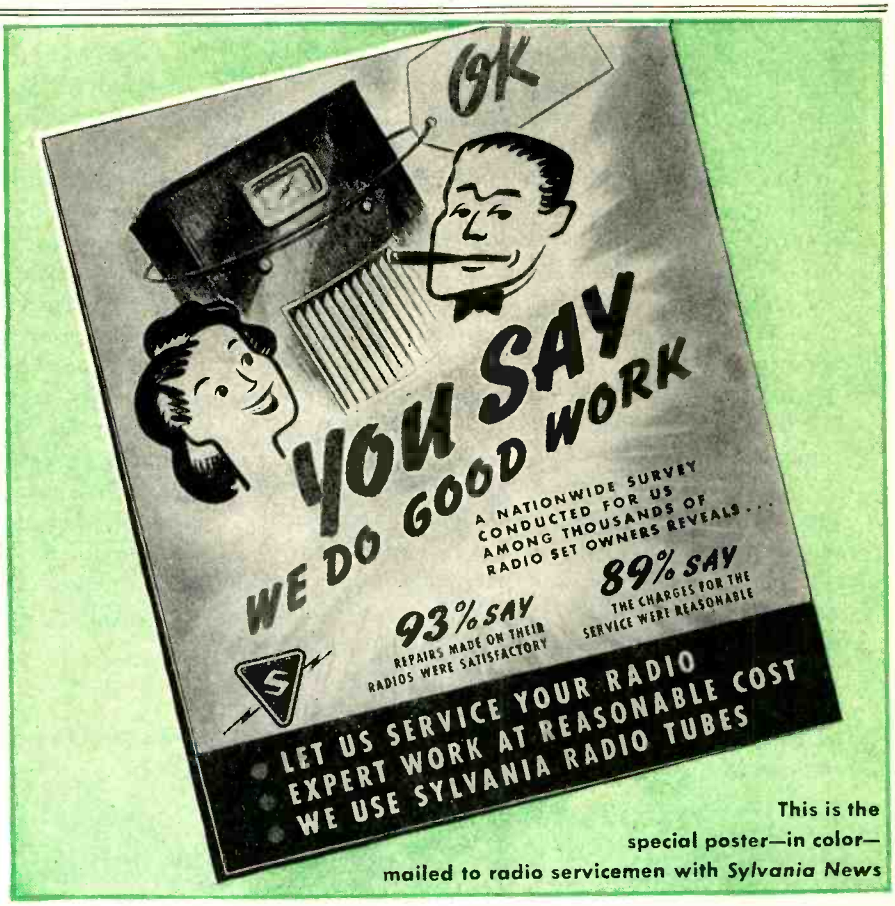
To radio servicemen this means they are virtually assured of the continuance of this public trust in the busy years ahead. For, if this confidence was maintained throughout the past *difficult* period, it certainly may be expected to continue—and grow—in the following years, when the millions of radio tubes and parts needed will be *available*.

All of this spells opportunity for the radio serviceman. Knowing that he has the public confidence, he can combine the other ingredients of quality components and high class equipment, backed by aggressive promotion, to form an unbeatable recipe for success.

Now that the war's over, radio tube production is rapidly getting into its stride. All the pre-war tubes should be available gradually—and along with them will come the newly developed tubes, or improvements and modifications of some of the older ones.

So to keep you in step with the latest tube characteristics and base diagrams, we at Sylvania are having prepared a brand new Radio Tube Characteristics Sheet as well as an up-to-date Base Chart.

You can get both your copies—free—from your Sylvania Jobber or send your request direct to me at Emporium, Pa.



This is the special poster—in color—mailed to radio servicemen with *Sylvania News*

SYLVANIA ELECTRIC

Emporium, Pa.

MAKERS OF RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; ELECTRIC LIGHT BULBS

SERVICE
A Monthly Digest of Radio and Allied Maintenance

TELEVISION AND THE SERVICE MAN

by R. B. CARWOOD

WHILE television at present is in a state of flux, the Service Man will find it to his advantage to become acquainted, even superficially, with some of the problems of this new field.

The FCC rules governing the broadcast of television signals contain many facts of interest to Service Men.

FCC Rules

Thirteen channels have been assigned for television broadcast, six between 44 and 88 mc, and seven between 174 and 216 mc, chart *1*. Channel *1* (44-50 mc) has been assigned exclusively to *community stations*. By FCC definition . . . "A *community station* is designed primarily for rendering service to the smaller metropolitan districts or principal cities." The other twelve channels are assigned to *metropolitan stations*, or stations located in large cities, or serving high population areas.

Thus far, the largest number of station channels have been assigned to the New York-northern New Jersey area, Los Angeles, and Chicago, where seven channels each are available. Next comes San Francisco-Oakland with six, and other large population areas with five channels. It does not necessarily follow that all these channels will come into immediate use, since these channels have been assigned to areas, and not to specific stations. In addition, present television receivers cannot receive stations assigned above 88 mc. For example, in the New York area only channels *2*, *4*, and *5* will be immediately available. It would be to the Service Man's advantage, therefore, to ascertain what is being done to establish television service in his service area, so as to be able to answer customer queries on this subject honestly.

Community stations will be permitted a maximum radiated power of 1000 watts, and *metropolitan stations*, 50,000 watts, at maximum antenna heights of 500′ above the average terrain. Where television antennas are higher than 500′, the permissible power will be reduced, so that the signal coverage will be equal to that of an antenna 500′ high, at a signal strength of 50,000 watts. This would correspond to an average effective signal radius of approximately 35 miles.

Transmitting hours for each station will be in the neighborhood of six hours per day. At present, the few television stations that are in operation transmit infrequently, and then only for a few hours, two or three at the most. Most of these transmissions take place after 8:00 P.M., except for week-end sporting events. The Service Man should find out what the exact schedules of transmission are, now and in the future. In this way, any contemplated television service work or checking can be assigned to the proper hours.

It is difficult to predict what the public will expect from television. Some of the new receivers give excellent results in black and white images, under ideal reception conditions. How much deviation from the ideal will be tolerated by the television set owner is unknown. From observation, many people will accept television even when it is not perfect. From personal observation among men, sporting events such as boxing and football games go over big, even though the present results on prewar receivers are not very good. Few television stations have made an effort to present well-staged studio programs. For this reason it has not been possible to establish public reaction to a good television program. However, anyone who has seen television has evinced a positive interest in it.

Channel	Mc.	Channel	Mc.
1	44-50	7	174-180
2	54-60	8	180-186
3	60-66	9	186-192
4	66-72	10	192-198
5	76-82	11	198-204
6	82-88	12	204-210
		13	210-216

Chart 1

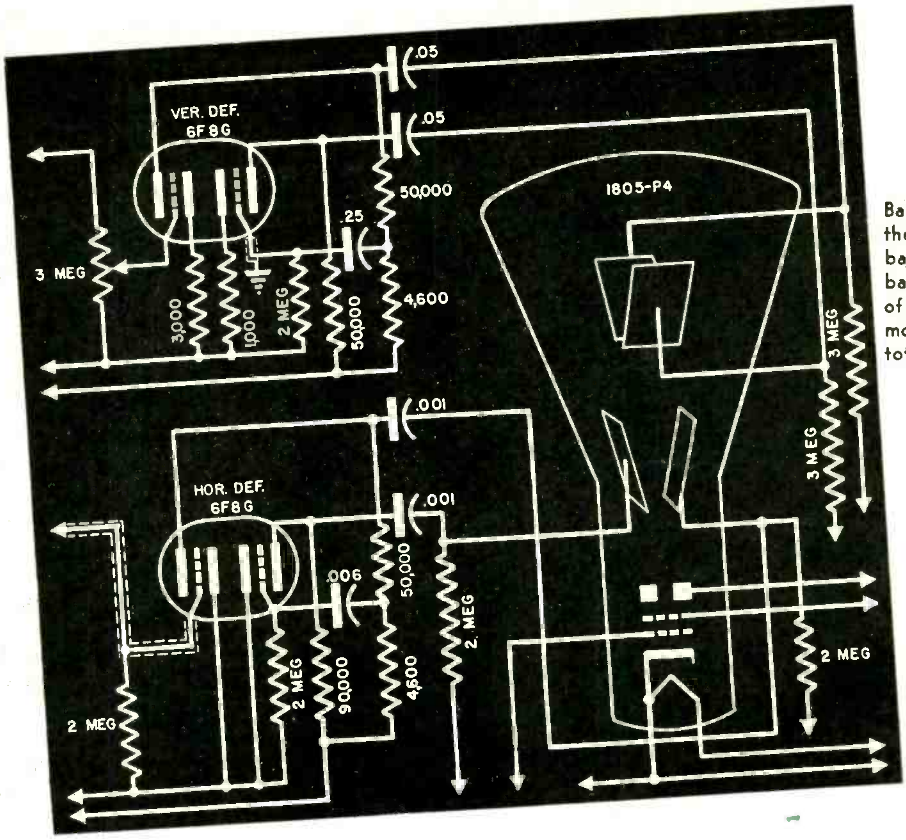
From the Service Man's viewpoint, the installation of television antennas may turn out to be his biggest problem. Reflectors will undoubtedly be necessary. However, the problem of how to construct an antenna with directional qualities, so that it can pick up signals from 7 different directions, and spread out over a band extending from 44 to 216 mc is a problem that is going to require a lot of thought and ingenuity. In addition, the problem of *ghosts* and shielding effects are bound to be trying. In apartment houses, the problem will be further complicated by the installation of numerous television antennas, and unless some method is found to solve this problem, it will be necessary for the Service Man to adjust all the other antennas every time a new antenna is put up.

The next problem faced by the Service Man is the presence of car ignition interference on receivers installed at street or second floor levels. Power and telephone line interference may also be present, particularly in areas where the signal level is low. The Service Man's approach here would be to determine just what is the attitude of television set owners and how much interference will be tolerated by the consumer. To determine public reaction to television Service Men could place a sign in their store window reading:

"Do You Own a Television Set? Come Inside for Pertinent Information."

Since present frequencies are to be reassigned, and new stations will undoubtedly spring up, it will become necessary for these set owners to have their sets realigned. Therefore, in addition to bringing in business, it will be possible to find out their reaction to television, determine what con-

(*Continued on page 21*)



Balanced electrostatic deflection circuits of the Andrea 1F5 television receiver. In a balanced push-pull amplifier working into balanced deflecting plates, we use only ½ of the *B* voltage of an unbalanced, common tube connection system. That is, the total deflecting voltage is the sum of the two output voltages.

DEFLECTION CIRCUITS IN

by

FRANK G. STRONG

ONE of the most interesting and important circuits in the television receiver is the deflection circuit. It is this circuit, linked to the picture tube, that controls the video response to provide acceptable pictures.

There are two general methods of deflecting the beam of a cathode-ray tube; electrostatic method in which the deflection is produced by a pair of parallel plates within the tube, and the magnetic method which makes use of deflecting coils or yokes wrapped around the outside of the tube. The two methods require radically different deflection circuits, although other circuits in the television receiver, including the synchronizing system remain the same for either deflection system.

Electrostatic deflection is familiar to most Service Men since it is commonly used in most oscillographs.

Electrostatic Deflection

In electrostatic deflection circuits we have a high-impedance system where a high voltage of the order of 500 or more (peak-to-peak) is applied to a pair of deflection plates to produce a uniform electrostatic field between the plates with a little fringing beyond them. When the plates are sections of horizontal planes, the field produced is vertical, providing vertical deflection of the electron beam. This deflection is based upon the fundamental law of charged bodies: like charges repel, opposite charges attract. The beam, being formed of negative electrons, are repelled from the plate which is momentarily negative and attracted to the plate which is momentarily positive.

In television receivers we must have balanced deflection systems. This necessitates separate terminals for all deflection plates. A balanced system may be produced by a push-pull amplifier or a center-tapped transformer, the latter being good for the lower frequencies only. The important feature is to maintain the same average potential on the plates as on the second plate, balancing the voltages on a pair of plates with respect to that plate. In inexpensive oscillographs, there is usually a common connection between one plate of each set and the second plate. This causes the deflection sensitivity to decrease with a positive voltage and increase with a negative voltage applied to the free plate. Thus accurate measurement is not always possible. Focussing is also disturbed by the common connection. A type of astigmatism is produced, causing distortion of the normally round spot.

Deflection Sensitivity

As the beam leaves the electron gun it is aimed at the center of the screen and can be displaced only by stray or intentional electrostatic or magnetic fields in its path, which can be identified as deflection sensitivity. This factor is proportional to the peak voltage on the plates, length of the static field and distance from the plates to the screen material. It is inversely proportional to the separation of the plates and the accelerating plate potential. We can control only the deflecting voltage and plate voltage. The other

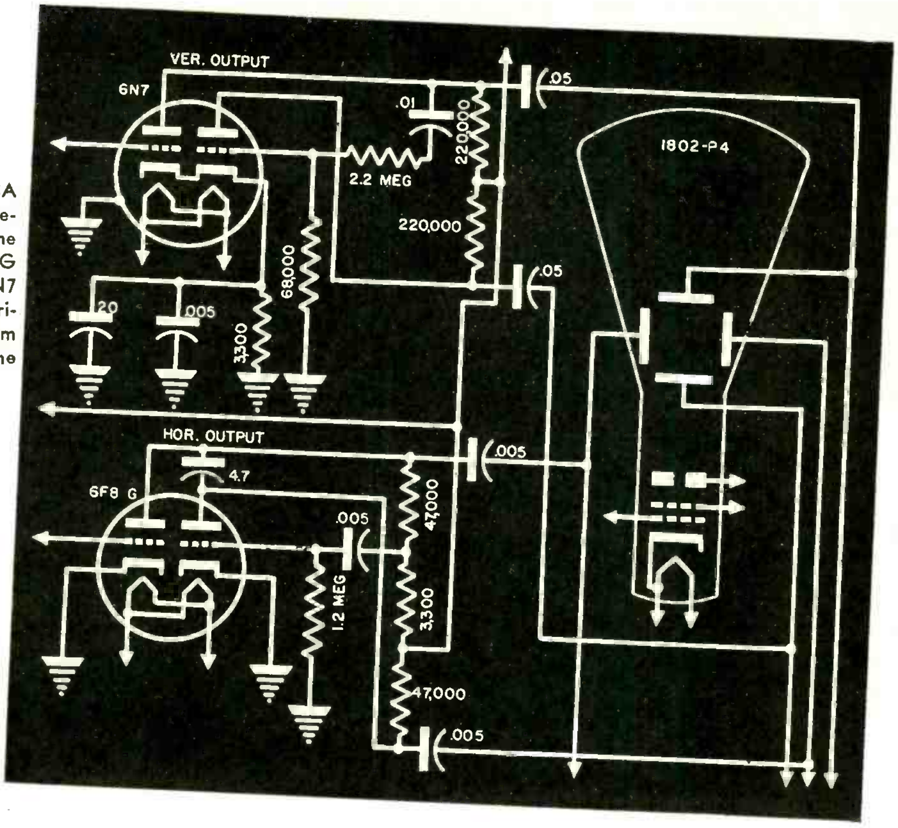


Fig. 2. Deflection system used in the RCA TRK-5. The coupling system in this television receiver is similar to that used in the Andrea model shown in Fig. 1, with a 6F8G used for the horizontal output and a 6N7 for the vertical. In this circuit, the horizontal plate load consists of a 47,000-ohm resistor and a .005-mfd capacitor. The vertical load is 220,000 ohms.

