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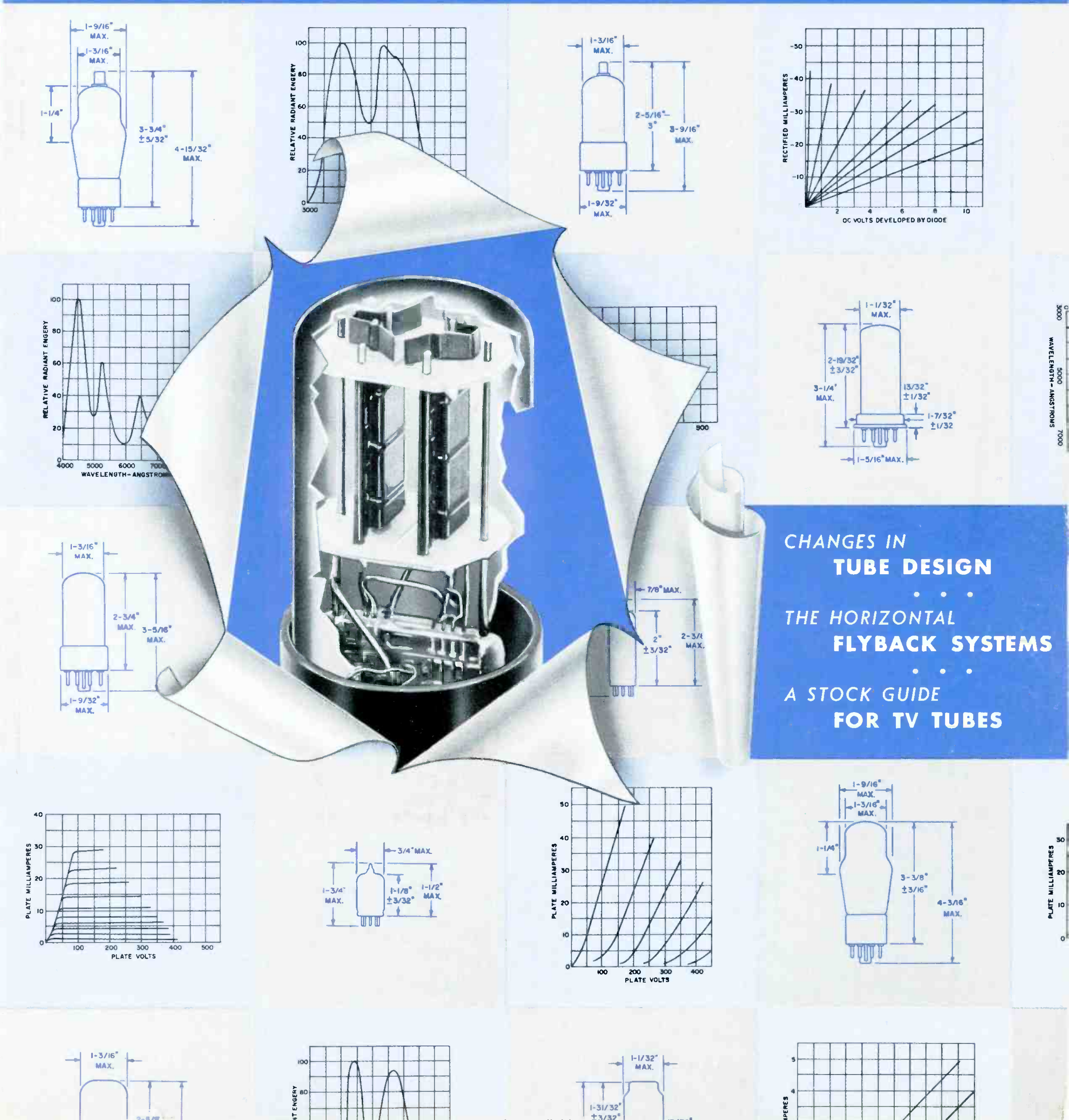

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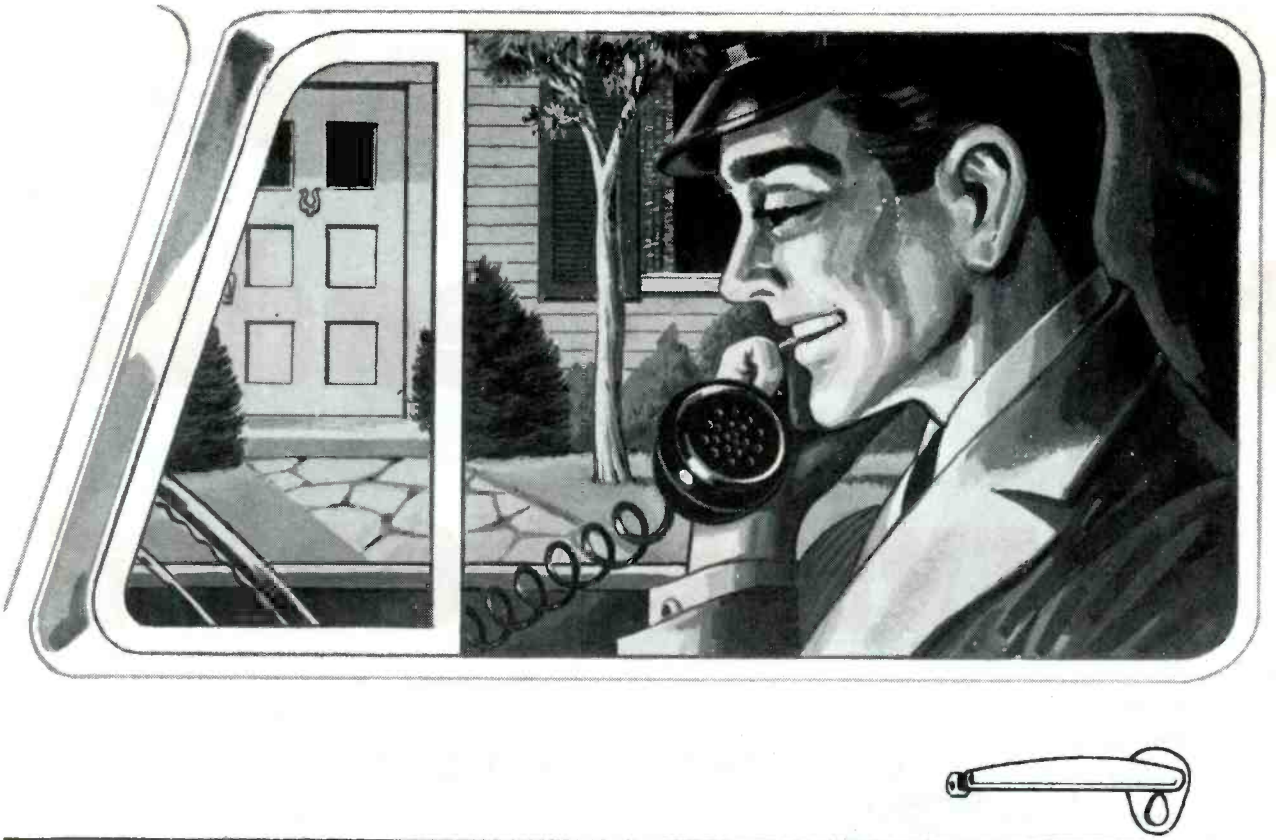

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ABOUT THE COVER

Keep abreast of tube designs and new tubes for TV receivers. See "Changes in Tube Design" and "A Stock Guide for TV Tubes" in this issue. The stock guide is a regular bimonthly feature. Cover design by Glenn R. Smith.

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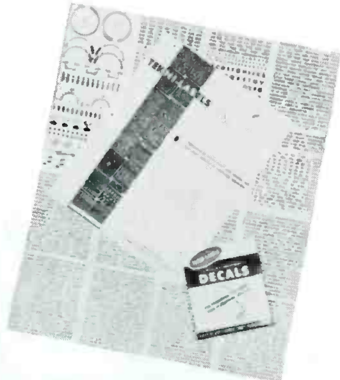

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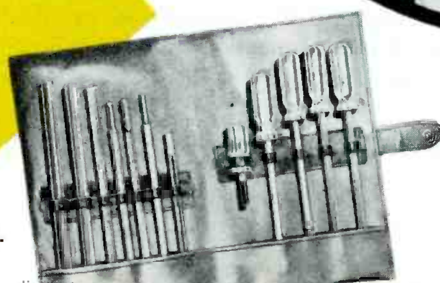

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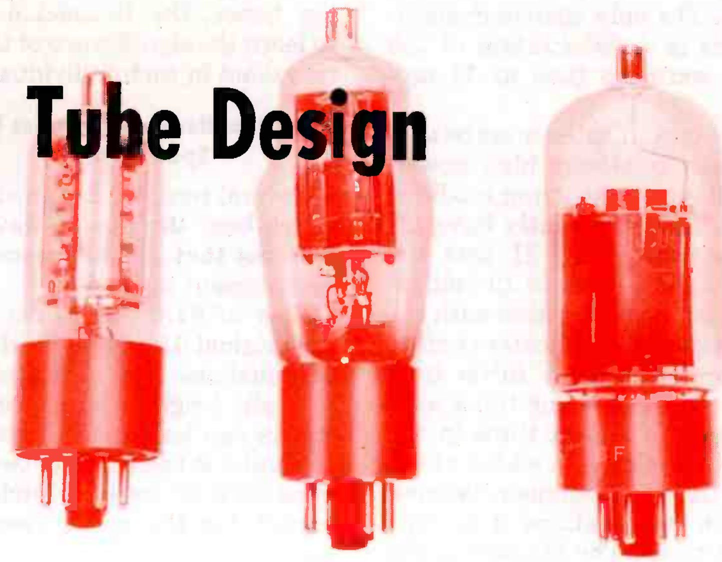
Changes in Tube Design



Demands for Series-String Operation and Greater Sweep Power Are Being Met

by Thomas A. Lesh

Many familiar types of tubes have recently been redesigned. Some of the modified ones are especially suitable for operation in series strings, and others are able to withstand higher voltages and currents than the original tubes. The type numbers of the redesigned tubes differ only slightly from those of the originals. In some cases, the first digit of the number is changed in order to indicate that a new value of filament voltage is necessary; in other cases, a final letter is added to the original type number as an indication that some specification has been changed. Since most of the original designs are still in common usage, the number of tube types which the service technician must keep in stock has been vastly increased.

The presence of so many new designs has created some confusion about the differences between closely related tubes. It is our purpose in this article to explain these differences and to point out instances in which similar types of tubes can be interchanged.

Series-String Operation

When modifications were made to existing 6-volt and 12-volt tubes in order to permit series-string operation, the filaments were redesigned to conform to two standards. First, the filament current had to be held to 600 milliamperes within close tolerance. Second, the time taken by the filament to attain operating temperature had to be approximately 11 seconds. These standards were maintained in order that voltage surges would be minimized across any of the filaments in the series string.

