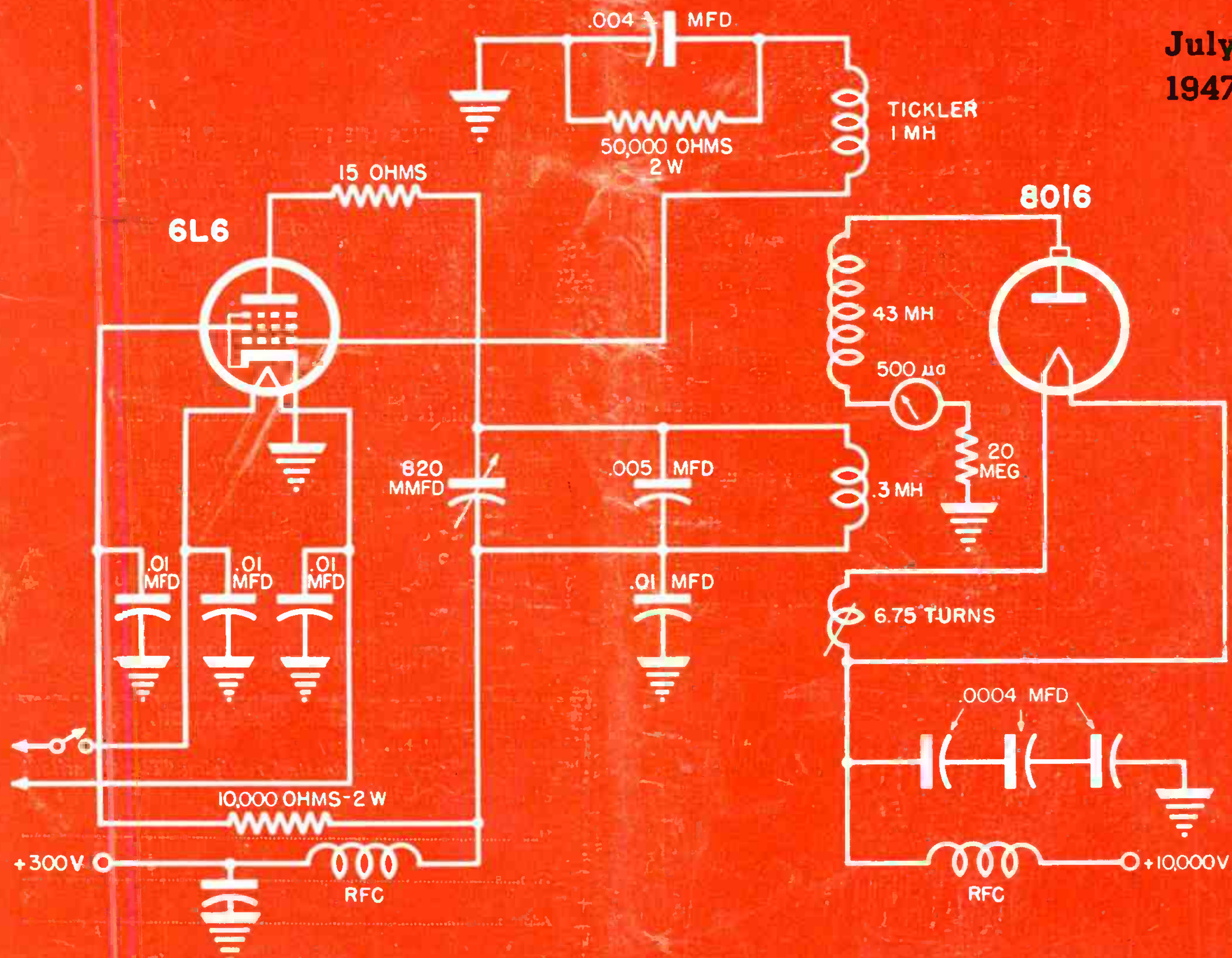
RADIO · TELEVISION · ELECTRONIC

SERVICE

July
1947



Television receiver r-f high-voltage power supply, using a beam-power 6L6, which with a B+ supply of 300 provides an output of 10,000 volts.

See page 21

THE TECHNICAL JOURNAL OF THE RADIO TRADE

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1910 — 1947

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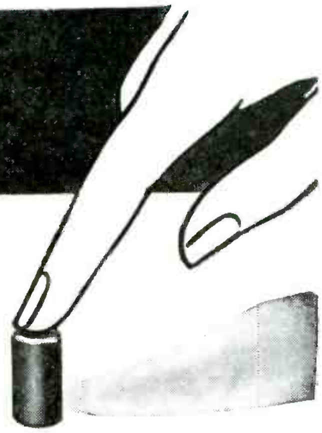

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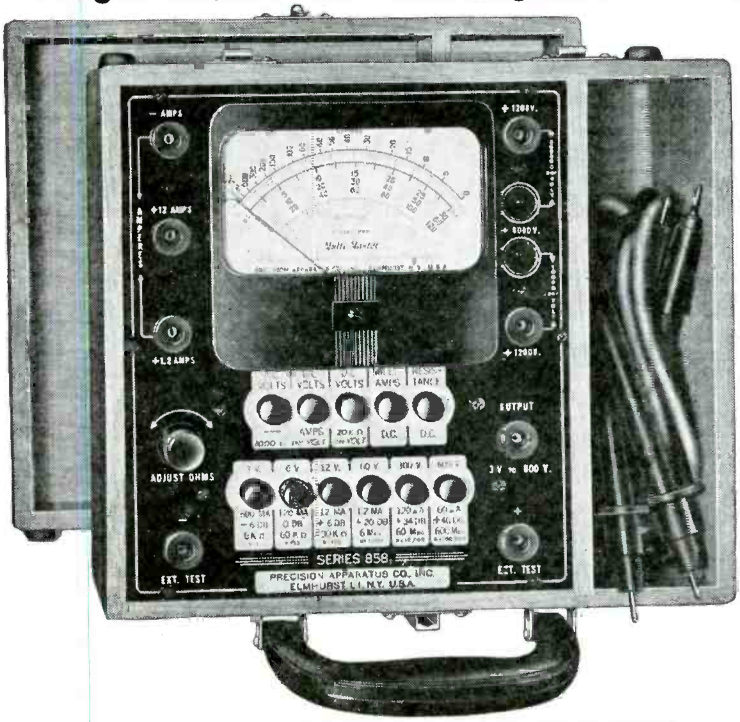

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EDITORIAL

THE ADVENT OF NEW FORMS of aural and video broadcast services such as f-m and tv, and highly-efficient accessories and components, has uncovered many additional income-producing sources for the Service Man. In the case of f-m, for instance, Service Men, more than ever before, can not only drum up installation and maintenance business, but sales, too. Whereas the standard broadcast receiver with its extremely sensitive input circuits and highly developed loops did not require antennas, the f-m receivers when located beyond the primary coverage areas *do require an antenna*. Thus in many instances, Service Men have the opportunity of selling and installing antennas.

The advent of f-m also has made it possible for Service Men to create sales for receivers. Many Service Men have been following this practice with a-m sets, operating in conjunction with dealers. To further promote this practice, one manufacturer has developed a field-test instrument which can be used as an f-m demonstrator and antenna locator. The instrument, supplied with a signal-strength meter, indicates minimum and maximum field strengths and thus serves as an accurate guide for the placement of the antenna. The unit also provides a-m reception and thus it is possible to demonstrate the reception characteristics of a-m and f-m. The demonstration is particularly striking in noisy areas.

Multiple speaker installations provide another interesting source of income for the Service Man. This is particularly true in locations where multiple receiver installations are difficult because of noise. The use of one or two receivers, located in the best receiving areas, coupled to several speakers located in different rooms, provide excellent quality and high signal-to-noise ratio reception.

Dealers have always found that Service Men can serve as very effective sales aids and are quite willing to participate in a variety of arrangements which can be profitable to both dealer and Service Man.

THE IMPORTANCE OF CLINICS to teach the new concepts of f-m and television is being stressed daily in sessions being held throughout the country by manufacturers. These sessions are extremely complete running from one to two days in length and offering theoretical and practical courses on receivers and servicing equipment.

As pointed out in this column some months ago, industry associations are also going to sponsor clinic sessions throughout the country. First of these clinics will be presented during a Servicing Convention and Show in Philadelphia, September 19 to 21. Complete reports on the clinics will appear in SERVICE. Watch for them!

RADIO · TELEVISION · ELECTRONIC

SERVICE

Vol. 16, No. 7 July, 1947

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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.
F. Walen, Secretary
A. Goebel, Circulation Manager

Chicago Representative: Lawrence Wehrheim, 5510 W. Lemoyne Ave., Chicago 51, Ill.; Telephone MERrimac 7919
Cleveland Representative: James C. Munn, 2656 E. 126th St., Cleveland 20, Ohio; Telephone CEdar 7783
Pacific Coast Representative: Brand & Brand, 1052 W. Sixth St., Los Angeles 14, Calif.; Telephone Michigan 1732
Brand & Brand, 1085 Monadnock Bldg., San Francisco 5, Calif.; Telephone Douglas 4475

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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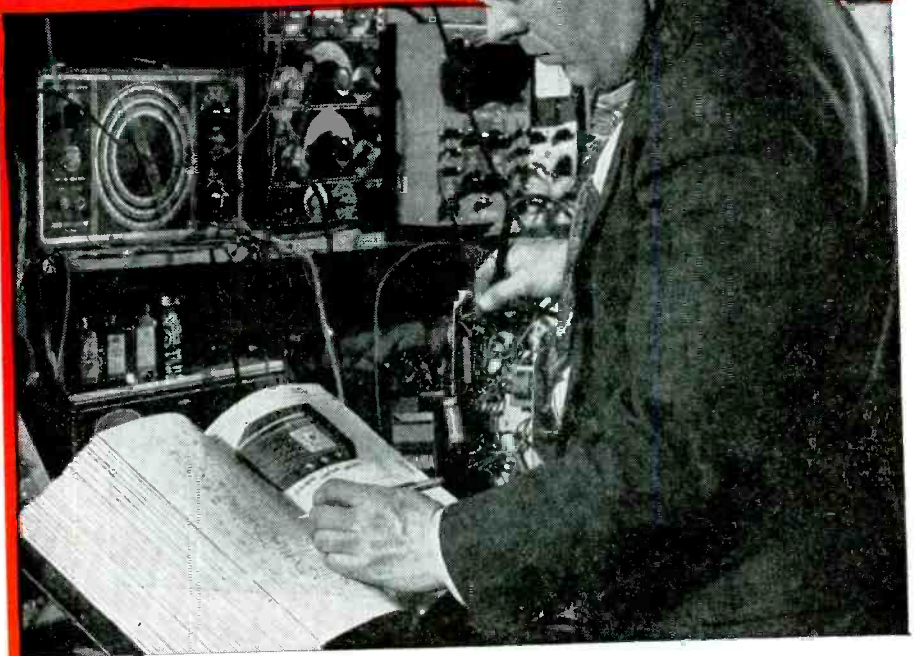

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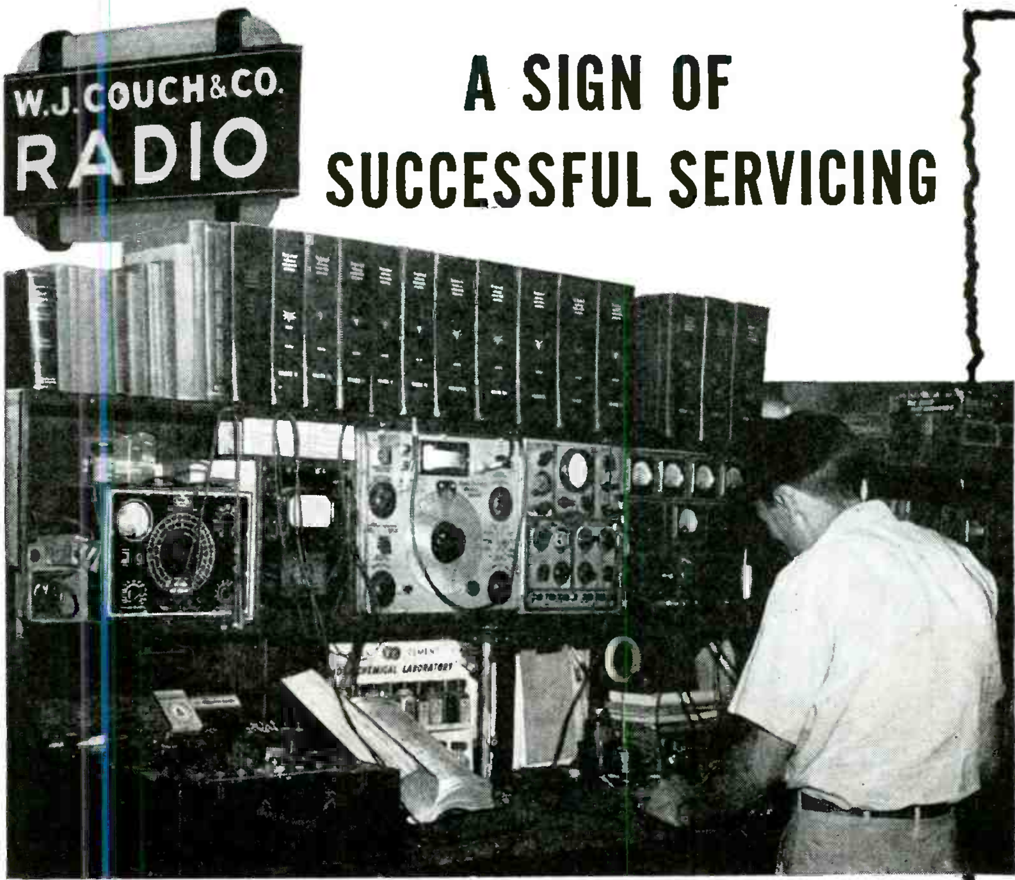

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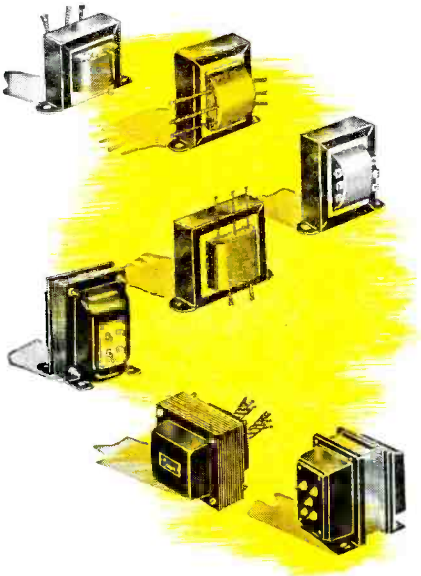

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WILL TRADE—1-CE-1-60 Solar capacitor Exameter; also 1 Green Flyer phono motor dual speed & gor. control. Want a 3" or 5" scope. Write for details, Gregg Radio Service, 10 S. Evergreen, Chanute, Kans.

FOR SALE—520R receiver, Collins VFO unit, electric instructograph with tapes, code oscillator, 6 meter beam elements and parts to complete 200-watt phone transmitter with a lot of spare parts, $200. The Radio Shop, 111 N. Jefferson St., Rockville, Ind.

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WANTED—Thordarson transformers new: T-19F83; T-19F85; T-19F96; T-33A91; T-75D10; T-11M77; T-75R50; T-19P59; T-19F90; T-19P62; T-19C36; T-19C42; T-19C43. Also unpunched panels and standard chassis. Two or three 80-80 mf. 3000v spacing var. condensers—prefer Bud. Cash or trade. Eddie Howell, 501 W. Harden St., Graham, N. C.

FOR SALE—Hallicrafters S-41G, 6 tubes, .54-30 mc. complete, excellent condition, $25. f.o.b. D. S. Overton, 316 N. Maple, Oak Park, Ill.

WANTED — Hickok signal generator and trace-o-meter. Will sell two Buick push button radios. Looko Service, 1430 E. 55th St., Cleveland 3, Ohio.

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FOR SALE—Complete electrical and radio shop, fully equipped. Must sell because of health. Big discount for quick sale. Flanery's Electric, Freeman, Mo.

FOR SALE—Silver Vomax used once, $50. R. B. Brown, 1363 Duncan Ave., Los Angeles 22, Calif.

WANTED—Recent N.R.I. or similar radio course. Have German camera or binoculars to trade or what have you? W. C. King, 64 Andrew St., Bayonne, N. J.

FOR SALE—Shop stock tubes, parts, supplies at reduced prices. J. C. Thimijan, 715 North 7th St., Lake City, Minn.

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WANTED — Will rent or buy used Instructograph or similar code practice machine. Must have necessary tapes and be in good condition. John B. Braffett, 520 S. 6th St., Clinton, Okla.

FOR SALE—Complete test equipment and stock consisting of Riders Manuals, 400 tubes and other test equipment. $700. Write for list. A. L. Dyhemon, Kenesau, Nebr.

SELL OR SWAP—25 tested 6AC7's one or all for what have you? C. L. Kogge, 6425 Sapphire Drive, Jacksonville, Fla.

WANTED—Recorder below $70. Send details to Jack Kamenietzky, 3801 W. Harrison St., Chicago 24, Ill.

SELL OR SWAP—Hickok #155 indicating traceometer with accessories add instructions, all perfect. Also N.R.I. course complete with texts, parts, instruments and experiments. Will trade either for Hallicrafters SX-25 or cash. Robert N. Wallace, Box 175, Richland, Mo.

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WANTED—Signal Tracer & scope. Will sell European used tubes, KDD1—KB2—KC3—KF4, RV12P2000; parts from Korting Radio; G-E exposure meter; case and instruction book, Model DW-58. John Reed, Mansfield, Mo.

FOR SALE—Large quantity radio tubes, new and , in cartons. Includes 1A7GT 1LN5, 6N6G, 14AF7 and others. Send for list. Whitcomb Electric Shop, Box 345, Albany, Wisc.

FOR SALE—Triplett #1232 Signal Generator, also Model 1341 Condenser Checker with instructions, $18. ea. Also several Whiskette rubber-covered steel-wool brushes for cleaning chassis, cabinets, etc., $1. ea. postpaid. R. G. Jolly, Gulrock, N. C.

WANTED—Bushing or spindle for automatic record changer used in RCA console radio V-200. Ernest Cook, South Fallsburg, N. Y.

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SELL OR TRADE—RCA Chanalyst never used. $120 or will trade for new Supreme Audolyzer. Richard A. Bryan, 1415 Main St., Columbus, Miss.

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FOR SALE — Motorola #70 auto radio, universal mounting, $35; '37 Ford custom-fit auto radio, $35; '38 Oldsmobile custom-fit auto radio, 8-tubes, $40; Stancor A power pack, $30. Paul Capito, 637 W. 21st St., Erie, Pa.

FOR SALE—Universal radio tube tester, portable, only six tubes have been tested with it, $45; a-c. d-c volt-ohm-milliammeter. brand-new, $27.50. Robt. J. Chantler, 1143 Naval Ave., Apt. 3, Bremerton, Wash.

FOR SALE—Meissner 8-tube f-m tuner #9-1047A, 40-50 megacycles, with new Hallicrafters CN-1 converter to cover new band. $20 for both. H. F. Ellwood, 9023 215 St., Queens Village 8, N. Y.

FOR SALE OR TRADE—Supreme Radio Servicing course book slightly used. Jones Radio Company, Douglassville, Pa.

WANTED — Urgently needed circuit or schematic drawing of now-out-of-business Approved Technical Apparatus tube checker model 1300A. Will pay for trouble and circuit. Jewell Radio Service, Box 24, Irving, N. Y.

TRADE—Brand new table model or portable radios or electrical appliances for typewriter, multigraph or printing press. B & F Radio, 300 W. 75th St., Chicago 21, Ill.

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WANTED—Silver Radio No. 30 diagram, 1938—later. $2. Henry Skoritouski, 1501 Crown Ave., Scranton 5, Penna.

FOR SALE—National all-metal Hawaiian guitar with beautiful lined case. large powerful amplifier. $150, worth twice as much. Cash or trade or what have you? G. C. Busick, 114½ W. South St., South Bend 11, Ind.

FOR SALE—Superior tubetester, fil. voltage 1.4-117v and one multi-meter, will check volts ac and dc, ohms, capacity, milliamps, and db. Both in good condition. Cheap. Bill Horan, Goodyear Service, Webster City, Iowa.

WANTED — Mimeograph or duplicator machine, state model, condition and price in first letter. Will pay cash. J. & C. Radiolabs, c/o C. H. Cote, 111 Woodlawn Circle. E. Hartford, Conn.

FOR SALE—Tubes in original cartons in lots of 10 or more. 20—6B4G, $1.25; 15—6B8G. 80c; 30—39/44, .65; 10—14A7/12B7, 75c. Joseph H. Strom, Stony Point, Watertown, S. Dak.

FOR SALE—Master Teleplex code practice set, complete with instruction book, full set of practice tapes and 10 blank tapes. Excellent condition, $20. Paul R. Hinzmann, 935 Spruce St., Hancock, Mich.

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The Sprague Trading Post is a free advertising service for the benefit of our radio friends. Providing only that it fits in with the spirit of this service, we'll gladly run your own ad in the first available issue of one of the six radio magazines in which this feature appears. Write CAREFULLY or print. Hold it to 40 words or less. Confine it to radio subjects. Make sure your meaning is clear. No commercial advertising or the offering of merchandise to the highest bidder is acceptable. Sprague, of course, assumes no responsibility in connection with merchandise bought or sold through these columns.

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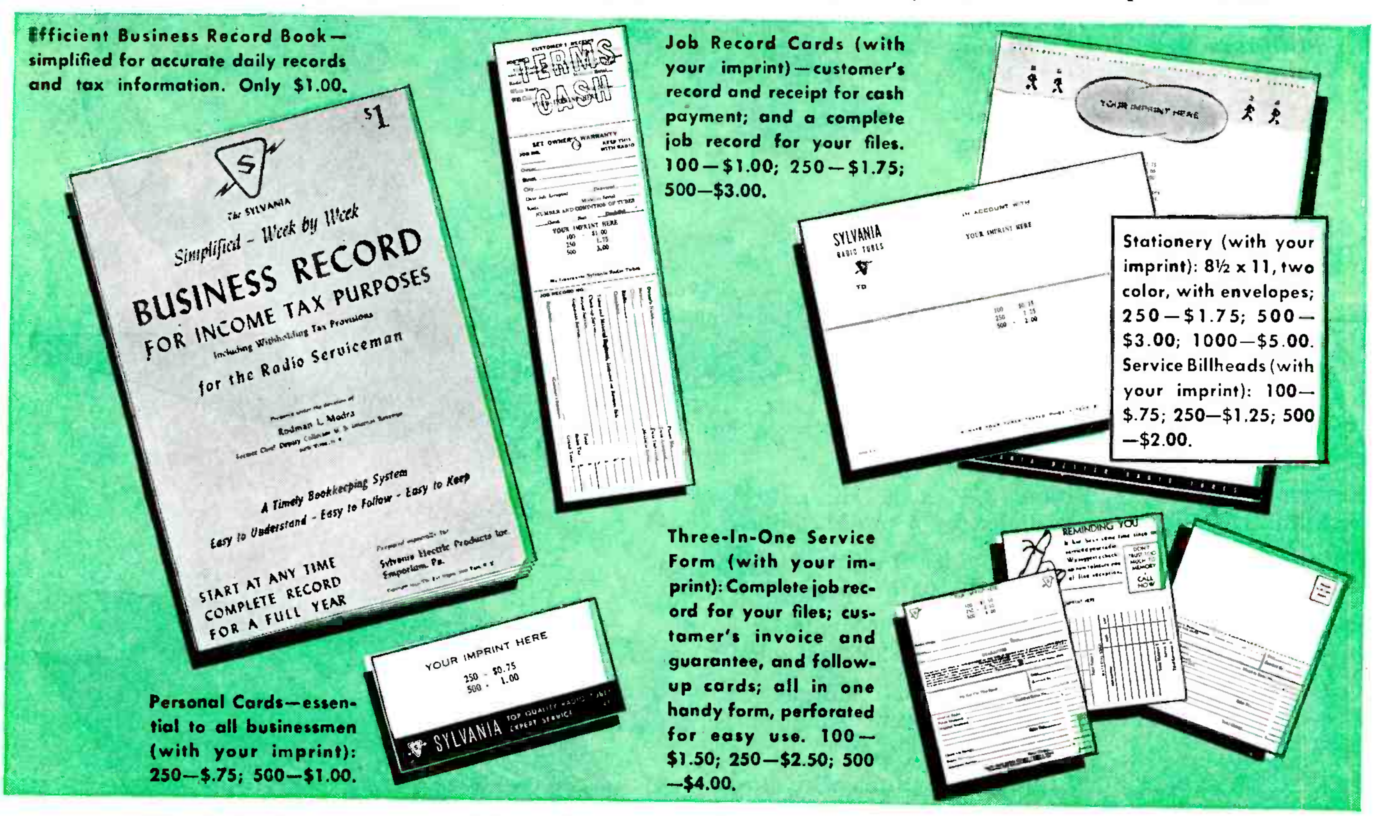
SYLVANIA NEWS
RADIO SERVICE EDITION

JULY *Prepared by* SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa. 1947

SYLVANIA PRESENTS: Personal Business Forms and Stationery for Time- and Money-Saving EFFICIENCY!