TELEVISION RECEIVERS

factors are inherent in the tube. Expressed as a formula:

$$\text{Amount of deflection} = \frac{V_d \times l \times distance}{2 \times E_a \times d}$$

where: V_d is the peak voltage between deflecting plates
l is the length of the plates (length of the field)
distance is measured from the center of the plate to the screen
E_a is the second plate accelerating voltage
d is the distance between the pair of plates
dimensions are in centimeters

The path of the beam curves while it is acted upon by the static field. The deflection produced upon the screen is directly proportional to the voltage applied; i. e., the system is linear. A tolerance of about ±20% in deflection sensitivity is allowed between tubes of a given type. This is usually allowed for in circuit design. Electrostatic tubes have a deflection angle limited to approximately 35° as compared to 55° for magnetic tubes. This requires a longer tube for a given screen size which, in turn, requires higher voltage for the same brilliance.

The power requirements for electrostatic deflection are not great, and much less than in magnetic systems. A linear voltage output up to 500 or more is the main necessity for the amplifier, although there is some leakage current, as well as about 10 mmfd of capacity to offset.

Some receivers require compensators or trimmers for tube-to-tube variations. Centering controls operate at a high potential requiring very good insulation and, sometimes, insulated couplings. Service Men must exercise caution in handling these controls.

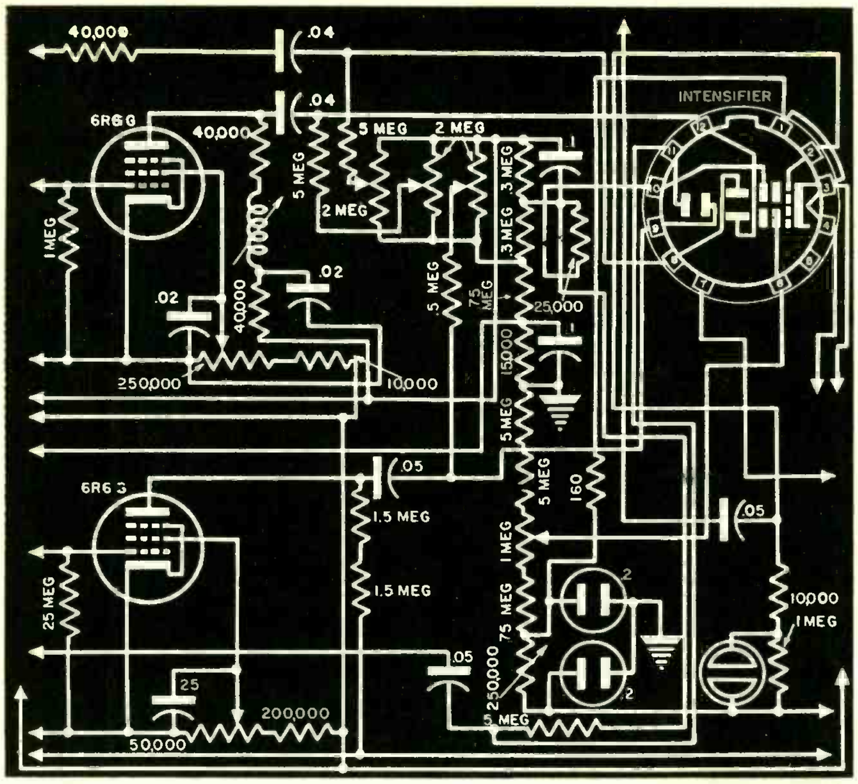
Magnetic Deflection

Magnetic deflection systems are inherently low-impedance systems requiring coupling transformers for impedance matching between the output amplifier tubes and the deflecting coils. The beam is deflected by motor action. This is the action of a magnetic field on a conductor carrying current, the conductor being the beam itself. The design of magnetic deflecting circuits is much more difficult than electrostatic circuits, because a sawtooth current is required in the deflection coils. To obtain such a current waveform, a negative pulse must be superimposed upon a sawtooth voltage, just before the start of the sawtooth rise, to offset a surge caused by collapse of the magnetic field in the yoke.

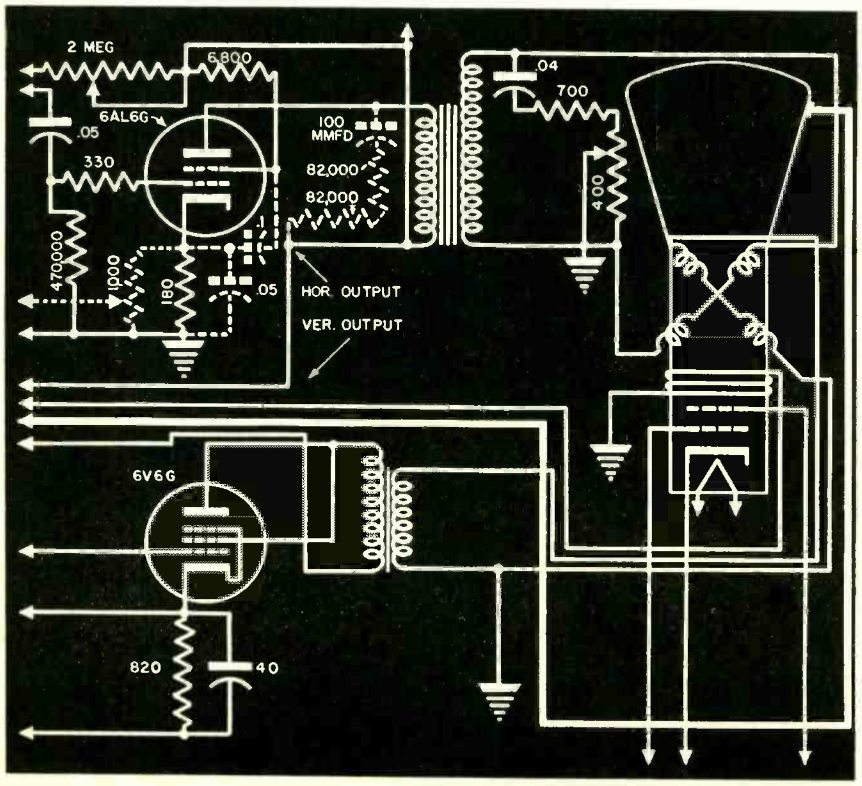
In this system, we have a horizontal amplifier handling 15-kc. In the vertical amplifier 60 cycles are used. Thus the control problem is quite acute in the horizontal amplifier.

Both yoke and coupling transformer must have sufficient insulation to handle the great inductive kick due to the collapse of the magnetic field when the current suddenly returns to zero during the return sweep. At 15 kc with 10% return time, this voltage has a peak value of 2,000-4,000 and, for shorter returns, it is still higher. Damping is required to prevent oscillations following the surge of the return sweep. The speed of return depends upon well engineered transformers and coils having a minimum of distributed capacity. The linearity requirement also demands the best in matching transformers.

Because of the power requirements of the yokes, losses due to damping circuits, and severe surges, power tubes with plenty of tube insulation are employed. Special power tubes



Figs. 3 (above) and 4 (below). In Fig. 3 we have the electrostatic deflection system used in the DuMont television receiver, with a 14" tube. A special high-voltage driver tube, 6R6G pentode, is used for both deflection circuits. A neon voltage stabilizer is also used. The magnetic deflection circuit of the G.E. HM-225B is shown in Fig. 4 A 6AL6G power tetrode is used. Horizontal damping *RC* circuits are in both primary and secondary of the matching transformer.



have been designed for this purpose, although some models have used 6L6s. In the 60-cycle vertical amplifier the power problem is not too difficult because of the low frequency. Thus a 6J5 or 6V6 delivers adequate power.

Projection television systems use high quality yoke systems which require high power because of tremendous beam velocities. Most large cathode-ray tubes, except those made by DuMont, use yokes. Magnetic type tubes are simpler in construction, hence less expensive. This helps to offset the cost of coupling transformers and yokes.

New Tubes

With new tubes having improved brightness and resolution, both deflection systems have been found to offer satisfactory results. Booster plates have been used in the DuMont tubes to add to brilliance without sacrificing sensitivity. Operating at a potential about double that on the plate, the booster accelerates the beam after it has been acted upon by the deflection media.

Greater intensity and contrast is also being obtained by applying the screen emulsion with a settling process instead of spraying, giving a very thin but very satisfactory coating. A wide variety of (tinted) white screens are also now obtainable.

Circuits

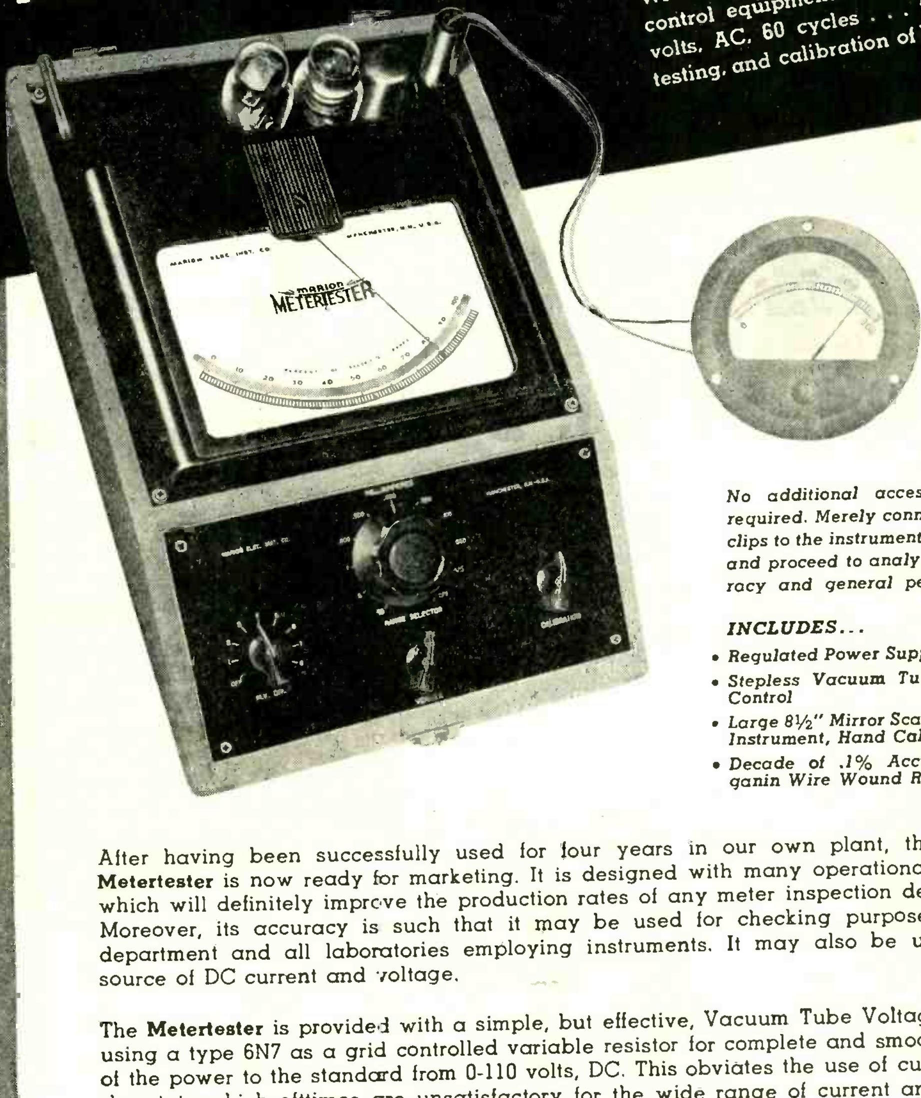
In Fig. 1 we have Andrea's model 1F5, which uses balanced push-pull electrostatic deflection circuits with 6F8Gs for both horizontal and vertical output. With half-wave excitation, phase inversion in the second triode provides the other half. It should be noted that a balanced push-pull amplifier working into balanced deflecting plates requires only one-half the *B* voltage of an unbalanced, common tube connection. (The total deflecting voltage is the sum of the two output voltages). The 6F8G supplying 15 kc has 50,000-ohm plate resistors and .001-mfd coupling capacitors; the vertical amplifier has the same load resistance but .05-mfd coupling capacitors (for 60 cycles). The c-r tube vertical plates have 3-megohm resistors in series, between plate and centering potentiometer, while the horizontal plates have 2-megohm resistors.

The RCA TRK-5, Fig. 2, uses a similar coupling system with a 6F8G for horizontal and 6N7 for vertical deflection. The horizontal plate load is 47,000 ohms; capacity is .005 mfd.

For use in any department and all laboratories where instruments are employed and their performance must be carefully checked

MARION Multi-Range METERTESTER

With self-contained power supply and control equipment for operation on 110 volts, AC, 60 cycles . . . for production testing, and calibration of DC instruments



No additional accessories are required. Merely connect the two clips to the instrument under test, and proceed to analyze its accuracy and general performance.

INCLUDES...

- *Regulated Power Supply*
- *Stepless Vacuum Tube Voltage Control*
- *Large 8½" Mirror Scale Standard Instrument, Hand Calibrated*
- *Decade of .1% Accurate Manganin Wire Wound Resistors*

After having been successfully used for four years in our own plant, the **Marion Metertester** is now ready for marketing. It is designed with many operational features which will definitely improve the production rates of any meter inspection department. Moreover, its accuracy is such that it may be used for checking purposes in any department and all laboratories employing instruments. It may also be used as a source of DC current and voltage.

The **Metertester** is provided with a simple, but effective, Vacuum Tube Voltage Control using a type 6N7 as a grid controlled variable resistor for complete and smooth control of the power to the standard from 0-110 volts, DC. This obviates the use of cumbersome rheostats which ofttimes are unsatisfactory for the wide range of current and voltage covered by the **Metertester.**

Range of this unit is 25 microamperes full scale to 10 milliamperes full scale, with the first scale division reading ¼ microampere, and 0-100 volts full scale. Overall accuracy is better than ½ of 1%. Basic sensitivity of the Mirror Scale Standard Instrument is 10 milliamperes. The complete unit is housed in a hand-rubbed, solid oak carrying case.

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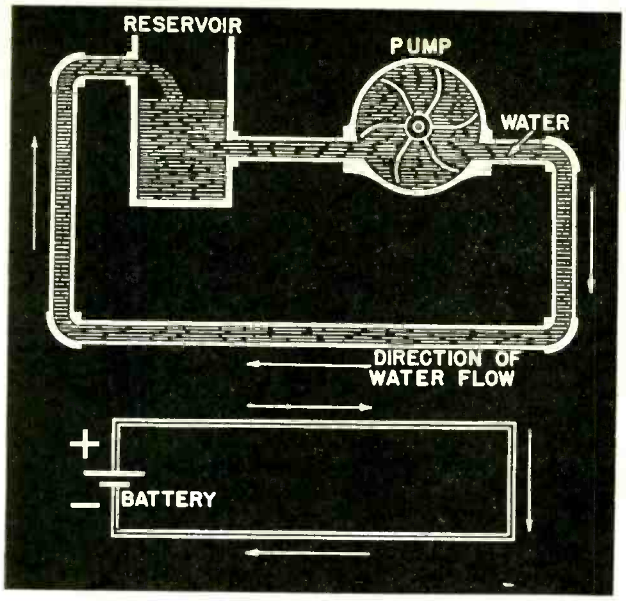
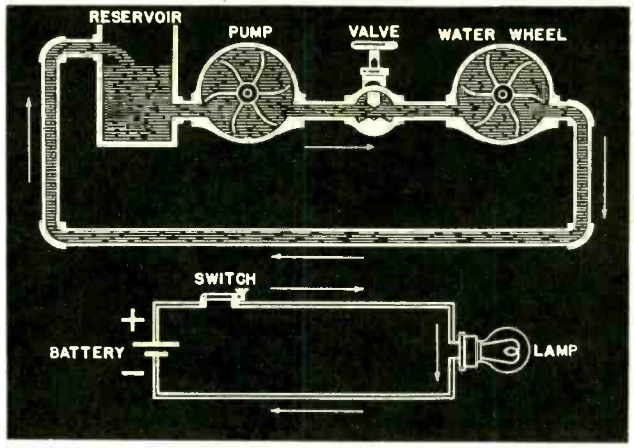




Figs. 1 (left) and 2 (above). Fig. 1. Analogy of the continuous water system and the electrical circuit. The battery in the electrical circuit is equivalent to the reservoir and pump of the water system. Fig. 2. Here we see an analogy of the work accomplished by water and electrical systems. The pump drives the water from the reservoir against the water wheel, which turns, due to the pressure against its vanes. The water then returns to the reservoir.