Some of the older types of 6-volt tubes have filaments which are rated at less than 600 milliamperes. The corresponding series-string tubes were designed with filament voltage ratings that are lower than those of the older tubes. These voltages were reduced so that the performance of the tubes would not be affected by an increase in filament current. The type numbers of these redesigned tubes begin with the figures 2, 3, 4, or 5. These correspond to filament voltages of 2.35, 3.15, 4.2, or 4.7 volts, respectively. Some examples of series-string tubes which employ a reduced filament voltage are given in Table I.

Series-string tubes like those in this table are readily recognized by their unusual filament-voltage ratings, and there need be no doubt about the suitability of one of these tubes for series-filament operation.

The 6S4 tube has a 6-volt, 600-ma heater. In its original form, this tube is not suitable for series operation because the warm-up time of the heater is improper. A

TABLE I

Series-String Tubes with Low Filament Voltages

TUBES FOR 600-MA SERIES STRINGS	ORIGINAL TUBES	FILAMENT CURRENT OF ORIGINALS (milliamperes)
2AF4	6AF4	225
3AL5	6AL5	300
3BC5	6BC5	300
4BZ7	6BZ7	400
5AN8	6AN8	450
5U8	6U8	450

TABLE II

Series-String Tubes with 12-Volt Filaments

SERIES-STRING TUBES	ORIGINAL TUBES	FILAMENT CURRENT OF ORIGINALS (milliamperes)
12AX4GTA	12AX4GT	600
12BH7A	12BH7	300 or 600
12BY7A	12BY7	300 or 600
12L6GT	25L6GT	300
12W6GT	6W6GT	1200
12CA5	None	—

new type called the 6S4A has been produced for series-string service. The only change in specifications is a stabilization of the heater warm-up time at 11 seconds.

Since output tubes must be able to handle relatively high power, the 600-ma series-string modified output tubes frequently have 12-volt heaters. Table II lists the type numbers of some 12-volt series-string tubes together with the type numbers and heater-current ratings of the older tubes from which the series-string tubes were developed. The first three in the list have the letter A added at the end of their type numbers because they are modifications of existing 12-volt tubes. The filament of the original 12AX4GT already has a 600-ma rating, and the other two original tubes have the same rating when the two halves of the center-tapped filament are connected in parallel. But the warm-up times of the originals do not meet the standard for series strings; therefore, the new varieties had to be developed.

The type numbers of the next two series-string tubes in the list do not have final letters because the tubes were not developed from existing 12-volt tubes. The filament voltage was changed from that of the original tube in each case in order to permit a change of filament current to 600 milliamperes without alteration of the other electrical ratings of the tube. The last series-string tube in Table II is a completely new type, the 12CA5 audio output tube.

Tubes such as the 6S4A and 12AX4GTA which have the same filament-voltage ratings as the tubes from which they were developed may generally be used as replacements for the tubes of the original designs, but the reverse of this statement is not true. Only those tubes which have a controlled warm-up time should be used in 600-ma series strings.

The use of the final A in the type number of a modified tube does not always indicate that the tube will operate satisfactorily in a series string. The final letter refers merely to the first modification that has been made to the original design of the tube. The change could have affected any electrical or physical characteristic; hence, the technician needs to learn the significance of the letter added in each individual case.

Miscellaneous Changes in Specifications

Several recently designed tubes which bear the final A have new features that do not concern series-filament operation.

The 6AF4A tube differs from the original 6AF4 only in that the modified one is 3/8 inch shorter in over-all height. More compact tuners can be designed when the new tube is used. These two varieties may be freely interchanged except for the space consideration.

The 12AU7A tube has a more rigid internal structure than the original 12AU7 so that microphonics are reduced to a minimum. Since neither the bulb size nor the electrical ratings have been changed, the two tubes are interchangeable.

The 6BQ7A tube has electrical ratings which are slightly higher than those of the original 6BQ7. The increases are intended to improve the efficiency of the 6BQ7 design. The transconductance has been increased from 6,000 to 6,400 micromhos, and the amplification factor (mu) has been raised from 35 to 39.

The 6BK7A is another tube which has higher transconductance and mu ratings than the original 6BK7. All four of the tubes of the 6BQ7 and 6BK7 types are interchangeable, but the tuner may have to be slightly realigned to compensate for the differences between the types.

Variations of the 6SN7GT Tube

Two modifications have been made to the original 6SN7GT design. The original and both modified tubes are very closely related, and all three are currently in use.

The first modified tube, which is called the 6SN7GTA, is different from the original in maximum voltage and power ratings. The maximum DC voltage rating of the 6SN7GTA is 450 volts, the maximum rating for positive pulse voltage is 1,500 volts, and the maximum dissipation is 5 watts per plate. The corresponding ratings of the 6SN7GT are 300 volts, 1,200 volts, and 3.5 watts.

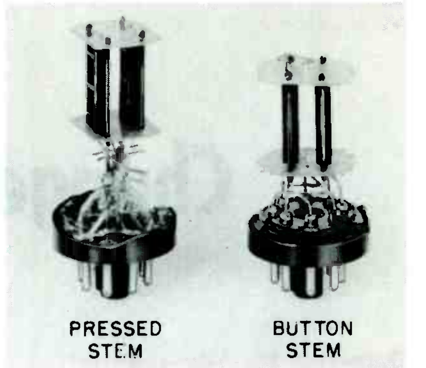


Fig. 1. Comparison Between Two Kinds of Stem Construction.

The increase in maximum ratings make the 6SN7GTA well suited for use in vertical deflection circuits which tax the limits of capability of the 6SN7GT. In other circuits which do not place such heavy demands upon the tube, the 6SN7GT and 6SN7GTA are interchangeable.

The 12SN7GTA is a redesigned tube that is comparable to the 12SN7GT in the same way that the 6SN7GTA is comparable to the 6SN7GT.

The second modified tube is designated as the 6SN7GTB. This new tube is electrically and physically the same as the 6SN7GTA except that it has a heater which is designed for use in 600-ma series strings. The 6SN7GTB has no 12-volt counterpart.

A major change in internal construction is an important feature of the modified 6SN7GTA and 6SN7GTB tubes which are being made by several manufacturers. In Fig. 1, a 6SN7GT and a 6SN7GTA are shown with bulbs removed and bases cut away in order that this change will be vis-

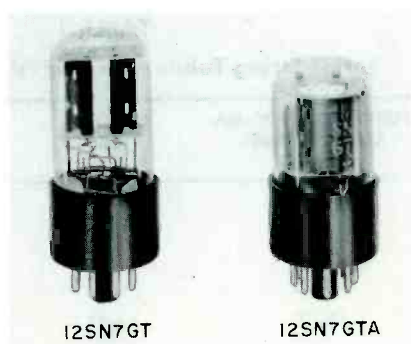
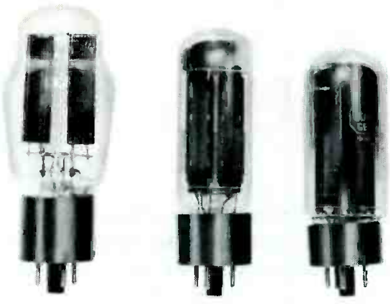


Fig. 2. Comparison of Original with Redesigned Tube.



5U4G 5U4GA 5U4GB

Fig. 3. Comparison of Original with Two Redesigned Tubes.

ible. In the stem of the tube, the leads which connect the electrodes to the base pins are passed through the bottom of the glass envelope. The 6SN7GT at the left side of the figure has a pressed stem in which all the connecting leads are arranged in a straight line and are sealed into the glass as one group. The 6SN7GTA on the right side of the figure has a button (or wafer) stem in which the connecting leads pass through small individual glass seals that are arranged in a circular pattern. The button stem has short, rigid leads which are widely spaced; and a tube that employs this construction dissipates heat efficiently. The electrical ratings of this tube can therefore be made greater than those of a tube that has a pressed stem.

The compactness of button-stem construction also permits a reduction in the height of the tube. Observe in Fig. 2 that the 12SN7GTA at the right is considerably shorter than the 12SN7GT at the left.

Modifications of the 5U4G Tube

Two new variations of the 5U4G design are among the tubes which have recently appeared on the market. These two tubes, the 5U4GA and the 5U4GB, are shown in Fig. 3 together with their prototype. Notice that the new tubes are similar to each other in that they use straight-sided envelopes.

Employment of button-stem construction and other internal features that are new to the 5U4G design made it possible to reduce the size of the redesigned tubes even though the ability of the tubes to dissipate heat was actually increased. The electrical ratings of the 5U4GB are higher than those of the 5U4GA, but both new tubes have considerably higher current ratings than the original 5U4G. Some of the comparative ratings are presented in Table III. These tubes are all designated as G-type instead of GT-type because their glass envelopes are relatively large in size.

Survey of Horizontal Output Tubes

The most confusing assortment of similar tube types is found among the beam-power tubes which are used in horizontal output circuits. Brief descriptions of the many types of tubes that are used in horizontal output circuits will be given in the following paragraphs. This discussion will be confined to tubes which have top caps and are used in monochrome receivers. Each tube that has a number marked with a dagger symbol in the following discussion has a 600-ma heater and a controlled warm-up time and therefore is suitable for operation in series strings.

The tubes which will be described in this survey may be divided into two basic classifications. The first of these is composed of several types of tubes that have been developed from the basic design of the original 6BQ6GT, and the second classification contains types of tubes that had been developed from another basic design, the 6BG6G. Tubes which are alike except for filament-voltage rating will be grouped together for the purpose of this discussion. For example, the 6CU6 and the 12CU6 will be described together.

TABLE III

Comparative Ratings of Three Closely Related Tubes

TUBES	CHARACTERISTICS				
	Steady-State Peak Plate Current, per Plate (milliamperes)	Transient Peak Plate Current, per Plate (amperes)	Output from Filter Network of Full-Wave Rectifier (milliamperes)	Type of Bulb	Height of Tube (inches)
5U4G	675	2.5	225	sides curved	5 5/16
5U4GA	900	4.3	250	sides straight	4 ½
5U4GB	1000	4.6	275	sides straight	4 ¼

6BQ6GT 6BQ6G 6CU6

Fig. 4. Comparison of Three Closely Related Tubes.

Tubes Based on the 6BQ6GT

The familiar 6BQ6GT tube is the prototype from which many closely related types of tubes have been developed. A 6BQ6GT is shown in Fig. 4 together with a 6BQ6G and a 6CU6. Both of the latter are representative of the modifications which have been made to the basic 6BQ6GT design.

6BQ6GT
25BQ6GT

The GT designation of the prototype tube 6BQ6GT indicates that it has a relatively small tubular envelope. The total height of the tube is approximately 3¾ inches. The plate is designed to withstand positive pulses that have an amplitude of 5,500 volts, and the maximum rated plate dissipation is 11 watts. The filament current of the 6BQ6GT is 1.2 amperes.