The special business forms shown on this page are items essential to a carefully planned, systematic radio service shop. Sylvania's aim in the preparation of this material was simply this: to offer radio servicemen the advantages of these time- and money-saving helps at the lowest possible cost.



Efficient Business Record Book—simplified for accurate daily records and tax information. Only $1.00.

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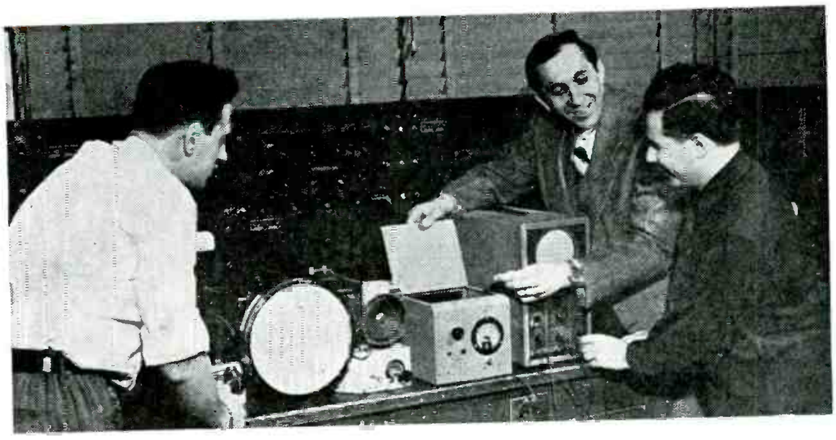
[[1]See Cover Diagram]



The r-f tv power supply, built at RCA Institutes, being demonstrated by Kaufman to students at the school. At left is the chassis of a RCA 630TS television receiver.

Television Power Supplies[1]

by MILTON KAUFMAN
RCA Institutes

LARGE SCALE PRODUCTION of television receivers and cathode-ray equipment, has led to the development of more economical and efficient methods of generating high voltages.

In prewar equipment, tv receivers used conventional 60-cycle supplies which suffered from many inherent disadvantages:

(*1*)—Danger to the user of death from contact.

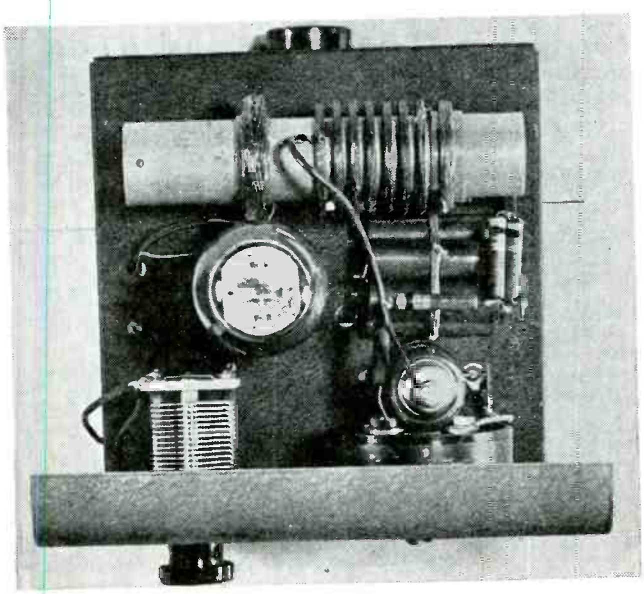
(*2*)—Use of large and expensive high voltage filter capacitors.

(*3*)—High voltage insulation requirements for rectifier filament transformers.

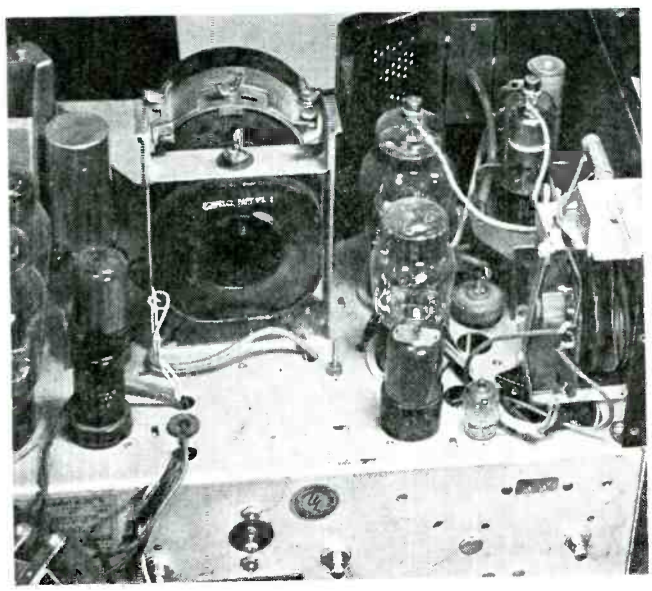
(*4*)—Excessive weight and bulk.

To combat the effect of the foregoing disadvantages, two alternative systems for obtaining high voltages have been developed: (*1*) A radio-frequency power supply which makes use of the rectified output of an r-f oscillator. (*2*)—Type commonly known as the *kickback* or *flyback* power supply which takes advantage of the high induced voltage created by the rapidly collapsing magnetic field during the retracing of the horizontal sweep in

Top view of the r-f tv power supply built at RCA Institutes. At right of the chassis, from top to bottom, are the r-f coil, filter capacitor (series), high-voltage rectifier and meter. The oscillator tube is at the left.



View of the fly-back power supply. The deflection yoke for magnetic deflection, used with the picture tube, appears at upper left. At extreme right is the high voltage rectifier, 8016, while at the lower right appears the horizontal output transformer.



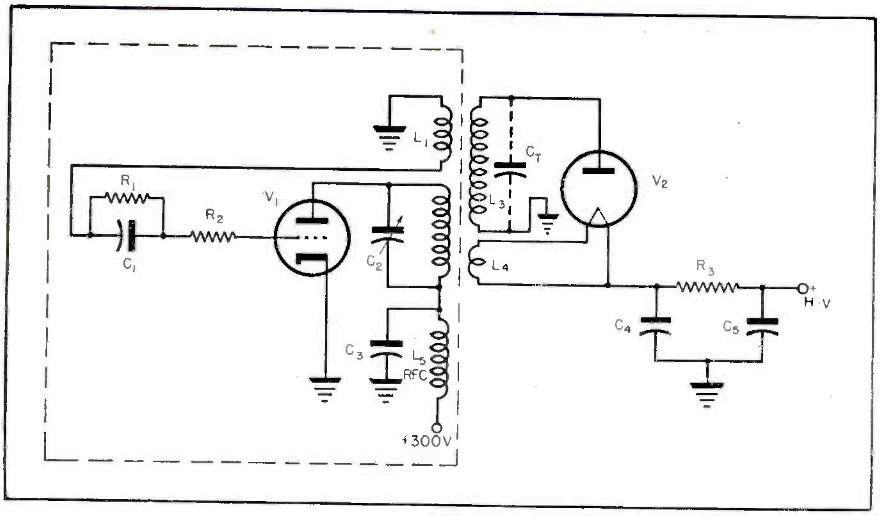


Fig. 1. Circuit of a basic r-f tv power supply.

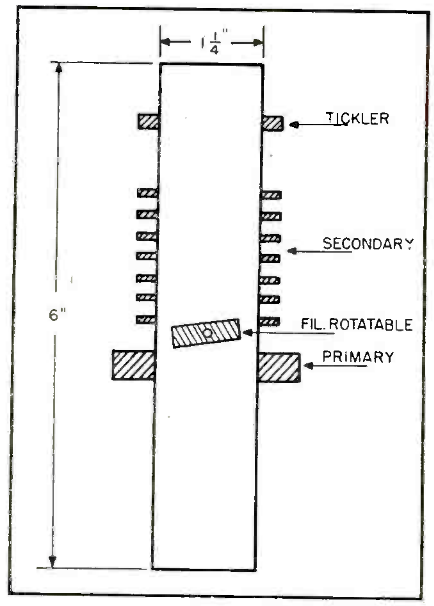


Fig. 2. Cutaway view of r-f coil. Top coil is grid-tickler winding; center, multiple pi sections of high voltage secondary.

the deflection transformer of a television receiver.

Basic R-F Supply

A simplified drawing of an r-f supply is shown in Fig. 1.

The section of the figure enclosed by the dotted lines will be recognized as a tuned plate-tickler feedback type of oscillator. It has been found by experimentation[1] that this type of oscillator is most suitable for use in r-f power supplies, as it has good stability characteristics over its tuning range.

The range of operating frequencies varies from about 30 to 500 kc. Lower frequencies of operation are preferred for the higher-voltage supplies.

The plate tank circuit is tuned to the desired operating frequency. A small amount of energy is picked up by the grid tickler coil, L_1, by inductive coupling and fed back to the grid of the oscillator tube in the proper phase relationship to reinforce oscillations in tank circuit; oscillations are self sustaining. Operating bias for the oscillator is obtained by the series grid network, R_1 C_1. The constants are chosen so as to maintain class *C* bias to obtain the greatest operating efficiency from the oscillator tube. In this way tube efficiencies in the order of 80% may be realized. Resistor R_2 is a non-inductive element of approximately 25 ohms and is used to suppress parasitic oscillations which would reduce the efficiency of the oscillator. The r-f choke, L_5, and bypass capacitor, C_3, are necessary to prevent any r-f from feeding back into the power supply and thus affecting the other circuits using the same supply.

High Voltage Secondary

To generate the high voltages needed, a step up winding, L_3, which has a great many turns, is coupled to plate coil. System is similar to a high-voltage Tesla coil, wherein high voltages may be easily realized by making use of the fact that the induced voltage into the tuned secondary of a transformer is a function of the *Q* of the secondary. Therefore, the *L/C* ratio of the secondary must be kept as high as possible. To accomplish this, no actual tuning capacitor is used across L_3, but instead the capacitance C_T, which is made up of the coil capacitance, wiring capacitance and the capacitance of the rectifier V_2, is used to resonate with L_3 at the operating frequency.

The design of the r-f transformer is the most critical part of the circuit. The capacitance of the secondary coil must be kept to a minimum in order that the greatest number of turns for a given frequency may be used, thus giving the highest voltage output. To this end, and also to reduce the potential difference between layers, the secondary coil is divided into a number of *pi* sections. No sharp edges may be permitted, as they would cause corona with a subsequent loss of power and eventual breakdown of insulation. All soldered joints must be smooth and round with all points filed down. To maintain the high *Q* in the secondary coil, it is essential that the load current taken from the system be kept to a low value, but since the requirements of cathode-ray tubes seldom run beyond 1 ma, this is easily met.

Filament Power

It will be noted that the filament power for the high-voltage rectifier tube is also obtained from the energy in the oscillator. Inductance, L_4, consists of a few turns (one turn may be satisfactory) coupled to plate coil. Degree of coupling is varied until the filament of V_2 glows with the desired intensity. Since this represents a rather severe demand on oscillator power, a special rectifier tube such as the 8016 is used. This tube requires only .2 ampere for filament current as compared with 1.75 amperes for the 879 type. Care must be taken when adjusting the filament power on the 8016 as a slight overload may ruin the operating characteristics of the tube.

Filtering

Filtering requirements are not very stringent due to the high ripple frequency (30 to 500 kc) and low-current drain. Excellent results may be obtained from simple *r-c* filters such as R_3, C_4, C_5. The values of C_4 and C_5 are generally not more than 500 mmfd each. The use of such small capacitors means that their energy storage will not be enough to generate shock voltages. The voltage output of the supply decreases rapidly as the current drain increases giving further protection to personnel handling this equipment.

The output voltage from this basic circuit can be expected to be as high as 8,000 or 9,000 volts with a current drain of possibly 500 microamperes, and about 4,000 volts at 1 ma.

RCA Institutes Power Supply

To demonstrate the principles involved in the construction and operation of an r-f high-voltage supply, in the television laboratories of R.C.A. Institutes, a unit was built based on a design set forth by O. H. Schade and

[1] O. H. Schade, Proceedings of IRE; Apr. 1943.

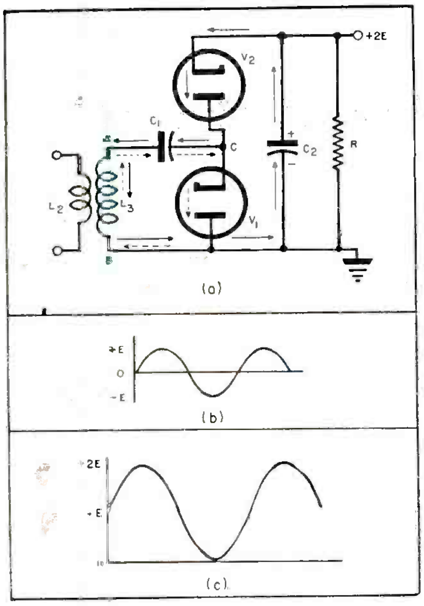


Fig. 3a, b and c. In a appears a circuit of a cascade voltage doubler. Plots of b and c represent the doubler action, shifting of axis of input sine wave; this is similar to d-c restorer operation in tv receivers.

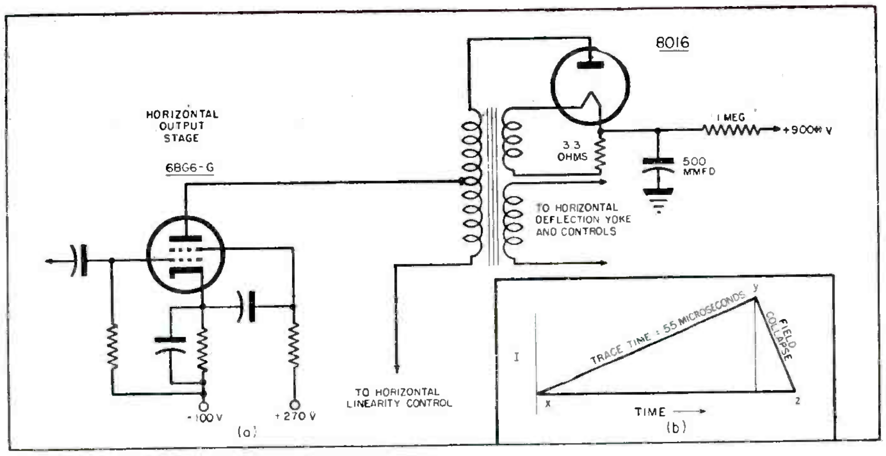


Fig. 5a and b. In a appears circuit of the *kick-back* power supply used in the RCA 630TS television receiver. In b appears a plot of the applied wave; trace time between x and y causes slowly increasing current through portion of scanning transformer.

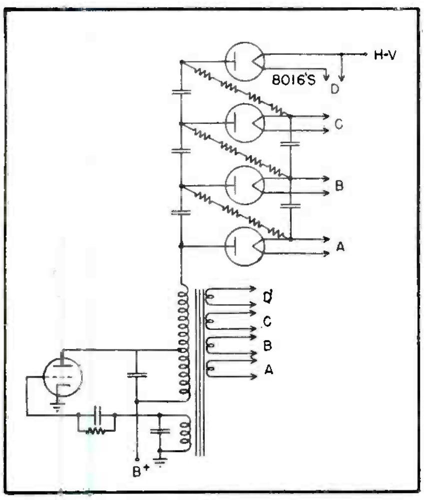
developed by RMCA. Schematic of this unit is shown on the front cover.

This circuit has several interesting features. Instead of a triode oscillator tube, a beam power 6L6 type is used. This makes it possible, with a B+ supply of only 300 volts, to realize an output of 10,000 volts from the high-voltage secondary.

Filament bypass capacitors are used to prevent r-f from feeding back into the filament supply.

A cutaway sketch of the r-f coil is shown in Fig. 2. The top coil is the grid-tickler winding. In the center appears the multiple *pi* sections of the high-voltage secondary, and the lower

Fig. 4. Schematic of a high-voltage supply for a projection television receiver. (*Courtesy G.E.*)



winding is the plate coil. Since the plate winding is separated by quite a distance from the tickler winding, coupling between the two is accomplished indirectly, first from the plate coil into the secondary and from the secondary to the tickler coil.

The filament coil consists of about 7 turns mounted on a rotable form. Turning the coil regulates the degree of coupling and provides the proper amount of power to light the filament of the 8016.

A method of measuring the magnitude of the output voltage is provided. This consists of a 20-megohm resistor in series with a 500-microampere meter. The current through the meter causes a deflection which is proportional to the voltage output. The meter is calibrated directly in kilovolts and 10,000 volts causes full scale deflection.

A slightly different type of output filter is used. This consists of a capacitance made up of four series units in order to obtain the necessary high voltage rating with moderately priced parts, and a series inductance which is an r-f choke. Adequate filtering is provided by this arrangement.

This unit has been thoroughly tested and found to be entirely reliable and stable in operation.

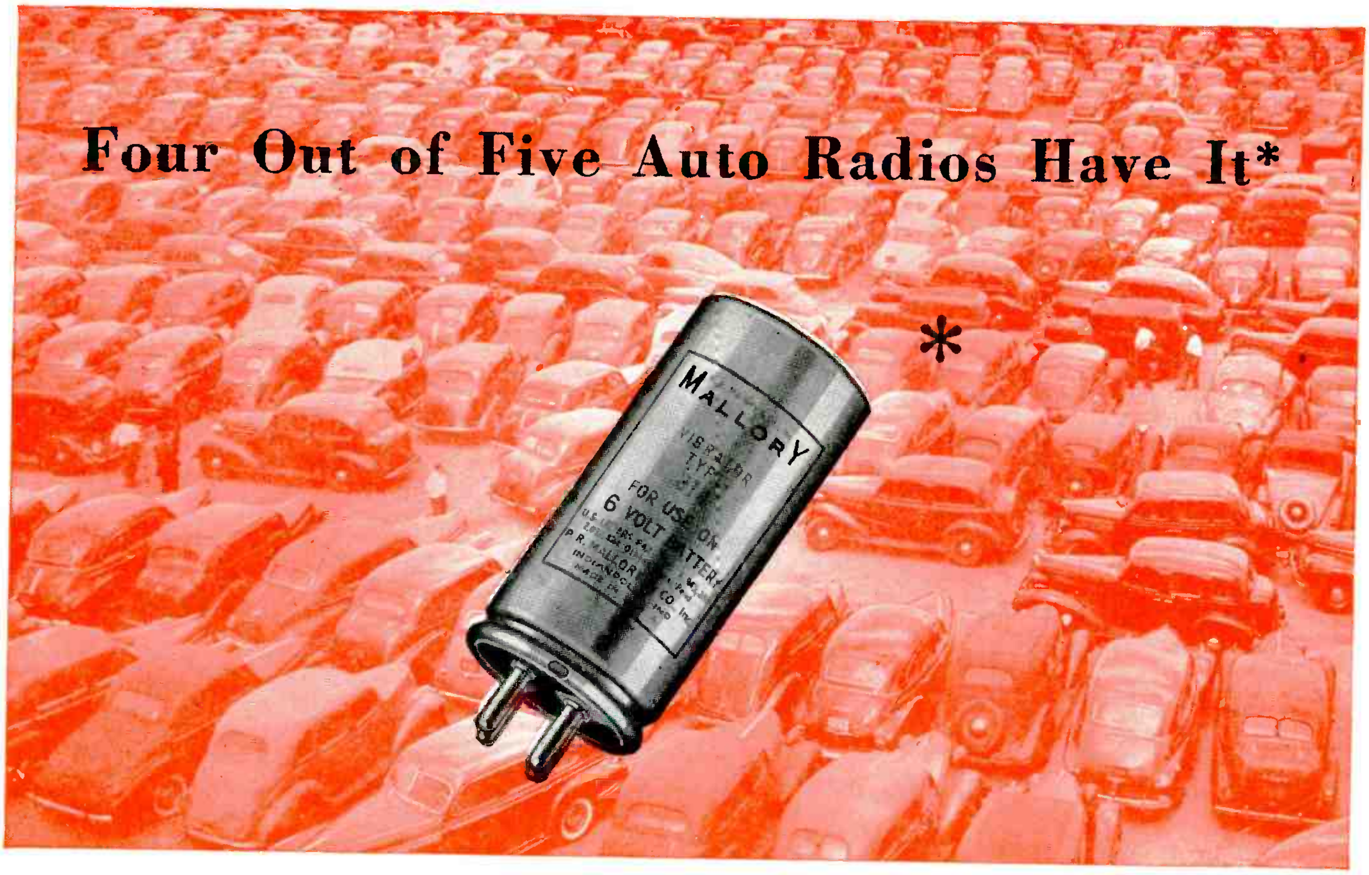
Shielding

Due to the strong radiated fields from the unit which would cause severe interference in the associated equipment with which the supply is to be used, it must be very carefully shielded. This problem was met by enclosing the entire power supply in a standard metal case.

High voltage power supplies of the type described are usually limited to a maximum of about 10,000 volts due to the extreme difficulty of designing secondary windings capable of operating at greater voltages. Thus in order to obtain a greater voltage output from a given unit, use is made of volttage multiplication. In practical application the output voltage may be increased to four times its original value.

Since the conventional type of voltage doubler is probably well known, only the cascade type will be considered. Fig. 3a shows a cascade voltage doubler circuit. Inductance L_2 represents the plate winding or primary, and inductance L_3 the high voltage secondary. For the purpose of explanation, let us assume that the rectifier, V_2, is initially not connected in the circuit. Effectively we now have a half-wave rectifier system with C_1 in series. Whenever the lower end, *B*, of the secondary becomes positive with respect to end, *A*, the plate of the diode, V_1, is made more positive than its cathode and will conduct. Electrons will flow in the direction indicated by the dotted arrows. Since capacitor, C_1, is in series with this electron flow, the right hand side will lose electrons to the cathode of V_1, flow to the plate through the secondary from *B* to *A*, and into the left hand side of C_1. After a short interval of time C_1 will become charged to the peak value of the operating half cycle of V_1, with the right hand side of C_1 being positive. Actually the axis of the input sine wave has shifted from the center of the wave to the bottom; Figs. 3b and 3c. This is similar to d-c restorer operation in television receivers. The voltage at the point *C* fluctuates, as is shown in Fig. 3c. It will be noted that we have not actually doubled the available voltage,

(*Continued on page* 43)



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F-M Antennas

A Discussion[1] of the Design, Operation and Installation of Antennas Which Can Be Used for F-M. Factors Considered Include Height, Polarization, Reflection, Transmission Lines and Impedance Matching.