OHM'S LAW

A SIMPLIFIED ANALYSIS

by L. A. MOHR

THE three basic elements of the electric circuit are *current, voltage* and *resistance*. Since there is a close kinship between the behavior of electricity and water, the action of the electrical circuit can be explained by a water analogy.

Current, which is measured in amperes, is the flow of electricity, usually along a conductor, and may be likened to the flow of water through a pipe, measured in gallons per minute.

Voltage, which is measured in volts, is the force which pushes the current, and may be compared to the pressure exerted on the water flowing through the pipe, measured in pounds per square inch.

Resistance, which is measured in ohms, is a static force opposing, or slowing down the flow of electrical current, and is comparable to the type or size of pipe used in the water analogy; Fig. 1.

Current

In measuring the flow of water, a time element is involved, in that we say that 10 gallons, or 15 gallons, or 20 gallons of water are flowing past some preselected point in the space of one minute. If comparisons were to be made between two or more pipes and their effect on the flow of water, we could compare the flow of water in each by using some time base, such as one second, or one minute, or one hour.

Suppose that an agreement had been reached that in measuring water flow, a basis of one minute would always be used. Then we could say that the flow in one pipe was 10 gallons, in another 16 gallons, etc., with the added expression *per minute,* understood. Similarly, when we say that a current of one ampere is flowing in a circuit, we mean a measured amount of electricity, which takes one second to flow past some point. The term ampere is therefore one which embodies within itself not only a definite quantity, but also a definite time element.

Voltage

Referring again to the water analogy, one influence which governs the amount of water passing a given point is the pressure exerted at the source. Any increase in the pressure will increase the flow of water, and conversely, a decrease in the pressure will decrease the flow.

Water pressure is indicated in pounds per-square-inch. Similarly, the volt represents the unit of electrical pressure, and variations in voltage produce corresponding variations in current or amperes. To summarize, the ampere represents the amount of electricity flowing in a circuit, and the volt represents the force responsible for that flow.

The Ohm

The third element in the analogy is the *ohm,* or unit of resistance. For water there is no term which adequately defines resistance to the flow of water. However, we can define the resistance offered to the flow of water in a pipe in a general way, since we know that a small pipe will not deliver as much water as a large pipe, even though the pressure on the two is equal. In other words, the dimensions of the water conductor influence the amount of water flow.

Wire Size and Current Flow

In much the same way, the size of the electrical conductor determines the amount of electricity, or amperes, which will flow through it when a pressure, or voltage is exerted on it. That is, for the same force, a large electrical conductor will permit a greater flow of current than a smaller one; this brings up other influences on current flow.

Pressure

For a given pressure, the longer the pipe, the slower will be the flow of water, and the resultant quantity of water emitted at the end of the pipe will be less. That is, if two similarly

(*Continued on page* 42)

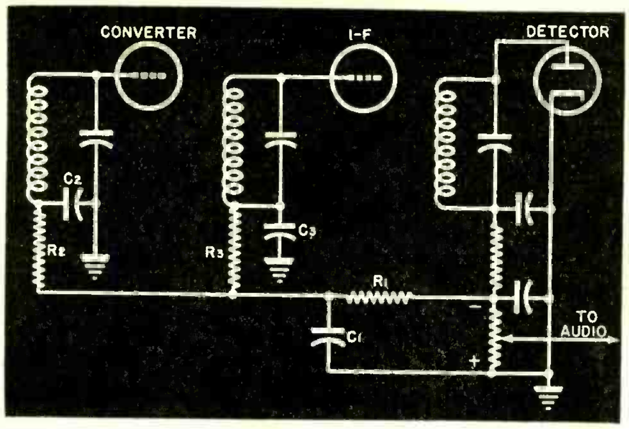


Fig. 2 (left). The avc system of a typical midget receiver. The time constant for the circuit is determined largely by the values of R_1 and C_1. R_1C_1 also act to filter the audio component of the rectified signal voltage developed across the volume control, which acts to bias the converter and i-f stages.

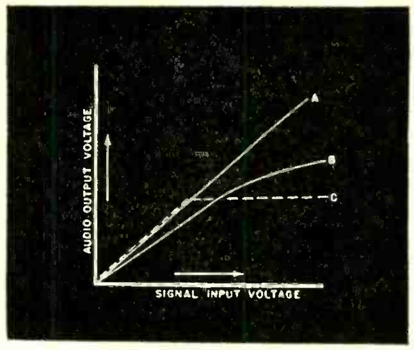


Fig. 1 (above right). Three graphs to illustrate audio output versus signal input. Curve *A* shows the response of a receiver with no avc system. Curve *B* is the response curve for the average midget receiver of the 5 tube a-c/d-c type. Curve *C* is an idealized version of receiver response, with uniform gain for input to a predetermined point, and constant output for increased input beyond this point.

AVC SYSTEMS IN

by

THOMAS T. DONALD

THE avc systems of communications receivers are basically identical in function to those employed in home receivers, but on a more elaborate scale. Avc systems are employed to keep the audio output level fairly constant for a wide variety of station signal levels, and to compensate to some extent for fading signals. In communications receivers they are doubly important, because the set is invariably being tuned over a band of frequencies, and *dx* is an important factor.

In Fig. 1 is shown a simplified graph of avc action. Curve *A* shows the audio-response level for a receiver with no avc, Curve *B* is the response curve for a receiver with simple avc, such as in 5-tube a-c/d-c receivers, and curve *C* is an idealized response curve. Curve *C* indicates that the audio output of the receiver would increase uniformly with input for weak signals, with no avc action taking place until a predetermined signal input level had been reached. Any increase in input signal beyond this level would produce no appreciable increase in audio output.

Fig. 2 shows the simplest form of avc. Here, the signal voltage rectified by the diode detector develops a d-c voltage across the volume control. The amplitude of this voltage will be a function of the amplitude of the r-f signal applied to the detector. Since this voltage will vary at audio frequency, an additional filter consisting of R_1 and C_1 is used to level off or filter the recovered signal. This voltage is then applied as additional grid bias to the r-f and i-f tubes. Decoupling filters are used in these control grid feeds (R_2, R_3, C_2 and C_3) to prevent feedback. In addition, R_1 and C_1 serve to establish a time constant for the avc action.

The time constant is due to the fact that a capacitor shunted by a resistor takes a finite time to charge or discharge. Thus, by shunting a capacitor with a high value resistor and charging the capacitor with a voltage, the capacitor will take longer to discharge than when shunted by a low value one.

Since the capacitors in the avc system are charged by the rectified signal, and since this voltage is applied to the r-f and i-f control grids to reduce stage gain, it can be seen that the time constant should be slow enough so as not to be affected by audio variations in amplitude, yet fast enough to respond to variations induced by signal fading. The time constant used depends on the service for which the receiver is designed. In high-fidelity receivers, the time constant is kept slow, about ¼ to ½ second, so that the bass response is unaffected. If the time constant of the avc system were faster, the avc voltage might respond to low audio-frequency modulation of the rectified signal. Thus at peak low audio amplitudes the signal level at the detector would be reduced, and vice versa. This action would tend to remove low-frequency notes. However, in receivers designed for short-wave reception, the time constant is made faster, about 1/10 second or less, to instantly compensate for fading characteristics. (*Time constant* $= R$ [*in megohms*] $\times C$ [*in mfd*] *seconds*.) The formula for computing the time constant of an avc system becomes quite complicated due to the presence of the decoupling filters, but may be roughly estimated from the product of the original filter, such as R_1 and C_1 of Fig. 2.

Since it is sometimes desirable to prevent avc action until a signal of predetermined level is being received, the avc action may be delayed, Fig. 3. Here, a second diode is coupled to the detector diode with its cathode at a positive potential above ground. D_2 will not conduct until the incoming signal exceeds the value of cathode potential. Therefore, no avc will be applied to the r-f section until the signal at the detector is in excess of the delay diode-cathode voltage. Most delay systems operate on a similar principle, that is, a voltage applied to a cathode prevents rectification below a given voltage level.

Fig. 4 shows the circuit of an amplified form of avc. This type of circuit is used extensively in communications type receivers, and has several advantages over simpler forms of avc. First, it will be noted that the avc amplifier tube does not have avc controlling its amplification. Thus, it will respond to increased signal strength to a greater extent than would the diode detector. This action would tend to keep the signal output at a more constant level. In addition avc systems that are derived from detectors tend to load or shunt the audio circuit, producing distortion. The system in Fig. 4 does not affect the audio re-

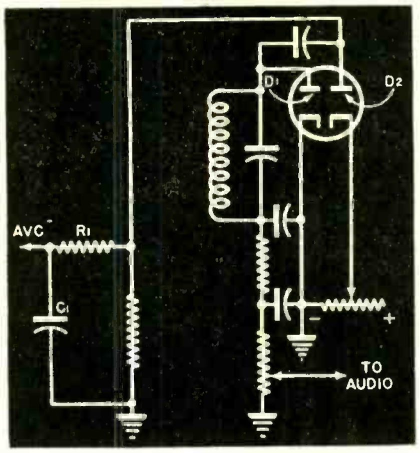


Fig. 3 (above). A simple form of delayed avc. The application of a d-c voltage to the cathode of the delay diode, D2, prevents rectification until the signal voltage exceeds the cathode voltage. All delay systems employ some version of this principle.

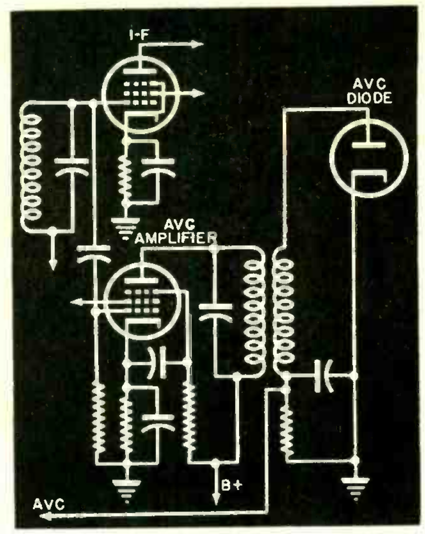


Fig. 4 (right). A generalized form of amplified avc. In effect, the avc amplifier and diode duplicate the i-f and detector system of the receiver, designed with special emphasis on avc action. Improved avc is provided by the cathode-type bias on the avc amplifier, and the untuned coupling transformer.

COMMUNICATIONS RECEIVERS

sponse at all. A third benefit is that the avc circuit is being fed from a fairly broad signal source point in the receiver, usually the first i-f stage input. This permits aural tuning of the receiver, since detuning of the signal causes a sharp drop in audio volume level. This sharp drop in audio level is due to the fact that while the signal is being detuned, the avc voltage tends to remain at a uniform level, since it is derived from a broadly tuned signal point. In ordinary avc systems, detuning of the receiver would cause a drop in avc voltage, which would tend to keep the signal at a constant level, even when detuned.

Hallicrafters SX-28

Amplified avc is sometimes used in conjunction with detector type avc systems to improve the uniform response characteristic of communications receivers. One such system is shown in Fig. 5, Hallicrafters SX 28. Here, the avc amplifier tube, a 6B8, is used to supply the avc voltage for the first and second r-f stages, and the first detector. At the same time, it is also used as an amplifier for the a-n-l system. The detector supplies the avc voltage for the first i-f stage. The second i-f stage operates at a fixed bias. The entire avc system represents several principles involved in avc design.

The signal is fed to the avc amplifier from the input to the first i-f stage, a broadly-tuned signal point. The secondary of the avc i-f transformer is untuned so as not to increase the selectivity of the voltage to be used for avc purposes. The control grid of the 6B8 avc amplifier is grounded through a .5-megohm resistor, with no avc applied, thereby increasing its efficiency as an avc amplifier. The two diodes of the rectifier portion of the 6B8 return to ground through the cathode resistor. Therefore, any voltage developed by the diodes across the avc feed resistors, due to contact potential, is more than overcome by the drop across the 6B8 cathode resistor. This voltage also represents a modified form of delayed avc voltage, since a slightly positive voltage is being applied to the grids of the r-f section until a signal strong enough to exceed this cathode voltage is received. It will also be noted that the avc voltage applied to the first de-

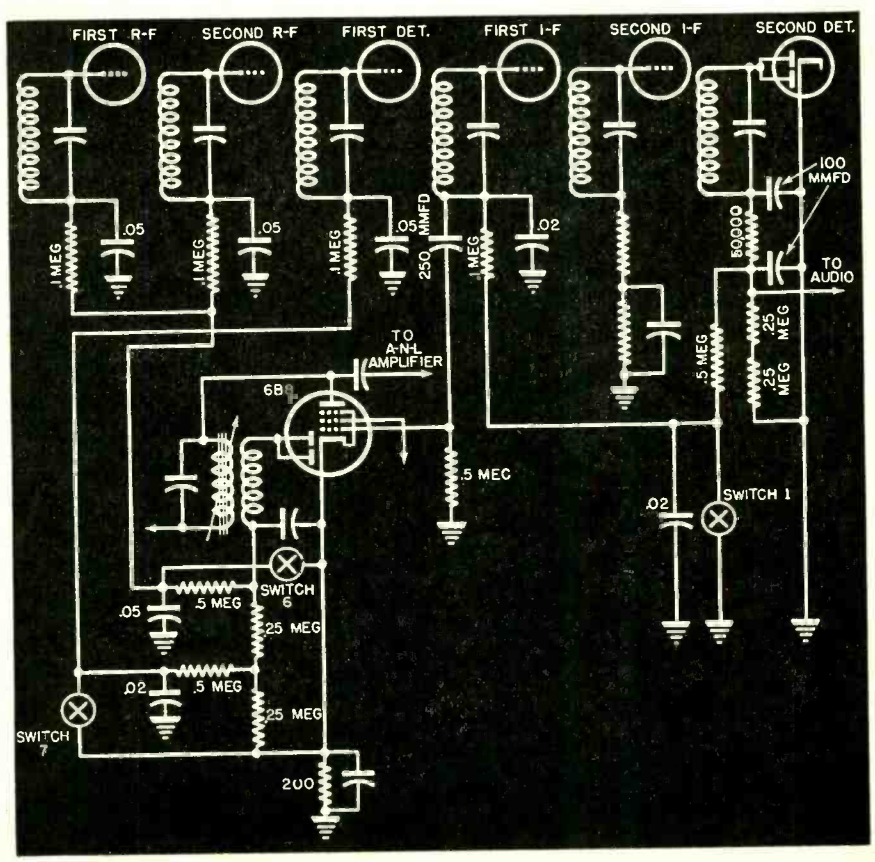


Fig. 5. Avc system of the Hallicrafters SX28. The 6B8 not only acts as an avc amplifier and detector, but also amplifies the r-f signal for the automatic noise limiter. The audio detector supplies avc voltage for the first i-f. The first detector is biased at a lower avc voltage to prevent cross-modulation.