The 25BQ6GT is designed for use in receivers which have several 300-ma filaments connected in series. One form of series connection is shown in Fig. 5. In this circuit, the 25BQ6GT is part of a special series string that also includes a 25AX4GT damper, a

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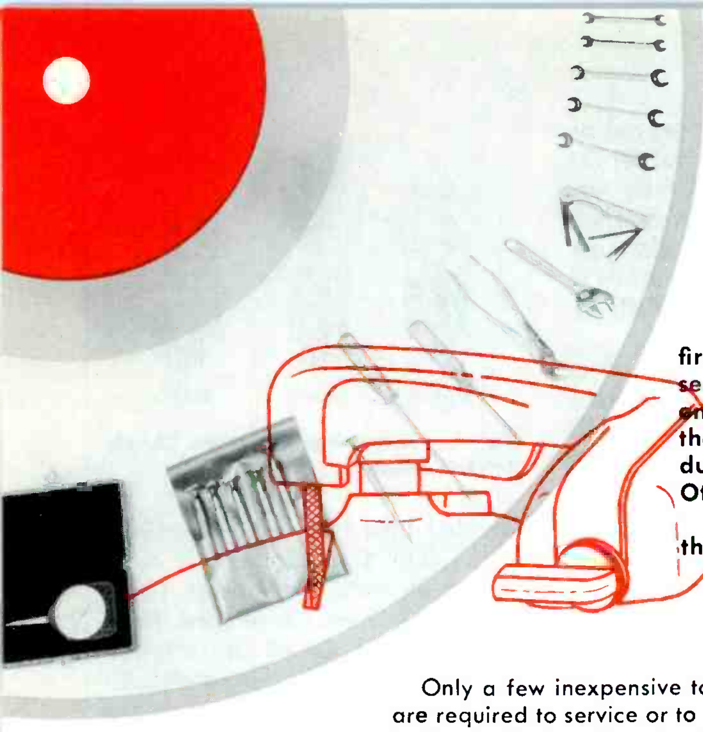


RECORD-CHANGER ADJUSTMENTS

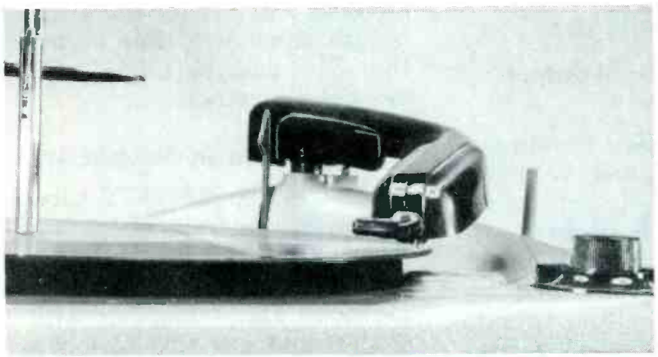
Part I

This pictorial coverage of record-changer adjustments is the first of a series of articles which are intended to acquaint the service technician with the basic adjustments that may be made on most record changers. In this article, the basic adjustments and their purposes are presented. In addition, the location and procedure for making these adjustments on two changers are included. Other record changers will be covered in future issues.

These are all basic adjustments that can normally be made in the home with a minimum number of special tools or equipment.

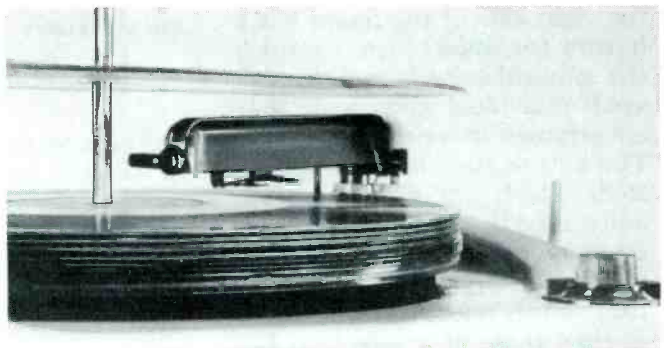
1. Tools and Equipment

Only a few inexpensive tools in addition to the normal complement of pliers and nut drivers are required to service or to make adjustments on record changers. These are shown in the illustration in the heading. Starting at the left, there is a gram scale; a set of jeweler's screwdrivers; a small-blade 4-inch screwdriver; a No. 0 Phillips screwdriver; a small pair of adjustable pliers; a 4-inch adjustable wrench; and a set of 5 small wrenches from $^{13}/_{64}$ to $^{3}/_{8}$ inch.



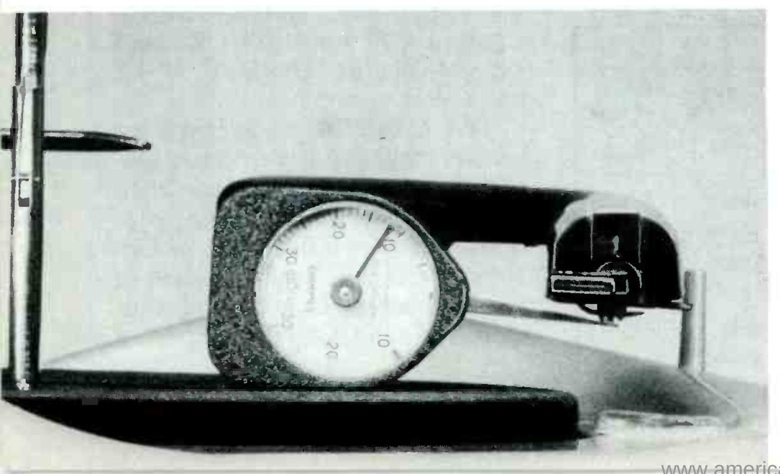
2. Needle Setdown

The point of first contact between the needle and the record is called the setdown point. This point must be in the outside band of the record and should be as near the grooves of the record as possible without actually being directly in the grooves. If the needle should be permitted to drop directly into the playing grooves of the record because of improper setdown adjustment, damage to the grooves could result. The loud pop that would appear from the speaker when the needle is dropped into the grooves of the record is also undesirable. The lead-in grooves provided in the outer band of the record cause the needle of the tone arm to be led gently into the grooves of the record and thus into the very beginning of the tune or other recorded matter on the record.



3. Height of Pickup Arm

When the pickup arm goes up each time, it must go high enough to clear the last of a full load of records; but it must not go high enough to strike the record which will be on the spindle before the full load has dropped. The correct adjustment of the height of the pickup arm is illustrated with eleven records on the spindle. Ten records are shown on the turntable, and these represent the full capacity of records that can be played on this changer. The eleventh record is put on the spindle so that the adjustment for the maximum upward movement of the arm can be properly made.



4. Needle-Tracking Force

The pressure which the pickup arm places on the needle when the needle is in position to engage the first grooves of the record is called the tracking force. This pressure may vary from as little as 6 grams to more than 14 grams in various record changers. The correct weight in grams is usually specified by the manufacturer of the particular cartridge or changer. This recommendation should be closely followed because excessive weight will cause excessive wear on the needle and the record. Too little weight can result in groove hopping by the needle, and this will cause damage to both the record and the needle.

5. Turntable Speed

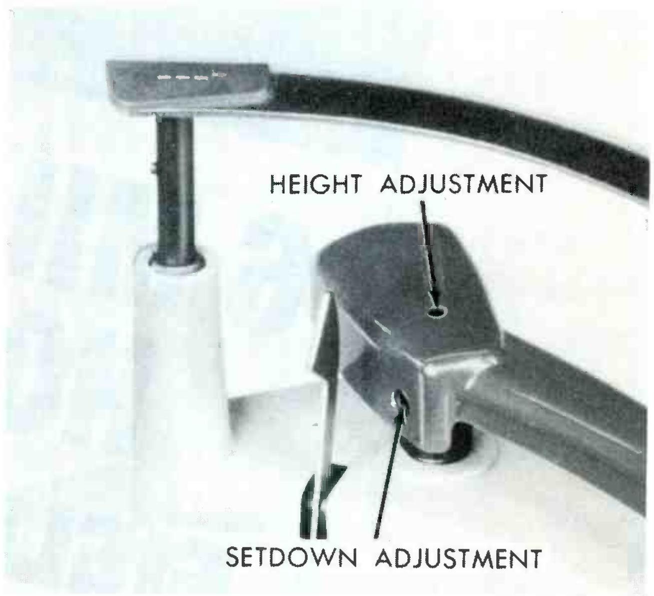
The speed of record-changer turntables is determined by the power-line frequency and the mechanical size and arrangement of the drive pulleys or drive wheels of the changer. Any line voltage between 105 and 125 volts AC at 60 cycles per second should keep the speed of the turntable constant. On account of the sound of the music, there will be times when it will be suspected that the turntable is turning too slowly. A check with a stroboscopic card or disc will show the speed. Slowness could be caused by dirt in the motor bearings, lack of lubrication, worn or oily drive wheels, worn or oily drive belts, or other similar troubles which a check of the service literature will reveal. If a record changer is to be maintained at its best performance, it should be cleaned and relubricated at intervals. The interval will vary, but once a year would not be too often.

6. Adjustments on Admiral Changers

SETDOWN. The steps in setdown adjustment are as follows: (1) swing the leveling arm to the right as far as possible; (2) place a 10-inch record on the turntable; (3) slide the control pointer to the reject position, and then return to the OFF position; (4) rotate the turntable clockwise by hand until the pickup arm starts its downward travel; (5) adjust the setdown screw so that the needle will land in the lead-in grooves; (6) check the setdown on 7-, 10-, and 12-inch records.

HEIGHT. The elevation of the arm should be adjusted so that the needle will clear the base plate by approximately ¼ inch when the changer is out of cycle. With this adjustment, the pick-up arm should clear a stack of twelve 10-inch, 78-rpm records on the turntable and should also clear the bottom of a record resting on the spindle shelf. Turning the screw clockwise will increase the elevation of the arm.

TRACKING FORCE. No provision is made for adjusting the tracking force because the Admiral cartridge automatically ensures that the needle will have the proper tracking force.