The advent of highly-efficient loop type antennas and high-gain input circuits in *a-m* receivers outmoded outdoor antenna installations, in many instances. Today with the increasing popularity of f-m sets, we find that the outdoor antenna is once more an essential factor. For, in many areas, an outdoor antenna is required to provide sufficient pickup to properly operate the f-m limiter and provide noise- and distortion-free signals.

Since the f-m carrier is at a much higher frequency than that for a-m transmission, it is necessary to use an antenna that will be efficient at these higher frequencies. Experience has shown that an outside antenna of the dipole type, correctly installed, will give the best results.

The Half-Wave Antenna

The simplest antenna for f-m reception is the half-wave dipole and consists of two quarter-wave rods spaced about 1" apart at the center. This antenna provides a radiation resistance or about 72 ohms at resonance. A dipole resonates when its length is approximately equal to one-half wavelength of the frequency that it is to be used on.

The over-all length of a half-wave dipole for any desired frequency can be computed from the equation:

$$L(\text{in feet}) = \frac{492 \times .94}{\text{Frequency (mc)}}.$$

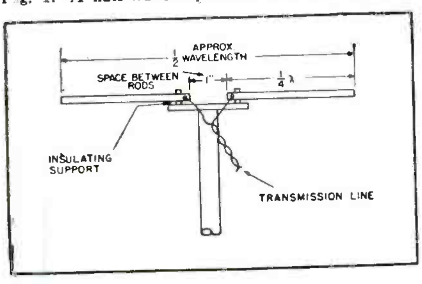
Each rod of the dipole will then be one-half the over-all length. The factor .94 compensates for the end effect of a half-wave antenna at high frequencies and consequently the actual length of a half-wave antenna will not be exactly equal to one-half wavelength of the frequency it is to be operated on, but will be about 5% less.

In actual practice the length of the antenna depends upon a number of factors. If the antenna is to pick up signals from only one station, then the over-all length should be calculated from the middle of the frequency band for that particular station. However, in most cases it is desired to be able to pick up signals from a number of different stations in the band and therefore some compromise must be made in the exact length of the antenna. The usual procedure is to cut the antenna so that it will be ½ wavelength long at the center of the range it is desired to cover. For a range of frequencies of from, let us say, 42 to 46 mc, the antenna should be cut so that it will be ½ wavelength long at a frequency of 44 mc. Substituting this value in the foregoing equation, we find that the over-all length of the antenna would be:

$$L\ (\text{in feet}) = \frac{492 \times .94}{44} = 10'\ 6'',$$

and thus the length of each half of the dipole would be 5′ 3″.

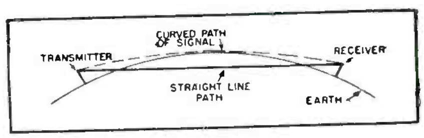
Fig. 1. A half-wave dipole antenna used for f-m.



Range of F-M Signals

For all practical purposes the frequencies assigned to f-m are too high to be refracted back to earth by the ionosphere, as is the case for frequencies somewhat lower. The critical frequency above which refraction in the ionosphere fails to return signals back to earth depends upon the electron density of the ionized region which has daily, seasonal, and yearly variations, dependent upon the sun's radiation. For this reason f-m must depend upon waves travelling directly

Fig. 2. Refraction path of an f-m signal.



[1]*Data courtesy G.E.*

Height	Straight-Line Path	With Atmospheric Refraction, $K=1.3$	H_r 20′	H_r 40′	H_r 100′	H_r 200′	H_r 400′
1,250	44	57	64	67	73	79	89
1,500	48	62	69	72	78	85	94
2,000	55	72	79	82	88	94	104
3,000	68	88	95	98	104	111	120
4,000	78	101	108	111	117	124	133
6,000	95	123	130	133	139	146	155
10,000	123	160	167	170	176	183	192

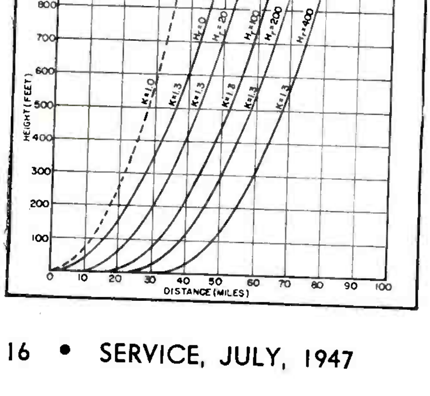
Table 1
Transmitter heights above 1000′.

from transmitter to receiver through the space above the ground. However, due to the curvature of the earth the range of the signals is limited to moderate distances.

Signals received over a greater distance than the straightline path are unreliable because of such factors as refraction. Refraction of ultra-high frequencies by the earth's atmosphere comes about because the variation of atmospheric temperature, pressure, and moisture content with height, cause the refractive index of the atmosphere to decrease with elevation and tends to bend the waves back toward the earth. The amount of curvature that results varies with atmospheric conditions but, on the average, it is equivalent to assuming that the earth's diameter is increased by 25 to 35 per cent. However, due to the continually varying conditions upon which this refraction depends, it is obvious that a signal travelling along this path will not be reliable and, consequently, we must depend upon the straight-line path or the line-of-sight path for dependable f-m reception.

The range of a station, considering only the straight-line path depends upon the heights, H_t and H_r, of the transmitting and receiving antennas respectively.

Fig. 3. Curves showing effects of antenna heights and atmospheric refractions upon the direct line-of-sight transmission. Distance $= 1.23K (\sqrt{H_t} + \sqrt{H_r})$; where H_t = transmitter antenna height (feet), H_r = receiving antenna height (feet), and K = factor (varies between 1.25 and 1.35).



According to the formula: Maximum distance for straight-line path $= 1.23 (\sqrt{H_t} + \sqrt{H_r})$, where the antenna heights are in feet and the distance is in miles.

If atmospheric refraction is considered, the distance is increased by a factor of 1.25 to 1.35, depending upon the atmosphere's refractive index, K. In Fig. 3 there are several curves showing the effect of antenna heights and atmospheric refractions upon the direct line-of-sight transmission. With the exception of the path, all curves are calculated on the basis of the effective range being increased by a factor 1.3 because of refraction in the earth's atmosphere. In Table 1 appears a chart giving the range for several transmitting antennas in excess of 1,000′. It is of interest to note that when one antenna is high (usually the transmitting antenna) and the other relatively low, a given number of feet increase in either antenna is much more effective in increasing the range if it is applied to the lower antenna. This fact may not at first be apparent until we reconsider the fact that the line-of-sight range is directly proportional to the square root of the height of either antenna. For example, if one antenna is 10′ high and the other 1000′ high, the straight-line path in miles will equal:

$$D = 1.23 (\sqrt{10} + \sqrt{1000}) = 1.23 (3.16 + 31.6) = 42.75 \text{ miles}$$

Now suppose we increase the height of the lower antenna by 90′, the straight-line path will now be:

$$D = 1.23 (\sqrt{100} + \sqrt{1000}) = 1.23 (10 + 31.6) = 51.8 \text{ miles}$$

Now suppose that instead of increasing the lower antenna by 90′, we had increased the higher antenna by 90′, the straight-line path would have then been:

$$D = 1.23 (\sqrt{10} + \sqrt{1090}) = 1.23 (3.16 + 33) = 44.5 \text{ miles}$$

From the foregoing example, it is obvious that since receiving antennas are relatively low and transmitting antennas relatively high that increasing the height of the receiving antenna is much more effective than increasing the height of the transmitting antenna an equal amount. Therefore, the importance of placing the receiving antenna as high as possible when the receiver is located a considerable distance from the transmitter.

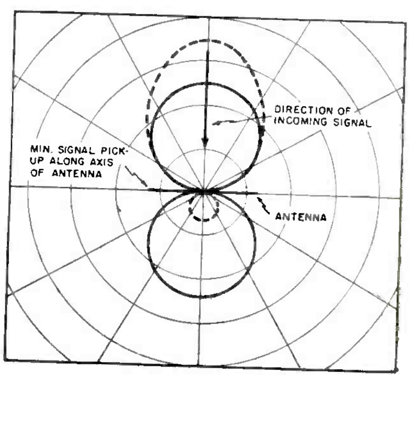
Polarization of Antenna

Since a radio wave consists of magnetic and electrostatic fields at right angles to each other, the polarization of a radio wave simply means the relationship of the electrostatic field with respect to the earth as the radio wave travels into space. If the electrostatic field is vertical with respect to the earth, the radio wave is said to be vertically polarized. If the electrostatic field is horizontal with respect to the earth, the radio wave is said to be horizontally polarized. If the arms of a dipole transmitting antenna are vertical with respect to earth, then the antenna is said to be polarized vertically and for maximum induced voltage the receiving antenna should also be vertically polarized, i.e., the arms of the receiving dipole should also be vertical with respect to earth.

If the arms of the transmitter dipole are horizontal with respect to the earth, then it will send out a horizontally polarized wave and therefore for maximum signal pickup the receiving antenna should also be horizontally polarized.

It has been found that a horizontally polarized receiving antenna is less susceptible to ignition noise and other electrical interference and, conse-

Fig. 4. Horizontal directivity pattern of a dipo



quently, most f-m transmitting antennas send out a horizontally polarized wave.

Response Characteristics of the Dipole Antenna

The solid curve of Fig. 4 illustrates the horizontal directivity of a horizontal dipole antenna. As shown, the signal pickup is greatest when the signal arrives in a direction that is at right angles to the broad side of the antenna. In other words, for maximum signal pickup, the broad side of the antenna should be pointed in the direction in which the signals are arriving from, i.e., toward the transmitting antenna. An inspection of the plot shows that in the direction along the axis of the antenna the signal pickup is practically zero. Use can be made of this fact in locations having a high-noise level by rotating the antenna so that its axis points in the direction from which the noise signal is arriving. Such an orientation may decrease the signal pickup somewhat since the broadside of the antenna may not be pointing exactly in the direction of the arriving f-m signal, but will be very beneficial because of the very great reduction in noise signal pickup.

As shown by the plot, the horizontal dipole responds equally well to signals arriving in either direction that are at right angles to the broad side of the antenna, and under certain conditions this is undesirable.

Noise Source

For instance if there is a noise source near the antenna such that the noise signal from it arrives in a direction that is just the opposite from that of the arriving f-m signal, as shown in Fig. 5, it will greatly reduce the signal-to-noise ratio which may result in poor reception. This undesired condition can be greatly reduced by making use of a reflector. A reflector is simply another rod which is placed parallel to and in back of the receiving dipole. The reflector element is usually about 5% longer than the receiving dipole and is placed about ¼ wavelength in back of the receiving dipole with a resulting gain in signal pickup of about 3 db in the direction in which the broadside of the receiving dipole is pointed; a half-wave dipole with a reflector is shown in Fig. 6. The directional characteristics are illustrated by the dashed curve in Fig. 4 and, as shown, results in strengthening the desired signal and also in greatly reducing any

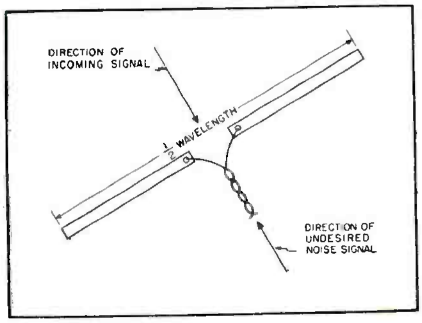


Fig. 5. Signal response of a half-wave dipole.

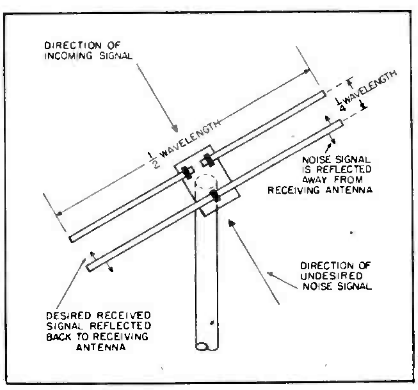
interfering signal that comes from a direction which is directly in back of the receiving dipole.

When a reflector is added to the regular dipole, it increases the antenna directivity considerably, so that the orientation of the antenna array with respect to the direction of the incoming signal is a rather critical adjustment for optimum results. When installing antennas of this type it is usually advisable to check the results of rotating the antenna by listening to the receiver. This normally requires two men to make the installation, one on the roof at the antenna and the other at the receiver, with an intercom system to relay two-way messages.

Transmission Lines

A transmission line is used to transfer power with a minimum of loss from its source to the device in which the power is to be usefully expended. At r-f where every wire carrying r-f current tends to radiate energy in the form of electromagnetic waves, special design is necessary to minimize radiation and thus permit as much as possible of the input power to be delivered to the receiving end of the line. There are various types of transmission lines in use, namely, the open-wire line which consists of two parallel wires maintained at a fixed spacing of a few inches by insulating spacers; the twisted-pair line which consists of two rubber-insulated wires twisted together to form a flexible line; the coaxial or concentric line which uses a wire conductor centered inside of a metal tube which is used as the outer conductor; the flexible coaxial line which uses solid insulation between the inner and outer conductors, instead of spacers or beads, with the outer conductor being made of copper braid rather than solid tubing so that the line will be flexible; the shielded pair balanced to ground which consists of two parallel wires maintained at a fixed spacing by solid insulation around which is an outer shield of copper braid.

Fig. 6. A dipole mounted with a reflector.



Twisted and Parallel Lines

The open-wire line has a fairly low attenuation loss per wavelength, but due to its rather high surge impedance it is more difficult to balance out extraneous signal pickup. The most usual method of transferring the signal from the antenna to the receiver is by means of a low-impedance twisted or parallel pair transmission line, which has a surge impedance of about 100 to 300 ohms. An ordinary twisted pair line is not satisfactory for this purpose since it probably will not have the correct surge impedance and will also probably have a high attenuation loss. A special type of twisted or parallel pair line is made for this purpose, having the correct surge impedance and the proper kind of insulating material to keep the attenuation losses as low as possible, even after being exposed to the elements. However, even the best line has a fairly high attenuation loss, about 3 db per 50′ of length at 100 mc. A twisted or parallel pair transmission line is usually satisfactory for distances up to about 100′, but for distances beyond this it is advisable to use one of the low-loss transmission lines, such as the coaxial line or the shielded pair balanced to ground.

Impedance Matching

In the foregoing paragraph, mention was made of the surge impedance of a transmission line. The characteristic or surge impedance of a line is not determined by the ohmic resistance of the conductors, but by the construction of the line and is equal to the square root of the ratio of inductance to capacity per unit length of line; thus

(*Continued on page 47*)

TUBE *News*

IN INTERPRETING RECEIVING tube ratings, it is quite necessary to be familiar with the standards' terminology adopted by RMA.

For instance, in voltage values certified for the cathode, or heater or filament, the voltage is usually given as a normal value. This means that transformers or resistances in the heater or filament circuit are designed to operate the heater or filament at rated value for full-load operating conditions under average supply voltage conditions. A reasonable amount of leeway is incorporated in the cathode design so that moderate fluctuations of heater or filament voltage downward will not cause marked falling off in response; also, moderate voltage fluctuations upward will not reduce the life of the cathode to an unsatisfactory degree.

Battery Tube Types

Dry battery operation: According to RMA the 1.4 volt line of battery tubes is designed to be operated from a dry cell battery rated at a terminal potential of 1.5 . In no case should the voltage across any 1.4 volt section of filament exceed 1.6. In the case of series operation, shunting resistors may be required to obtain this condition.

Operation from other power sources: When other power supply sources are used the voltage drop across each 1.4-volt section should have a nominal value of 1.3 volts and should be maintained within a range of 1.25 and 1.4 volts at normal line voltage and for tubes of rated filament current. In the case of series operation shunting resistors may be required to obtain this condition. This assumes a normal line voltage of 117 volts, and a normal storage battery terminal voltage of 2 volts per cell.

The 2 volt line of tubes is designed to be operated with 2 volts across the filament. In all cases the operating voltage range should be maintained within the limits of 1.8 volts to 2.2 volts.

Plate and Screen Voltages

In the case of plate and screen voltage, the RMA standards call for recommended maximum values. The interpretation of this maximum value depends on the power source.

A-c or d-c power line: The maximum ratings of plate and screen voltages and dissipations given on the tube type data sheets are *design maximums*. For equipment designed for use in this country on nominal power-line services of 105 to 125 volts, satisfactory performance and serviceability may be anticipated, provided the equipment is designed so as not to exceed the *design maximums* at a line voltage of 117.

Automobile storage batteries: When a tube is used in automobile receivers and other equipment operated from automobile storage batteries, consideration must be given to the larger percentage range over which the battery voltage varies as compared with the power-line voltage. The average voltage value of automobile batteries has been established as 6.6. Automobile battery operated equipment is thus designed so that when the battery voltage is 6.6, plate voltage, plate dissipation, screen voltage, screen dissipation, and the rectified load current will not exceed 90% of the respective recommended *design maximum* values.

In a-c/d-c sets line voltage is applied directly across a rectifier tube and the associated filter system without using a power transformer. Whenever operation above 117 volts is required, a resistor of 50 to 100 ohms is inserted in series with the rectifier plates to prevent damage to the tube or filter capacitor. In many modern sets a filter capacity of 30 mfd or more has been used, which requires the addition of a peak current limiting resistor to prevent damage to the rectifier tube. The proper value will be found specified for each type under the various conditions of load. Except in circuits designed for voltage doubling, the rectified voltage will be relatively low and somewhat below the peak value of the impressed line voltage supply.

The r-f converter and power output tubes suitable for use in this type of receiver are indicated by the inclusion of a rating of 100 volts for both plate and screen. The characteristics under these conditions show very little reduction in the mutual conductance but a great decrease in the plate resistance due to the plate and screen being at the same potential.

Bypassing is also quite an important voltage-standards factor. In the

(*Continued on page* 44)

Miniature 6.3-V pentode power amplifier recents announced by Hytron. See p. 45 for specifications.

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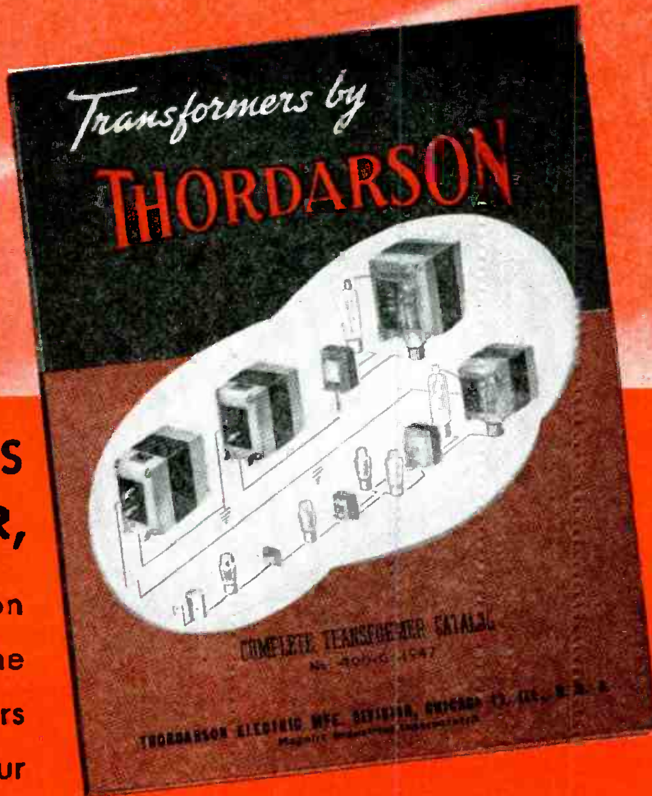

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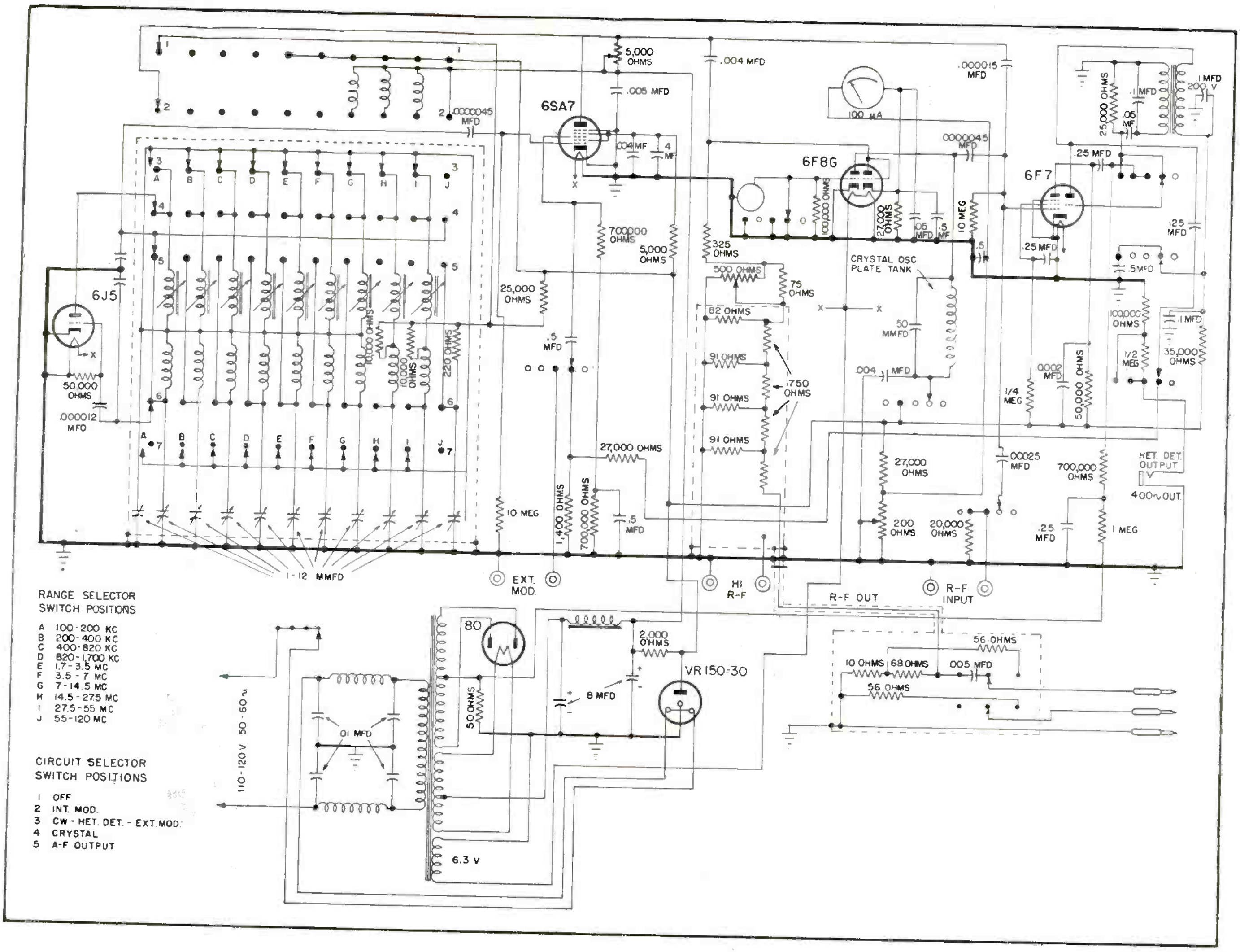


Fig. 1. Circuit of the Triplett 1632 signal generator.

INSTRUMENT Design

In this, the first of a series of instrument circuit analyses, appears a discussion of a 6-tube signal generator, which combines a standard modulated r-f signal output with a heterodyne mixer circuit and crystal standard; Triplett 1632. Six tubes are employed to serve eight circuit functions, and a frequency range of 100 kc to 120 mc is covered in ten steps of a bandswitch.

For purposes of analysis, the various tube and associated circuits, have been isolated; Figs. 2 to 7. The circuits shown are analytical in nature, and do not necessarily follow the switching and mechanical features of the instrument.