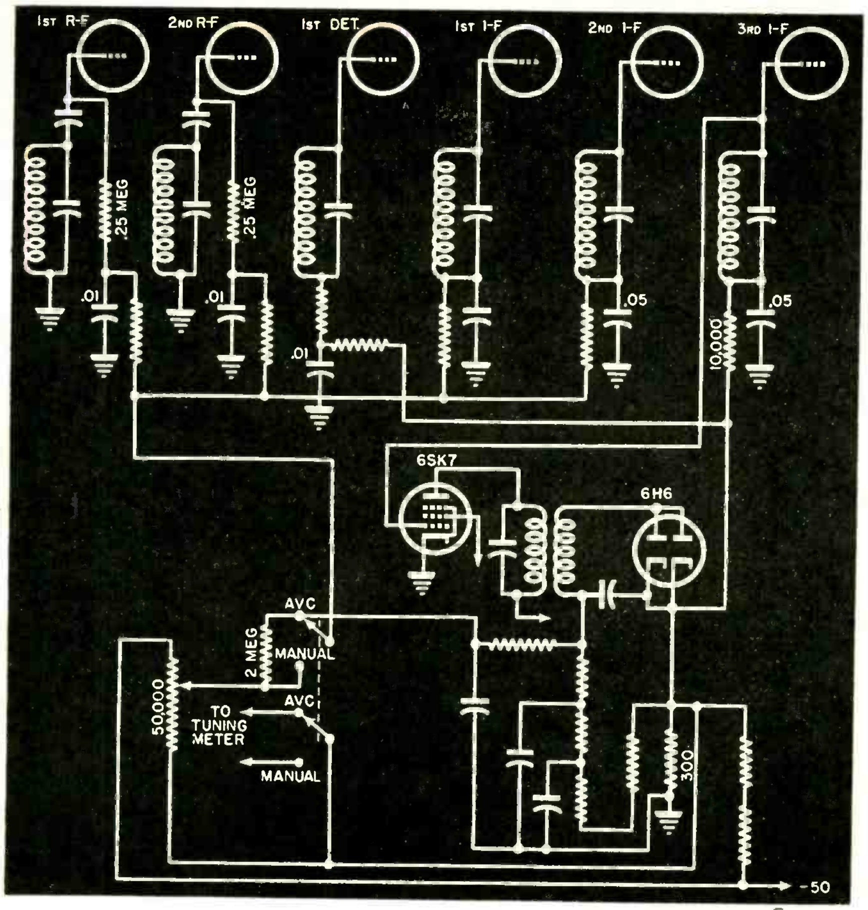
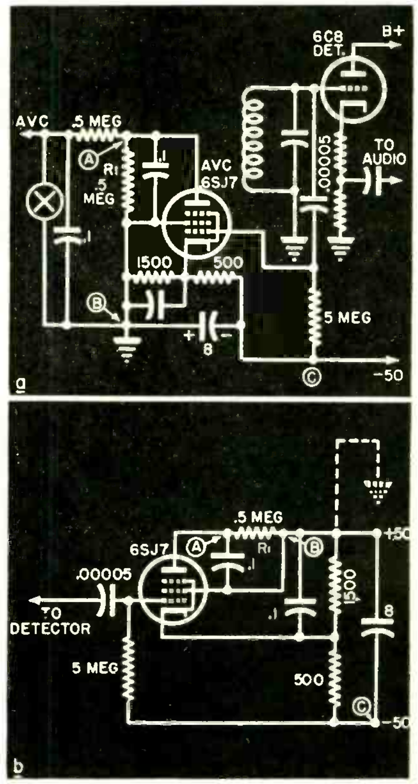


Fig. 6 (above). Avc system employed in the Hammarlund SP 200-X. Here, the avc amplifier and detector supply all r-f and i-f stages, with the exception of the first detector and third i-f. Since all cathodes are grounded, a 3-volt fixed bias is maintained on all tubes through the avc system.

Fig. 7 (below). In *a* is shown the avc system of the National NC 200. The avc voltage is developed between points *A* and *B*. Fig 7b shows the avc tube in relation to the voltages applied, to simplify the explanation of its action. This tube acts as a plate type detector to supply the avc voltage.



tector stage is lower than that to the r-f section. This is done to reduce the possibility of cross modulation or distortion arising in this stage. The three switches shown, *1, 6* and *7*, are used to cut out the avc action when it is not desired, or when the b-f-o is being used.

The detector circuit is used to supply the avc voltage to the first i-f stage. The second i-f has no avc applied to prevent modulation rise. Modulation rise is a form of distortion that is due to the curved amplifier characteristic of a tube. The use of a fixed bias on this stage prevents this distortion. In addition, the shunting effect of the avc system on the audio response is reduced by having few capacitors and resistors across the audio feed resistor. In this instance .02-mfd capacitors are used in the second detector avc system as opposed to .05-mfd capacitors in the amplified avc system. This has been done to further reduce the audio shunting effect of the avc system.

Hammarlund SP 200-X

Fig. 6 shows a similar system used in the Hammarlund SP 200-X. Here, again, an avc amplifier and rectifier is used to supply the avc voltage. In this receiver, the detector circuit is not used at all to supply any part of the avc voltage. The first detector and third i-f stages are at a fixed bias potential of about *3* volts, supplied by a bleeder system from the bias voltage rectifier in the power supply. In addition, the fixed bias voltage for the other r-f tubes is supplied through the same circuit, since the cathodes of all the r-f tubes are directly grounded. The cathode of the 6H6 diode is *3* volts negative with relation to ground, since the cathode resistor is a part of the bleeder system connected to the *–50* volt source. Since the diode plates return to cathode, and not to ground, the same voltage will appear in the avc system, and consequently on the r-f control grids.

AVC Manual Switch

An avc manual switch provides a method for cutting out the avc action, and controlling the receiver sensitivity manually through a 50,000-ohm bias voltage control. The r-f control grids are connected to the avc system through 250,000-ohm resistors, with blocking capacitors to the r-f coils. The other stages are connected conventionally through transformers.

National NC 200

Fig. *7* shows the avc system used in the National NC 200. This type of circuit is used in most National receivers. Since an infinite impedance type detector is used, avc voltage must be derived from some other source. Here, this is accomplished by employing a second type of detector in combination with the bias voltage supply. To simplify the explanation of the action of the avc tube, this portion of the circuit has been redrawn and is shown in Fig. *7b*.

The purpose of the avc tube is to establish a voltage between points *A* and *B* which will increase with signal input, and of such polarity that point *A* is negative with respect to point *B*. It will be noted that in Fig. *7a* point *B*, or ground, is positive with relation to point *C*, which is *B*–.

Studying Fig. *7b*, we see that the circuit is a plate-type detector. Here, the tube has been biased to cutoff. On the negative halves of the signal input cycle, nothing happens, since

(*Continued on page* 20)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AVC SYSTEMS

(*Continued from page 18*)

the grid bias only becomes more negative. On the positive halves, the negative grid voltage is cancelled, and the plate draws current, the amount of current depending on the degree of cancellation. This action creates a voltage across the plate dropping resistor, R_1, with point *A* negative in relation to point *B*. The greater the signal input, the more current the plate draws, and the higher will be the voltage drop. The receiver ground is shown in dotted form in Fig. 7b, to show the voltage relationships in the original circuit. The input signal voltage is developed between the control grid of the 6SJ7 and ground. However, the high value capacitances in the plate and screen grid circuits actually bring point *C* to r-f ground.

Servicing AVC Systems

Many receiver troubles arise in the avc system; fading and intermittent conditions to distortion. A fading receiver should first have its avc system checked. This can be done by shorting out the avc system to see if the trouble is coming from this portion of the receiver, Fig. 8. If C_1 were defective, instead of developing the stage voltage gain across the secondary of transformer, T_1, the gain would be divided between the transformer and R_1. This would result in a drop in stage gain. If R_1 were open, or increased greatly in value, the voltage on the control grid of the tube would depend to a great extent on the voltage charge on C_1. This would result in periodic variations in volume, depending on how fast the capacitor

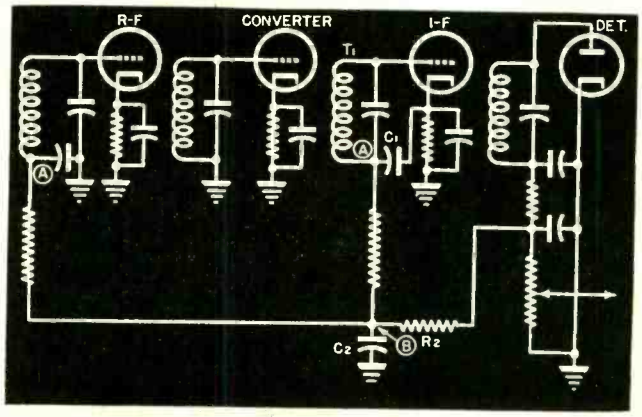

Fig. 8. A standard avc system, showing possible points of failure. To check whether avc system is causing trouble, points marked *A* should be grounded. A short to ground from point *B* will cause receiver to distort on strong signals.

discharged. The symptoms would be similar to that of an open grid.

In checking whether the avc system is at fault, it is necessary that all stages fed by the avc system be grounded, not at the source of avc voltage, but at point *A* in Fig. 8. This precaution is necessary, since the trouble point may be C_1 or R_1, both of which remain in the circuit if the avc system is grounded at point *B*.

If R_2 were to open, or if either R_2 or C_2 were to be intermittent, the set would react similarly. The trouble may not be in the parts themselves, but in soldered connections at these points. This condition has been found in several receivers. Again, in those receivers employing an avc tube, fading was traced to the tube.

Distortion in the receiver may sometimes be traced to a grounded avc system, or some portion of it. The distortion arises from the fact that the signal applied to the control grid is greater than the bias. Where no avc action is present, this stage will rectify, or draw grid current when the signal exceeds the bias, thereby distorting the signal. In one receiver, the audio volume control could only be advanced slightly, and the receiver would blast out at full volume. The trouble was traced to a partial ground after the avc *RC* filter. The voltage developed across the volume control was so high, that only a slight advance of the control was necessary to derive the full driving voltage for the first audio stage.

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TELEVISION

(*Continued from page 9*)

stitutes satisfactory reception from the public's point of view, and also what reception is like in the area. The distribution of a printed or typed card of local television station hours will help keep the Service Man's name near the television receiver. It is also suggested that a record be made of all television set owners for future reference.

Too much stress cannot be placed on the dangers involved in television servicing. Some of the new receivers contemplate voltages ranging to 30,000. In addition, the dangers attendant in breaking the CR tube, with its accompanying hazard of flying glass introduce new problems in service.

The Service Man should become thoroughly acquainted with the television field and its problems before he attempts to establish a television service. But such a service, carefully planned with a sound background of information will pay real dividends.

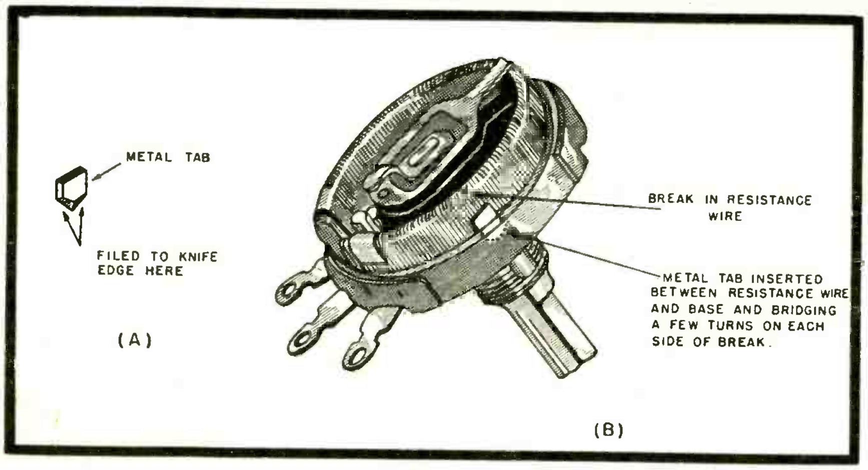

Fig. 1. How a small metal tab may be inserted to bridge *open* wire in a wire-wound control. At *A* appears a view of the tab, that can be cut from old tube shields. The lower edge must be cut to a pointed shape and filed almost to a smooth knife edge.

VOLUME AND TONE CONTROL RESISTORS

REPAIRING, RECONDITIONING AND CIRCUIT SUBSTITUTIONS

[Part Eleven of a Series]

by ALFRED A. GHIRARDI

Advisory Editor

MODERN good-quality volume and tone controls are remarkably inexpensive, compact, smooth in mechanical operation and free of noise, when new. Extensive design and manufacturing experience, and efficient production methods employed by the leading manufacturers of such controls are largely responsible for this. However, after the many thousands of operation cycles they receive in a radio receiver that undergoes several years of continual use, volume and tone controls become subject to various troubles[1]—principally that of *noisy* operation.

Repair Versus Replacement

There is no doubt but that the best service policy is to *replace* a faulty volume or tone control with a suitable replacement unit whenever this is possible. A repaired unit seldom continues to give as long or satisfactory service as a new one.

However, as every Service Man knows, it often is not convenient or possible to quickly obtain a replacement control that matches the original unit in resistance value, taper, physical dimensions, etc. This is particularly true when a *special* unit is encountered. In such cases, it is necessary to: (*1*) Repair the faulty control as well as possible to obtain further use from it; and (*2*) make an *almost-as-good* substitution. This situation was quite prevalent during the war when volume and tone controls were scarce. However, even though they now are more plentiful and the policy of exact replacement should be adopted whenever possible, the Service Man should know how to repair and recondition a volume or tone control whenever it is necessary, for he still will encounter many instances where a suitable new replacement control is not readily obtainable.

Many Repair Methods

The methods of repair that are suggested in this installment are those generally used by Service Men for the majority of types of controls. However, they are by no means the only methods that can be employed! Experienced Service Men seem to develop an amazing amount of ingenuity and resourcefulness when they are confronted with the necessary repair of volume and tone controls, and many perfectly satisfactory *pet* repair meth-

(*Continued on page* 24)

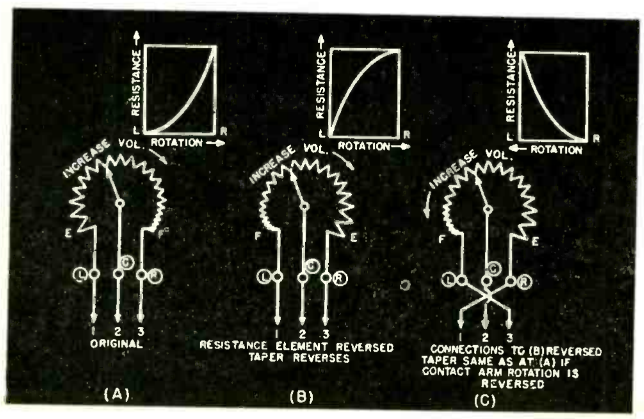

Fig. 2. What happens to a volume control having unsymmetrical taper when position of resistance element is reversed.

[1]Part 10, December 1945, SERVICE.

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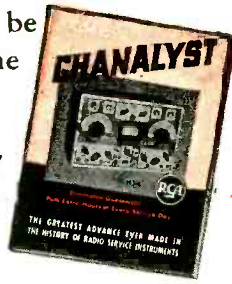

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VOLUME AND TONE CONTROLS

(*Continued from page 22*)

ods in addition to those outlined here are in use.