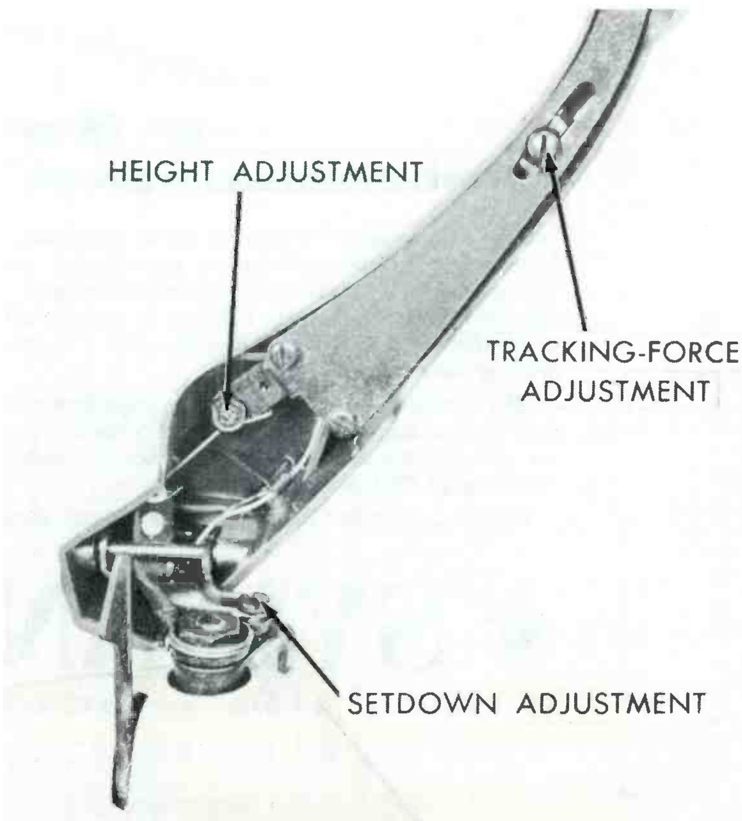
7. Adjustments on V-M Changers

In most of the V-M changers, adjustments screws are provided in the locations shown for setdown, height, and tracking force.

SETDOWN. The steps in setdown adjustment are made as follows: (1) swing the leveling arm away from the spindle, (2) place a 10-inch record on the turntable, (3) turn the speed selector to 78 rpm, (4) turn the switch to the REJ position and release it, (5) rotate the turntable clockwise by hand until the pickup arm starts its downward travel, (6) adjust the setdown screw until the needle is over the lead-in grooves.

HEIGHT. The pickup arm should be adjusted so that it lifts straight up ¼ inch as the change cycle starts. A 1⅛-inch stack of records should be on the turntable for this check. Turning the adjustment screw clockwise lowers the arm.

TRACKING FORCE. The needle pressure should be adjusted by loosening the adjustment screw and sliding it along the slot until the required weight is obtained. Usually this will be between 8 and 12 grams with about 10 grams being the most common. The service literature should give the correct weight. If the cartridge is replaced, then follow the specifications of the manufacturer to get the correct tracking force.



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Shop Talk

MILTON S. KIVER

Author of . . .
How to Understand and Use TV Test Instruments
and Analyzing and Tracing TV Circuits

Transistor Specifications

Now that we have become familiar with some of the structural features of transistors, we are ready to consider some of those things which we as service technicians will encounter. One of the first of these is the specification sheet that the manufacturer provides for each kind of transistor he produces. This may be part of a volume containing the data for many transistors, or it may be a single data sheet which the manufacturer may enclose with each transistor that he ships out. Both methods have been employed to date.

Two examples of such data sheets are given in Tables I and II. One is for the Raytheon Type 2N65 *p-n-p* junction transistor, the other is for the Texas Instruments Type 202 *n-p-n* junction transistor. In Table I, the mechanical specifications for the 2N65 are listed first. These include the type of housing, the mounting base (or lack of it), and the manner of identifying the terminal connections. The lead that is labeled No. 1 is the connecting link to the collector. The central lead, labeled No. 4, is the base lead; and the end lead, No. 5, is the emitter lead. This positioning sequence is now fairly standard, although not universal. (The choice of numbers is not universal either.) Power transistors, for example, frequently have their leads positioned differently. When any doubt exists, always check the data sheet because you can ruin a transistor if you apply the wrong voltages to one or more elements.

Under the electrical data for the Type 2N65 transistor, the absolute maximum values are listed first. The maximum collector voltage that is recommended is −12 volts, although it may extend as high as 45 volts if certain precautions indicated in the footnotes are observed. The maximum collector current that should be permitted to flow is 10 milliamperes. Collector dissipation is a function of the ambient or surrounding temperature, and a suitable formula is given for computing this value for a given condition. Under the average characteristics, an ambient temperature of 27 degrees centigrade is assumed; and this is close to what may be considered as the normal operating temperature. (This is approximately equal to 77 degrees Fahrenheit.)

· *Please turn to page 72*

TABLE I

SPECIFICATION SHEET FOR THE RAYTHEON 2N65 TRANSISTOR

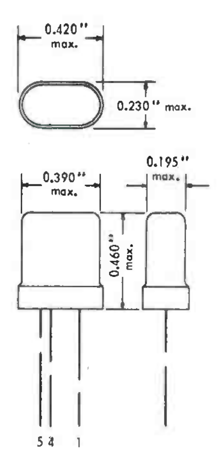
MECHANICAL DATA

CASE: Metal and Glass

BASE: None (0.016″ tinned flexible leads. Length: 1.5″ min.
Spacing: Leads 1-4 0.144″ center-to-center;
Other Leads 0.048″ center-to-center)

TERMINAL CONNECTIONS:
Lead 1 Collector
Lead 4 Base
Lead 5 Emitter

MOUNTING POSITION: Any



ELECTRICAL DATA

RATINGS—ABSOLUTE MAXIMUM VALUES:

Collector Voltage (V_c)	−12 volts
Peak Collector Voltage (V_c) § ¶	−24 volts
Collector Current	−10 ma
Collector Dissipation ‡	
Emitter Current	10 ma
Ambient Temperature *	85 °C

AVERAGE CHARACTERISTICS (at 27°C.):

Collector Voltage	−6 volts
Emitter Current	1.0 ma
Collector Resistance	2.0 meg
Base Resistance	1500 ohms
Emitter Resistance	25 ohms
Base Current Amplification Factor	90
Cut-off Current (approx.)	6 μa
Noise Factor (max.) **	20 db

AVERAGE CHARACTERISTICS (at 27°C.):

	COMMON EMITTER	COMMON COLLECTOR	COMMON BASE
Collector Voltage	−6 volts	−6 volts	−6 volts
Emitter Current	1.0 ma	1.0 ma	1.0 ma
Input Resistance †	2700 ohms	1.0 meg	110 ohms
Load Resistance	20,000 ohms	20,000 ohms	0.1 meg
Power Gain (Matched Input)	42 db	16 db	30 db

* This is the maximum operating temperature recommended. However, characteristic damage will not result from occasional exposures to storage temperatures up to 100° C.

** Measured under conditions for grounded emitter operation at V_{cb} = 2.5 volts for 1 cycle bandwidth at 1000 cycles.

† Higher input impedances, without appreciable loss in gain, can be achieved by operating at lowered collector current.

‡ This is a function of maximum ambient temperature (TA) expected. It is approximately equal to 1.7 (85° C - TA) milliwatts.

§ Collector voltage V_{ce} at which I_c rises to 2 ma. in common emmitter circuit with base lead connected directly to emitter lead. Ambient temperature = 25° C.

¶ In circuits stabilized for I_e or I_c and which do not have critical distortion requirements, absolute maximum peak voltage is 45 volts.

Notes On TEST EQUIPMENT

Presenting Information on Application, Maintenance, and Adaptability of Service Instruments

by Paul C. Smith

ROLL CHARTS FOR PRECISION TUBE TESTERS

The Precision Apparatus Company announces a plan for supplying owners of Precision tube testers with new roll charts and supplementary data for tube testing. Under this plan, the charts and data are made available on an annual subscription basis. Tube-testing data will be published and forwarded periodically to subscribers who will therefore no longer need to write for information whenever new tubes appear on the market. The service will include a minimum of two new roll charts plus other supplementary data. The total cost for this service will be $2.00 for a full year's subscription.

Subscribers are requested to provide information concerning the model and serial numbers of their Precision tube tester as well as the form number of their present roll chart when they initially subscribe for this service. Inquiries should be addressed to the Tube Test Data Department of the Precision Apparatus Company, Inc., 70-31 84th Street, Glendale 27, L. I., N. Y. The application for a subscription should be accompanied by the required subscription fee.

VACUUM-TUBE VOLTMETERS

As with multimeters, VTVM's have a number of features common to most models; and the prospective purchaser can be influenced in his choice by the presence or omission of any of these features in any particular model as well as by certain physical aspects such as the size of the instrument, the size of the meter movement, and the general appearance.

The input impedance is high on all models. It is seldom less than 10 or 11 megohms on all DC ranges or 1 megohm on AC ranges; and in some cases, the impedance values are much greater than these.

In most models, a 1-megohm isolation resistor is included in the DC probe to prevent the capacity of the lead from affecting any circuit to which the probe is applied. The probe may be a combination AC/DC probe with a switch to make the changeover from AC to DC. With this probe, the number of test leads necessary for use with the instrument will be reduced.

Even though a meter movement of low sensitivity is used, vacuum-tube voltmeters have high sensitivities because of the gain provided by the tubes; therefore, a less sensitive and more rugged movement than that in a VOM can be used. The pointer and scale size can be increased accordingly. The circuits are usually designed in such a manner that protection against overloading of the meter movement will be provided.

A polarity-reversal switch is usually provided on VTVM's. It is more necessary with metal-case VTVM's than with multimeters because the ground lead connects to the chassis and case of the VTVM; and if the test leads are reversed for negative DC voltage readings, the case would then be above ground potential and erroneous readings might be obtained.

Two types of rectifier circuits are commonly used for measurement of AC voltages. One gives an indication that is proportional to rms values, and the other gives an indication proportional to peak-to-peak values. Either type can be provided with scales calibrated in both rms and peak-to-peak values, but one of these scales will not be as accurate as the other unless the voltage being measured has a sine waveform. A few instruments have provisions for accurate measurement of both rms and peak-to-peak voltages—both types of rectifier circuits are included in the instruments.

The frequency response of most VTVM's to AC inputs is very good. It extends upward to several megacycles; and if an RF probe is used, it extends up to several hundred megacycles.

The following VTVM's with the manufacturer's specifications are grouped alphabetically according to their respective manufacturers.

Electronic Instrument Co., Inc. (EICO)

EICO MODEL 214

Ranges (20)

DC voltage and *AC voltage*, 0 to 1000 volts in 5 ranges each; *resistance*, 0 to 1000 megohms in 5 ranges; *decibels*, —20 to +55 db in 5 ranges.

Other Features

Input resistance, 25 megohms for DC voltage and 3 megohms for AC voltage; accuracy, ±3% for DC voltage, ±5% for AC voltage, and ±3% for ohms; frequency response for AC voltage, 20 cycles to 200 kilocycles per second, and up to 200 megacycles with accessory probe; accessory probe for measuring peak-to-peak voltages; polarity-reversal switch for DC voltages; zero-center scale; 7½-inch meter; size of case, 9 by 13¼ by 6 inches.

EICO MODEL 221

Electrical specifications are the same as those for the Model 214. Other features are 4½-inch meter; size of case, 9$^{7}/_{16}$ by 6 by 5 inches.

EICO MODEL 232

Ranges (28)

DC voltage and *AC rms voltage*, 0 to 1500 volts in 7 ranges each; *AC peak-to-peak voltage*, 0 to 4200 volts in 7 ranges; *resistance*, 0 to 1000 megohms in 7 ranges.