Fig. 2 shows the oscillator circuit in simplified form. A 6J5 is used in a tuned-grid plate-feedback circuit. For the first seven bands, covering 100 kc to 14.5 mc, a two-gang tuning capacitor is tied in parallel to supply the necessary tuning capacitance. For the next two bands, covering 14.5 to 55 mc, one section of the tuning capacitor is left open as shown in Fig. 2*b*, simplifying the problem of coil design. For band *J*, covering 55 to 120 mc, both sections of the tuning capacitor are tied together again, and the inherent inductance in the circuit is used for the coils. Air trimmers and iron core coils are used in the r-f section to provide increased frequency stability. The signal is transferred from the oscillator grid through a 4.5-mmfd capacitor to the oscillator grid of a 6SA7 converter tube, used as a mixer; Fig. 3.

The 6SA7 serves the dual function of mixing the r-f and audio modula-

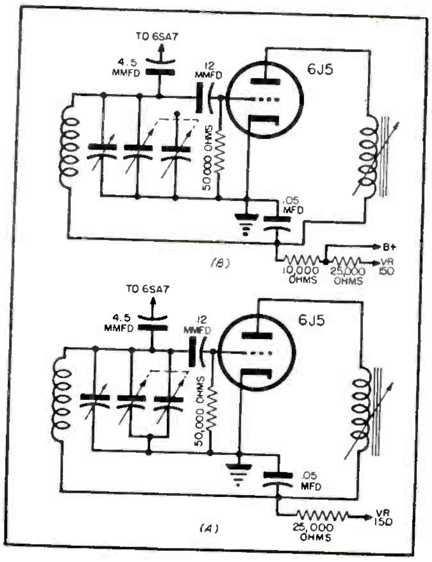


Fig. 2*a* (bottom) and *b* (top). In *a* appears the oscillator circuit of the signal generator which covers the 100-kc to 14.5-mc bands. And in *b* we have the 14.5 to 55-mc circuit. A section of the tuning capacitor has been left open to simplify coil design.

An Analysis of the Circuits Employed in a 100 kc-120 mc Signal Generator

by A. L. W. MARTIN

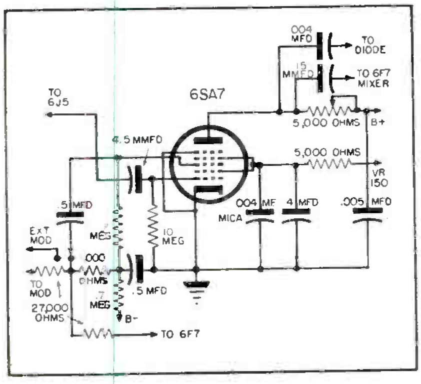


Fig. 3. The mixer circuit. In this circuit the signal is transferred from the oscillator grid through a 4.5-mmfd. capacitor to the oscillator grid of a 6SA7 converter.

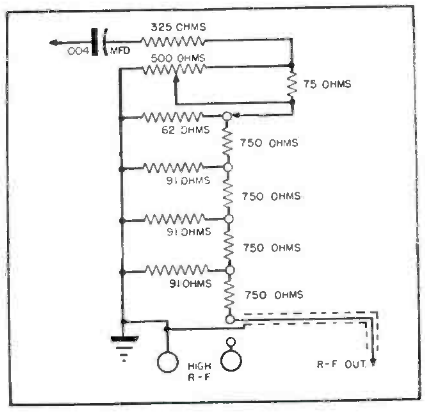


Fig. 6. Ladder-type attenuator used in the output circuit of the signal generator.

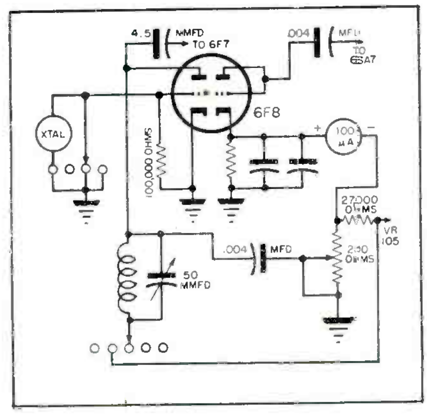


Fig. 5. Circuits used in conjunction with the 6F8 twin triode.

tion, and at the same time acts as an amplifier and buffer stage between the oscillator and external load. It will be noted that the screen grid supply is filtered by two capacitors of .004 and 4 mfd. High-value capacitors are known to have high r-f impedance, particularly at the higher frequencies. For this reason, the 4-mfd electrolytic has been shunted by a .004-mfd mica capacitor for r-f bypassing. Actually the electrolytic serves its function of filtering the a-c ripple of the *B* supply voltage. The signal voltage from the mixer tube is taken off at the plate through a .004-mica capacitor and then fed into a ladder type attenuator.

The audio modulator and heterodyne mixer are shown in Fig. 4. Here, the triode portion of the 6F7 is used as an audio oscillator in a tuned-grid plate-feedback circuit, employing an audio transformer and a .1-mfd capacitor. This circuit is fixed tuned to supply 400-cycle modulation and is fed into the control grid of the 6SA7 mixer tube. Provision is also made for feeding the audio signal alone to an external jack.

The pentode portion of the 6F7 is used as a mixer for zero beating the local oscillator against any external signal. Thus an external r-f signal may be used to check the local oscillator for accuracy. The same mixer circuit is also used to heterodyne the signal oscillator against a local crystal oscillator. The resultant beat note may be audibly reproduced and fed to a pair of headphones. It will be noted that, in the heterodyne position, the triode oscillator is converted into a triode audio amplifier. The plate of the mixer has been bypassed with a .0002-mfd capacitor to bypass any residual r-f in this circuit, in much the same way as a detector.

Fig. 5 shows the circuits used in conjunction with the twin triode 6F8. One triode is used for a crystal oscillator employing a Hartley circuit. The circuit is designed to use a Bliley 1000 kc MS 432 or equivalent.

The second triode has its plate and control grid tied together to make it a diode, and supplies rectified r-f to the 100 microampere microammeter which is calibrated as a multiplier. This meter may be used to set the generator portion for uniform output to the attenuator. Thus approximate signal microvolts can be obtained at the output terminals. The meter also permits compensation for variations in

(*Continued on page* 51)

Fig. 4. The audio modulator and heterodyne mixer.

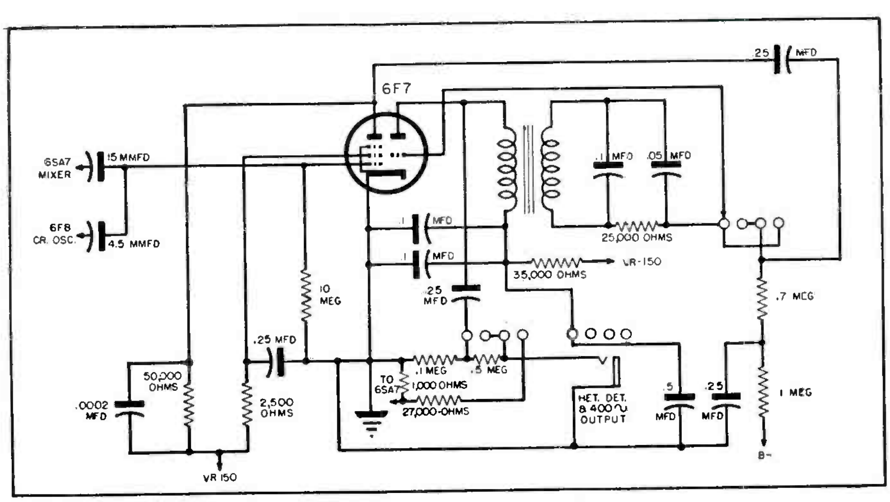
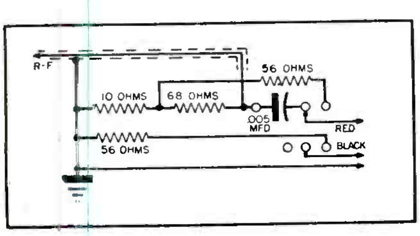


Fig. 7. Output lead with three-position switch which permits direct, capacitance or balanced doublet connection.



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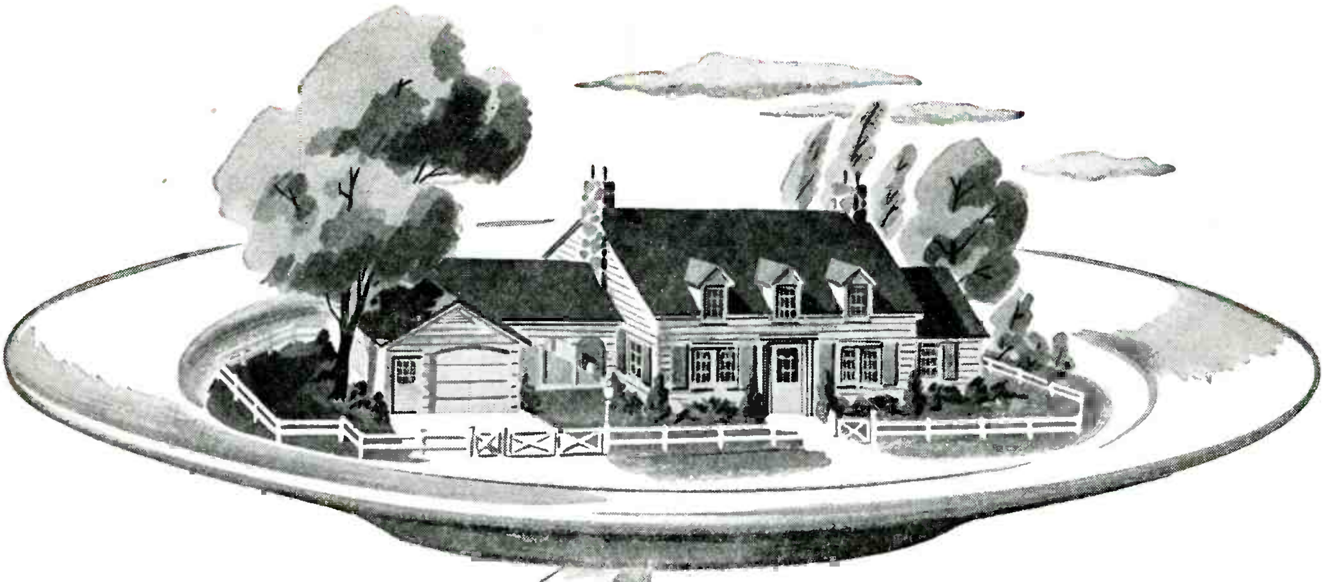

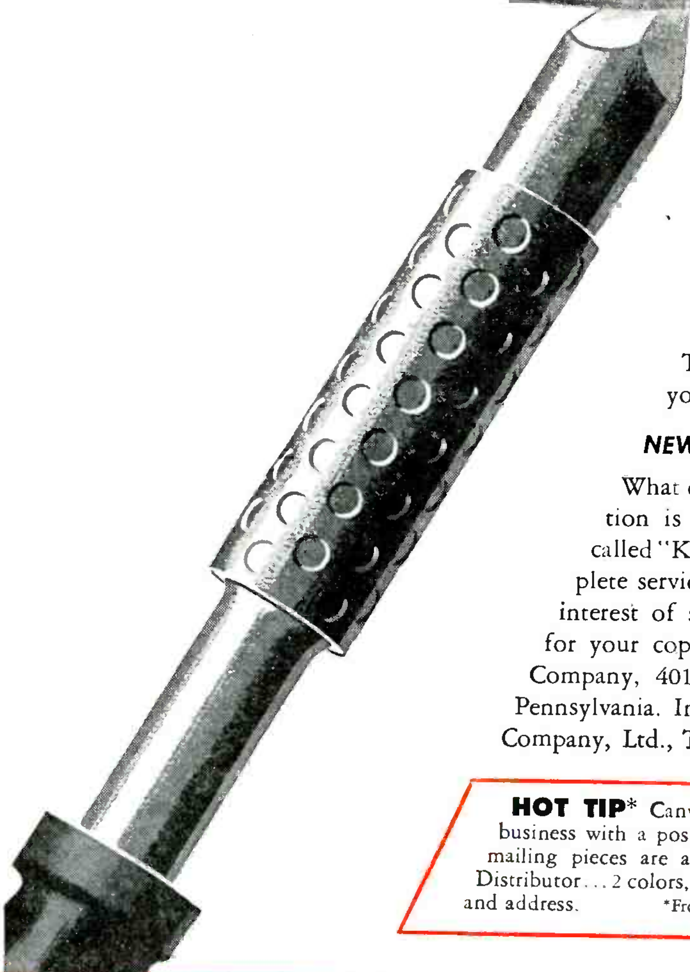

Yes! We don't blame you or any radio technician for wanting a new home only you can't get it by wishing. You can with your soldering iron. Every electronic device you service requires the use of your soldering iron. Therefore, anything that gives you more time behind your soldering iron means more cash for you.

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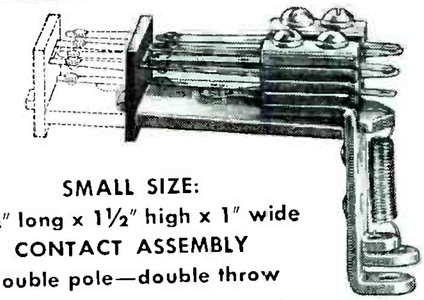
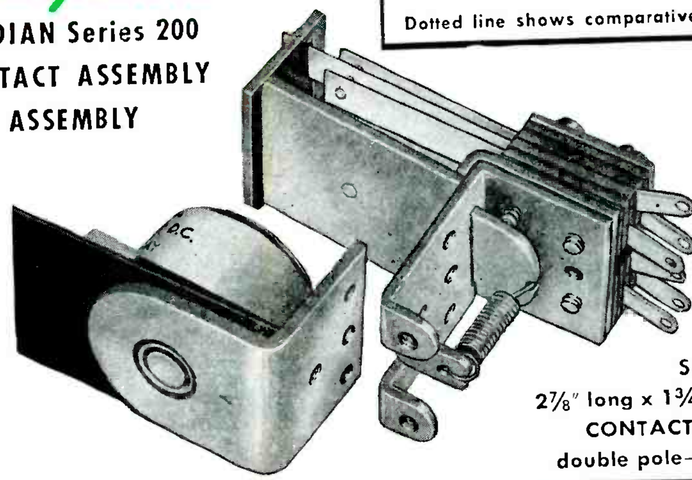
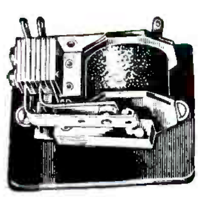


SMALL SIZE:
1⅝″ long x 1½″ high x 1″ wide
CONTACT ASSEMBLY
double pole—double throw
Dotted line shows comparative size

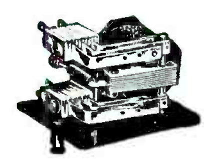


SIZE
2⅞″ long x 1¾″ high x 1″ wide
CONTACT ASSEMBLY
double pole—double throw

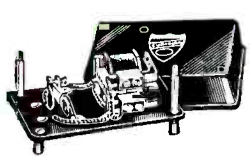
Popular RADIO RELAYS in the GUARDIAN line:



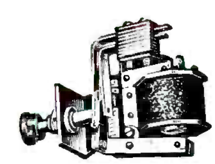
K-100 Keying Relay For low voltage control of high voltage transmission. Guardian Series K-100 Relay will follow key or bug at highest WPM rate attainable. High speed response, strong magnet and return spring give clean make and break, produce best CW note. Coils: 5 to 16 v., A.C.; coils for other voltages on specifications.



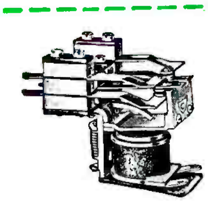
B-100 Break-in Relay For break-in operation on amateur transmitters. The Guardian B-100 Relay has laminated field piece and armature. Fine ¼″ silver DPDT contacts, capacity to 1500 watts, 60 c., non-inductive A.C., and in A.C. primary circuit of any inductive power supply delivering up to 1 KW, inclusively.



T-100 Time Delay Relay In radio transmitter circuits, Guardian's T-100 Time Delay Relay prevents damage of rectifiers and tube filaments by preventing plate current before filaments are sufficiently heated. Laminated field piece and armature. Mounted in dust-proof metal box.



L-250 Overload Relay Provides accurate, fixed overload protection against current surges and continuous overloads. Guardian's L-250 Relay replaces expensive, time-wasting fuses. Attracts armature on 250 mils. Max. drop across coil—10 v. Guardian's L-500 Relay attracts armature at 500 mils. Max. drop across coil—5 volts. Ideal for experimenters on new circuits.



A-100 Antenna Relay A low loss AlSiMag insulated relay. For single wire fed installations specify the A-100-C, SPDT unit. Two A-100-C in place of one A-100 in open wire line systems will avoid possible impedance mismatch. A very popular relay with radio amateurs.

SEE THESE AND OTHER GUARDIAN RELAYS AT YOUR JOBBER — OR WRITE FOR BULLETIN R-6.

Ask your jobber for the new midget contact switch assembly which is interchangeable with the Guardian Series 200 coil assembly. Your jobber carries a complete line of Guardian radio relays.

GUARDIAN ELECTRIC

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A COMPLETE LINE OF RELAYS SERVING AMERICAN INDUSTRY

Right
Centralized school sound system with six inputs; four low-impedance high-gain microphone inputs, one high-impedance high-gain phono input and one high-impedance moderate-gain phono input. Unit has twelve zone switches, mounted in groups of six. (*Courtesy RCA*)

Left
Amplifying and control equipment for a restaurant sound-distribution system. (*Courtesy Western Electric*)

Illustration at left on p. 25
Newcomb portable sound system, consisting of a battery-operated amplifier, in use during a recent railroad accident in California.

Choosing The Proper P-A SYSTEM

THE P-A MAN is constantly faced with the problem of installing the most satisfactory system, for a given job, at the most reasonable cost. There is usually also the problem of determining what power amplifier to use, and what type microphones and loudspeakers will offer best results.

To determine what equipment an installation will require it is necessary to survey the location. If the location is out of doors, the size of the area to be covered, and its distance from the most practicable loudspeaker location, must be found. The kind and intensity of interfering noise made by people, machinery, etc., should be determined. If the location is indoors, information on the size and shape of the hall or arena is necessary, as well as the normal audience capacity. It is necessary to learn whether the place is *live* or well damped. Very often it will be found that a large hall with considerable *echo* or reverberation cannot be covered nearly as well with a relatively high-power single source of sound, as with several lower-power loudspeakers dispersed around the auditorium. Information on the noise level to be expected must also be obtained.

In determining a selection of p-a systems, it is wise to study the types of units available today, and the relation of their cost to power capacity. The most common *nominal* ranges, in terms of rated amplifier power, are shown in the *Table I*, together with the approximate reduction in cost per watt, compared to a 10-watt amplifier. It will be noted that manufacturers ratings vary somewhat from one to the other in any nominal-range.

Naturally the foregoing applies to amplifiers of the same general quality of manufacture as used for average p-a work. It can be seen, then, that the comparative cost per watt of rated output power of commercial p-a amplifiers of a given standard becomes progressively lower for larger power values, within this range. This cost decreases most rapidly in the 30- to 50-watt bracket. Naturally more dollars are required for a larger amplifier, but often Service Men are apt to overlook the fact that the additional available watts in one 30- to 50-watt amplifier cost much less than the watts in several 10- or 15-watt units. Another aspect in using a higher power amplifier is that it may obviate the necessity of using more expensive higher efficiency loudspeakers which may become necessary to *squeak by* if, say, only one 15-watt amplifier is used.

Nominal Amplifier Output Power Rating in Watts	*Approx. % Reduction in Cost/Watt*
10	0
15	15%
30	30%
50	33%
100	30%

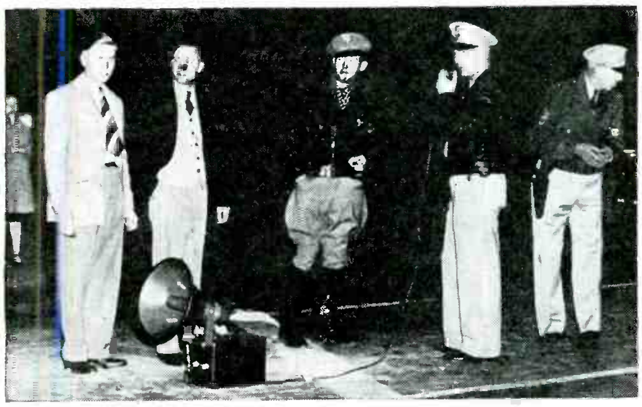
TABLE I

Again, the additional margin of power in a *larger* amplifier will reduce overload distortion and result in a more satisfied client. The choice of the loudspeakers depends upon the intended use, as covered in a previous article.[1] In general, horn and driver types are more satisfactory for outdoor use, while both these and cone types in suitable baffles may be used indoors. The former type are more efficient, particularly for speech in the sizes practical for p-a applications. The cost of loudspeakers depends primarily upon their power capacity, frequency range, and efficiency, for a given standard of ruggedness and reliability. Thus, choice of the correct type and size loudspeaker for the job will effect the greatest economy with satisfactory performance.

P-a microphones are today generally confined to crystal, moving coil, and ribbon types, and combinations of velocity and pressure elements or the equivalent, to effect various directional properties. Choice of one of the many variations of the first two types, depending on the system's requirements as to range, microphone output, directive properties, etc., will give adequate service for all but the highest quality sound systems, and are most popular with p-a engineers. The cost of mi-

[1]Sanial, A. J., *Loudspeakers*, SERVICE, June and July, 1946.

Right
Operadio sound system with an a-m/f-m receiver, transcription player, emergency 'phone and intercom unit, and channels for transmitting the same or different programs into individual rooms. At microphone is Paul Chauncey, chief sound and communications engineer, Walker-Jimieson, Inc. Looking on are Operadio chief engineer, Bill Torn; J. M. Stone, president, and Arch Samuelson, sales manager of Operadio.



A Discussion of the Relation of Costs to Power Capacity; Intelligibility and Noise Levels; Matching; Voice and Instrument Coverage; Speaker Designs; Voltage and Power Amplifiers; Pickups; Microphones, etc.

by ARTHUR J. SANIAL
Electronic-Acoustic Consultant

crophones increase in the order given, and for any one type vary chiefly with sensitivity and range and fidelity of frequency response.

We can now consider various sizes of p-a systems for covering typical applications economically. In Table I we noted that a 10-watt amplifier was shown as the smallest, but it should be mentioned that many so-called *ballyhoo* systems incorporate amplifiers rated between 5 and 8 watts, an inexpensive crystal microphone, and a cone speaker. Such a system is only adequate to cover small crowds such as gather around a side-show entrance or in a small auction room, and even these are usually overloaded and full of distortion due to the enthusiasm of the announcer in his attempts to be emphatic and persuasive.

A more satisfactory small system utilizes a crystal microphone, a 10-watt amplifier (normal), and one of the small folded horns with self-contained driver unit, which are rated at 11 to 13 watts. Such a system is entirely adequate to cover 1,000 to 2,000 square feet of outdoor area near the speaker, as long as the noise level is not too high, with good speech intelligibility. Indoors, a typical audience of 200 to 400 people can be covered. It must be recognized that this type loudspeaker has a generally narrower coverage angle than a direct radiator cone; thus this speaker will give better coverage if directed along the longer dimension of the room or area. Even better results will be obtained with two such speakers, because of lower loudspeaker distortion and more uniform coverage, assuming they are located and directed to best advantage.

For musical reproduction (at lower level due to the more rigid distortion requirements) a turntable and crystal pickup can be used to drive the amplifier through its phono connection, and the horn-type speaker will give passable reproduction. It is advisable to adjust the tone control to reduce the bass response as these small speakers will not handle the larger low-frequency amplitudes at full power. Even though somewhat less efficient, improved musical reproduction can be obtained by connecting a 12″ p-m cone (in adequate baffle) in place of the horn type. A method which gives surprisingly good results considering its simplicity, and provided a cone speaker having an impedance not too far different from that of the horn (about 10 ohms) is used, is to connect both to the amplifier output. In this case a 10- to 15-mfd capacitor (an electrolytic will do temporarily) is put in series with the horn speaker, and the combination is paralleled with the cone speaker. This is not advocated as a substitute for a high-quality two-channel system, but it is better than either speaker on music.