Repairing and Reconditioning Wire-Wound Controls

1. Open: (*a*)—Wire-wound controls which become open due to a break in the resistance wire often may be repaired quickly and effectively by cutting a small metal tab which is then wedged in between the fine-wire element and the phenolic-molded base, as illustrated at (*B*) of Fig. 1, thus bridging the broken turns. The metal strip should be as thin as possible, tinned and clean, and should be cut wide enough to bridge only several turns on either side of the break. Tabs cut from tube shields are excellent for this purpose. They may be inserted easily and without tearing the fine resistance wire, if the lower edge is first cut to a pointed shape as shown at (*A*) of Fig. 1, and filed almost to a smooth knife edge with a fine-toothed file.

(*b*)—If the break has been caused by wearing away of the wire where the contact arm slides along it, the foregoing repair procedure is not recommended, since the fact that the wire has worn through at one point indicates the likelihood that the whole resistance element is badly worn and susceptible to subsequent break-through at other points.

In such cases, it is preferable (when possible) to remove the resistance element from the groove in the phenolic base and turn it upside down so the worn surface rests in the supporting groove and the contact arm slides along the new, unworn surface made available. This new surface should be cleaned with very fine sandpaper until it is smooth and bright. It should also be lubricated with one of the special contact lubricants (see Fig. 3) made for such controls. The break in the winding can be repaired (before inserting the element in the groove) by unwinding one turn to provide the necessary wire and twisting the broken ends together, soldering the joint if possible. The resistance element usually will have to be wedged or cemented back into place in the groove.

If the control employs an unsymmetrical resistance taper, this method of repair cannot be employed. Study of the three illustrations in Fig. 2 will reveal the reasons. When the resistance element shown at (*A*), which has the left-hand resistance taper characteristic indicated in the insert at the upper right, is turned upside down, its two ends E and F and the tapered portion of its winding reverse in position, as shown at (B). Hence its taper also reverses as indicated at the upper right of (B), which of course is undesirable. Reversing the connections to the left and right-hand terminals of the control to obtain the correct taper again does not solve the problem, for if this is done, as shown at (C), the shaft will have to be turned counter-clockwise for *increased* volume and vice versa. Such *reversed* manipulation of the control is confusing and undesirable.

2. *Noisy or Erratic Operation:* (*a*)—Noisy, erratic operation is sometimes caused by loose terminals on the control. The rivets on these may be tightened, or they may be re-riveted.

(*b*)—If the resistance element has loosened in the groove, causing it to make erratic contact with the contact arm, it may be cemented back in place or, in some constructions, paper shims may be inserted between the element and the phenolic base to make it fit tightly in place again.

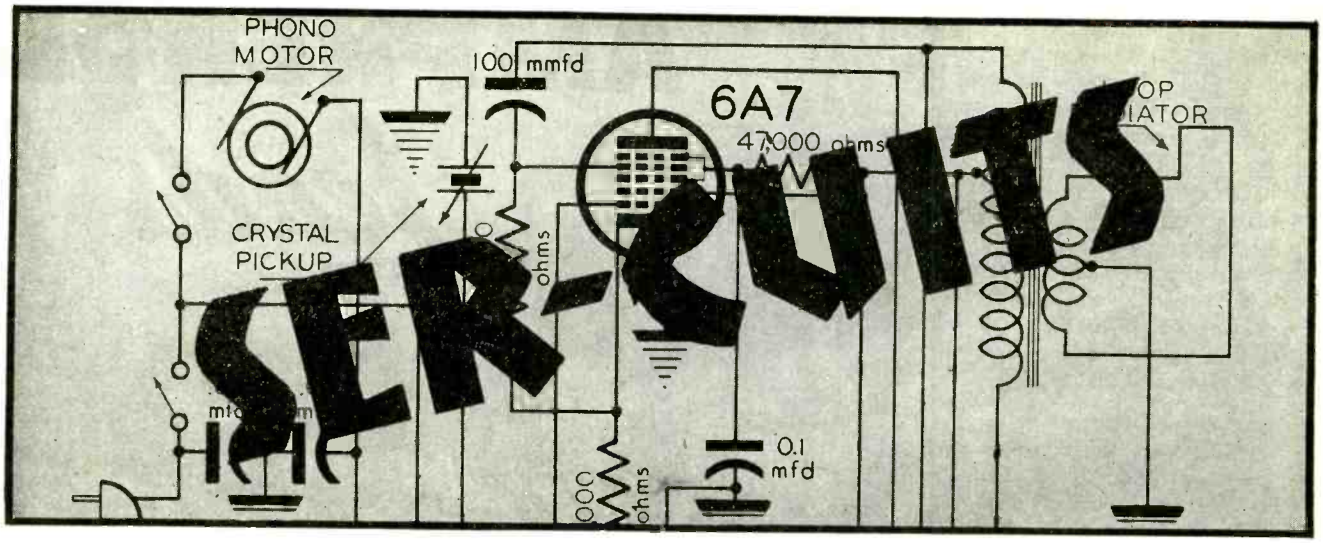
(*c*)—Wire-wound volume controls often become very noisy long before they are actually worn out. This may be caused by any one or more of several conditions. A non-conducting glazing of oxidized lubricant and particles of worn-away metal may form on the contacted surface of the resistance element, the contact surface of the arm, or the slip ring and wiper arrangement which makes electrical contact to the shaft or contact arm. This coating causes imperfect contact, and results in noises in the output of the receiver. The obvious remedy is careful removal of the offending substance, plus replacement of the lubricant. Several methods are in vogue for accomplishing this.

Carbon-element, as well as wire-wound controls, often may be quieted (usually only temporarily) by merely rotating the shaft back and forth repeatedly while the entire unit is immersed in a grease solvent such as carbon tetrachloride (Carbona), Ener-

(*Continued on page* 28)

Fig. 3. Applying *Lube-Rex* lubricant to the cleaned rubbing surface of a noisy wire-wound volume control.

(*Courtesy General Cement*)



by **HENRY HOWARD**

POSTWAR models, just released by Stewart-Warner, reveal many novel circuit developments, particularly in the antenna system. In these models all loops are balanced to ground, with the center at ground potential. Instead of being directly tied to the first grid the loops are coupled to the grid through an iron-core coupling transformer. Thus the loops have a lower impedance than a direct-coupled loop which, with the balanced feature, minimizes capacity coupling with its attendant noise pickup. Another advantage is that the loop may be placed further away from the chassis without the loading effects of long leads. Because of the lower capacity from input grid to ground, the loop will peak at a higher frequency and maintain a better *Q* through the band. These advantages are obtained only when the coupling transformer has a high coupling coefficient at all frequencies and is otherwise well designed and constructed.

Oddly enough there is a disadvantage to a well-balanced, well-engineered loop system in broadcast receivers. This is the improvement in directional characteristics. While of extreme importance to radio compasses and direction finders, this directional effect may prove annoying to some because the set (or the loop) has to be frequently rotated to avoid a directional minimum when tuning from station to station.

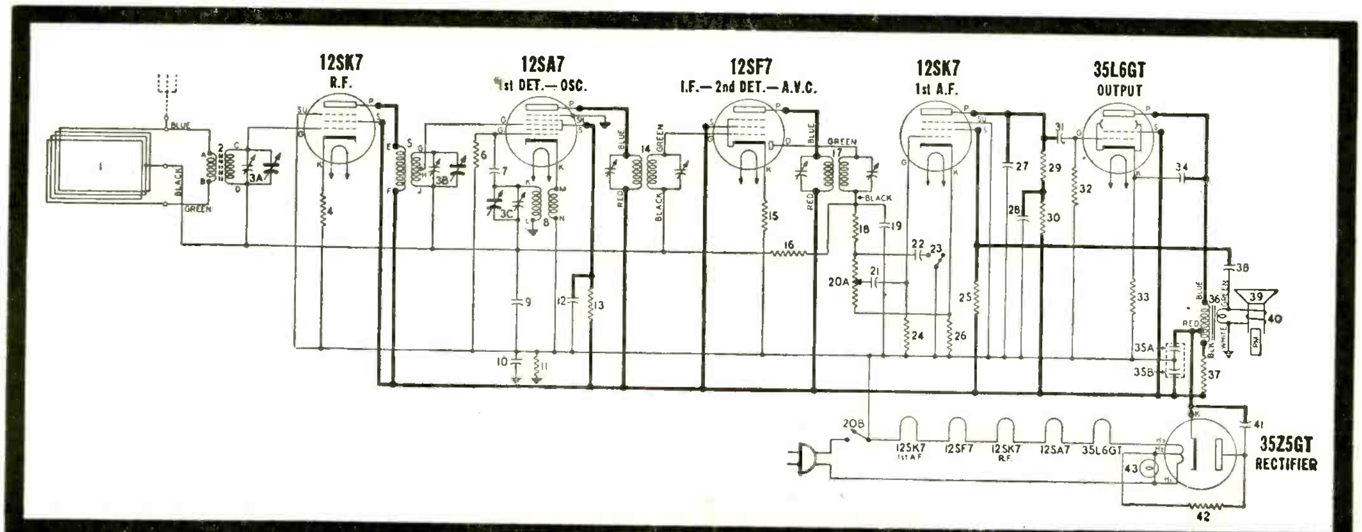
	CONDENSERS
3A-3B-3C	Condenser—variable gang (with drum)
7	Condenser—mica—50 Mmfd. 500 Volt
9	Condenser—.1 Mfd. 200 Volt
10	Condenser—.2 Mfd. 200 Volt
12	Condenser—.25 Mfd. 200 Volt
19	Condenser—mica—110 Mmfd. 500 Volt
21	Condenser—.002 Mfd. 400 Volt
22	Condenser—.0008 Mfd. 400 Volt
27	Condenser—Mica—110 Mmfd. 500 Volt
28	Condenser—.05 Mfd. 200 Volt
31	Condenser—.004 Mfd. 400 Volt
34	Condenser—.01 Mfd. 400 Volt
35A-35B	Condenser — electrolytic A-40 Mfd. 150 Volt B-20 Mfd. 150 Volt
38	Condenser—.02 Mfd. 400 Volt
41	Condenser—.05 Mfd. 400 Volt
	RESISTORS
4	Resistor—carbon 390 Ohms ¼ Watt
6	Resistor—carbon 22,000 Ohms ¼ Watt
11	Resistor—carbon 220,000 Ohms ¼ Watt
13	Resistor—carbon 4700 Ohms, ¼ Watt
15	Resistor—carbon 47 Ohms ¼ Watt
16	Resistor—carbon 3.3 Meg. ¼ Watt
18	Resistor—carbon 47,000 Ohms ¼ Watt
20A-20B	Volume control 500,000 Ohms (with switch)
24	Resistor—carbon 10 Meg. ¼ Watt
25	Resistor—carbon 2.2 Meg. ¼ Watt
26	Resistor—carbon 2200 Ohms ¼ Watt
29-30	Resistor—carbon 220,000 Ohms ¼ Watt
32	Resistor—carbon 470,000 Ohms ¼ Watt
33	Resistor—carbon 130 Ohms ¼ Watt
37	Resistor—carbon 1500 Ohms 1 Watt
42	Resistor—carbon 33 Ohms ½ Watt

Fig. 1. Stewart-Warner 5-tube and rectifier a-c/d-c single-band receiver, model 9002-A, B, P and R. Sharper tuning is provided by tapping the secondary of the transformer that couples the r-f amplifier and the 12SA7 converter. Parts list above.

Another interesting feature of the postwar Stewart-Warner sets is a tuned r-f amplifier. It serves to eliminate many types of interference, including code signals from commercial stations, crosstalk from strong local stations and a multitude of squeals and squeaks from harmonic combinations. The gain in the broadcast band is of the order of 10 to 20, not to be compared with an i-f stage, but substantial.

Instead of the popular dual diode-triode, detector-avc-first audio tube of the 6SQ7 family, these receivers use the 6SF7-12SF7 diode-super-control pentode amplifier type for the i-f amplifier and detector-avc, and a 6SK7-12SK7 for the first audio stage. The pentode audio amplifier permits the use of a novel method of screen grid inversed feedback from the voice coil to the 'SK7 screen. The lower end of

(*Continued on page* 30)



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In Outlook

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THE HALLICRAFTERS CO., MANUFACTURERS OF RADIO AND ELECTRONIC EQUIPMENT, CHICAGO 16, U. S. A.

VOLUME AND TONE CONTROLS

(*Continued from page* 25)

gine, or white (non-leaded) gasoline. Another method, often used for temporary relief, is to use an eye-dropper to force some carbon tetrachloride into the control at the terminal lugs and where the shaft enters the mounting bushing. These procedures are not recommended for permanent relief from the trouble, since they do not allow for thorough cleaning, or for replacement of the lubricant on the rubbing surfaces.

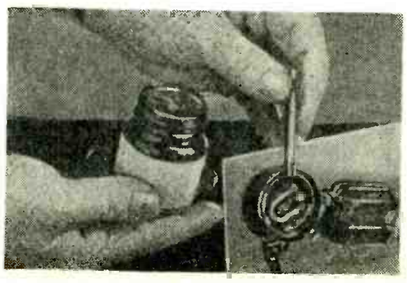
The only really satisfactory method of quieting noisy wire-wound controls entails removal of the attachable switch or dust cover from the back so as to make the vital parts of the control accessible and permit visual inspection of the surfaces of the resistance element, contact, etc. If the condition of the control is really bad, the split retainer washer pressed into the groove in the shaft should next be removed by clamping the shaft in a vise, leaving just enough of it exposed to work on the washer. The washer should then be removed and the contact arm and shaft pushed out through the mounting bushing.

The rubbing contact surfaces on the resistance element, contact arm, wiper and slip ring, etc., should now be inspected. One method of cleaning consists of immersing the disassembled parts in a grease solvent (carbon tet., white gasoline, Energine, etc.) and brushing the rubbing surfaces thoroughly with a 1/2-inch soft paint brush. Then allow to dry. The rubbing surfaces should then be carefully polished with an ordinary pencil eraser (never use sandpaper) until they are brightly polished without scarring. All traces of the eraser dust must then be brushed away. It is advisable at this point to increase the tension of the various springs by a little careful bending. These should not be bent too far, or excessive pressures and wear will result.

Next, a suitable lubricant should be

Fig. 4. Applying *Grafoline*, a combination cleaner and lubricant, to a noisy wire-wound control.

(*Courtesy General Cement*)



applied sparingly to these rubbing surfaces by means of an ordinary match stick, finally wiping over the contact surfaces with clean fingers. White (uncarbolated) vaseline, or Russian mineral oil is satisfactory. So is *Lube-Rex*,* a lubricant that can be used on volume and tone controls, push-button and all-wave switch contacts, the Philco mystery control, etc., Fig. 3. Oil or graphite grease should never be used, since the first cannot be depended upon to remain where it belongs and the second contains a conducting substance.

Some Service Men prefer to use a combination cleaner and lubricant in one, such as *Grafoline*,* on wire-wound controls. Fig. 4 illustrates how this may be applied. This cleaner-lubricant may also be used for the contacts of push-button and all-wave switches, tube prongs, etc., or any application where good contact and lubrication must go hand in hand.

Another excellent combination cleaning and lubricating solution can be made by dissolving one-half level teaspoonful of white (uncarbolated) vaseline in two ounces of carbon tetrachloride (both are obtainable at any drug store). They should be thoroughly mixed and allowed to stand overnight. The solution may be applied as above, finally wiping over the contact surfaces with clean fingers.