Other Features

Input resistance, 11 megohms for DC voltage and 1 megohm for AC voltage; accuracy, ±3% of full scale for DC voltage, ±5% of full scale for AC voltage; frequency response for AC voltage, 30 cycles to 3 megacycles per second, and up to 250 megacycles with accessory probe; dual-purpose probe with switch for AC-OHMS or DC functions; polarity-reversal switch for DC voltages; zero-center scale; 4½-inch meter; size of case, 8½ by 5 by 5 inches.

EICO MODEL 249

Electrical specifications are the same as those for the Model 232. Other features are 7½-inch meter; size of case, 8½ by 13 by 5 inches.

The Hickok Electrical Instrument Co.

HICKOK MODEL 209-A

Ranges (41)

DC voltage, AC rms voltage, and *AC peak-to-peak voltage*, 0 to 1200 volts in 6 ranges each; *current*, 0 to 1200 milliamperes DC in 6 ranges, lowest range 0 to 3 milliamperes DC; *resistance*, 0 to 10,000 megohms in 7 ranges; *capacitance*, 0 to 10,000 micromicrofarads in 2 ranges, 0 to 1000 microfarads in 5 ranges; *inductance*, 50 millihenries to 100 henries in 3 ranges.

Other Features

Input resistance, 15 megohms for DC voltage and 12 megohms for AC voltage; frequency response for AC voltage, up to 200 megacycles; AC rms and AC peak-to-peak voltage functions are built in and are selected by a switch; polarity-reversal switch for DC voltages; zero-center scale; 9-inch meter; size of case, 13¼ by 16¼ by 7 inches.

HICKOK MODEL 215

Ranges (28)

DC voltage and *AC rms voltage*, 0 to 1200 volts in 7 ranges each; *AC peak-to-peak voltage*, 0 to 3200 volts in 7 ranges; *resistance*, 0 to 1000 megohms in 7 ranges.

Other Features

Input resistance, 10 megohms for DC voltage and 30 megohms for AC voltage; accuracy, ±3% of full scale for DC voltage and ±5% of full scale for AC voltage; frequency response for AC voltage, flat from 40 cps to 3.5 megacycles, range extends to 250 megacycles with accessory probe; dual-purpose probe serves for both AC and DC voltage measurements; polarity-reversal switch for DC voltages; zero-center scale; 5-inch meter; size of case, 5¾ by 8⅜ by 4½ inches.

HICKOK MODEL 225

Ranges (28)

DC voltage and *AC rms voltage*, 0 to 1200 volts in 7 ranges each; *AC peak-to-peak voltage*, 0 to 3200 volts in 7 ranges; *resistance*, 0 to 1000 megohms in 7 ranges.

Other Features

Input resistance, 10 megohms for DC voltage and infinite ohms shunted by 150 micromicrofarads for AC voltage; frequency response for AC voltage, 40 cps to 3.5 megacycles; dual-purpose probe serves for both AC and DC voltage measurements; polarity-reversal switch for DC voltages; zero-center scale; continuity-test buzzer provides audible check for circuit resistances under 10 ohms; 9-inch meter; size of case, 13¼ by 16¼ by 7 inches.

HICKOK MODEL 415

Ranges (21)

DC voltage and *AC rms voltage*, 0 to 1500 volts in 7 ranges each; *resistance*, 0 to 1000 megohms in 7 ranges.

Other Features

Frequency response for AC voltage, flat from 40 cps to 3.5 megacycles; built-in power supply for ohmmeter section; dual-purpose probe serves for both AC and DC voltage measurements; size of case, 8½ inches long by 5⅞ inches wide; height, 3 inches tapering down to 1¾ inch.

Hycon Mfg. Company

HYCON MODEL 614

Ranges (28)

DC voltage and *AC rms voltage*, 0 to 1500 volts in 7 ranges each corresponding to the *AC peak-to-peak* ranges; *resistance*, 0 to 1000 megohms in 7 ranges.

Other Features

Input resistance, 11 megohms for DC voltage; frequency response for AC voltage, 30 cps to 3 megacycles with direct probe and 50 kilocycles to 250 megacycles with crystal probe; accuracy, ±3% of full scale for DC voltage and ±5% of full scale for AC voltage; polarity-reversal switch for DC voltages; zero-center scale; probes and leads stored in a compartment in the case; 6½-inch meter; size of case, 8½ by 11 by 7½ inches.

HYCON MODEL 615

Ranges (12)

DC voltage, 0 to 1000 volts in 4 ranges; *AC voltage*, 0 to 1000 volts in 3 ranges; *resistance*, 0 to 10 megohms in 5 ranges.

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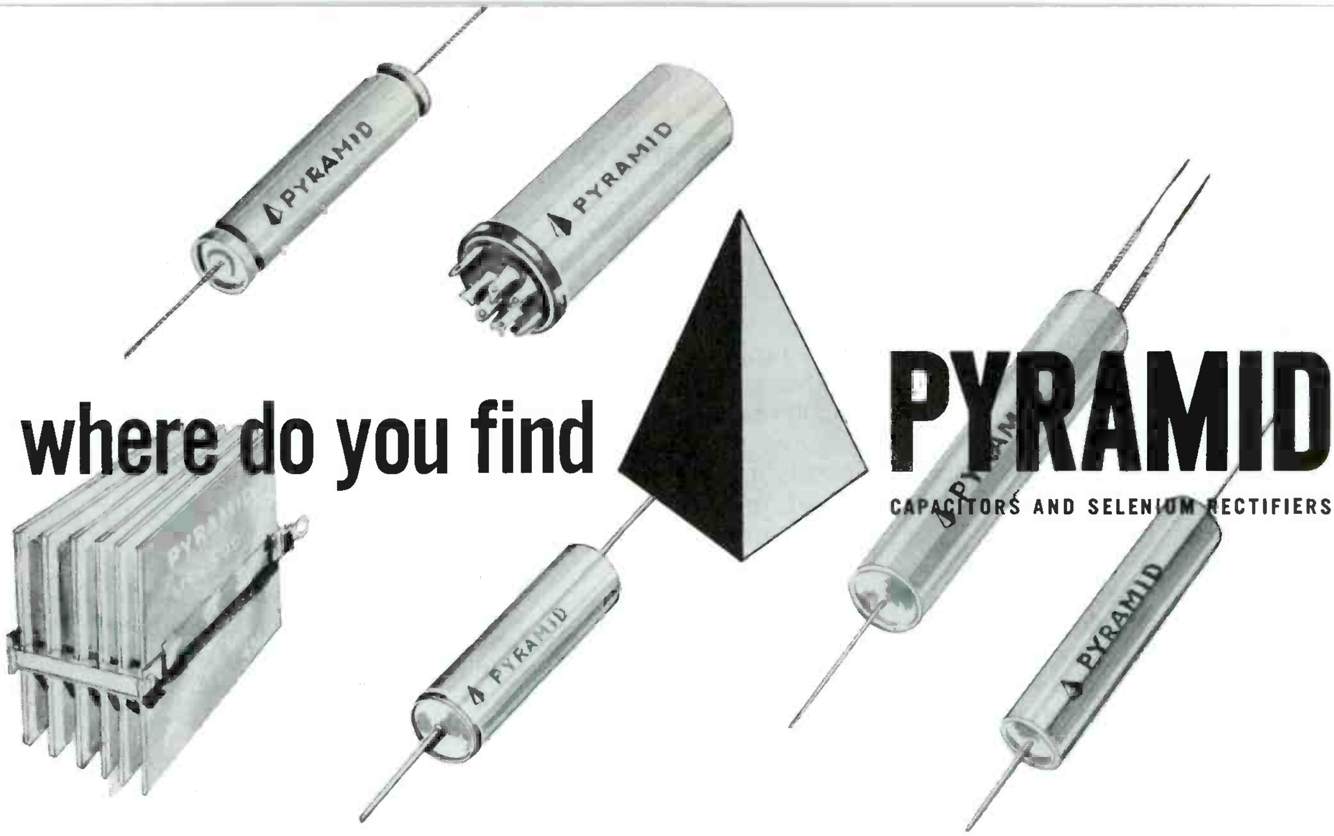

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INSTALLING HOME INTERCOM SYSTEMS

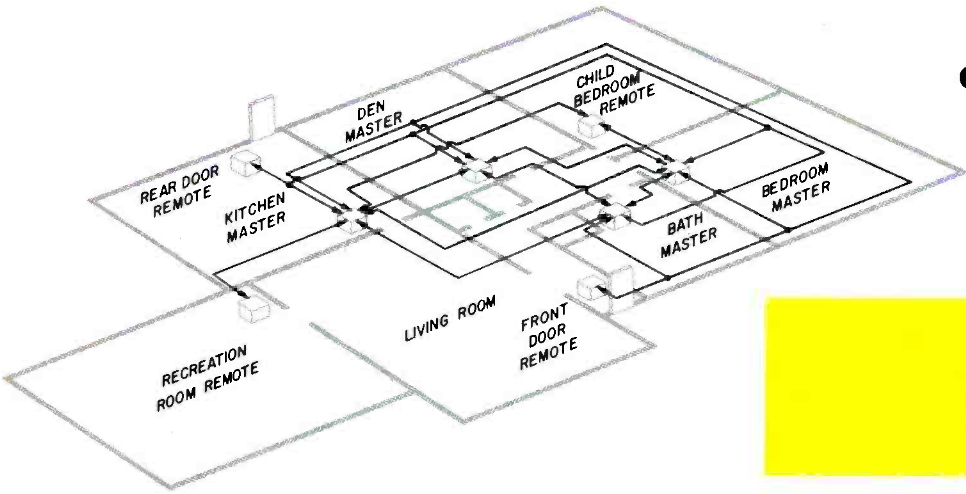

Fig. 1. Block Diagram of Intercom System.

GETTING A PROFITABLE START IN AN EXPANDING FIELD

by CALVIN C. YOUNG, JR.

Intercom systems for home installation present the enterprising service technician with a real opportunity for work that can be both profitable and interesting. Home construction is buzzing along at a fast clip even in the luxury price class, and both the builders and the buyers are potential customers for intercom systems. This is especially true when the homes are more expensive. While the potential market for home intercom installations is very large, the field is barely being touched. Relatively few service technicians are doing intercom work at the present time, and they generally have more work in this field than they can handle.

Actually, the sale of intercom systems is different from the sale of other types of electronic equipment because the general public may not even be aware that such systems are available. Those people who know that intercom systems can be obtained may not realize that there is a practical use for such a system in their home.

For these reasons, two things must be done if you wish to make a successful venture into the field of intercom installations. First, the public must be made aware of the availability of suitable intercom systems; and second, they must be convinced of the practicability of such units.

The problem of acquainting the public with the fact that suitable intercom systems are available is not too difficult, but it does require that a certain amount of effort be expended in the proper direction. This consists mostly of the proper presentation of the facts about intercom systems to the prospective customers. Several measures which can be taken are:

1. To persuade the builders of luxury-class homes to install suitable intercom systems in their model or show homes.
2. To persuade as many builders as possible to list intercom systems as available accessory items.
3. To have electrical contractors list intercom systems as available items.