It is preferable to figure on more amplifier power if music is to be reproduced, even in a small hall. The increased margin of even a 15-watt amplifier is worth the small additional cost. In this case, two 12″ cones may be used, and if care is used in considering impedance, and power division, one of the small horn units can be added, as above, to brighten the treble register. For speech only, at least two of these horns should be connected to the amplifier output for safety and reduced distortion. This combination will cover a somewhat larger audience, possibly 300 to 500 people, depending upon the level of room noise. The use of two speakers allows more uniform sound coverage of the audience also.

This same system is also suitable for outdoor use, it being possible to adequately cover an area of between 1,500 to 2,500 square feet, always remembering the influence of ambient noise level, plus additional noises due to the audience or other transient causes.

Noise naturally decreases the intelligibility of speech, so the sequel level of reproduced speech must be boosted to counteract this effect. It has been shown and verified in field use that about a 10-db increase in sound level is required for every 10-db increase in noise level in the region of conversational sound (speech) level. In p-a work a sound intensity level of +70 db is the minimum that should be figured on, and this must be increased to about +80 db if there is an ambient noise level of 10 db. If the noise level is higher, the speech level must be increased more, but increases of about 5 db in the speech are most effective for 10-db increase in noise levels *at the higher intensities*. A chart showing approximately how this works, assuming a uniform type of noise, is shown in Table II; derived from the work of Fletcher[2] and others.

If Noise Level Is Increased in Decibles Required		*Speech Sound Level Increase in Decibles, for Optimum Intelligibility*	
From	To	From	To
10	20	70	80
20	30	80	90
30	40	90	95
40	50	95	100
50	60	100	105
60	70	105	110

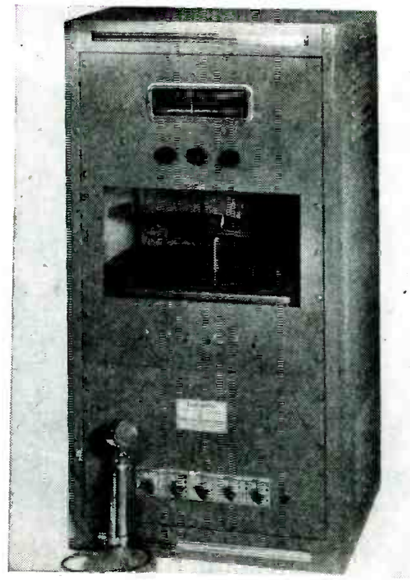
TABLE II

It will be noted that *optimum intelligibility* is specified; this does not mean the intelligibility of speech increases with the acoustic power in the presence of noise, but only that there is a preferred value of acoustic power level for every value of noise level that gives the best result. The intelligibility of speech is highest in the 65- to 75-db range *under very quiet conditions* and actually decreases as the level is raised, under any condition. This is important to the p-a man, because a 10-watt amplifier system may be perfectly satisfactory when figured for a quiet locality, but would be a disappointment when installed in a noisy area. It is important, then, to either measure the noise or estimate it from published tables or charts which show the approximate noise level of representative classes of noise. Suppose, for instance, we were to install a p-a system in an outdoor location where the average noise level is 40 to 50 decibels. The sound level required for *best* speech intelligibility is about 95 decibels. Ordinary acceptable intelligibility will still be obtained, however, up to noise levels of 60 decibels. For a 1,000-square-foot area, with maximum distance of listener being 25 feet from the loudspeaker and a good grade of horn driver type being used, 9 watts of available amplifier power should be figured on, for low distortion intelligible reproduction. This assumes ideal uniform distribution of the sound over the whole area. This condition usually will not be obtained in practice with one- or even two-horn type loudspeakers. However, we can say that a 10-watt amplifier has sufficient power to give good coverage over an area of a shape which the particular horn speaker's directivity characteristic will cover most effectively. Such a shaped area is seldom found, for areas at wide angles off the speaker axis usually have lower sound levels than necessary for best intelligibility. It is better therefore, particularly for outdoor applications, to use somewhat more power such as provided by the 15-watt range of amplifier units, driving two of the small 11-13-watt horn-type loudspeakers. The 15-watt type amplifier can also be used very effectively to drive a single folded-horn loudspeaker of the next largest size available. These use driver units rated at 25 watts, which is advantageous, as much less distortion will be produced by such a speaker being worked below its maximum rated power. Horns vary in size depending upon the low frequency cutoff rating, but all of these types are more directional than the smaller type. For this reason these larger loudspeakers are more advantageous where it is desired to cover a long narrow area, or an area located somewhat further away from the loudspeaker than could be covered by the smaller type. However, the larger loudspeakers are more costly and thus are usually only justified in a more expensive installation, in which the added cost of a 30-watt amplifier is relatively unimportant.

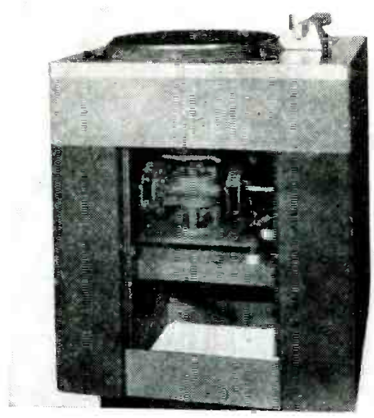
The use of a 30-watt range amplifier is not recommended for a single 25-watt horn loudspeaker, for even though those of reliable manufacture will withstand this power for some time without failing, the life of the driver unit is definitely shortened. More important, however, is the fact that even with 25 watts applied, considerable distortion results, particularly from the application of signals of 200 to 250 cycles and below. If one loudspeaker only is required, the amplifier output should be reduced 3 db, or if safety is a major consideration, a resistance equal to the nominal loudspeaker impedance may be shunted across it, and the amplifier output tap moved to a value one-half the speaker impedance. The latter expedient, of course, reduces the available margin for peak signals, so the first method is best if a reliable operator is on the job.

Two such speakers, therefore, should usually be the minimum connected to a 30-watt amplifier.

[To Be Continued]



A 35-watt amplifier for indoor use, which features a 2-band tuner and record changer player. System is supplied with fourteen 12" p-m speakers. (*Courtesy Radio Wire Television Inc.*)



Transcription turntable featuring two separate motors for 33⅓ and 78.26 rpm. (*Courtesy Presto*)

A 10-watt phono amplifier, featuring an inverse feedback circuit, and using two 6SJ7s, one 6J5, one 6SN7, two 6B4s and one 5U4G. (*Courtesy Thordarson*)

[2]Fletcher, Harvey, *Speech and Hearing;* D. Van Nostrand.

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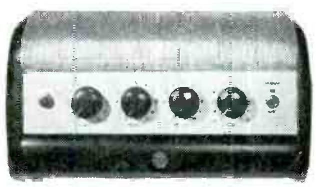

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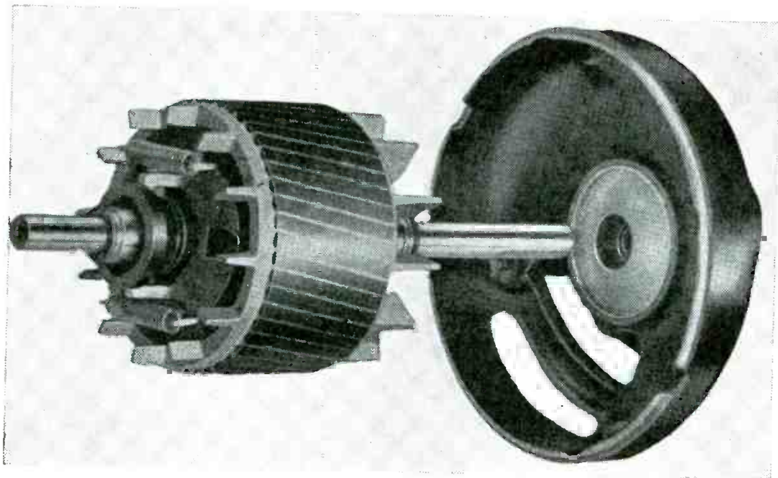
MOTOR *maintenance and repair*



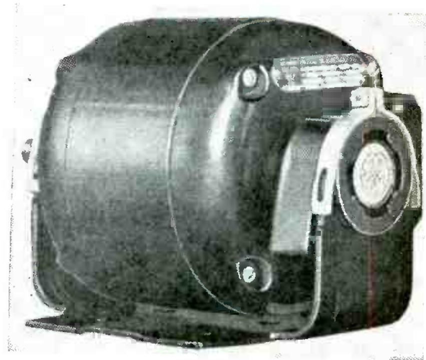


Fig. 1. A split-phase motor. (*Courtesy G.E.*)

Fig. 2. Rotor of a split-phase motor. (*Courtesy G.E.*)

THE SPLIT-PHASE MOTOR is an a-c motor of fractional horsepower size with four main parts: (*1*) A rotating part, the rotor; (*2*) stationary part, the stator; (*3*) end plates or brackets and (*4*) centrifugal switch located inside the motor. This motor is generally operated from 115-volt single-phase circuit.

The rotor consists of three elements: A laminated iron core; a shaft on which the core is pressed and a one-piece cast aluminum winding located in the slots of the core.

The stator consists of a laminated iron core with semi-closed slots and has two windings of insulated copper wire wound into the slots. These are called the *running and starting windings.*

The end brackets are fastened to the stator frame by means of screws or bolts and serve mainly to keep the rotor in position. The brackets are fitted with either ball- or sleeve-bearings. These sustain the weight of the rotor, keep it precisely centered within the stator and permit rotation without allowing the rotor to rub on the stator.

The centrifugal switch is located inside the motor. Its function is to disconnect the starting winding after the rotor has reached a predetermined speed. Circuit of the starting winding, running winding and centrifugal switch appears in Fig. 5. The switch is normally closed when the motor starts but opens when the motor attains speed. The usual type of centrifugal switch consists of two parts, namely a stationary part (Fig. 6) and the rotating part. The stationary part is located on the front end bracket and has two contacts. It is similar in action to a single-pole, single-throw switch. The rotating part is located on the rotor.

Centrifugal Switch Action

Referring to Fig. 7, we note that when the motor is at a standstill the two contacts on the stationary part of the switch are kept closed by the pressure part. At approximately 75% of full speed the rotating part releases its pressure against the contacts and causes them to open, thus automatically disconnecting the starting winding from the circuit.

Operation of Split Phase Motor

The stator windings (Fig. 8) consist of a winding of heavy insulated copper wire which is generally located at the bottom of the stator slots and is known as the running or main winding, and a winding of fine insulated copper wire which is usually located on top of the running winding and is known as the starting or auxiliary

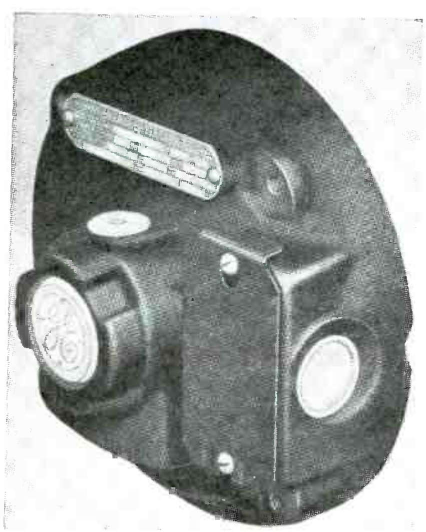
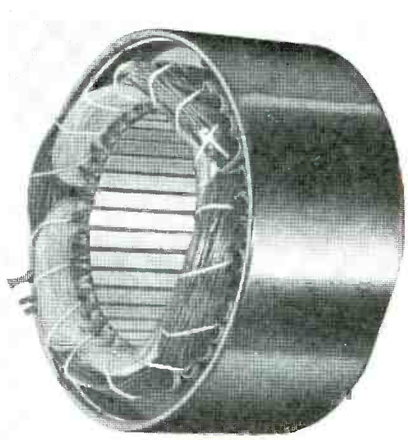


Fig. 4. End bracket of a split-phase motor. (*Courtesy G.E.*)

Fig. 3. Stator of a split-phase motor. (*Courtesy G.E.*)



Third of a Series[1]. . . Testing and Trouble Shooting of the Split-Phase Type Motor Used in Small Power Machines, Pumps, etc.

by ROBERT ROSENBERG

Instructor in Armature Winding and Motor Repair
George Westinghouse Vocational High School

winding. These two windings are connected in parallel. When the motor is started both windings are connected to the line; Fig. 9*a*. Upon reaching approximately 75% of full speed, the centrifugal switch opens (Fig. 9*b*), and disconnects the starting winding from the circuit, thereby causing the motor to operate on the running or main winding only.

At the start, the current flowing through both running and starting windings caused a magnetic field to be formed inside the motor. This magnetic field rotates and induces a current in the rotor winding, which in turn causes another magnetic field. These magnetic fields combine in such a manner as to cause rotation of the rotor. The starting winding is necessary at the start in order to produce the rotation of the field. After the motor is running the starting winding is no longer needed and is cut out of the circuit by means of the centrifugal switch.

Procedure for Analyzing Motor Trouble

When a motor fails to run properly a definite procedure should be adopted to determine the repairs necessary to put it into running condition. Then a series of tests should be applied to discover the exact trouble.

In analyzing motor troubles, it has been found best to follow four steps of study:

(*1*) The motor should be inspected to detect such mechanical troubles as broken or cracked end brackets, badly bent shaft, broken or burnt leads.

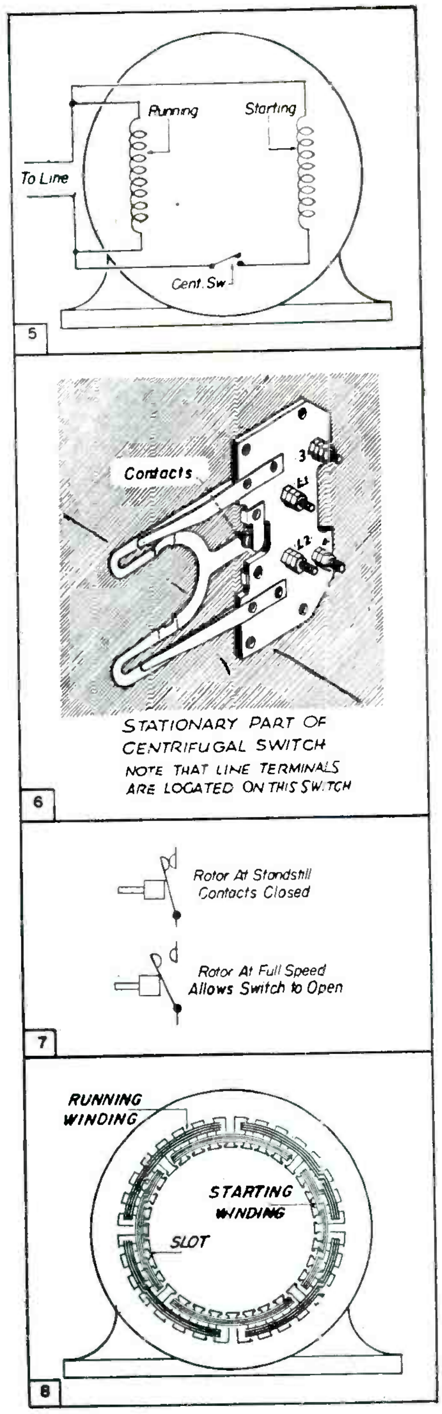
(*2*) The motor should be tested for bearing troubles. To do this, you should try to move the shaft up and down in the bearing. Any such movement indicates a worn bearing. Next the rotor should be turned by hand to determine whether it rotates freely. A shaft that does not rotate freely indicates bearing trouble, a bent shaft or an improperly assembled motor. In any case a fuse is likely to burn out should the motor be connected to the line.

(*3*) The motor should be examined to discover whether or not the internal wires are touching the iron core of the rotor or stator. This is called a ground test and is accomplished by using a test lamp.

(*4*) After determining that the rotor turns freely, the next test is to run the motor. The power line wires are connected to the terminals of the motor and the switch closed for a few seconds. If there is something wrong internally the fuse may blow, the windings may smoke or the motor may rotate slowly or noisily or may not turn at all. Such symptoms always indicate trouble inside the motor, usually a burned-out wire. The end brackets are then removed and the windings tested more carefully. Should the trouble be a badly burned winding, the winding itself will look burned and will also feel and smell burned.

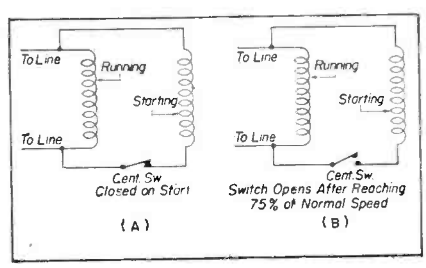
Rewinding the Split-Phase Motor

After previous tests have shown that the windings of the motor are burned out or severely shorted, rewinding is required in order to recondition it. Before the motor is taken apart the end brackets and frame should be marked with a center punch so that it may be reassembled properly. One center punch mark should be made on the front end bracket and adjacent frame and two marks made on the back end and also at a corresponding point on the frame. The motor can be



Figs. 5, 6, 7 and 8. Fig. 5 shows a wiring diagram of a split-phase motor. Note windings and the centrifugal switch. In Fig. 6 we have the stationary part of a centrifugal switch. Fig. 7 shows the steps involved in the operation of a centrifugal switch. The two windings of a split-phase motor appear in Fig. 8. Note the four sections or poles in each winding.

Fig. 9. The change in a motor circuit caused by a centrifugal switch.



[1]*Parts I and II appeared in the April and May issues of* SERVICE.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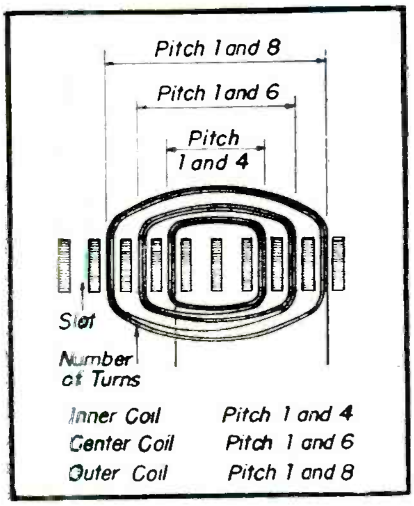


Fig. 11. The pitch of the three coils which form one pole.

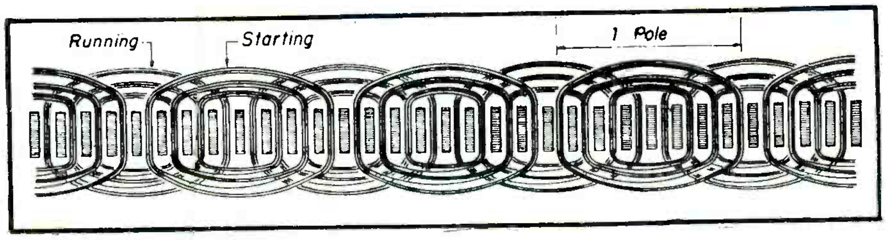


Fig. 10. Diagram of the poles of a thirty-two slot four pole motor. Note how the starting winding overlaps the running winding.

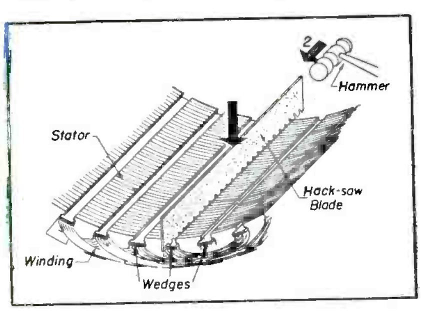
then disassembled and made ready for repair.

There are six major steps to be followed in the repair of a split-phase motor with a damaged winding: (*1*) Taking data; (*2*) stripping the windings; (*3*) insulating the slots; (*4*) rewinding; (*5*) connecting the winding, and (*6*) testing.

(*1*) Taking data consists of noting and recording specific information concerning the old winding so that no difficulty will be encountered when the motor is rewound. The information necessary includes the number of poles in the starting and running windings, number of turns in each coil, size of wire, pitch of each coil, kind of connection, etc. (Fig. 10 shows all the poles of a 32-slot motor and Fig. 11 shows one pole of the running winding. Notice the location of the running winding, in respect to the starting winding. The starting winding overlaps two poles of the running winding.)

(*2*) If only the starting winding needs replacing its coils can easily be removed by cutting the wires on the end of the stator and then pulling them out from the other side. Sometimes the wires can be lifted from the slots after removing the wedges that hold them in place. The wedges can be removed by using a power hack-saw blade; Fig. 12. After the winding is removed the slot insulation should be cleaned out.

Fig. 12. How to remove wedges from slots.



(*3*) Before placing the windings in the slots some form of insulation must be installed so that the wires do not touch any part of the iron core. Different types of insulation material are available for this purpose. The insulation is cut (Fig. 13) so that it is about ¼″ longer than the slot and shaped to fit the walls of the slot. Sometimes the ends are cuffed as shown to prevent it from sliding in the slot. For the average size of fractional h-p motor, insulation paper approximately .015″ thick is used.

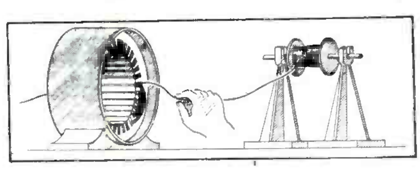
(*4*) There are several methods of winding a split-phase motor, but only one will be briefly described. This method is called the hand winding and is illustrated in Figs. 14, 15, and 16. The stator and spool of wire are arranged as shown in Fig. 14 and the end of the wire is placed in the bottom of the slot. The inner coil, pitch *1* and *4*, is wound with the required number of turns. Then the next coil is wound on; Fig. 15. This is continued until all the coils of a pole are wound. After the entire running winding is wound, the starting winding is put on in the same manner.

Connecting

The next step after the poles of the motor have been wound is to connect the windings. Regardless of the number of poles it is essential that adjacent ones be of opposite polarity. This is accomplished by connecting them in such manner that the current will flow through the first pole in a clockwise direction and through the second pole in a counterclockwise direction; Fig. 17. This shows a four-pole running winding of a thirty-six slot motor.

Four-pole motors connected in series are by far the most common in use. Fig. 18 shows the connections of a series four-pole split-phase motor.

Fig. 14. Position of the rotor and wire spool during the winding operation.



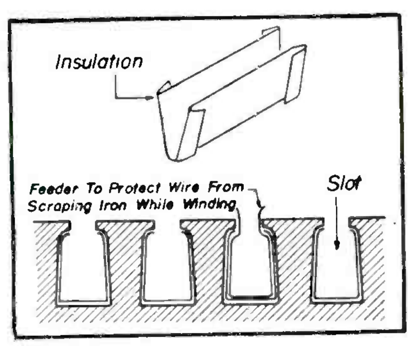
Reversing a Split-Phase Motor

The direction of rotation of a split-phase motor may be changed by reversing the wires of either the running or starting windings. Fig 19 shows the wires of the starting winding reversed as compared with those in the circuit of Fig. 20.

Speed Control

The speed of a split-phase motor is governed by the number of its poles, for a given line frequency. A four-pole motor will run approximately 1,750 rpm, a six-pole motor approximately 1,150 rpm, etc. To change the speed of the motor it is necessary to change the number of the poles. This is done when it is desired to run a motor at two different speeds. A two-speed motor used for fan service is an excellent example of the speed-control application; Fig. 21. This motor has two running windings and one starting winding. One running winding has eight poles for low speed, and six poles

Fig. 13. An insulating strip and its placement in a slot before winding.