The control should then be reassembled and the split washer pushed into place on the shaft and squeezed shut with a pair of pliers.

In most cases, an astonishing improvement in noisy wire-wound controls results from such simple cleaning and lubricating. The contacts on noisy *switch-type* tone controls may be cleaned and lubricated in the same way.

*General Cement Mfg. Co.

[*To be concluded in February*]

Fig. 5. Touching up with *Carbon-X*. Liquid is used on worn and noisy spots on the resistance elements of carbon volume or tone controls. (*Courtesy General Cement*)

SER-CUITS

(*Continued from page 26*)

the voice coil is grounded and the high end is connected to the screen through a blocking capacitor and across a resistor-straight resistance coupling. The constants differ in the various models but the circuits are the same.

Stewart Warner 9002-A, B, P, R

In Fig. 1 appears a 5-tube and rectifier a-c/d-c single-band model, 9002-A, B, P, R, with the external antenna directly connected to the loop. The coupling transformer between the r-f amplifier and 12SA7 converter has a secondary tap for the signal grid for sharper tuning. A cathode tickler type oscillator is used. All tuning capacitors as well as transformers and loop center tap are returned to the avc bus instead of *B–* or ground. The *B–* is grounded through a .2-mfd capacitor and 220,000 ohms in parallel.

As previously mentioned, the 12SF7 i-f amplifier contains the single diode used for detector and avc. A 47-ohm resistor from cathode to *B–* provides a bit of bias. The detection capacitor of 110 mmfd returns to *B–*, while the detector load resistance composed of 47,000 ohms and a ½-megohm volume control returns to the first audio cathode and then to *B–* through a 2,200-ohm bias resistor. The audio pick-off is through a .002-mfd capacitor to grid and a 10-megohm grid leak. Since the signal voltage is supplied between grid and cathode directly, no bypass capacitor is required across the cathode bias resistor, there being no common coupling between grid and plate return circuits.

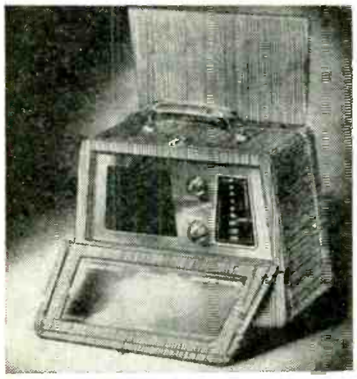
A hum and decoupling filter of 220,000 ohms and .05 mfd is used for the 12SK7 first audio plate. A 2.2-megohm screen supply resistor serves also as a coupling resistor for the degenerative feedback loop from the output transformer through a .02-mfd blocking capacitor and screen bypass.

Power Amplifier

A 35L6 power amplifier has a 130-ohm unbypassed resistor for bias, a .01-mfd output capacitor and p-m speaker load. The output transformer primary is tapped for hum bucking. This permits the 35L6 plate to be supplied directly from the 35Z5 rectifier. Hum, or filter ripple, is attenuated in the same manner as in a push-pull amplifier where the primary is tapped so that ripple currents travel in opposing directions through the winding, causing their cancellation. Here, the output tube load is balanced against the total drain of all plates and screens (except the 35L6 plate) through a 1,500-ohm filter and audio load resistor. A 33-ohm anti-surge resistor and .05-mfd r-f bypass are associated with the 35Z5 power rectifier.

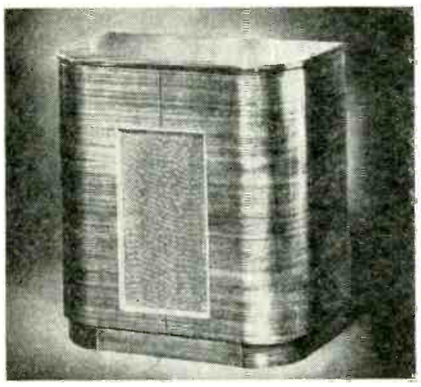
(*Continued on page 46*)

POSTWAR RECEIVERS

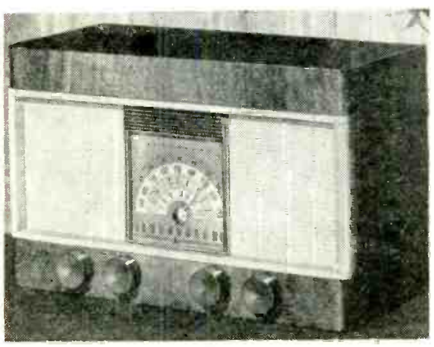


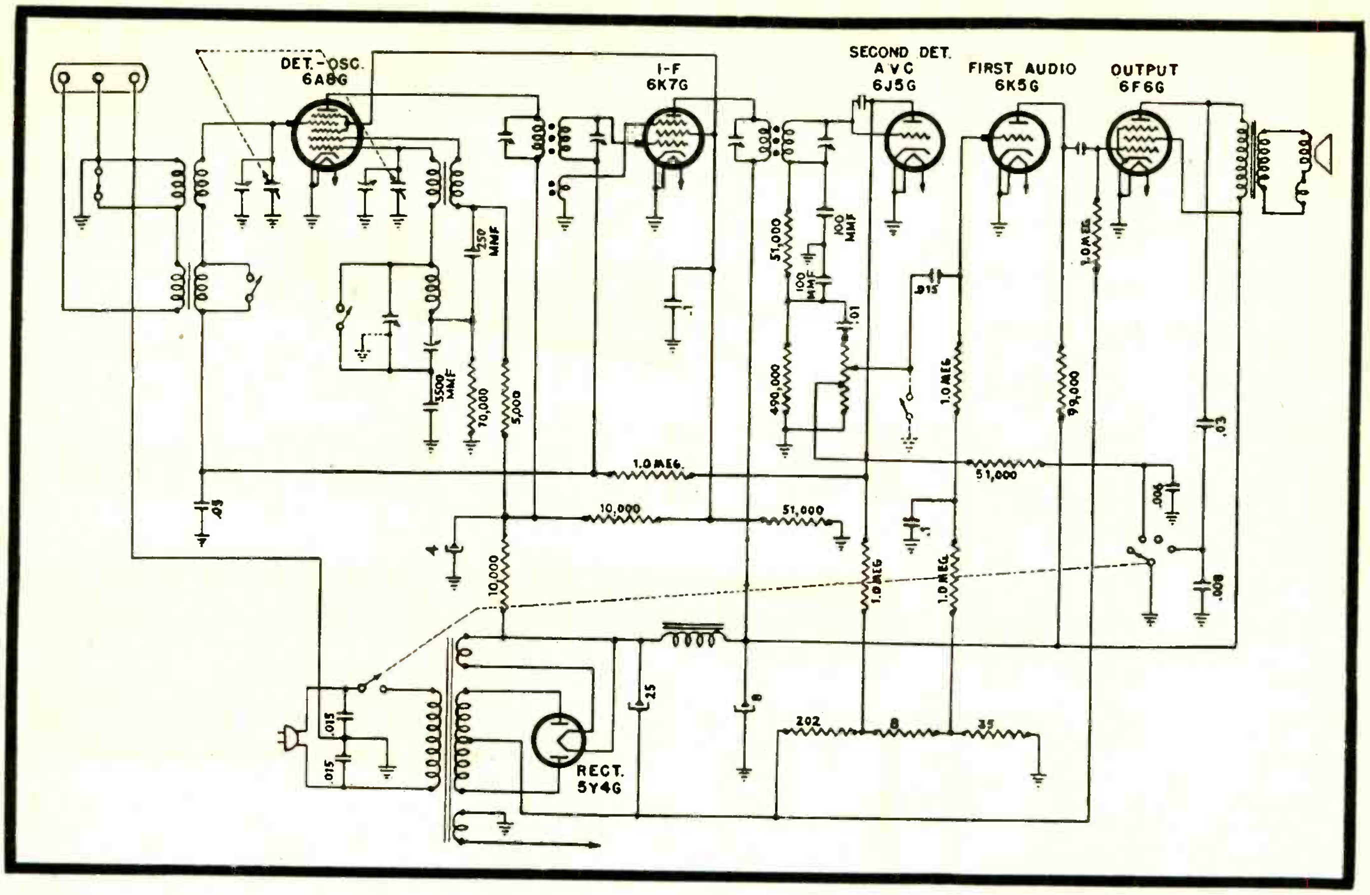
Above, Farnsworth portable loop type, single-band receiver, type EP-351. Below, Farnsworth table model television receiver.

Below, Farnsworth 6-tube automatic record changer console, type EX-263.



Below, Echophone 5-tube, 3-band a-c/d-c table model, type EC-103.





ANALYZING

by WILLARD MOODY

THE average Service Man isn't too keen about servicing receivers that have intermittent troubles. Often such sets are extremely difficult to service. The word *intermittent* means, literally . . . *alternating, recurrent, coming* and *going at intervals*. That just about describes an intermittent receiver.

There are a number of causes of intermittent operation. One of the most common is a defective paper capacitor or, as in some Philco sets, a defective bakelite housed type of capacitor. The capacitor may open up in a grid circuit or develop a short circuit in a screen grid or plate return circuit after the receiver has warmed up.

Tubes often cause intermittent operation. The set may cut on and off and be restored to normal by flipping a light switch or tapping the tube, producing either a mechanical disturbance, an electrical disturbance, or both types of disturbances.

Vibrators in auto and farm radios may develop defects that cause intermittent functioning.

Other causes are: Faulty electrolytic capacitors, poorly soldered joints, defective pushbutton tuning and bandswitch contacts, faulty trimmer and padder capacitors, defective volume controls, intermittently shorting tuning capacitors, carbon resistors, candohm and wire-wound voltage dividers, line cords, plugs, i-f and r-f transformers, oscillator coils, antenna and ground connections, loop antennas, voice coils and leads, audio transformers and chokes, and tube sockets.

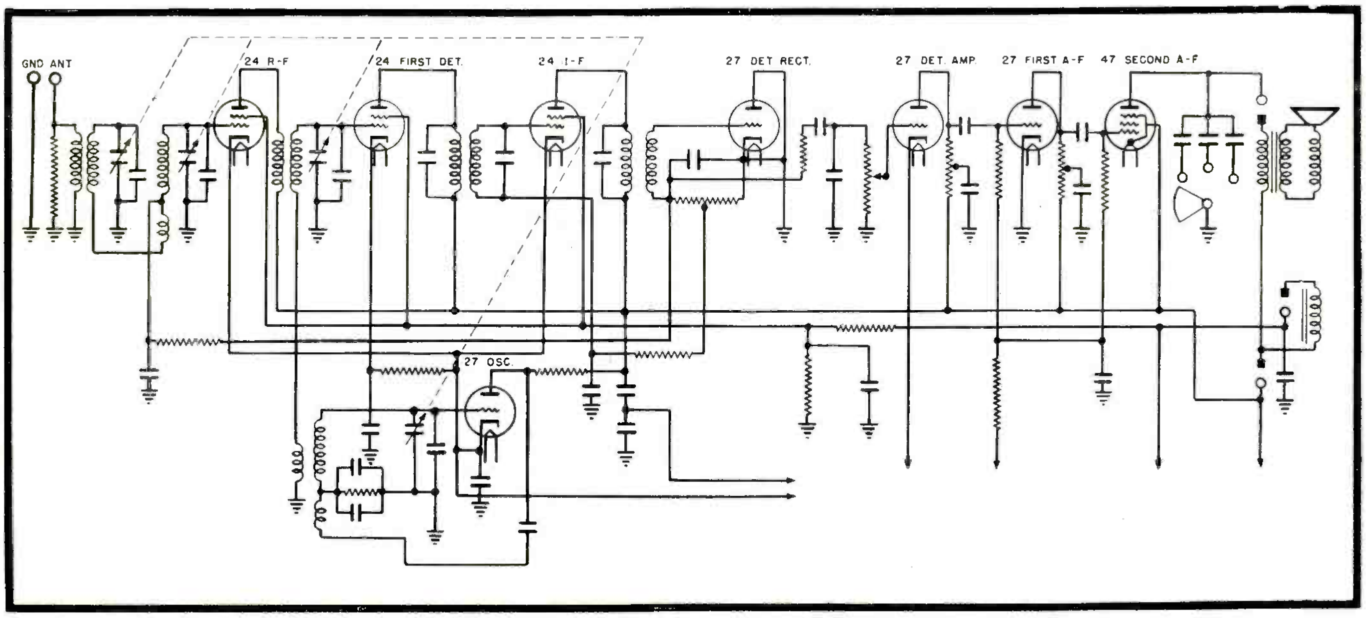
The intermittent operation of the receiver may be observed coincidently with some other trouble such as a hum, distortion, noise, loss of sensitivity, oscillation, or failure of an oscillator. These accompanying symptoms may be clues to the trouble.

If the set cuts off suddenly and a hum is heard, the filters may be suspected. If, in an a-c/d-c set the pilot lamp flickers when the hum develops, the trouble may be a *hot* cathode to heater leak in one of the tubes, often the rectifier or power tube. In some cases the hum may be caused by a sudden change in the grid circuit resistance of a tube. In Fig. 1, if the grid-circuit resistance of the 6K5G changed to a much higher value or the volume control resistance increased, the effect of any stray hum entering the grid circuit would become far more pronounced than usual and there might, in addition, be considerable distortion observed.

Distortion suddenly developing in the set, accompanied by a loss of volume, might be due to leakage in the .015-mfd coupling capacitor or a gassy output tube. The tube might require ten or fifteen minutes to warm up sufficiently to produce the choked effect in the output.

If a d-c voltage is measured across the 1-megohm in this coupling circuit with the .015-mfd capacitor out of the circuit, the output tube should be replaced and the results observed. If the reading is obtained only with the capacitor in the circuit, the capacitor itself probably is defective and a replacement should be tried.

Sudden cutting-off, accompanied by a hissing sound or higher than normal noise level, might be due to an open 6A8G mixer grid or 6A8G oscillator grid circuit. The ends of the wires which lead to the stator connections of the tuning capacitor may require, in such cases, resoldering. If the wires, when wiggled, cause the set to cut on and off, the flexible, stranded wires themselves may be in need of replacement. In making a test, an effort



Figs. 1 (left) and 3 (above). Fig. 1. Circuit of the Philco 38-7. This diagram is used to illustrate the possible sources of intermittent operation. Three such sources are padder capacitors, particularly mica types, defective wiring or cold solder joints, or a loose voice-coil connection. The use of a signal tracer facilitates the localization of the particular circuit responsible. Fig. 3. Philco model 90. In this receiver, breakdown of the bypass capacitors causes a high-pitched squeal, and intermittent reception. The defective capacitor may be found by bridging the suspected capacitor with a .25-mfd. capacitor and noting if the receiver returns to normal.

INTERMITTENTS

should be directed to move only one part or element of the set at a time, since excessive vibration or jarring may extend throughout the set and make it difficult to locate the real cause of the intermittent operation.

If wriggling the bandswitch causes noise and intermittent operation, the contacts of the switch should be cleaned with carbon tetrachloride or an equivalent solvent. The soldered joints on the switch should be *gone over* with a hot soldering iron. Noise and cutting on and off at the low-frequency end of the dial, while the high frequency end is all right, indicates that rubbing and shorting tuning capacitor plates are causing the low-frequency trouble. Should the set cut on and off as the volume control is adjusted, it's likely the control itself is defective and in need of replacement.

In some sets of this kind, where a sharp break in reception occurs, the wires leading from the loudspeaker to the rectifier and output tube circuits may not be securely soldered, and the make and break of the end of a wire or wires will cause intermittent operation that shows up when the speaker cable or wiring is *wiggled* by hand. In some cases the wires themselves are defective, due to rotted insulation causing short circuits between the wires or between the wires and chassis.