Getting intercom systems into model or show homes is a very effective measure. The real-estate salesmen can then present the features of the system to the prospective buyers at the same time that the other features of the home are being presented. A suitable sales plan should be worked out and given to these salesmen so that the intercom systems can be intelligently explained.

If intercom systems are listed as accessory items along with such other extras as air conditioners, garbage-disposal units, and automatic washers and dryers, the prospective buyer who does not find an intercom system in a model home will nevertheless be made aware of its availability.

Electrical contractors who specialize in wiring the more expensive homes may be questioned by either the home buyer or the builder about an intercom installation. Since the electrical contractor is usually not prepared to do this kind of work, he would be less inclined to discourage the customer if he knew that some qualified company or person were readily available to make the installation. It is usually the electrical contractor who is asked to install the outlet boxes and drop cables, for which he charges a standard rate; therefore, he should be willing to co-operate in the matter of selling the systems.

Direct dealing with the buyer of a home under construction can be satisfactory, but usually it should be avoided in order to prevent any difficulties with the builder or the electrical contractor. If you should happen to sell a home buyer on an intercom system, then the approximate price and other details should be worked out and you should have the home buyer authorize the builder to do whatever additional work will be required. This will make it possible for the builder to proceed with any work specified by the intercom installer with a minimum of friction or red tape. It is also normal practice to include a commission for the building contractor when you estimate a job for the buyer of a home under construction.

This brings up two points which should be stressed when dealing with the builder—that an intercom system adds value to a house and that he can realize a profit on it. Since most builders are successful businessmen, it follows that any approach aimed at selling them on intercoms must be based on sound business practice and must be presented in such a way that these points are made known to them.

In the light of this, it becomes apparent that a working proposition which outlines a suitable intercom system should be prepared. This proposition should contain a sample system laid out in a block diagram and should be prepared so that the operation of the system can be readily seen. A block diagram of a typical system is shown in Fig. 1. In addition to this, a preliminary estimate of the possible installation charges and cost of the equipment should be prepared and included in the outline. A list of the basic charges of one firm will be given later in the article and will be discussed at that time.

Type of System to Suggest

There are many intercom systems manufactured under a variety of trade names, and the job of choosing the best one for a particular installation involves some thought. If a customer should ask you to suggest a system, try to point out all the features necessary and the good points of more than one system; and always do it in an objective manner. Some of the specifications of a good system would be: AC transformer operated, recognized brand name, competitive price, pleasing appearance, and thoroughness of the wiring data furnished by the manufacturer. Above all, always insist on quality units for systems of any size and always allow one or two spare positions in order to provide for expansion of the system. For example, if a 12-station master unit is employed, then the wiring should be able to accommodate 12 stations even though only 10 are to be used. The extra wires in the cable should be dead-ended in an easily accessible place such as the attic so that they can be extended to a location to be chosen in the future.

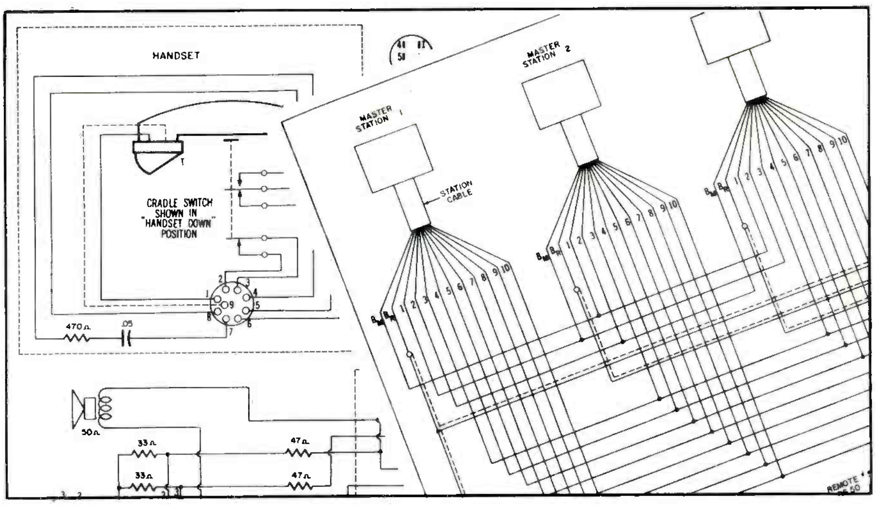

Fig. 2. Sample Data Furnished by Manufacturer.

Working with the Builder

Working well with the builder is rather important because the balance of profit hangs upon this. With proper co-operation between the builder and the installer, intercoms can be installed with a minimum of time and materials. Without this co-operation, the extra time and material can make an otherwise good system unprofitable and undesirable. These things are caused by the fact that the "drops" made up of the outlet boxes and the flexible tubing are best installed at the same time that the electrical wiring is roughed in because this avoids any possible conflict between the intercom and electrical outlets. Since he has the material and necessary specifications, the electrical contractor can best do the installation of the drops.

After the drops are installed, the balance of the installation can be delayed until the house is completed; however, it is probably best if the wires are pulled through the drops before the inside walls are completed. In this way, the installer avoids the risk of marring the finish on the inside walls.

Installation Data Required

With the intercom system, the manufacturer furnishes schematic diagrams of the master and remote units and also furnishes wiring diagrams so that the units may be connected together properly. Fig. 2 is an example of the schematic and wiring diagrams furnished.

There are several things which, in addition to the data furnished by the manufacturer, are essential when intercom systems are to be installed in homes. As soon as the locations of the desired master and remote units have been determined, a floor plan of the house showing a layout of the intercom locations should be prepared. This layout should be presented to the builder and buyer and approved by both. A copy with approval signatures should be filed by the installer for future reference. Additional copies should be given to the buyer, building contractor, and electrical contractor. The electrical contractor will use his copy as a guide to install the required drops and to provide AC power at the required locations. In addition to being provided with the unit-location chart, the electrical contractor should be consulted and all pertinent details should be worked out. This will serve to avoid any misunderstandings.

Since the wires in the different makes of multiwire cables are coded differently, a wiring diagram which shows the matching of the coded wires to the numbers or letters of the intercom terminal boards should be prepared. A similar diagram for interconnecting cables should be prepared. Through the use of these charts, the system can be wired or serviced with a minimum of time or wasted effort. To facilitate service at a later date, a list contain-

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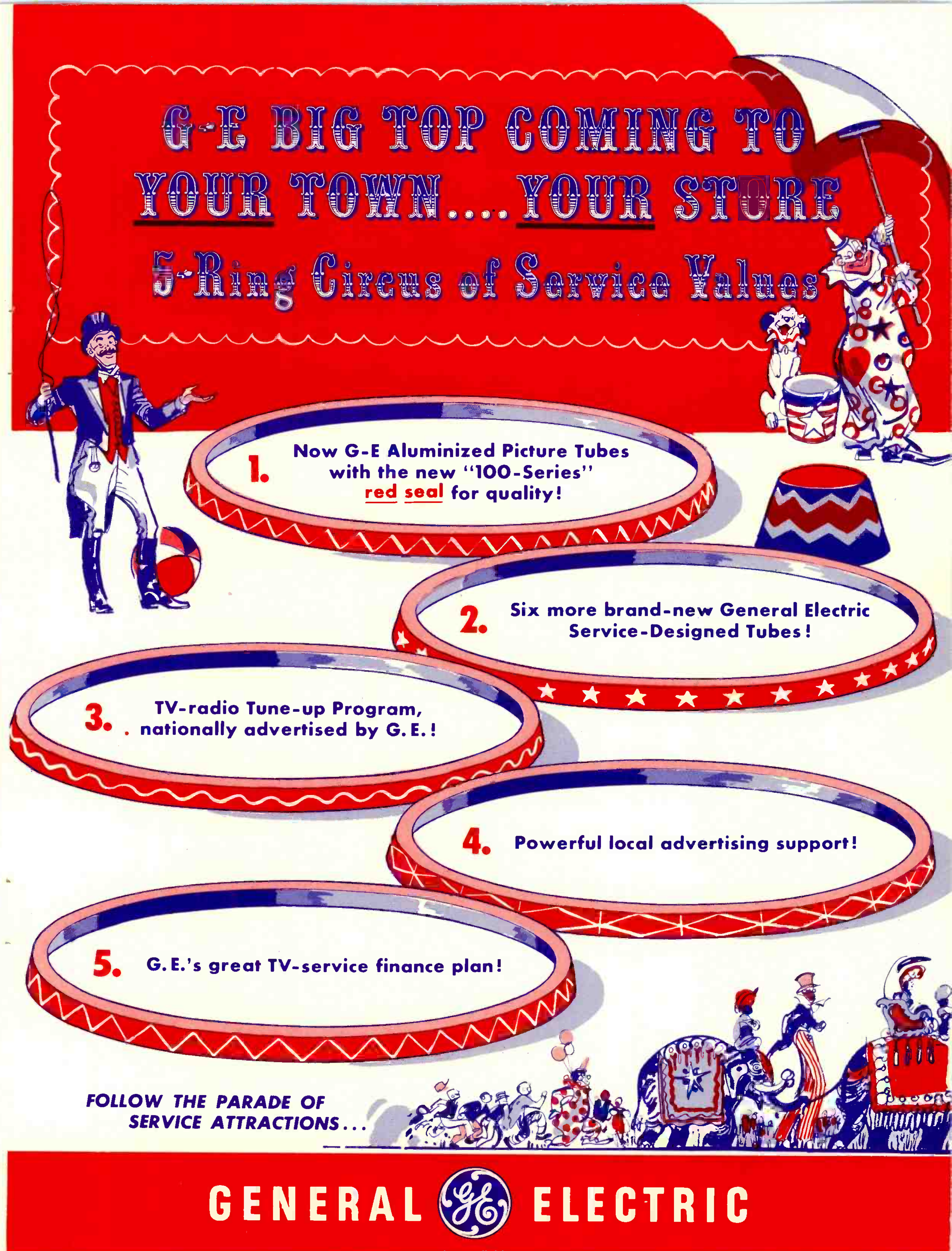
G-E BIG TOP COMING TO
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5-Ring Circus of Service Values
1. Now G-E Aluminized Picture Tubes with the new "100-Series" red seal for quality!
2. Six more brand-new General Electric Service-Designed Tubes!
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G-E ALUMINIZED TUBES WITH THE RED SEAL. FINEST EVER!

TV owners will learn about them through big G-E color ads—"100-Series" G-E Aluminized Picture Tubes with the *red seal,* finest ever built! The new *red seal* stands for top picture tube quality. Bright, sharp, clear pictures; dependable performance that lasts throughout tube life—these spell customer satisfaction, establish you as a dealer handling only the best. Large-scale G-E advertising of "100-Series" Aluminized Tubes with the *red seal,* soon to commence on a nationwide basis, will boost your tube and service sales. Here is a new and important business and profit-builder —with all the sales impetus behind it of a tremendous national advertising campaign!