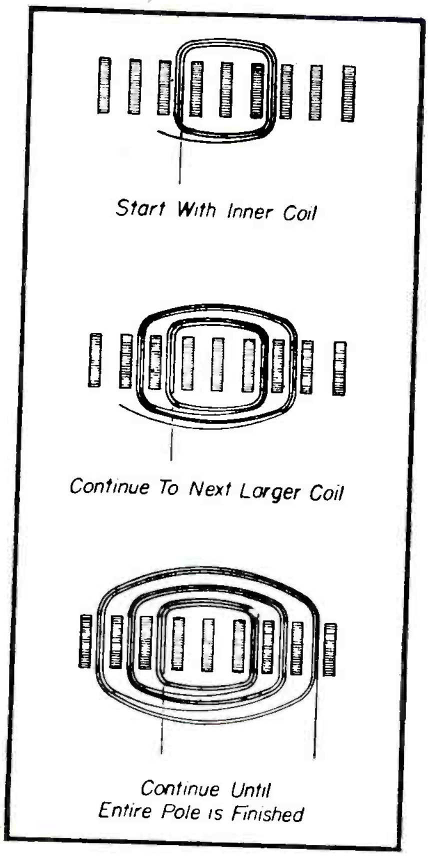


Fig. 15. Procedure for winding a stator pole by hand.

for high speed. Only one starting winding is used for starting at either high or low speed. A double contact centrifugal switch is used on this motor.

Trouble Shooting and Repair

Testing

To detect defects in a split-phase motor, both the running and starting windings should be tested for *grounds, opens, shorts* and *reverses*.

Grounds

A winding is said to be grounded when it makes an electrical contact with the iron of the motor. To determine if the winding is grounded a test lamp is used. One test lead to the lamp is connected to the winding and the other winding to the stator core; Fig. 22. If the lamp lights, the winding is grounded. Should the winding prove to be grounded you should try first to locate the ground by visual inspection. If this does disclose the ground it will be necessary to disconnect the splices between poles and test each pole separately. When this grounded pole is located the point of ground should be determined and removed by reinsulating or rewinding.

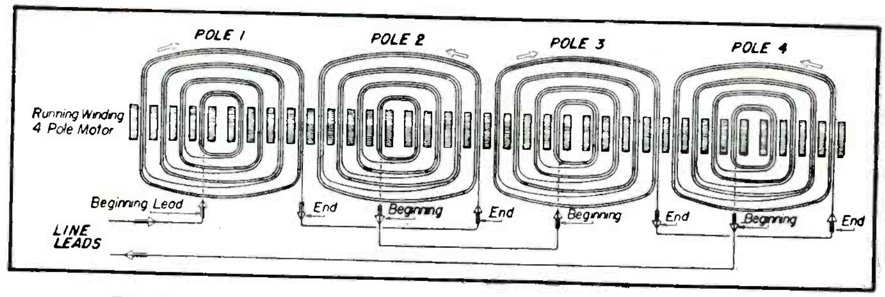


Fig. 17. Four poles of the running winding connected for correct polarity.

Open and Short Circuits

The usual cause of an open circuit in a split-phase motor is a loose or dirty connection or broken wire, which may be either in the running or starting winding or in the centrifugal switch.

Two or more turns that connect each other electrically will cause a short circuit. Usually a short circuit exists if the winding smokes when the motor is running or when it draws an excessive current at no load.

Several methods may be employed to find shorted coils:

The motor should be run for a short time, and the hottest coil located by feeling the poles. This coil will generally be the one that is shorted.

The voltage-drop test is another useful test method. The winding is connected to a source of low d-c voltage, and a voltage reading taken across each pole. The pole that has the least voltage drop is the shorted coil. To repair a shorted pole it is necessary to remove the coil and rewind it, unless the short can be located by inspection and thoroughly insulated without rewinding.

Reverses

Reverses result from wrong connections between poles and are discovered by means of polarity test. Two methods can be used: compass and nail method.

In using the compass, a low d-c voltage is applied to the running or starting winding. The compass is then held near the stator and moved slowly from one pole to another. If

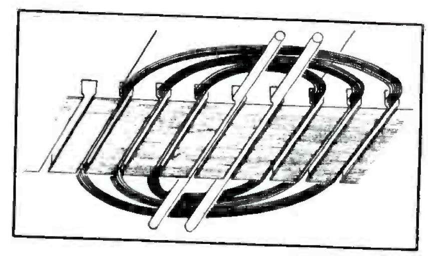


Fig. 16. How wooden dowels may be placed in empty slots to hold coils in position while winding.

the winding is connected correctly the compass needle will reverse itself at each pole, as shown in Fig. 23. If the same end of the needle is attracted to the adjacent poles a reverse pole is indicated. In using the nail method a low voltage of either alternating or direct current is applied to the winding. A nail is placed on the core so that it extends from the center of one pole to the center of the next pole. If the adjacent is correct the nail will be attracted to the next pole, but if the polarity is incorrect one end of the nail will be repelled from its pole.

Should it be found that one pole has the wrong polarity this error can be corrected by reversing the two lead connections to this pole.

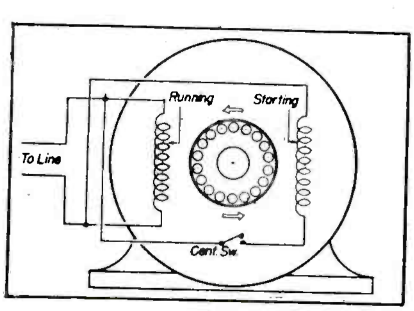
Repairs

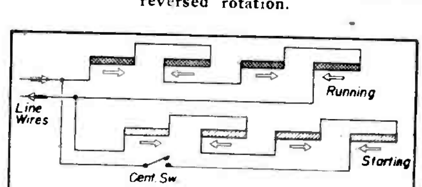
It is now in order to consider the various troubles that develop in split-

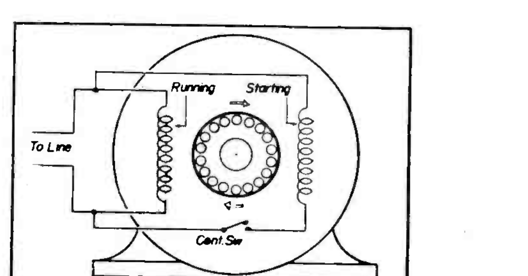
(*Continued on page* 41)

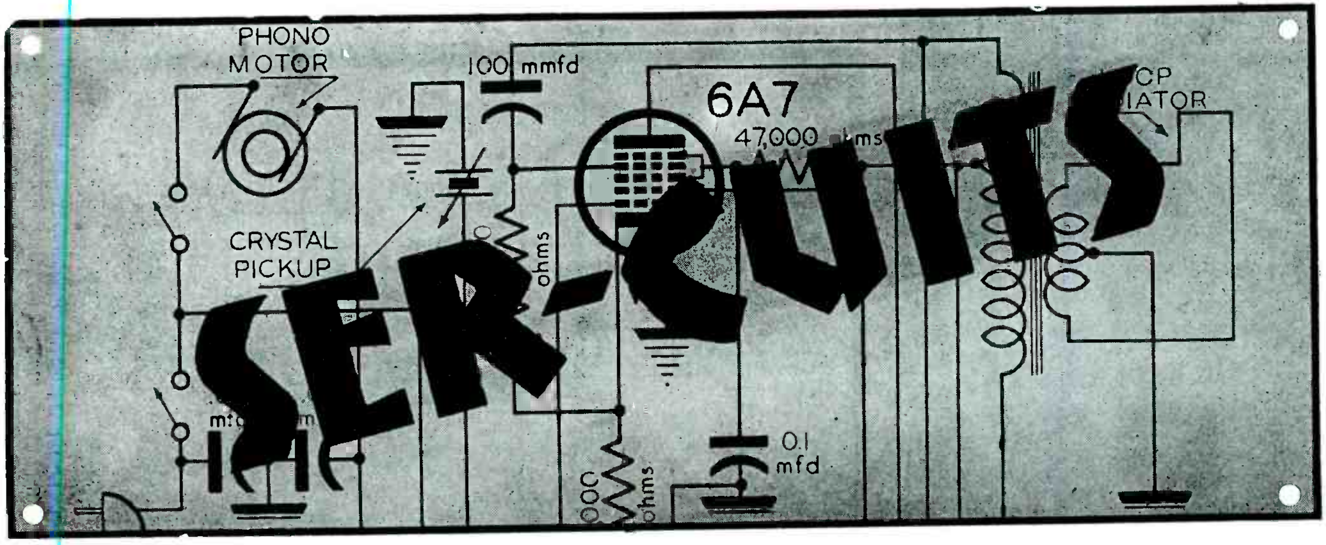
Fig. 18 (below). A four-pole split-phase motor connection.

Figs. 19 and 20 (left and right). Fig. 19 shows a split-phase motor with the four leads brought outside the frame for reversing. In Fig. 20 we have the motor shown in Fig. 19, connected for reversed rotation.









In last month's discussion of phono amplifiers, crystal pickup circuits were analyzed.

Continuing our study, let us now trace the circuits of typical amplifiers employing crystal pickups.

High-Voltage Pickup Amplifier

In Fig. 1 we have a typical high-voltage pickup-type amplifier. Here the output of the crystal is used to drive the output stage directly. The use of a 50A5 in parallel with a 35A5 for the output stage permits greater power output for a given input. For maximum signal output, 1.5 watts for the 35A5 and 2.2 watts for the 50A5, both tubes require 7.5 volts r-m-s input. It should be noted that in practice these values are seldom achieved. However, since the two tubes are in parallel, the lower input voltage delivered by the pickup (max. 4 volts) will provide an output comparable to that of a single tube.

Isolating resistors are used in the screen and control grid circuits. A two-section filter, using three 40-mfd capacitors and two resistors, is used to filter the plate and screen grid supplies. A tone control consisting of a 10,000-ohm pot and a .1-mfd capacitor is used in the plate circuit to attenuate highs and thereby remove needle scratch. This high value of capacitor is necessary, since the impedance in the plate circuit is very low, due to the two tubes being in parallel.

Electromatic Amplifiers

Figs. 2 and 3 show two versions of Electromatic amplifiers. In Fig. 2 the 12SK7 is used as a triode with the plate and screen grid tied together. The pickup output is fed directly to the control grid of the first audio amplifier, across a .5-megohm volume control. Ordinarily a 12SK7 used as a triode would have a gain of about 10 to 12 in the circuit shown. However, because of the use of negative feedback and the omission of cathode bypass capacitors, the actual gain has been considerably reduced. There is sufficient gain though, and by using a fairly high output pickup the 50L6 may be driven to rated output. The degeneration introduced into the first stage by the unbypassed cathode resistor has the advantage of equalizing the frequency response of the pickup.

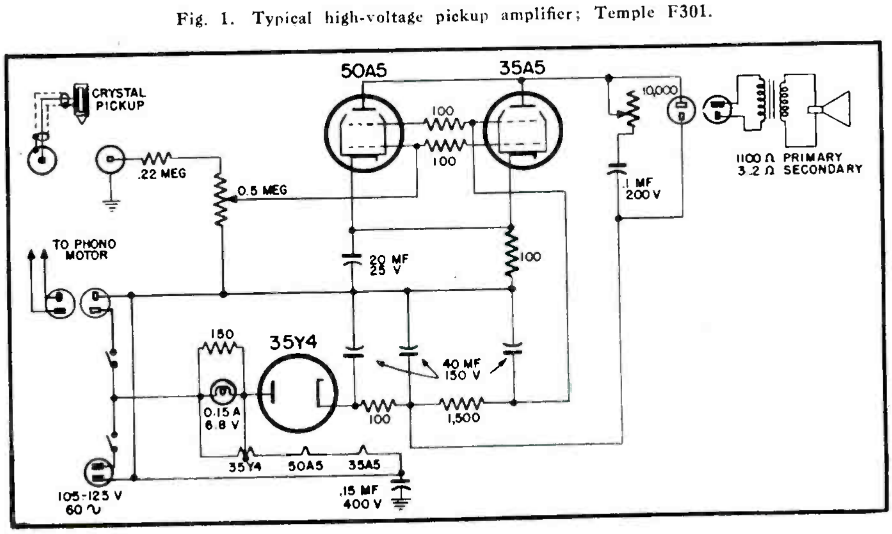
In Fig 3 we have an almost identical circuit. The differences are in the tone circuit which has been shifted to the control grid circuit of the 50L6, additional degeneration provided by feeding back the voice coil voltage to the volume control, and a three-section filter network used for additional filtering. It will be noted that the volume control returns to ground through the voice coil.

RCA Victor 66E

A more elaborate type of phono amplifier is shown in Fig. 4 (page 36); RCA Victor 66E. This player uses a low-voltage pickup, and is rated at 7 watts undistorted output.

Crystal output is fed into the 6J5 first audio stage. This is more of an isolating stage than an amplifier, the plate load resistance having a low value of 18,000 ohms. A high-frequency filter, across the pickup, consists of a 22,000-ohm resistor in series with a .005-mfd capacitor. The output of the 6J5 is then fed into a 1.5-megohm volume control with high-frequency filter networks at .25 and .5 megohm points on the control. These are introduced to further attenuate the high frequencies at low volume settings. The output is then applied to a

Fig. 1. Typical high-voltage pickup amplifier; Temple F301.



Ser-Cuits

(*Continued from page* 33)

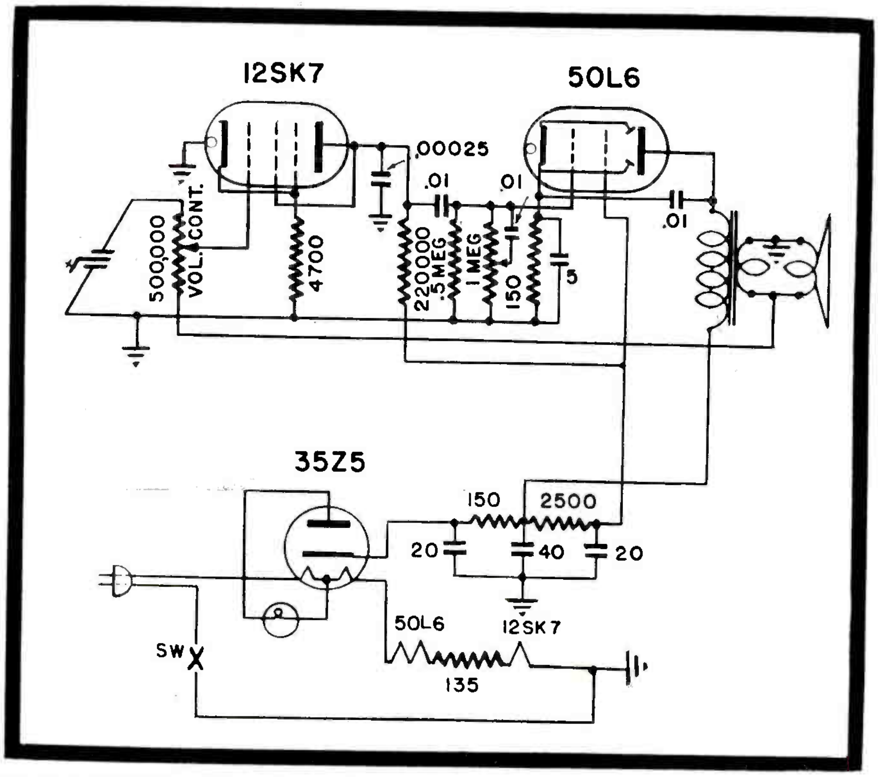
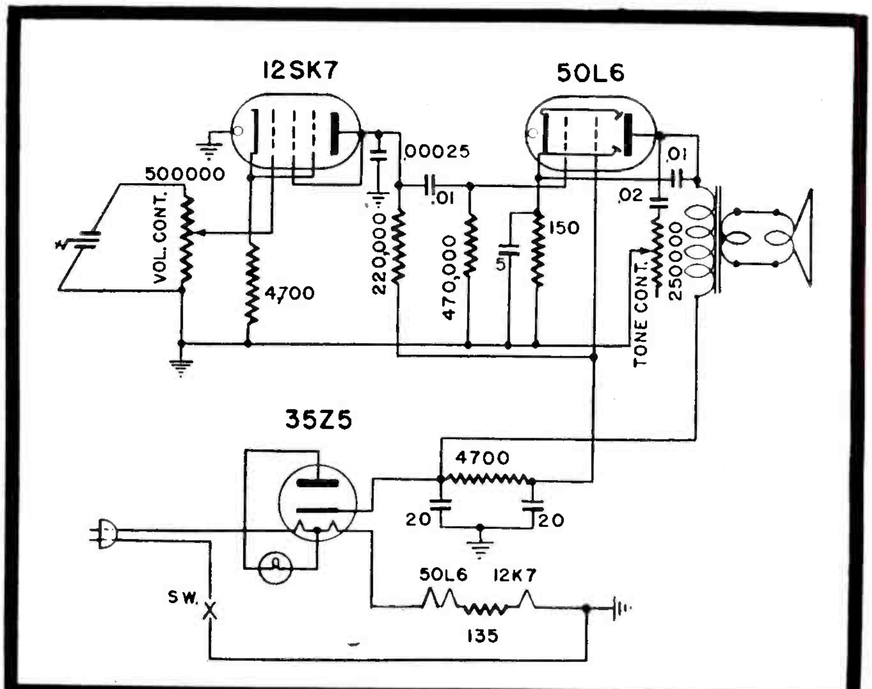


Fig. 2. Electromatic APH 301A amplifier using one 12SK7 as a triode with plate and screen tied together.

6SQ7 second a-f amplifier, which has both high and low frequency tone controls in its plate circuits. The treble control operates by adding additional capacitance (.0035 mfd) in the plate circuit. Low frequencies are increased by bypassing the .00056-mfd coupling capacitor with a .01-mfd capacitor, and at the same time decreasing the r-c ratio by increasing the value of grid-load resistance for the 6K6 and 6SQ7 phase inverter input circuits. The

Fig. 3. Another Electromatic amplifier (APH 301B), which is similar to that shown in Fig. 2, except that the tone control circuit has been shifted to the control-grid circuit of the 50L6 and additional degeneration has been provided by feeding back the voice coil voltage to the volume control.



second 6SQ7, used as a phase inverter, feeds the two 6K6 output tubes in push-pull, to provide the necessary output.

PHONO OSCILLATORS

A PHONO OSCILLATOR may be compared, in operation, to a miniature transmitter. However, because of its proximity to the receiver, the transmission power requirements for good reception of the recordings are very slight. A signal strength of a few milliwatts is all that is generally necessary. Most commercial-type phono oscillators have a transmitting range of a few hundred feet, even at their comparatively low-output levels.

For this reason, and also considering that a modulation level of 30% will give satisfactory reception, the output voltage requirements for the pickup itself are on the order of two volts. The modulation power requirements are necessarily a function of the modulation methods. Accordingly in single-tube phono oscillators, grid modulation, or some similar form, where low-level modulation may be used, are generally employed.

One such system involves the use of the suppressor-grid modulated oscillator. The basic circuit for such a system is shown in Fig. 5, page 36. If the suppressor grid were connected to the cathode, the circuit would then represent a conventional pentode-type oscillator, with the signal output obtained from a tertiary coil adjacent to the plate coil. The amplitude of the signal would be a function of the bias voltage developed in the cathode circuit. As the bias voltage was increased, by increasing the size of the bias resistor, the signal voltage would decrease, and vice versa. Any voltage impressed on the suppressor grid from an external source operates in much the same way, since any negative voltage at this point creates a virtual cathode between the suppressor and screen grids. Therefore, the plate current, and hence the oscillator output power, will vary in accordance with this suppressor voltage.

Motorola HS 18

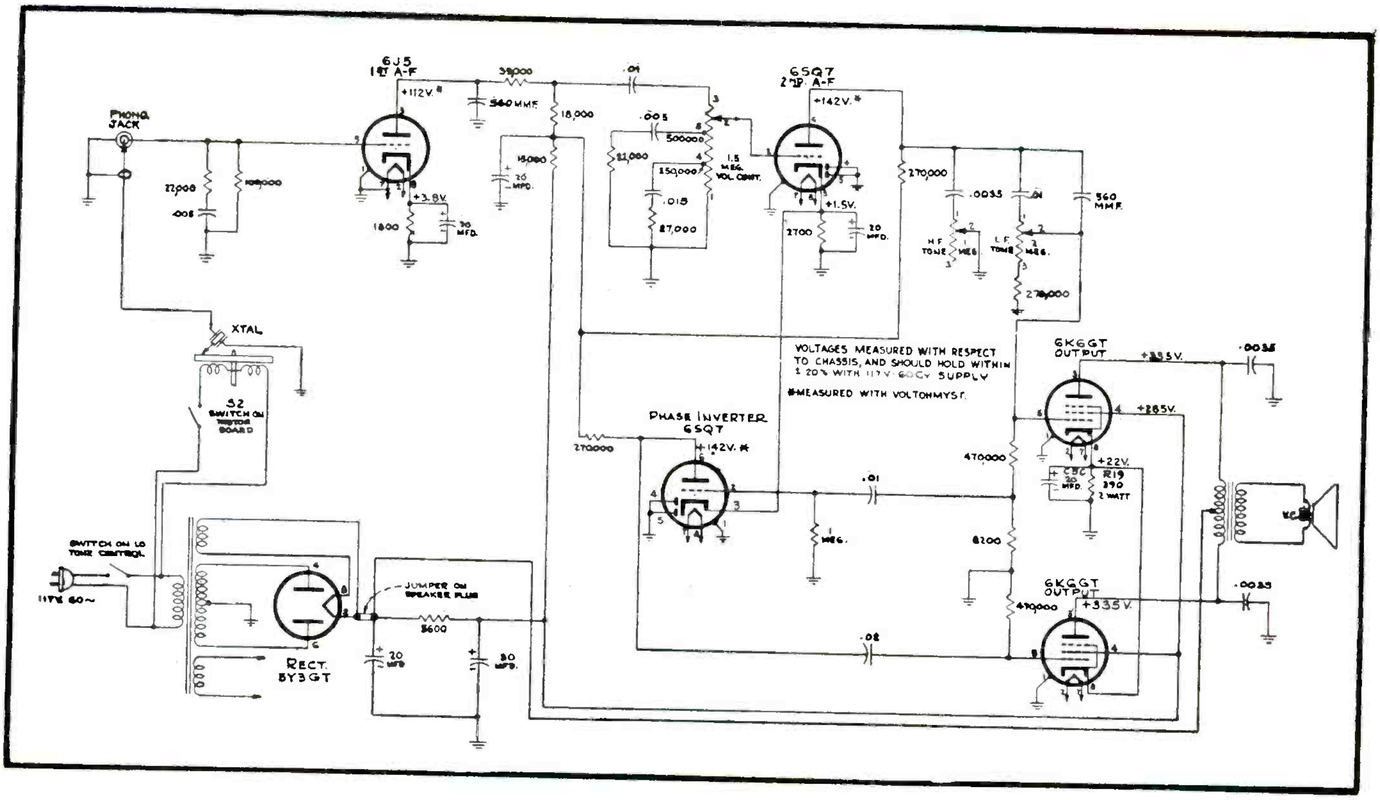
Fig. 6, page 36, shows a typical phono oscillator; Motorola HS 18. Since the current requirements of the oscillator are low, a 6J5 triode has been connected as a diode half-wave rectifier. The rectified voltage is fed through a two-section, resistor-type filter network. Because of the low current requirements of the circuit, 10-mfd capacitor filters are all that is required for adequate filtering. The oscillator coil is of the tuned-grid, plate-feedback type, with the antenna, a short piece of wire, connected across the grid coil through a .000025-mfd capacitor. This coil will tune through the range of 1,250 to 1,750 kc.

The crystal pickup output is fed directly to the suppressor grid, which is returned to ground through a 4.7-meg-ohm resistor bypassed with a .001-mfd. capacitor for r-f frequencies.