A loose connection anywhere in the set may cause noise as well as intermittent reception. The trimmers in the antenna and oscillator circuits or the padder in the Philco 38-7, Fig. 1, could cause such trouble. A loose voice-coil connection could be responsible and some peculiar intermittents have been traced to such sources. Many such faults may be located by carefully inspecting the wiring and chassis, using a small penlight or flashlight which augments the regular shop lighting or

(*Continued on page* 39)

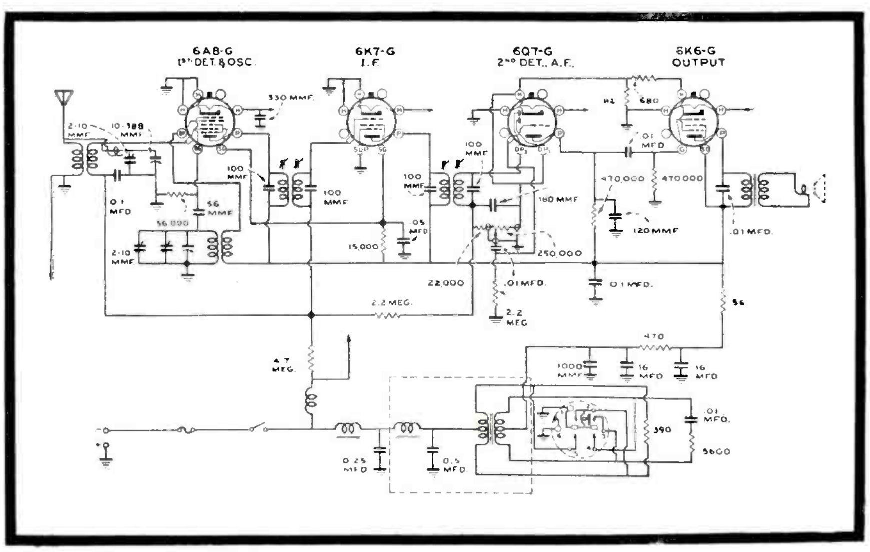


Fig. 2. RCA auto receiver, model 94 BT6. Most intermittents in auto receivers can be traced to the vibrator and power supply system. Two frequent offenders are the 1000-mmfd and the .01-mfd capacitors in the vibrator circuit.

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OLD TIMER'S CORNER

by SERVICER

SEEMS as if many feel that luck plays an important role in business. Well it may help, but hard work and sound business judgment is quite helpful too. A visit to Jerry's Radio Shoppe the other evening certainly proved this point.

I had been dropping into Jerry's store now and then to talk, but never questioned too much. On this particular evening I found Jerry in back of his well-stocked store hard at work putting some very nice-looking housekeeper's marketing pads into some very attractive envelopes. The pads consisted of about a hundred single sheets of printed lists with spaces for the woman of the house to check off what she needed to buy from the grocer and butcher. The pad was backed with stiff cardboard, and a hole for mounting the list was punched in the back.

Jerry was also putting a thumb-tack for the pad into the envelopes. At the top of the list and again on the envelope was Jerry's name and store address, together with a statement that when the radio went out *"Call Jerry"* and he would fix it.

I asked Jerry what was the big idea. Was he going into a big publicity stunt? How was he going to distribute them? What, besides the advertisement, was the purpose?

"It's this way," said Jerry. "I got the idea from my wife who used to get one of these from her grocery store. He got them from a breakfast food manufacturer. But somehow in the rush of war, the manufacturer did not come through, and so they stopped coming. I looked over her old one, or rather what was left of it, and decided that here was a fine medium with which to sell my service.

"So she and I got together and made up our own list. I put our advertisement on the front and then she suggested that I include a thumb tack so that the housewife would only have to put the pad up, and not search for any means with which to do it."

"In the first place," continued Jerry, "the housewife has the list in front of her every day. She picks out what she has to buy. On the list I inserted the reminders. . .*'Call Jerry to fix the radio set'* and *'Call Jerry to fix the iron, washing machine, lamp, etc.'*, and I included our phone number.

"I distribute these myself. Here's how I do it. I take a minimum of 6 hours a week to call on the housewives, which amounts to about an hour a day. Sometimes I call in the evening, sometimes in the morning. It all depends on how the work goes in the shop. I ring door bells.

"Of course a lot of women won't talk to me at all. They are busy and don't want to be disturbed. For those, who let me in or who talk to me, I have a brief message.

"After the woman answers the doorbell, I tell her who I am—actually the proprietor. Then I reveal that I have a marketing list for her which I will give her absolutely free of charge if she will answer a few questions for me. When she asks me 'Why the questions?' I tell her truthfully that I am making a survey so that I will know what to stock in my store.

"If she agrees to answer the questions, I ask her very few, marking the answers down on a pad I carry for the purpose. I ask: Name, and the name of her husband (or head of the household); number of persons in the family; is there a radio set in the house, or more than one; brand names; approximate date when the receivers were bought; electrical appliances about the house; approximately when were they acquired; and last, would she be interested in seeing any new radios or appliances when they are available?

"Just before I leave, I ask if the radio is working properly and if the appliances are all right. If they aren't I make a note of it and tell her that if she wants me to repair them, I'll return during business hours the next day. If she refuses to have me make the repairs, I still smile and say *'Thank you'*. Then I give her the marketing list and leave.

"When I get back to the office, I make up a list of the homes I called on. As a result, I have compiled very useful data. I know what radios are around, which ones are out of order and which ones the owners will have replaced or repaired. I also know a lot about the families. All this is valuable material for future sales campaigns.

"For instance, I have a list of all the larger families who do not own washing machines. They are logical prospects. If there are only two in the family, say man and wife, they usually send their laundry out. These are poor prospects. They are not very good prospects for a new radio since they are not home a lot. But with large families, there is ample opportunity to sell one or more radio sets as well as appliances. Since I know which homes are without working radios and appliances, I can tell where I can hope to do business. I also know where my competitors are too firmly entrenched to be displaced, for in those places I have been told that I cannot make any repairs or replacements.

"Meanwhile I have made valuable contacts. In many homes, I find that if you call at the door and offer to repair the radio set, there is some fear and doubt as to your identity. To offset that, I always use the company's truck or have business cards with me. I offer to have the housewife call the local bank or police station to verify that I am as represented. I also carry a flock of identification cards. If that does not satisfy, I tell the housewife to call the shop, looking up the number in the phone book. Then I either come out the next day or send out my helper.

"And believe it or not, I have not only made the price of printing the lists many times over, but I have been getting an ever increasing share of the radio service and new business in this town."

That's why I have come to know that Jerry is an uncommonly good business man, and not "jest lucky" as the boys say.

ANALYZING INTERMITTENTS

(*Continued from page* 33)

bench lamp. An open in the mixer grid circuit coil of the 6A8G might cause loss of sensitivity, yet still allow the receiver to play, after a fashion, even though reception might be very poor. Tapping the coil or its leads might restore operation momentarily. A defective coil or soldered joint on a terminal lug could cause the condition to develop.

The signal could be checked with a signal tracer. The gain of the stage would be much lower than normal with an open in the grid circuit. A gain of about 2 to 10, depending on the set design, normally would be expected from the antenna to the first grid circuit. For an auto set, the gain might be somewhat higher, about 10 to 50.

An auto type receiver is shown in Fig. 2. In such receivers, excessive noise accompanied by intermittent reception may be caused by a defective vibrator, 100-mmfd filter capacitor or .01-mfd vibrator secondary filter capacitor, or possibly a leaky or intermittently opening grid capacitor. Further, the filters might be defective. The excessive leakage in the filters might cause vibrator overheating and sticking of the contacts, making the vibrator operation critical and uncertain. The output of the *B* supply, in such a case, could be checked with a cathode-ray oscillograph to get a picture of the condition of the supply. An alternative method would be to substitute, temporarily, a battery supply or a *B* eliminator, and to localize the trouble in that way.

In some cases oscillations could be caused by an intermittent in a capacitor. The set might play, break into oscillation, drowning out reception, and then, suddenly return to normal. In the Philco 90, Fig. 3, this might be caused by faulty capacitors in the plate circuit of the output tube, or an open in a capacitor in the screen grid circuit of the i-f tube. Allowing the set to squeal or whistle, a .25-mfd., 400-volt capacitor could be bridged across the suspected unit and the results observed. If the oscillation cleared up and the set snapped back to normal operation, replacement could be tried. However, to make certain the job is a success, the receiver should be allowed to play for several hours continuously.

The time element is a clue to the trouble. If the set cuts off in three minutes or less, it may be a tube or poor connection that is causing the trouble. • If three to five minutes time

(*Continued on page* 45)

NEWS

KENNETH C. PRINCE APPOINTED RADIO PARTS SHOW G-M

Kenneth C. Prince has been named general manager of the Radio Parts and Electronic Equipment trade show scheduled for May 13-16 at Hotel Stevens, Chicago. Mr. Prince recently returned from active duty with the Navy, where he held the rank of Lieutenant.

Prior to entering the Navy, Mr. Prince was legal counsel for the Electronic Parts and Equipment Manufacturers Association.

The show corporation has established office headquarters at 221 North LaSalle Street, Chicago.

* * *

BLACKLIDGE NOW STANCOR G-S-M

James M. Blacklidge has been named general sales manager of the Standard Transformer Corporation, Chicago. Mr. Blacklidge was formerly sales manager of the industrial division.

Earl T. Champion has joined Stancor's distributor sales division.

* * *

MOULTHROP JOINS RADIO TELEVISION SUPPLY CO.

Jack Moulthrop has been appointed vice president and general manager of the Radio Television Supply Company, 1509 South Figueroa Street, Los Angeles. Mitchell Hirsch has retired due to illness.

Mr. Moulthrop, for the past ten years, has been manager of the electronic division of the San Francisco division of the Leo J. Meyberg Company.

* * *

NEWS OF THE REPRESENTATIVES

The New York chapter of The Representatives elected Leo Freed president during a recent meeting. Samuel Eggert was named vice president, and William Gold, secretary-treasurer.

E. G. Hendrickson, 121 S. Monroe Street, Spokane 8, Wash. has joined the Pacific Northwest chapter of the Representatives.

Hal F. Corry, 3522 Gillon Avenue, Dallas 5, Texas, was elected to the office of secretary-treasurer of the Southwestern chapter. The other officers of that chapter are: A. L. Berthold, president, and Ernest L. Wilkes, vice president.

The J. T. L. Sales Co., are now located

at 120 Liberty Street, New York, N. Y. Members of the firm are Jules T. Levy and Nat Rubin.

Harry B. Segar, veteran manufacturers representative, died recently. He is survived by his widow, Mrs. Carolyn L. Segar, who is carrying on her late husband's business.

* * *

JULIAN K. SPRAGUE AND DR. PRESTON ROBINSON BECOME SPRAGUE VICE PRESIDENTS

Julian K. Sprague and Dr. Preston Robinson have been elected vice presidents of the Sprague Electric Company, North Adams, Mass. Mr. Sprague joined the company in 1926. He was one of the original group of four employes at the old Quincy, Mass., plant where he served as production manager. Dr. Robinson has been with the company since 1929, serving as chief engineer and director of research.

* * *

L. R. O'BRIEN NOW G-S-M OF RAYTHEON RECEIVING TUBE DIV.

L. R. O'Brien has been appointed general sales manager of the radio receiving tube division of Raytheon Manufacturing Co.

* * *

MARION INSTRUMENT CATALOG

A 28-page catalog, describing standard and hermetically sealed electrical indicating instruments, has been published by the Marion Electrical Instrument Company of Manchester, N. H.

* * *

COL. SOULES NAMED ELECTRO-VOICE SALES MANAGER

Lt. Col. Webster F. Soules, now on terminal leave from the Army Signal Corps, has been appointed sales manager of Electro-Voice, Inc., South Bend, Ind.

* * *

GHIRARDI BOOK DISPLAY

A combination book display 12½" wide by 9¾" deep for Ghirardi radio books has been designed for distribution to dealers.

OHM'S LAW

(*Continued from page* 14)

dimensioned pipes were connected to a common source, and one was longer than the other, the amount of water coming out of the longer pipe would be less than for the shorter one. (One point should be noted: the rate of flow of the water will be the same at any point along the line of flow, or at the mouth of the pipe.) The reason for the reduced flow in the longer pipe is the greater friction loss in the longer pipe. In the same way, the longer an electrical conductor is, the smaller will be the current flow. In other words, less current will pass a given point for the same amount of time.

Again, for water, given two pipes of the same dimensions, both length and inside diameter, but with the inner wall of one smoother than the other, more gallons per minute will flow through the smoother one, since it offers less resistance to the flow of water. The same is true of electrical conductors. Two electrical conductors of identical dimensions, but constructed of different metals, will offer different resistances to the flow of electrical current.

The Closed Circuit

Using the water analogy again, an electrical circuit may be represented as a continuous system, in which the water is constantly circulating, within a closed circuit, and with some outside force, such as a pump supplying the motive force. If the circulation of the water were interrupted, for example by a stop valve, there would be no current flow. Here, the water analogy breaks down. Both water and electricity systems require continuity. However, in the water system we insert a stop to prevent the flow of water. In the electrical system we *open* the circuit to stop the flow of current. Although the effects are similar, the terms are different. A more apt analogy in this instance would be a draw bridge, which cuts

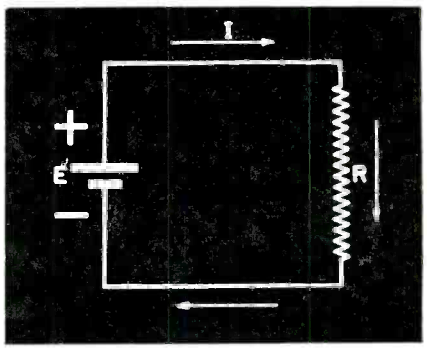


Fig. 3. Graphical representation of a closed electrical circuit. *E* represents the voltage source; arrows the accepted direction of current flow, and the resistance is designated by R. The wire connections are here shown as straight solid lines.

off the flow of traffic across it when it is open; Fig. 2.

A continuous water system would have two terminals, one the intake, the other the outlet. In a similar manner, voltage sources have two terminals. The outlet is called the plus or positive terminal, and the intake the negative or minus terminal. In the early days of electricity, current was thought to flow from the terminal designated as *positive* to that called negative, and all meters, batteries, and circuits were so marked. Modern electrical theory has proved the opposite to be true. However, all meters and circuit designations in use today still cling to the old system. A more complete explanation will be furnished later.

Ohm's Law

Ohm's law states that . . . "in any closed electrical circuit, the flow of electrical current is directly proportional to the force producing it, and inversely proportional to the resistance in the circuit." Stated mathematically: $I = E/R$, where I = current in amperes, E = force in volts, and R = resistance in ohms.

In this manner, all three quantities are defined in terms of each other. The same expression, or formula, may be expressed mathematically as $E = IR$, or $R = E/I$.

Examples

A simple circuit which represents the operation of this law is shown in Fig. 3. To find the value of any one of the three terms, the other two must be known.

Suppose we have a source voltage of *8* volts, and a circuit resistance of *2* ohms, and we wanted to know what current will flow in the circuit.