SIX MORE NEW G-E SERVICE-DESIGNED RECEIVING TUBES!

Ready to install: new types 1X2-B, 6AL5, 6BK7-A, 6BQ7-A, 6BZ7, 6CB6. Remember the fine reception given other G-E Service-Designed Tubes—how customer goodwill increased sharply, how service business boomed for dealers handling these superior tubes, made *only* by General Electric? The 6 new types will cut call-backs still more, increase your sales and profits further. A revolutionary new "lightning-rod" design, new low-level tube microphonics, greater sturdiness, longer tube life—these and many other vital improvements are included. Now—in all—you will have 20 G-E Service-Designed Tubes which will out-perform and outlast their prototypes!

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MOST ATTRACTIVE DEALER ADVERTISING AIDS EVER OFFERED!

Strong local advertising tie-ins will increase your sales still more. G.E. has ready for you a real Big Top group of colorful displays and other helps. Many of them are shown on the following page. Besides wall and window-banners, they include window-stickers—TV-radio spot commercials—point-of-purchase selling aids—direct-mail pieces—other items. Vivid, fresh, *new*, these advertising aids underscore G.E.'s nationwide TV-radio Tune-up advertising, and focus its appeal to set-owners on *your* store or shop. Become the service center for your neighborhood by using these Big Top tie-ins! Your G-E tube distributor has them. Ask his salesman for details!

G-E SERVICE FINANCE PLAN! YOUR CUSTOMERS CAN PAY OUT OF INCOME!

Most powerful stimulus ever given to tube, parts, and service sales, is G.E.'s great Service Finance Plan. Now the latest instalment methods are available for the benefit of dealers handling G-E tubes. Your customers' needs can be filled immediately and paid for out of income. They no longer will feel they must wait to replace worn-out picture tubes with new G-E Aluminized Tubes—instead, can afford, on an easy instalment basis, the best in tubes and service. Costly installation jobs will be far easier for you to sell. Your whole business will feel the beneficial effects of General Electric's pace-setting Service Finance Plan! Here is a Grade-A sales and profit-builder!

NEXT PAGE: HOW G.E. SPOTLIGHTS YOU TO REAP THE BENEFITS!

Every parent will want one or more of these fascinating books for their children's enjoyment. Amusing rhymes; appealing outline sketches to be filled in with crayons. A top-notch store traffic-builder!

G-E Big Top wall and window-banners, window-stickers, colorful tie-ins galore, will target your store as TV-radio service headquarters. All are available from your G-E tube distributor!

Television-radio service—how much it means to high-quality performance; why owners should consult their local independent technician—will be pushed from coast to coast, border to border, during General Electric's TV-radio Tune-up campaign. Giant *2-page magazine ads in color* will seize and hold readers' attention, show why regular service attention is a TV-radio "must". Six big national magazines will be used, all with many millions' circulation—Life, Look, Collier's, American Weekly, This Week, and TV Guide.

Tie-in displays are ready for you. Part are shown on this page—though justice can't be done here to their many bright colors, or smart and novel appeal. Eye-stoppers, every one! These Big Top tie-ins will focus sharply on *your* establishment all of General Electric's gigantic TV-radio service advertising effort.

Lead the TV-radio service parade! Profit from the business-building attractions G.E.'s Big Top holds! Your G.E. tube distributor is waiting to hear from you. *Tube Dept., General Electric Co., Schenectady 5, N. Y.*

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in the interest of . . .

Quicker Servicing

by **CALVIN C. YOUNG, JR.**

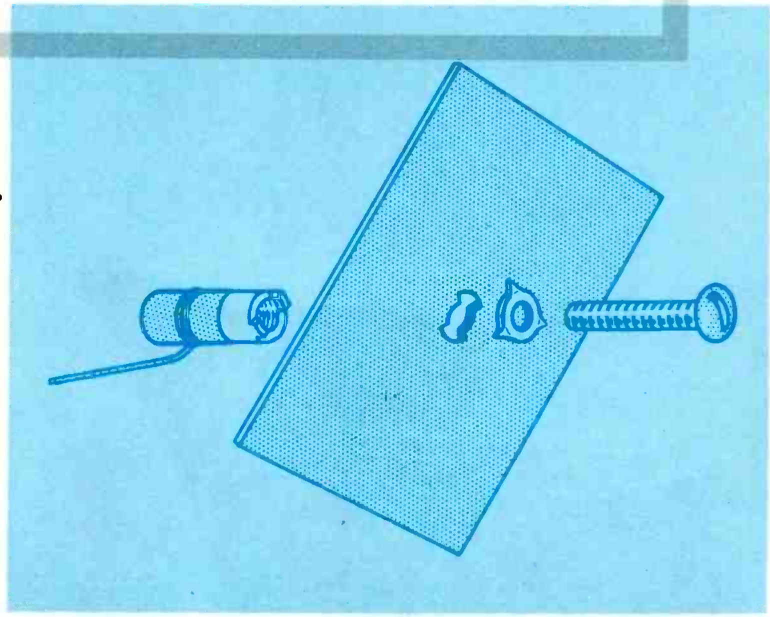


Fig. 1. Ceramic Trimmer Capacitor of a Type Used in Tuners.

Tuner Trouble in Zenith Chassis 20J21

In a Zenith Chassis 20J21, the picture on the high-band channels would come in sometimes and sometimes it would not. There seemed to be a loose connection in the tuner. The low-band channels were not affected as much as the high-band channels. The drum cover on the side of the tuner was removed, and the contacts were inspected. The contacts on all channels seemed to be clean but lacked lubrication. Since the high-band channel in this area was No. 8, the strip for this channel was removed and all connections were checked and found to be good.

The original tubes in the tuner had previously been checked only by substitution and had been reinstalled; therefore, these original tubes were checked in a high quality tube checker. The mixer tube was weak, so it was replaced. This failed to cure the trouble; consequently, the contacts of the turret strips and the contacts of the tuner itself were cleaned with carbon tetrachloride and were relubricated with Lubriplate. The tuner was still intermittent; and when the mixer tube was moved, the trouble would clear up momentarily. The top cover of the tuner was removed, and a close visual check was made.

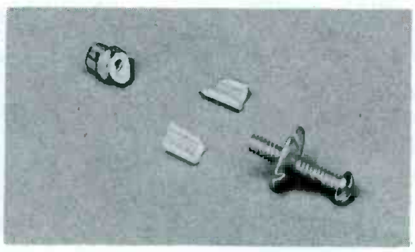


Fig. 2. Broken Trimmer Capacitor.

Several defects were noticed during this inspection. The most apparent trouble was a broken trimmer capacitor from the grid of the mixer tube to the chassis. This was a ceramic trimmer of the type shown in Fig. 1. Evidently the trimmer had broken because of excessive pressure of the mounting nut during its original installation, and its effect on the operation of the tuner had become progressively worse. The broken unit is shown in Fig. 2, and this shows the number of pieces into which the unit fell when the tuning screw and mounting nut were removed. The unit had been broken before the screw was removed, but all of the pieces had remained in place until removal of the screw.

In addition to the broken trimmer, the fine-tuning rotor was not centered between the two stator plates nor was it positioned properly on the shaft; consequently, the limits of rotation of the fine-tuning shaft did not correspond with the maximum and minimum values of the capacitor. Since the rotor was secured to its shaft by an Allen setscrew, it could be positioned very easily.

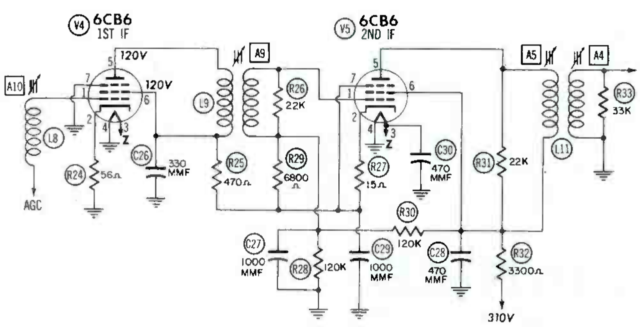


Fig. 3. Partial Schematic Diagram of Zenith Chassis 20J21 Video IF Section.

· *Please turn to page 34*

A *NEW* DEVELOPMENT TOWARD AUTOMATION

Erie PAC Modules Described and Illustrated

by C. P. Oliphant

Editor's Note:

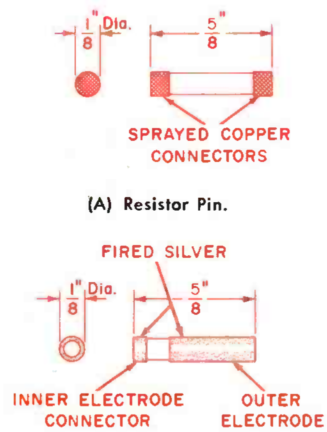
Much publicity is being given to the science of automation and to its probable effects upon the electronic industry. This stir of interest in automation has prompted us to describe for our readers one example of the several products that are being or have been designed with automation in view.

The Erie Resistor Corporation recently introduced their design of a modular unit which is primarily intended for use in conjunction with printed-wiring boards. This new unit, which is called "PAC" (pin-assembly circuit), is an assemblage of resistors and capacitors into a single package. The units are designed so that they can be produced by a fully automatic process and can be inserted into printed-wiring boards automatically if desired.

Up to the present time, these new module units have not appeared in commercially manufactured receivers. In order that the service technician will know what these units consist of and will recognize them when they do appear in a circuit, the following discussion is presented. The design features and the manner of application of the PAC units will be described.

Design Features

At the present time, resistors and capacitors are the only circuit components that are being incorporated in the PAC units. These components, which are referred to as "pins," are cylindrical in shape and have standard dimensions of ⅛-inch diameter and ⅝-inch length. The pin resistors are of the composition type and are made of a molded material. The pin capacitors are of the ceramic tubular type. The components have a size that has been standard for many years. Any other component which can be manufactured with the same basic form and size could be included in the pin assembly.



(A) Resistor Pin.

(B) Capacitor Pin.

Fig. 1. Basic Form of the Resistor and Capacitor Pins.

Fig. 1 shows the basic form of the resistor and capacitor pins. Fig. 1A shows the pin resistor, and Fig. 1B shows the pin capacitor. Copper is sprayed around each end of the resistor for the purpose of providing terminal connectors to the component. The electrodes of the capacitors are constructed on the tubular forms with fired silver.

The specifications of the pin resistors are as follows: resistance range, 5 ohms to 50 megohms; tolerances, ±5 to ±20 per cent; power rating, ½ watt; and maximum voltage rating, 500 volts. Higher wattage ratings are obtained by connecting multiple resistors in series or parallel.

Specifications of the pin capacitors are as follows: capacitance range, 1 to 5100 micromicrofarads; tolerances, ±1 to ±20 per cent; voltage rating, 500 volts DC. It is planned to have the capacitance range extended upward to about .05 mfd with a 50-volt rating.