The modulation is regulated by adjusting the bias in the cathode circuit. This circuit action can be traced by first considering the voltage output of the crystal as a constant. If the power output of the oscillator is increased, this would, in effect, be the same as decreasing the modulation level. Since the bias voltage controls the amplitude of the transmitted signal, adjusting the bias will vary the percentage of modulation.

Proper adjustment of the control is obtained by first turning the control for maximum output, and picking up signal on the receiver. Then the con-

(Continued on page 36)



Ser-Cuits

(*Continued from page* 35)

trol is turned back and the point at which the signal *plops out* is noted. The control is then advanced until the signal *plops in* again.

The best point of modulation may be also obtained by the use of a frequency record and a scope. Modulation should be set at 30% for best results.

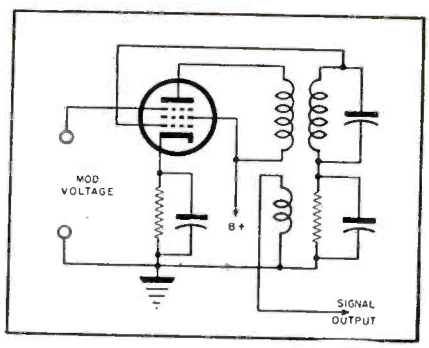
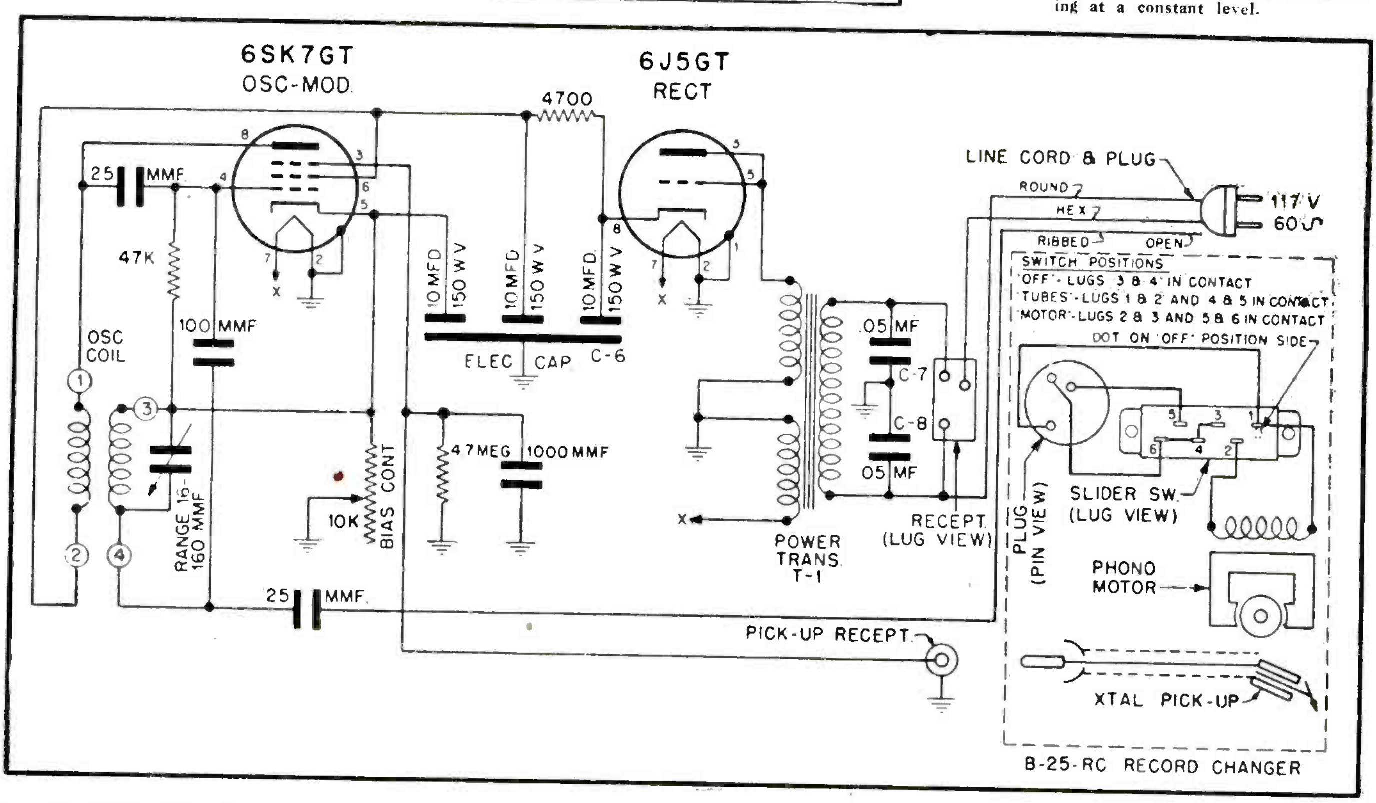


Fig. 4, above. RCA Victor 66E amplifier designed for a low-voltage pickup.

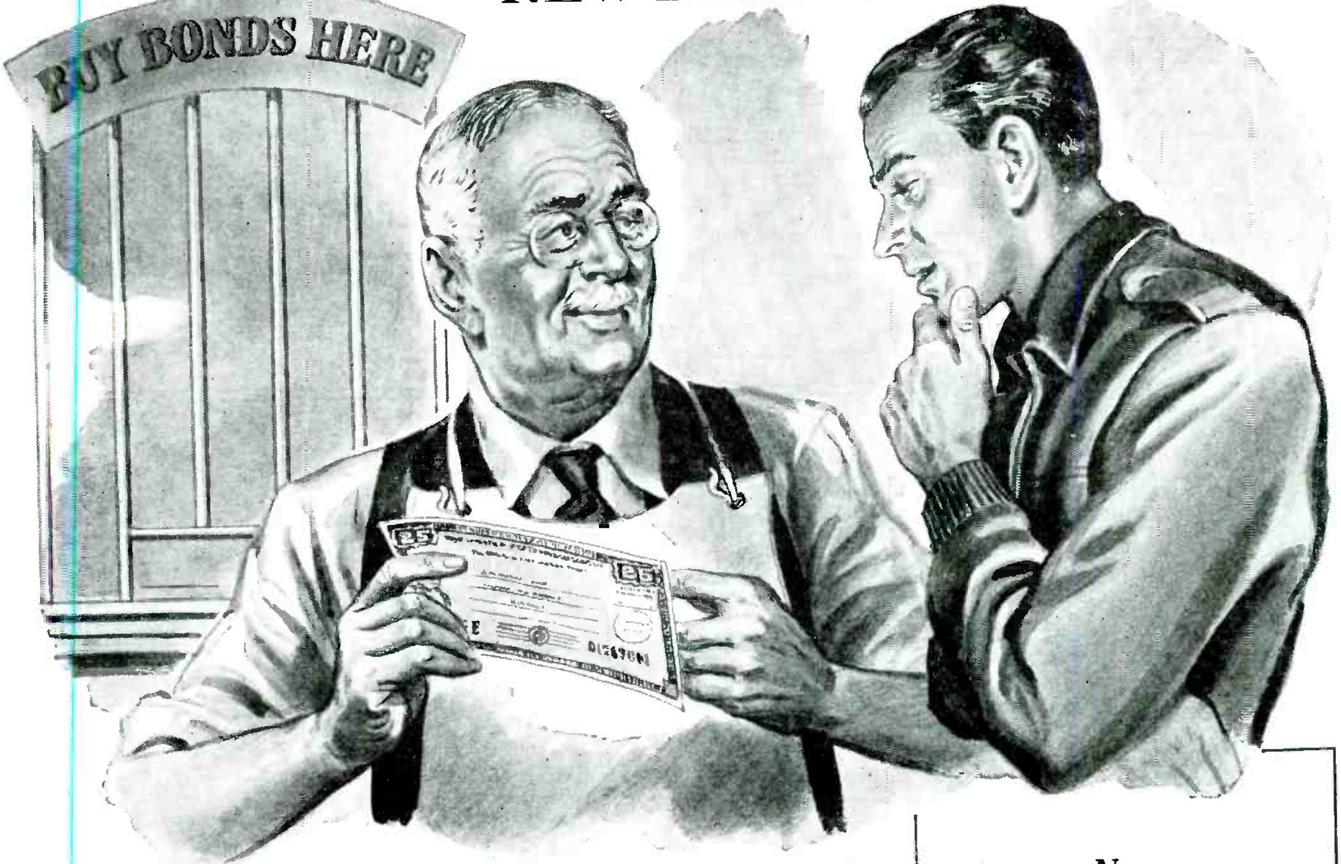
Fig. 5, left. Representative circuit of a suppressor-grid modulated oscillator. Any voltage impressed between the suppressor grid and ground will vary the oscillator signal by establishing a virtual cathode between suppressor and screen grid. The amplitude of the oscillation will then become a function of the amplitude and polarity of the suppressor voltage.

Fig. 6. A typical phono oscillator; Motorola HS 18. The frequency range covered is 1250 to 1750 kc. Modulation is controlled by varying the bias on the oscillator, keeping the modulating at a constant level.



A HABIT TO JOE...

"NEW IDEA" TO HIS NEPHEW



...YET BOTH WANT THE SECURITY your P.S. Plan Provides

HAVE YOU told all your new or recently hired employees about the benefits of the Payroll Savings Plan for the regular purchase of U. S. Savings Bonds? Wage earners, according to a recent nation-wide survey, want security more than anything else. They prefer security to big pay, soft jobs, authority, "success."

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Start a drive today for larger participation in the plan. Many employees may be unfamiliar with its advantages. If you want literature for distribution, contact your State Director of the Treasury Department's Savings Bonds Division.

New Savings Bonds Plan won't affect the P.S.P.

THE Treasury Department and the banks of America are making it possible for farmers, doctors, and other self-employed people to participate in "automatic" Bond buying by special arrangement with their banks. This extension of the Savings Bonds program is not a partial payment plan and is intended *only* for people who are not in a position to take advantage of the Payroll Savings Plan.

The Treasury Department acknowledges with appreciation the publication of this message by

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A PUBLIC SERVICE PROJECT · THE ADVERTISING COUNCIL

This is an official U.S. Treasury advertisement prepared under the auspices of the Treasury Department and The Advertising Council.

NEW PRODUCTS

VITAMITE RECHARGEABLE BATTERY

A one-ounce rechargeable battery, the Vitamite, that is said to be completely non-spill, has been developed by the Vitamite Company, 227 West 64th St., New York City. Battery is smaller than two penlight dry cells, and said to deliver 50% more wattage than two class *C* dry cells upon a single charging.

Battery is enclosed in a one-piece moulded plastic case.

* * *

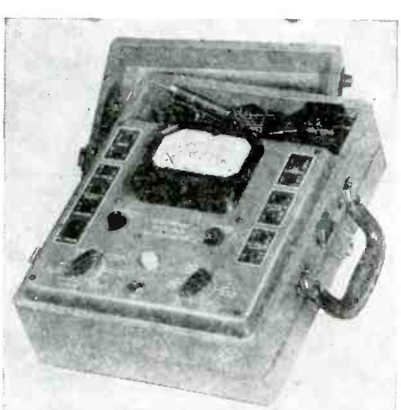
WESTON ELECTRONIC ANALYZER

An electronic analyzer, model 769, has been announced by the Weston Electrical Instrument Corporation, Newark 11, N. J.

Analyzer features vacuum-tube voltmeter for measurements on frequencies up to 300 megacycles, an electronic voltohmmeter, and a complete 10,000-ohm-per-volt dc- and 1000-ohm-per-volt a-c multimeter. The v-t-v-m and voltohmmeter use a unity gain d-c amplifier.

The vacuum tube voltmeter covers a frequency range of 50 cycles to 300 megacycles at ranges of 3/12/30/120 volts. Accuracy is said to be 5% to 150 mc, and 12% from 150 to 300 mc, direct reading. Has a 3½" and ¾" diameter r-f probe.

The electronic voltohmmeter covers ranges from 3 to 1,200 volts, and 2,000 ohms to 2,000 megohms full scale. Electronic zero balance is said to be unaffected by zero adjustments to the ohmmeter.



WALSCO UNIVERSAL DIAL BELT

A universal dial belt, unibelt, which is said to eliminate the need for 96 different sizes required to fit all models has been developed by the Walter L. Schott Company, Beverly Hills, Cal.

Belt is manufactured in continuous lengths, and put up on spools containing belting for an average of 5 to 8 dial belt replacements.

Construction of belt is made possible by using a patented zipper-like connector inserted in each end of the belt.

WARD ANTENNA DISPLAY

A self-serve floor antenna display unit displaying eight dozen assorted antennas has been produced by Ward Products Corp.

Featured in the display are universal split-ball design antennas; the *Eight-Ball* and *Phantom*. Models are supplied with a coaxial lead cable.

* * *

MAGNA-METAL IRON CORES

Kits containing magnetic iron cores for i-f, r-f and antenna coils have been announced by Magna-Metal Products Co., 4 South St., Stamford, Conn.

ALLIED RADIO 30-WATT AMPLIFIER

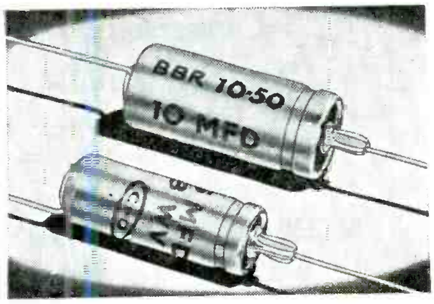
A 30-watt amplifier featuring three individually controlled input channels and a built-in mixer circuit; inverse feedback; and an output selector which permits matching of any number of speakers, has been announced by Allied Radio Corp., 833 W. Jackson Blvd., Chicago, Ill.

* * *

C-D SMALL TUBULARS

Hermetically sealed capacitors in cylindrical aluminum containers, type BBR, have been announced by Cornell-Dubilier Electric Corporation, South Plainfield, N. J. The negative lead is riveted to the case at one end, while the positive lead is anchored to a terminal brought out through a Bakelite washer at the other.

Specifications and dimensional drawings in bulletin No. 100-424.



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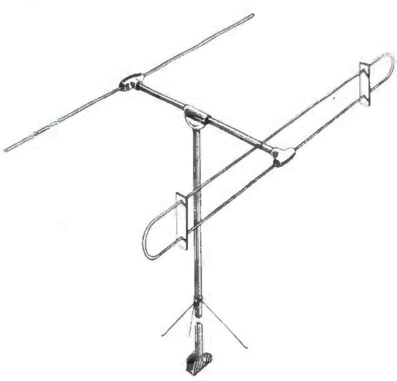
CAMCO F-M AND TV ANTENNAS

Dipole and dipole-reflector antennas for the f-m 88- to 108-mc and the tv 44- to 216-mc bands have been announced by Camburn, Inc., 32-40 57th St., Woodside, N. Y.

The dipole models are available in simple and folded form, and with reflectors. Antennas can be tilted and rotated.



Folded dipole and reflector

* * *

ELECTRO-VOICE BUTTON-CONTROL FLOOR STAND

A button-control floor stand, model 430, has been announced by Electro-Voice, Inc., Buchanan, Mich. Single button provides finger-tip control of shaft height.

Die cast three-legged base. One bolt locks three legs in position. Height adjustment 36" to 65"; three-leg spread 17".

* * *

STACKPOLE POLYTITE TRIMMER ELECTRODE CORES

Molded Polytite trimmer electrode core forms have been announced by the electronic components div., Stackpole Carbon

(*Continued on page 40*)

New Products

(*Continued from page 39*)

Co., St. Marys, Pa. Can be used as variable capacitors in high-frequency circuits. The molded Polytite is said to have a high dielectric constant. Cores are moisture repellent and carry a heavy dielectric coating.

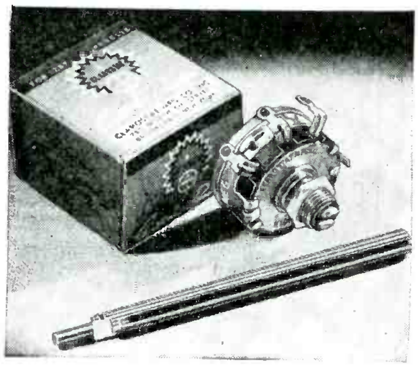
Polytite trimmers may be installed either across the tuning capacitor or across the tuning inductance. Trimmers can be mounted directly to tuning capacitors.

* * *

CLAROSTAT AD-A-SHAFT CONTROLS

An *Ad-A-Shaft* series of shafts for standard or tapped controls has been announced by the Clarostat Mfg. Co., Inc., 130 Clinton St., Brooklyn, N. Y. The selected shaft is inserted in the slot of the selected control and given a sharp blow by hitting it on a hard surface or with a hammer, whereupon it snaps into place.

Distributors or Service Men receive a selection of *Ad-A-Shafts* for the same number of *Ad-A-Shaft* controls on a one-for-one basis. Unused shafts can be exchanged for other types, or additional shafts can be ordered.



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COASTWISE TEST SPEAKER

A test-speaker unit, Ferret Model 724, to test speakers and also serve as a substitution for choke, capacitors, coupling, and resistors has been announced by Coastwise Electronics Co., Inc., 130 North Beaudry Ave., Los Angeles 12, Calif.

Voice coil connection permits substitution of output transformers. Rotating input and field switches on front panel

(*Continued on page 42*)

Motor Repair

(Continued from page 32)

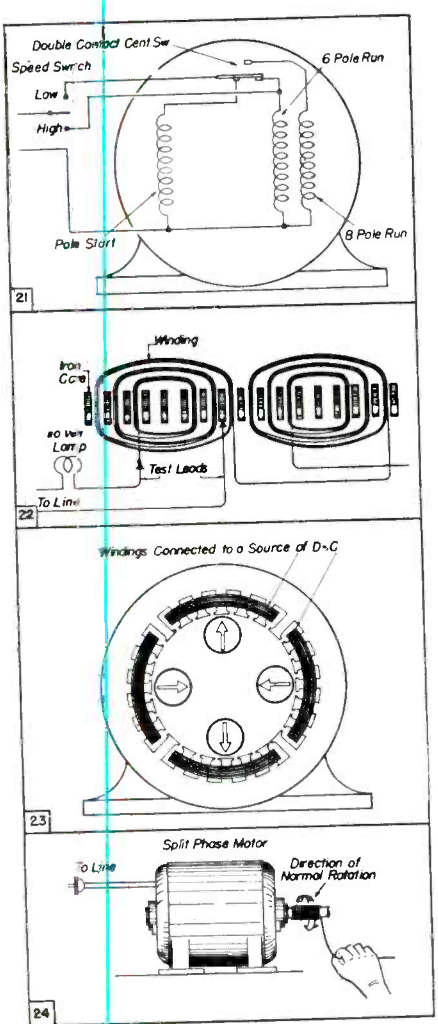
phase motors and to note how they may be repaired.

If the motor fails to start the trouble may be:

1. *Open running winding:* This may be discovered by testing the winding with a test lamp. If the lamp fails to light the winding has an open circuit.

2. *Open starting winding:* Three practical tests show whether the starting winding has an open circuit. One method is to connect a motor to the power line. An open circuit in the starting winding will cause the motor to hum. A second test is to turn the rotor manually. This may be done by winding a cord around the motor shaft, as in Fig. 24, and pulling the cord so that the rotor turns. When the motor ceases to turn the power-line switch is turned on. If the motor continues to run, the trouble is in the starting-winding circuit. The third test for discovering an open circuit in the starting winding is to use the test lamp. If the circuit is found to be open, the trouble is in either the centrifugal switch or starting winding.

3. *Grounded winding:* This is checked by means of a test lamp and repaired by reinsulating or rewinding. A grounded winding may cause a shock if touched and is therefore dangerous.



Usually a fuse will show before any damage is done.

4. *Burned or shorted winding:* This will cause the motor to smoke or a fuse to show. A burned winding is easily recognizable by its smell and its burned appearance. Repair is by rewinding only.

5. *Open circuited over device:* Some motors are equipped with one overload device consisting of a bimetal element that will expand when heated and cause associated contacts to open. This device is connected in series with the motor and its contacts will open if the motor is overloaded or if for any other reason too much current flows through the winding.

6. *Worn or tight bearings:* Bearing troubles frequently develop in motors after they have been in use for a considerable time. A worn bearing may be discovered by attempting to move the shaft up and down by hand. If the shaft moves it indicates a worn bearing or possibly a worn rotor shaft. In either event new bearings are required.

7. *End brackets improperly mounted:* When an end bracket is not fastened

(Continued on page 42)

Figs. 21, 22, 23 and 24. Connections of a two-speed split-phase motor are shown in Fig. 21. How to determine if a winding is grounded is illustrated in Fig. 22. Fig. 23 shows the compass method of testing a motor for reversed poles. Fig. 24 shows how to start a motor by mechanical means.

Motor Repair

(*Continued from page* 41)

securely around the entire edge of the motor frame the rotor will be very difficult to turn. The end bracket should sound solid when tapped gently with a mallet or lead hammer and should fit the stator perfectly at all points.

Motor runs slower than normal speed:

A motor that does not attain normal running speed is likely to have one or more of the following defects: Short circuit in the running winding; running winding remaining in the circuit; reverse running winding poles; incorrect stator connections, and worn bearings.

Motor runs hot:

A motor may become excessively hot after running a short time because of: Shorted windings; grounded winding; short circuit between running and starting windings; worn bearings, or overloading.

Noisy motor:

There are several reasons why a split-phase motor may operate with much noise, the most common of which are: Shorted winding; improperly connected poles; worn bearings; worn centrifugal switch, or foreign material in the motor.

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New Products

(*Continued from page* 40)

permit matching to single or push-pull output tubes.

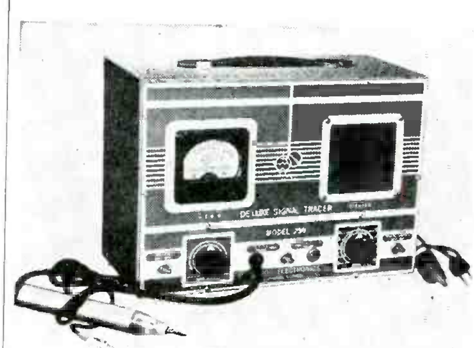
Has a 6" p-m speaker.

* * *

PRECISION ELECTRONICS SIGNAL TRACERS

A four-stage v-t-v-m signal tracer has been developed by Precision Electronics, Inc., 641-643 Milwaukee Ave., Chicago 22, Ill.

The unit, model 250, uses one 6AT6, one 6SJ7, one 6LS7, one 6K6 and one 5Y3. Input capacity said to be 3 mmfd. Probe, 7"x⅞" dia. Frequency range from 20 cycles to 300 mc.



TV Power Supply

(*Continued from page 13*)

but are really making use of the full peak to peak value of the sine wave instead of only half. If V_2 is now connected into the circuit, the voltage between point *C* and ground will charge capacitor C_2 to the peak-to-peak value at this point, which is twice the voltage otherwise available. This voltage causes electrons to flow around the circuit, as shown by the solid arrows.

With similar type circuits it is possible to triple, or quadruple. However, a separate filament supply is required for each tube, and the load current that can be supplied becomes less as the multiplication increases.

In Fig. 4 appears a voltage quadrupling power supply circuit used in a projection receiver.[2] The output voltage obtainable from this supply is about 30,000. It will be noted that there are four separate filament windings, and the secondary winding is not separate, but is an extension of the plate winding, thus acting as an auto transformer.

Flyback Supply

The use of the *Kickback* or *Flyback* type of power supply is rather specialized inasmuch as this type can only be used in television receivers incorporating magnetic-deflection systems. This type of supply is unique in that it makes use of energy within the receiver which would normally be lost.

To understand the principles of operation of the kickback supply it is necessary to review briefly what takes place during the scanning of a television picture. Each complete frame which is scanned is made up of 525 individual scanning lines. The scanning electron beam starts at the upper left hand corner of the screen and moves relatively slowly to the right hand side at the same time, dropping very slightly. When the beam reaches the right side it is extinguished and quickly returned to the left side. This quick return is the *flyback* period, which is used to produce the high voltage. To bring about this scanning procedure it is necessary that a sawtooth wave of current be passed through the horizontal deflection coils.