Substituting in the mathematical representation of Ohm's law:

$$I = \frac{E}{R},\ I = \frac{8}{2},\ \text{or } I = 4 \text{ amperes.}$$

Now suppose we have a current of *3* amperes and a circuit resistance of *5* ohms, and we wanted to know the source voltage. Using the second form of ohm's law:

$$E = IR,\ E = 3 \times 5,\ \text{or } E = 15 \text{ volts.}$$

Let us now take an example where we have a source voltage of *12* volts, and a circuit current of *6* amperes, and the circuit resistance is to be found. Here, the third form of Ohm's law is applied:

$$R = \frac{E}{I},\ R = \frac{12}{6},\ \text{or } R = 2 \text{ ohms.}$$

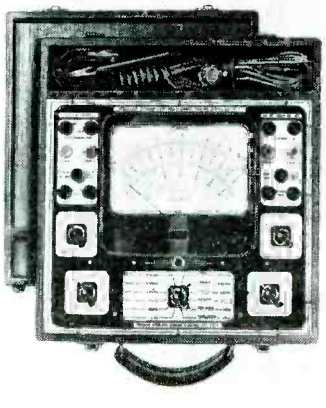
[*To be continued*]

NEW PRODUCTS

PRECISION MULTI-RANGE V-T VOLTMETER

A portable vacuum-tube multi-range tester, type EV-10-P, with direct-reading megohmmeter, milliammeter, ammeter, and db meter ranges, has been announced by the Precision Apparatus Company, 92-27 Horace Harding Blvd., Elmhurst, N. Y.

Has a 7" size rectangular meter. Uses a stabilized bridge circuit with a 6C5, 6X5 and VR-150. The meter is said to be zero-center on all ranges when used in the vtvm circuit, indicating both polarity and magnitude without reversing the prods or use of a polarity switch.



Eight zero-center vtvm ranges from ±3 volts d-c to ±6,000 volts d-c full scale; six resistance ranges from 0-2,000 ohms to 0-2,000 megohms; eight a-c and eight d-c ranges from 600 microamps to 12 amperes; eight output ranges from 3 to 6,000 volts and eight db ranges from —26 to +70 db. Overall dimensions 12" x 13" x 6".

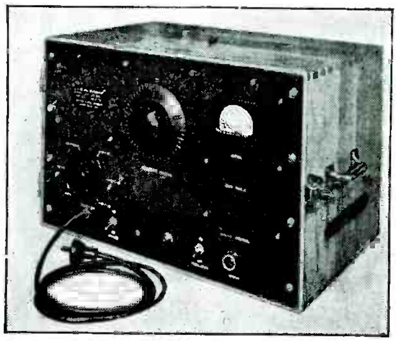
* * *

BARKER AND WILLIAMSON R-F SIGNAL GENERATOR

A high-level r-f signal generator covering 400 kc to 60 mc range in six steps has been announced by Barker and Williamson, 235 Fairfield Avenue, Upper Darby, Pa. Modulation of 30% at 1,000 cps is optional by means of a panel switch. Output is 3 volts (rms) at all frequencies and is read directly from a panel voltmeter. Output is through an output jack and coaxial cable terminated in a 75-ohm resistive load.

Calibration is said to be accurate to better than ½ of 1% and is read from a calibrated chart mounted on the lid of each cabinet.

Six ranges are: 400 to 1,000 kc; 1,000 to 2,500 kc; 2,500 kc to 6 mc; 6 to 13 mc; 13 to 28 mc, and 28 to 60 mc.



* * *

RCP POCKET MULTITESTER

A pocket multitester, model 448, featuring 6 instruments in one, is now being offered by Radio City Products Co., 127 West 26th Street, New York.

Db range is calibrated for a line of 500-ohm impedance. For lines of other impedance, correction charts are supplied. Size is 5⅞" x 3 1/16" x 2⅛"; weight 1¾ pounds with batteries.

* * *

FARNSWORTH RECORD CHANGERS

Automatic record changers, type P-50, using three shelves, have been announced by the Farnsworth Television and Radio Corporation, Fort Wayne, Indiana.

Plays either ten twelve-inch records or twelve ten-inch records.

Incorporated is an automatic stop which shuts off the unit after the last record has been played; simultaneously the tone arm swings off and away from the turntable which permits removal of the records for reloading.

The tone arm has a one-ounce needle pressure and will take any standard pickup cartridge. The turntable rotates on ball thrust bearings.

Baseplate size, 12" x 14¼"; required clearance above and below the baseplate is 6¼" and 1¾".

* * *

HICKOK TUBE AND SET TESTERS

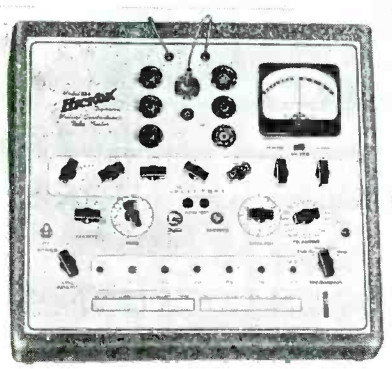
All-purpose tube and set testers with

a dynamic mutual conductance circuit have been developed by the Hickok Electrical Instrument Company, 10521 Dupont Avenue, Cleveland 8, Ohio.

Models 532C, (counter model) and 532P (portable) that tests and rejects all bad tubes, are fitted with scales having micromho ranges from 0-3,000, 0-6,000, 0-15,000 with legends indicating *replace*, *doubtful*, and *good*. This unit also provides for noise, gas, and hot and cold shorts tests. Diodes are tested separately with low voltage to prevent paralysis of the elements. Line voltage is indicated on a test meter, from 100 to 130 volts. Rectified current is used to energize plates and grids using two rectifiers and tests can be made of grid controlled rectifier tubes. Filament voltage is in steps to 117 volts. A roll chart is included. Tester is 17" x 18" x 8½". Operates on a power supply of 110-130 volts from 50-60 cycles.

The unit uses an 83 and a 5Y3GT.

Tests octal, loktal, miniature, ballast, magic eye and standard tubes.



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NATIONAL UNION MINIATURES

A miniature type (2⅜" bulb) half-wave high vacuum rectifier, the 1Z2, with voltage handling capabilities of 20,000, has been announced by National Union Radio Corporation, Newark, N. J. In addition to its application as a half-wave rectifier at line frequencies, the tube is also adaptable for fly-back pulse rectifiers, and r-f supplies for television circuits.

Filament (thoriated tungsten) voltage, 1.5 a-c or d-c; filament current, 300 ma; peak inverse plate voltage, 20,000 volts max.; peak plate current, 10 ma max.; average d-c plate current, 2 ma max.

Maximum overall length, 2.70"; maximum seated height, 2.45"; maximum diameter, 0.75"; bulb, T-5½; base, miniature button 7-pin; mounting position, any.

Typical operation, as half-wave rectifier: a-c plate supply voltage, 7,800; filter-input capacitor, 0.1 mfd; d-c output current, 2.0 ma; d-c output voltage, 9,200.

* * *

SHALLCROSS 0.5-WATT HERMETICALLY-SEALED RESISTORS

Hermetically-sealed resistors, type 1101, rated at 0.5 watt and ⅞" long x ⅞" in diameter have been announced by the Shallcross Mfg. Co., Jackson and Pusey Avenues, Collingdale, Pa.

Maximum resistance value when wound with nickel chromium wire is 350,000 ohms; maximum voltage, 420.

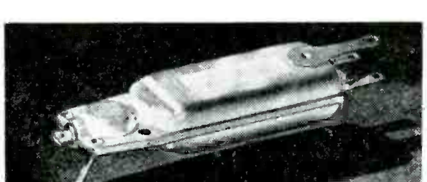
* * *

SHURE LEVER-TYPE PICKUP CARTRIDGES

A crystal pickup cartridge with the crystal driven by a lever has been announced by Shure Brothers, Chicago.

Lower needle point impedance is said to be obtained. The lever arrangement is said to absorb the full impact of sudden jars to the cartridge or needle. Needle force of ¾ to 1⅛ ounce is attainable with the output voltage from 1.6 to over 3.

Cartridge is available in an aluminum case. Weight, .43 ounce. It is also furnished in steel, weighing .85 ounce.



ANALYZING INTERMITTENTS

(*Continued from page 39*)

elapses before development of the intermittent, you should look for faulty carbon resistors, especially in cathode circuits of output tubes. If over five minutes are required for the defect to develop, suspect audio transformers, the primaries of first i-f transformers, r-f transformers, chokes, etc.

In any event, listening carefully to the customer's complaint may prove very helpful. Final judgment may be reserved, but if you know what you're looking for, it's easier to find than to look for something that is vague.

SER-CUITS

(*Continued from page* 31)

Fig. 2 shows a 2-band model having most of the features of the receiver shown in Fig. 1. Here, a separate loop primary is used in series with a short-wave antenna transformer, the loop acting as a capacity antenna for s-w in the event no external antenna is used. The waveband switch eliminates the r-f amplifier in the s-w position, connecting the antenna transformer directly to the converter signal grid. Two separate oscillation transformers are used, eliminating the need for shorting the unused coils. A tone control switch places a .0008-mfd capacitor across the detector output, from the high side of the volume control to *B*–.

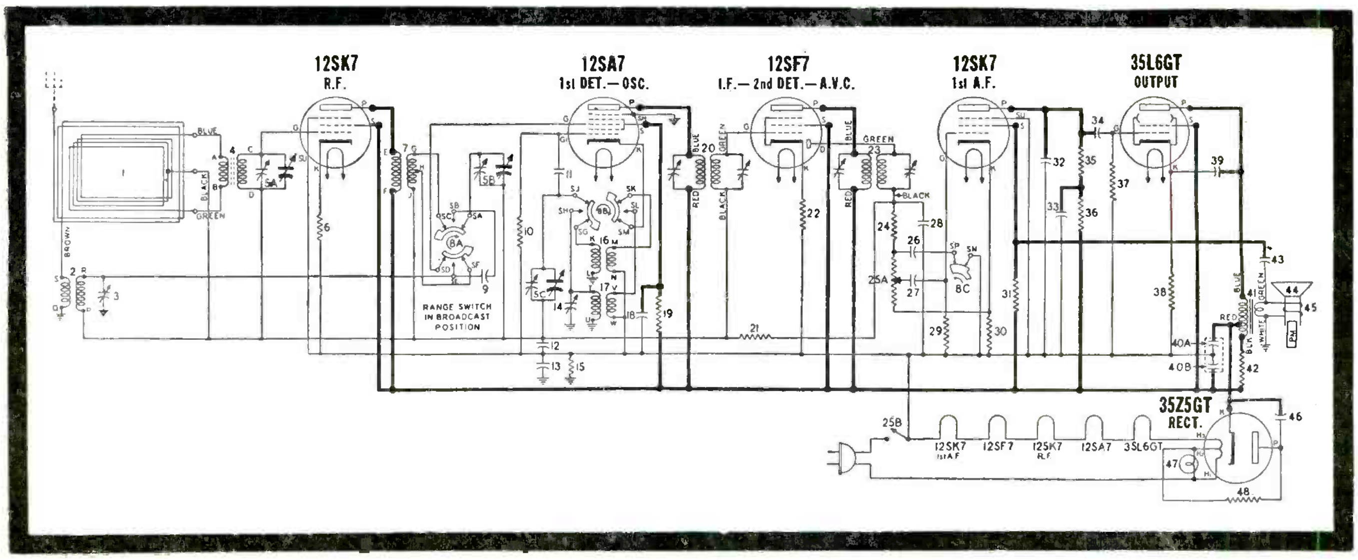


Fig. 2. Stewart-Warner 9000-B, 5-tube and rectifier a-c/d-c 2-band model.

POSTWAR A-C/D-C RECEIVER

(See front cover)

A POSTWAR 4-tube-and-rectifier a-c/d-c compact receiver, recently announced by Templetone, E-510 to 519, appears on the front cover this month.

The 2-stage resistance power-supply filter is more generous than usual, minimizing hum level. The 12SK7 i-f amplifier has a fixed minimum bias supplied by the oscillator. The loop primary has a .005-mfd series capacitor. A cathode-tapped oscillator uses a fixed 10-mmfd compensator. A 6.8-megohm bias resistor from the oscillator grid to the i-f grid return, supplements the avc bias. The amount of fixed bias depends upon the Q of the oscillator circuit which may be made to vary with frequency, a sort of automatic sensitivity control. Where oscillation troubles are encountered near the low-frequency end of the tuning range, the Q may be made to increase at that end, reducing i-f sensitivity to stop the undesired oscillation.

The r-f demodulation products from the detector are filtered out by a π filter using two 100-mmfd capacitors and a 47,000-ohm resistor. The filter and ½-megohm volume control serve as the diode load resistance.

The power filter uses a pair of 40-mfd capacitors and a 120-ohm resistor for the first section which feeds the 50L6 plate, and 1,800 ohms and another 40-mfd capacitor for the 50L6 screen and other tubes. A 20-mfd cathode bypass shunts a 150-ohm bias resistor.

•

SERVICING HELPS

RCA 5T

Dead or with intermittent, not due to tube: Usually one of the tubular capacitors is open. In most cases the faulty capacitor can easily be found by testing each of the leads for looseness. On some models I have found the defective capacitor by tapping each lightly with an aligning tool, while set is on. Set will cut on and off when defective unit is tapped.

Claude M. Prew

JOTS AND FLASHES

POSTWAR receivers now in production reveal many circuit innovations. An interesting analysis of these developments appears in Henry Howard's discussion of *Ser-Cuits* this month on page 26. . . . Ivan G. Easton is now in charge of the New York office of General Radio at 90 West Street. . . . John Altmayer is president of a new company, the Asco Corporation, 874 East 140 Street, Cleveland 10, Ohio. . . . Ben Joseph has been named eastern representative for the British Industries Sales Corporation, 401 Broadway, New York City. William Carduner organized the company to handle Garrard record changers, Ersin multicore solder and Solon soldering irons, British products. . . . Stanley A. Morrow is now assistant manager of advertising and sales promotion of Farnsworth. . . . John R. Hughes has been named assistant sales manager of Farnsworth sales. . . . Russ Owens has been appointed manager of the Shelby Woodcrafters, Shelbyville, Indiana, a subsidiary of Hallicrafters. . . . R. E. Samuelson, vice president in charge of Hallicrafters engineering, has been named chairman of the marine section of the RMA. . . . John M. Cage is now manager of the industrial electronic division of Raytheon, with headquarters at Waltham, Mass. . . . The needle resharpening service department of the recording blank division of Gould-Moody, 195 Broadway, New York City, has been expanded. . . . George D. Rice is now acting assistant chief engineer of the radio division of Lear, Inc. . . . E. F. Erickson has joined Carter Motor Company, 1608 Milwaukee Avenue, Chicago, Ill., as purchasing agent. . . . Sylvania has purchased the Wabash Appliance Corporation, 335 Carroll Street, Brooklyn, N. Y., makers of photoflash and incandescent lamps. . . . Edwards Sales Company have moved to 504 Erie Building, Cleveland, Ohio. . . . Charles B. Kennedy has become branch manager of the West Central district of Westinghouse Electric Supply at Dayton, Ohio. . . . Louis Alweis has returned to Garod Radio as a sales representative. . . . Walter Widlar is now general manager of the MecRad division of Black Industries, Cleveland, Ohio. . . . S. B. Levaur has been named sales manager of television receivers at Du Mont. . . . Cmdr. G. Robert Mezger has rejoined Allen B. Du Mont Labs., Passaic, N. J., as manager of instrument sales. . . . Comdr. Ralph T. Brengle has been appointed district sales manager of the Aero Needle Company, Chicago, for Indiana, Illinois and Wisconsin.

ADVERTISERS IN THIS ISSUE

SERVICE INDEX—JANUARY 1946

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