Studying the schematic diagram, Fig. 5*a*, and to the applied wave, Fig. 5*b*, it will be seen that the trace time

[2]D. W. Pugsley, *Postwar Television Receiver Design*, G. E., A.I.E.E., Technical paper; Jan. 1947.

(*Continued on page 46*)

Tube News

(*Continued from page* 18)

cathode or *self-biased* circuit it is essential, except in push-pull circuits or where degeneration is desired, that the cathode resistor be bypassed with sufficient capacity so that no appreciable a-c impedance exists between cathode and grid return.

G, GT and GT/G Tubes

Tubes are often classified according to their general design and construction.

G type tubes are glass tubes which are, in most cases, identical or very similar in operating characteristics to many of the regular types. The bases are of octal design with a bakelite locating lug while the top caps, if required, are of the miniature style. In these respects the *G* tubes resemble metal tubes.

A smaller version of the *G* tube is the *GT* style designed for use where tubes of this size are desired. For most *GT* types the characteristics are esentially the same as for the *G* type equivalent. All *GT* tubes are equipped with octal bases and a tubular bulb is employed. The suffix *GT* is derived from the base used on *G* types and tubular *T* style bulb. Reduction in physical size is secured through the use of a shorter stem.

Because of the similarity in characteristics between *G* tubes and the corresponding *GT* types it is usually possible to interchange *GT* for *G* tubes and vice versa if space permits. Consequently, many G types have been discontinued as such, the *GT* style adopted, and the tubes bulb-etched GT/G.

Two kinds of octal bases are employed on *GT* and *GT/G* types. Rectifier and output types are equipped with an all bakelike base as on *G* tubes. Converters, r-f and i-f types have metal shell bases, that is, a combination of a bakelite wafer to which is fastened a metal shell which is cemented to the glass bulb. The metal shell serves as a part of the shielding and is connected to pin *1*. This arrangement often permits *GT/G* or *GT* tubes to be substituted for equivalent metal types. Slight realignment of tuned circuits may be required to secure correct performance. If additional shielding is necessary on *GT/G* tubes an external shield can be slipped over the metal shell. Other *GT/G* types may have one or the other style of base described above, this being optional with the manufacturer.

Battery Tubes

There are two general groups of battery tubes: group designed for 2-volt operation and the newer group of 1.4-volt types. The former are now employed primarily for replacement purposes and their characteristics are quite well known. The latter both in *GT/G* and lock-in construction are widely used in all forms of battery receivers and several special features are outlined below.

The 1.4 volt group of battery tubes is of particular interest because of the economy afforded in power supply requirements and the reduction in space which is possible. These tubes have been designed especially for economical operation, non-microphonic action and long life. With the exception of the output types, the tubes are designed for zero bias operation, thus simplifying circuit applications and reducing couplings to some extent.

Since these tubes are of the direct-heated filament type there may be some small variation in contact potential which, in some instances, may result in slight variation in sensitivty

Tube News

(*Continued from page* 44)

between tubes of the same type if the grid return is made directly to minus filament. It is recommended that a resistance of at least .5 megohm, suitably bypassed, be connected between the grid return and minus filament. If these tubes are employed so that avc voltage is applied to the grids, the resistors used for isolation and diode load will be sufficient.

Since the filament wire employed in these tubes is extremely small in diameter, some precautions may be necessary to prevent filament vibrations resulting mainly from acoustic and mechanical feedback from the speaker to the tubes and chassis. Therefore, it is preferable not to mount the speaker directly on the chassis. A further point to bear in mind is the fact that the permanent magnet of the speaker produces a strong magnetic field which may influence the electron stream in tubes that are in close proximity to the magnet. [*Data courtesy Sylvania*]

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Hytron 6AR5 and 12AL5

Two NEW TUBES have been announced by Hytron; 6AR5, a miniature version of the 6K6GT, and 12AL5, a twin diode.

The 6AR5 is a miniature-pentode power amplifier designed for use in the output stage of automobile and a-c receivers. In new equipment applications, the 6AR5 is a replacement for 6K6GT.

Heater potential, 6.3 volts; heater current, .4 ampere.

Maximum Ratings, Design-Center Values

Plate potential, 250 max.; screen grid potential, 250 max.; plate dissipation, 8.5 max. watts; screen grid dissipation, 2.5 max. watts; peak heater-cathode potential, 90 max.

Maximum control grid circuit resistance: For fixed-bias operation, 0.1 megohm; for cathode-bias operation, 0.5 megohm.

The 12AL5 is a high-perveance, twin diode having a miniature button 7-pin base. Because of its high perveance, the 12AL5 is suitable for use as a detector in circuits utilizing wide-band amplifiers. It is intended for use as a discriminator, ratio or diode detector; avc diode, clipper or low-power rectifier. Each diode unit, shielded

(*Continued on page* 46)

Tube News

(*Continued from page 45*)

from the other, has its own plate and cathode base-pin connections and can, therefore, be used independently of the other or combined in parallel or full-wave circuits. The resonant frequency of each unit is approximately 700 megacycles. The 12AL5 is a replacement for the 12H6GT.

Heater potential, 12.6 volts; heater current, 0.15 ampere.

Maximum Ratings, Design-Center Values

Max. rms plate potential per plate, 117; max. peak-inverse plate potential, 330; max. peak-plate current per plate, 54 ma; max. d-c output current per plate, 9 ma; max. peak heater-cathode potential, 330 volts; min. total effective plate-supply impedance per plate, 300 ohms.

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TV Power Supply

(*Continued from page 43*)

between *X* and *Y* causes a slowly increasing current through the portion of the scanning transformer from terminal *2* to terminal *1*, creating a slowly expanding magnetic field. At the time *Y* (Fig. 5*b*), tube V_1 is suddenly cut off and the magnetic field is free to collapse at a very high rate of speed. This rapid collapse causes the primary of the transformer to break into oscillation at its natural resonant frequency of about 100 kc. The oscillations are permitted to continue for only the positive half cycle in the primary after which they are damped out in a controlled manner. However, this positive half cycle which is developed between terminals *1* and *3* is in the order of 9,000 volts. This positive 9,000 volts is applied to the plate of the 8016 and rectified. Filtering action is accomplished by the use of a 500 mmfd capacitor, and thus eliminates the possibility of a dangerous shock. Terminal *2* is approximately a center tap, and therefore, only about 4,500 volts is applied to the plate of the 6BG6G, and prevents the tube from arcing back from plate to cathode. The 6BG6G is actually a 807 tube which is built to much higher standards and specified for television operation. As with the r-f supply the amount of voltage developed is a function of the *Q* of the primary. To assure a very high *Q*, the transformer cores are made of thin laminated iron or powdered iron. The powdered iron has the advantage of lower cost and also does not *sing* at the applied frequency of 15,750 cycles.

Filament power for the high-voltage rectifier tube is obtained from a few turns of wire coupled to the primary of the transformer.

The use of either type of power supply has a number of important advantages in cost, weight, and efficiency. And particularly important is the fact that the possibility of deadly shocks are eliminated, thus making the equipment more practical for home use. Future equipment will see the wide usage of these high-voltage power supplies.

F-M Antennas

(*Continued from page* 17)

$Z_o = \sqrt{L/C}$. Therefore, every transmission line has a characteristic or surge impedance which acts as a pure resistance the value of which depends on the construction of the line.

If a transmission line is terminated in its characteristic or surge impedance, it is equivalent to an infinitely long line and there will be no standing waves or reflections along the line and the line is said to be non-resonant. The input end of a transmission line that is terminated in a resistance equal to its surge impedance will appear as a pure resistance having a value equal to the characteristic or surge impedance of the line.

However, if the transmission line is not terminated in a load that equals the surge impedance of the line, then there will be standing waves produced along the line which may result in a serious loss of signal between the antenna and the receiver, depending upon the amount of mismatch between the load impedance and the surge impedance of the transmission line.

For maximum transfer of power from the source to the load, it is necessary that the load impedance be equal to the source impedance. When the average resistance at the center of a half-wave dipole varies from about 72 to 100 ohms, the antenna input circuit of the receiver is designed for an impedance of about 100 ohms, so that there will be a maximum transfer of energy from antenna to receiver.

The transmission line is usually balanced to ground by means of a center tap on the primary of the antenna transformer so that any noise signal

(*Continued on page* 49)

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AT RCA SERVICE CLINIC

RCA service clinic meeting.

Frank M. Folsom, executive vice president in charge of the RCA Victor Division, discussing a new type of peak-to-peak probe, used with the RCA Advanced VoltOhmyst, with a group of RCA midwestern distributors' representatives at a recent 5-day training clinic on RCA laboratory measuring equipment in Camden, N. J. Group, left to right, are: I. O. Shepard, Radio Specialty Co., Detroit; A. O. Gray, Radiolab, Kansas City, Mo.; P. E. Wise, Associated Distributors, Indianapolis, Ind.; D. G. Knodle, RCA Victor Distributor Corp., Detroit, Mich.; L. A. Goodwin, manager of the RCA Test and Measuring Equipment Sales (behind Mr. Goodwin is E. Pond, Klaus Radio and Electric Company, Peoria, Ill.); N. E. Salisbury, Radio Specialty Co., Detroit; W. L. Garrett, RCA's Chicago office; J. W. Rothermel, Taylor Electric Co., Milwaukee, Wisc.; Frank M. Folsom; (behind Mr. Folsom is R. L. Jansson, RCA Victor Distributor Corp., Chicago); V. T. Peterson, Walker-Jimieson, Inc., Chicago; L. F. Waelterman, Interstate Supply Co., St. Louis, Mo.; and F. Kacsmer, Cameradio Co., Pittsburgh, Pa.

Servicing Helps

THE USE OF MULTIPLE INPUTS for mixing and switching has become a feature of most p-a systems.

The simplest method, two inputs, usually provides for a microphone and a pickup. The design of the system depends on whether mixing or switching are to be used.

A typical switch-type input system appears in Fig. 1. Used are two jacks, two volume controls, and a single-pole, double-throw switch. The volume controls are usually of the .5 or 1-megohm type, providing high-impedance inputs for use with high-impedance type devices.

Fig. 2 shows a mixer-type input. Here we have a twin triode tube. With this mixing method the output of one circuit may be gradually faded into the other. Resistors (.5-megohm) have been placed between the plates of the triodes and the coupling capacitor to reduce distortion level. These resistors also affect a reduction in stage gain; this is due to the low plate impedance of triodes. In this mixing system we also have high-impedance inputs. Where a low-impedance input is necessary, a transformer (dotted form in Fig. 2) is connected ahead of the input control.

Where more than two input circuits are required, pentodes are preferred. A typical circuit is shown in Fig. 3. Common cathode and screen-grid circuits are usually employed, since there is no danger of feedback. The gain of the individual circuits may be reduced somewhat, but the stage gain will still be relatively high.

The circuit of Fig. 3 may be combined with that of Fig. 1 to produce still more input combinations. The advantage of the circuit of Fig. 3 over that of Fig. 1 is that the source voltage may be opened without resetting the controls.

Fig. 1. A simple form of multiple input circuit. A double-throw single-pole switch is used to switch two inputs into a common first audio stage. The input circuits shown are high-impedance types.

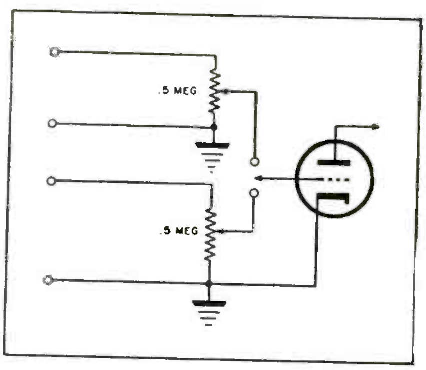


Fig. 3. Where more than two input mixer circuits are required, or where high stage gain is necessary, pentodes should be used, as shown. No plate-isolating resistors are necessary, since pentode plates are high impedance. Common screen and cathode resistors may be used, since there is no danger of feedback. However, resistance values should be reduced, and wattage ratings increased, depending on the number of circuits supplied.

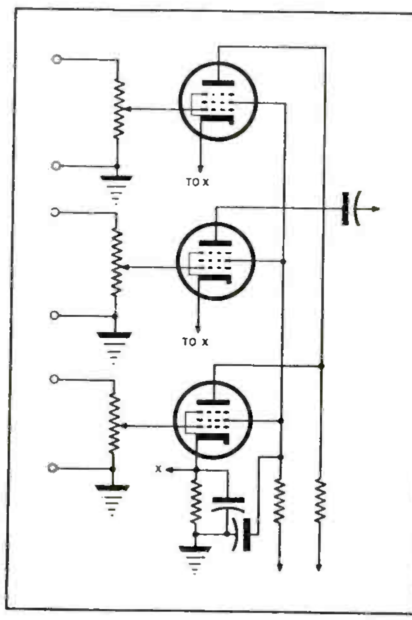
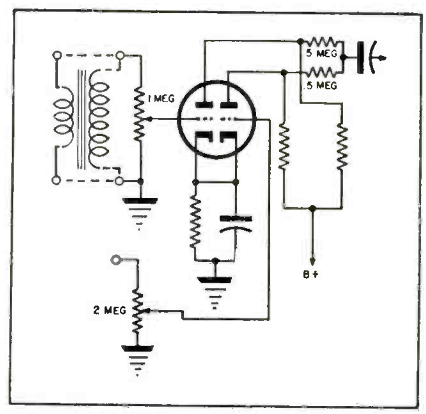


Fig. 2. A multiple input circuit of the mixer type. A twin triode is used, with the input circuits feeding individual triodes. An input transformer for low-impedance sources is shown, in dotted form, ahead of the channel. Two isolating resistors, between the individual plates and coupling capacitor, serve to reduce stage distortion. This is necessary in view of the low plate-impedance of triodes.



F-M Antennas

(*Continued from page 47*)

picked up by the line will cancel out.

From the foregoing it is evident that for the maximum transfer of signal from the antenna to the receiver it is necessary that the surge impedance of the transmission line match the input impedance of the receiver at least fairly closely, and also that the input impedance of the transmission line match the impedance at the center of the dipole.

Installation of F-M Antennas

The first step in installing an f-m antenna is to make a survey of the location and check on the line-of-sight of direction between the f-m station and the receiver and also determine the location of possible noise interference sources. It is also necessary to determine what the length of the transmission line is to be. If over 100′ it is advisable to use a low-loss line, such as a coaxial line, unless the antenna is in a location where the signal strength is quite high.

As a general rule, the antenna should be as high as possible and as far from any noise source as feasible, always bearing in mind that the longer the transmission line the greater will be the line loss. In residential sections, a height of from 30′ to 40′ above the ground or 10′ to 20′ above the roof is, in most cases, satisfactory.

Automobile Ignition Troubles

One of the greatest sources of interference to f-m signals originates in automobile ignition systems. It is accordingly desirable to locate the antenna as far from the traffic stream as is practicable.

Where it is desired to receive more than one f-m station, which is the usual case, the dipole antenna should be orientated for a satisfactory signal from all f-m stations. The position where the best signal strength can be obtained will be found by slowly turning the antenna in one direction and then in the other direction, while checking the results on the receiver.

Horizontally Polarized Antennas

Most f-m transmitting stations now use horizontally-polarized antennas. This means that the elements of these antennas are horizontal or parallel to the ground. The receiving dipole

(*Continued on page 51*)

JOHN RIDER SAYS . . .

There's money in Warranty Service

The fact that fewer faults are showing up in receivers now being produced has led a number of service organizations to enter into warranty service contracts with local distributors and dealers. Such contracts can be profitable from the servicing angle because a fixed amount per receiver is paid the servicer—a fee he retains in any case.

In actual dollars and cents, the individual receiver fee is small. But because only a small percentage of the receivers actually require service during the warranty period, the over-all fee averages out to a substantial amount for each receiver serviced. And for those receivers which do require diagnosis and repair, the majority will be comparatively easy jobs, calling for a minimum expenditure of time. Such activity, too, helps to increase your active customer list for additional sales and service.

NEWS

C.R.E.I. TWENTIETH ANNIVERSARY

Capitol Radio Engineering Institute recently celebrated its 20th anniversary with a banquet at Washington's Hotel Mayflower.

E. H. Rietzke, founder and president of CREI, was honored at the banquet for his outstanding educational activities.

Mr. Rietzke is author of the home-study course and the supervised study plan inaugurated in 1943 at the residence school. In 1944 Mr. Rietzke was elected president of the National Council of Technical Schools of which he is a founder. He has just been reelected for his fourth term. He is a past chairman of the Washington Section, IRE, as well as first vice president of the National Home Study Council in 1946.

E. H. Rietzke

OLSON PRICE GUIDE

A 64-page booklet illustrating and describing battery eliminators, books, chemicals, crystal cartridges, tools, knobs, microphones, phono equipment, speakers, receivers, wire, switches, plugs, lamps, tubes, coils, capacitors, resistors, etc., has been published by the Olson Radio Warehouse, Inc., 73 E. Mill St., Akron, Ohio.

* * *

TRI-CORE SOLDER DISPLAY

The Tri-Core & Core Solder Division, Alpha Metals, Inc., 363 Hudson Avenue, Brooklyn 1, New York, have packaged one-pound spools of solder in *handy cans,* and placed the containers in a display container. Both *tri-core* and *acid-core* solder spools are available in the display setups.

* * *

ATLAS SOUND TORTURE TEST

A unique driver-unit torture-test demonstration was conducted by Atlas Sound Corp. at the recent parts show in Chicago.

About 30 watts of energy were applied, at a frequency of 60 cycles, to a driver-type unit without any type of air column or acoustic load.

The speaker was operated during the entire show without any indication of failure. The temperature rise was unknown but was of such a degree that it was not possible to hold a hand to any

Left to right: R. C. Reinhardt, president of Atlas Sound; Carl R. Blumenthal, treasurer of Atlas Sound; Fred Harris of Atlas Radio Corp., Toronto, Canada; P. E. Mahoney of the Electronic Supply Company, Ltd., Ottawa, Canada.

part of the driver unit due to the heat generated by the voice coil and absorbed by the magnetic assembly.

* * *

TRANSVISION TO DEMONSTRATE 12″ TV KIT

A demonstration and an exhibit of a new 12″ television kit, as well as a line of products in the tv and f-m fields, will be held by Transvision, Inc., New Rochelle, at the Pillement Suite, Waldorf-Astoria on July 30 and 31, and August 1, from 10 A.M. to 10 P.M.

The exhibit and demonstration will be open to all Service Men.

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Instrument Design

(Continued from page 21)

either signal output or signal output variations over a period of time, thereby allowing resetting of signal levels with a fair degree of accuracy.

A ladder-type attenuator is used in the output circuit: Fig. 6. The signal output is taken off the plate of the 6SA7 mixer through a .004-mfd mica capacitor. This signal is then fed into the attenuator network. Two controls in the attenuator permit either graduated or stepped control of the output level.

The output lead, shown in Fig. 7, contains a three-position switch which permits either direct, capacitance, or balanced doublet connection.

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F-M Antennas

(Continued from page 49)

should also be installed in a horizontal position. Some f-m stations may, however, employ vertically polarized antennas, and in areas where signals from both types of transmitting antennas are present it may be necessary to make a compromise when installing the receiving dipole antenna. This can be effected by tipping the dipole to a diagonal position, half horizontal and half vertical.

The transmission line between the dipole and the receiver should be as short as possible to keep losses at a minimum. It should also be weather-proofed and should also have the correct surge impedance. When bringing the transmission line into the house it should not be cut, as is sometimes done, and connected to window strips since this will change the surge impedance of the line and will probably cause enough of an impedance mismatch to introduce a loss in signal. The transmission line should always be continuous from antenna to receiver.

JOTS AND FLASHES

THE FIRST FIVE MONTHS of the year have seen a production of over 360,000 f-m/a-m sets. Before the year is out industry expects to triple this volume. With the accent on multi-service receivers, Service Men will find an expanded profitable market for their services . . . services which will involve the installation of antennas (*see f-m antenna article in this issue*) as well as maintenance and servicing, particularly alignment of the f-m portion of the models. . . . Max F. Balcom of Sylvania Electric is the new president of RMA. . . . Philco recently introduced its projection-type television receiver with the image projected on a 15x20 screen in the lid of the console. . . . Magna-Metal Products Co. are now located at 4 South Street, Stamford, Conn. . . . Harold B. Donley has resigned his post as manager of the home radio division of Westinghouse in Sunbury, Pa. . . . Les L. Kelsey has joined the Dayton Acme Co., Cincinnati, as vice president. He was formerly vice president of the Hallicrafters. . . . Andrew A. Foley will cover Philadelphia for Astatic for the manufacturer's division. . . . Electroparts, 228 West 4th Street, Los Angeles 13, Calif., have appointed Progressive Marketers, 41 Union Square, New York City, as representatives. . . . A series of f-m service clinic classes are being conducted by Zenith Radio in twenty-three cities throughout the country. The classes, originated by Frank Smolek, general service manager, are being conducted by Zenith field engineers. . . . Nate Hast has organized the Hastcraft Corporation, with offices in the American Furniture Mart, Chicago. Hast will serve as manufacturer's rep, merchandising specialist, etc. . . . A 48-page catalog has been published by Mid-America Co., Inc., 2412 South Michigan Avenue, Chicago 16, Ill. . . . Grenville R. Holden has been named vice president of Sylvania Electric. . . . Electronic Labs, Indianapolis, Ind., are producing a 10-tube radio-phono model which features a dual-speaker system. . . . Edward Maged, former sales engineer of David Bogen, Inc., has joined University Loudspeakers, Inc., 225 Varick Street, N. Y. City, as a sales engineer. . . . Radio Products Sales Company, 238 W. 15th Street, Los Angeles, Calif., have been appointed Garod Radio reps for Southern California. . . . Harold Wengler has rejoined Altec Lansing Corporation, 250 W. 57th Street, N. Y. 19, N. Y., as manager of advertising and publicity. . . . General offices of the Solar Manufacturing Corp. and the Solar Capacitor Sales Corp. have been moved to 1445 Hudson Boulevard, North Bergen, N. J. . . . W. Austin Ellmore has become chief engineer and sales manager of Crescent Industries, Inc. . . . The Intra-Video multiple television antenna system, invented by Dr. H. E. Kallman, has been developed for apartment-house installation and will soon be demonstrated in typical apartment houses in New York. The antenna is being marketed by Intra-Video Corp. of America, 851 Madison Avenue, New York 21, N. Y. . . . Antony Wright, formerly manager of the RCA tv receiver engineering section, has become chief engineer of U. S. Television Mfg. Corp., 3 W. 61 St., N. Y. 23.

ADVERTISERS IN THIS ISSUE

SERVICE INDEX—JULY, 1947

Radiomen!

HERE ARE 1947's MOST NEEDED REPLACEMENT CAPACITORS

It's a lot easier to service both post-war and pre-war radios when you use Solar Capacitors. Following a thorough survey of the dry electrolytics actually used in post-war set production, Solar has pioneered in making available to the radio serviceman the capacitors needed for repairing today's compact receivers—quickly, neatly, and with a minimum of puzzling over what to do.

You'll find the needed listings of high capacitance and multiple-section capacitors in the three new Solar leaflets shown here.

Form ES-100A describes the newly introduced Solar DSB plastic-film internal wrap cardboard tubulars; Form ES-101A covers the famous metal-clad "MINICAP" units; and Form ES-102A describes the greatly expanded listing of twist-prong mounting Solar Type DY capacitors.

All three leaflets are available from your Solar distributor or directly from

SOLAR CAPACITOR SALES CORP.
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SOLAR

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There is also a handy Quick Selection Chart. It tells at a glance which types of RCA Batteries to use for more than 1000 portables and home radios. And . . . there's an equally useful chart that shows what RCA battery type replaces the corresponding number in more than twenty other brands!

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