The resistor and capacitor pins are mounted on a base plate of

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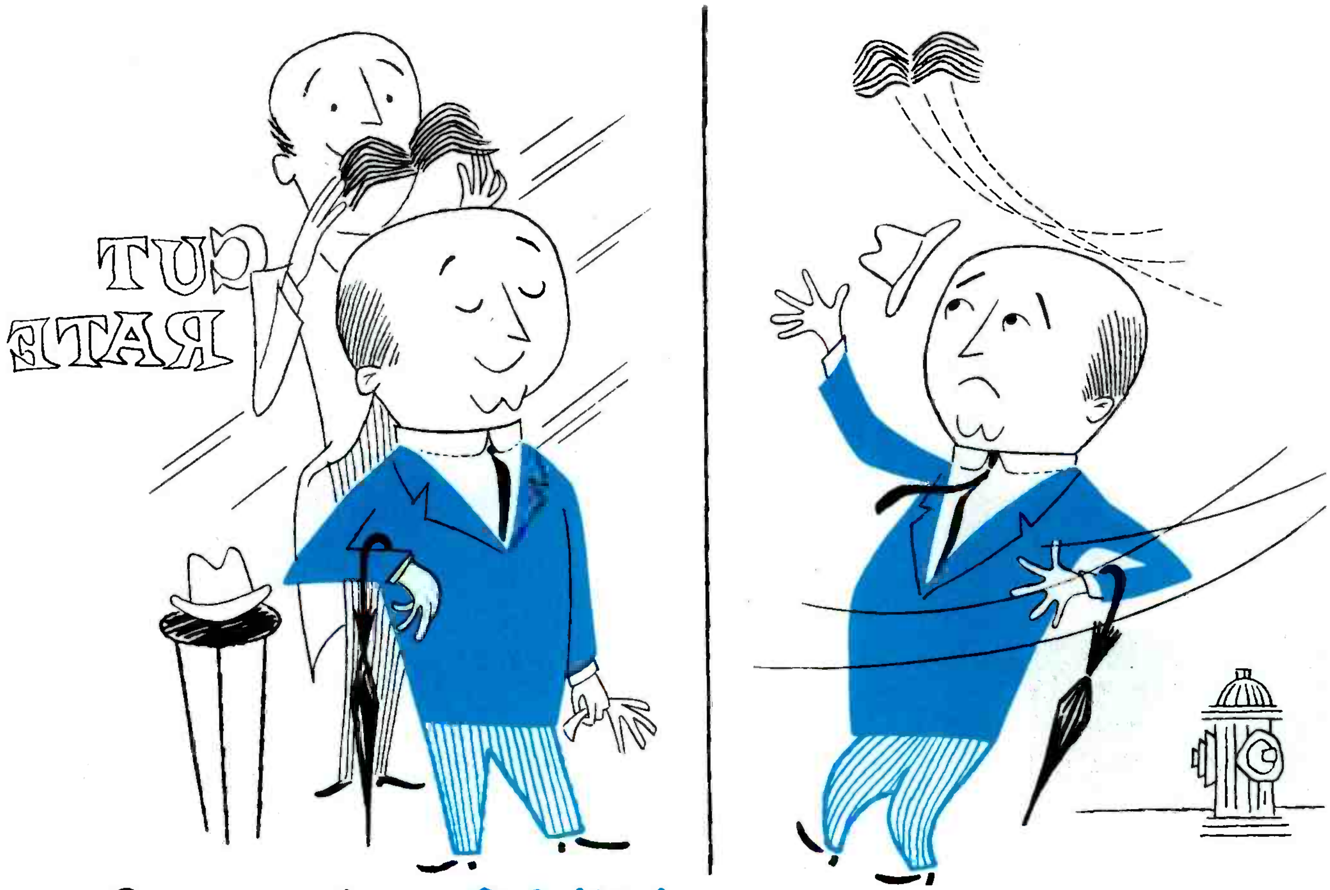

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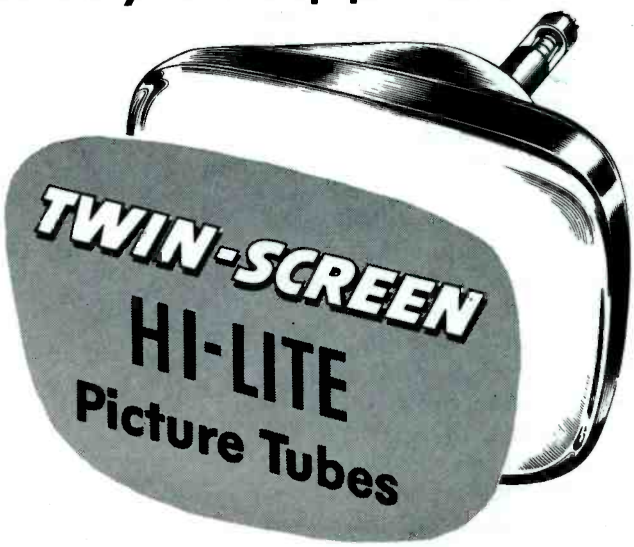

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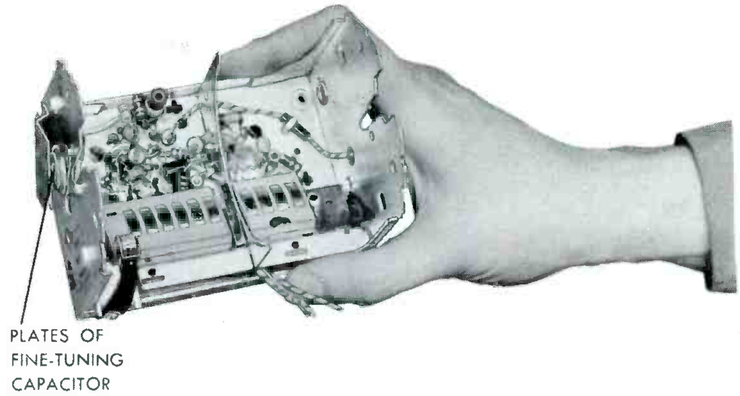
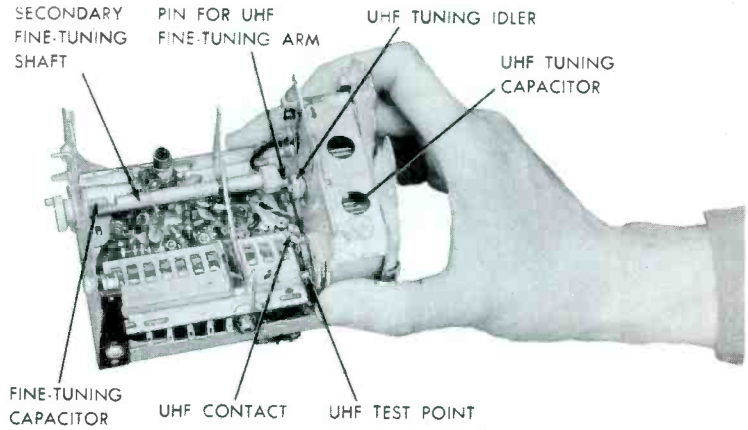
Examining DESIGN Features

by THOMAS A. LESH



(A) VHF Tuner.



(B) UHF/VHF Tuner.

Fig. 1. Bottom Views of Standard Coil T-Series Tuners.

UHF Reception with Standard Coil T-Series Tuners

One of the models in the current T-Series of Standard Coil tuners features all-channel UHF and VHF tuning. This 82-channel tuner is furnished as original equipment in some receivers. Its design is such that the UHF portion of it cannot be obtained separately for UHF conversion in the field. The VHF tuners of the T-Series can only be converted for UHF reception if an external converter is used or if strips for individual UHF channels are installed. Strip conversion of T-Series tuners were discussed in "Examining Design Features" in the August 1955 issue of the *PF REPORTER*. In that article, it was mentioned that the various VHF tuners in the T-Series are classified as TA, TB, TC, or TD tuners. The all-channel tuners are called TE tuners.

A bottom view of a T-Series VHF tuner with the turret removed is shown in Fig. 1A, and a similar view of a UHF/VHF tuner is shown in Fig. 1B. It can be seen in the figure that the over-all dimensions of the 82-channel tuner are no greater than those of the tuner which receives VHF channels only. The additional circuits which are needed for the reception of UHF are fitted into the basic shell of the original VHF tuner when certain changes in details of construction are made at the factory.

The UHF circuits of the all-channel tuner are mounted in a compact unit at the rear of the assembly. This unit can be seen in Fig. 1B. The UHF circuitry is shown schematically in Fig. 2.

The UHF antenna terminals are mounted on a small board on top of the tuner; and R1, R2, C1, and C2 are also on this board. The components L4 and C5 and the mixer crystal are mounted on the top of the UHF unit and are normally covered by a small removable shield. A picture of the top of the UHF unit is shown in Fig. 3.

The preselector and oscillator circuits are each enclosed in a shielded compartment, and these two enclosures make up the main body of the UHF unit. Each of the two circuits is tuned with a var-

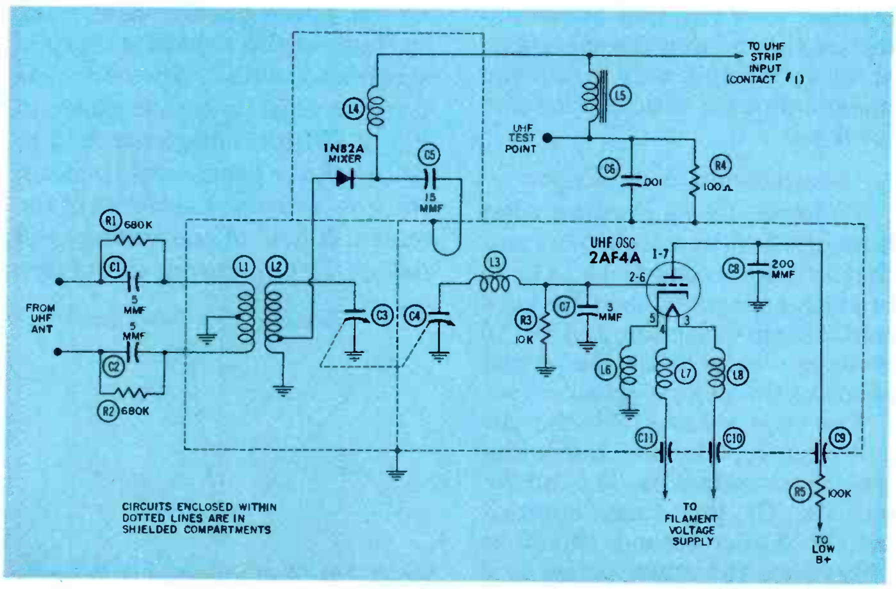


Fig. 2. Schematic Diagram of UHF Portion of Standard Coil TE Tuner.

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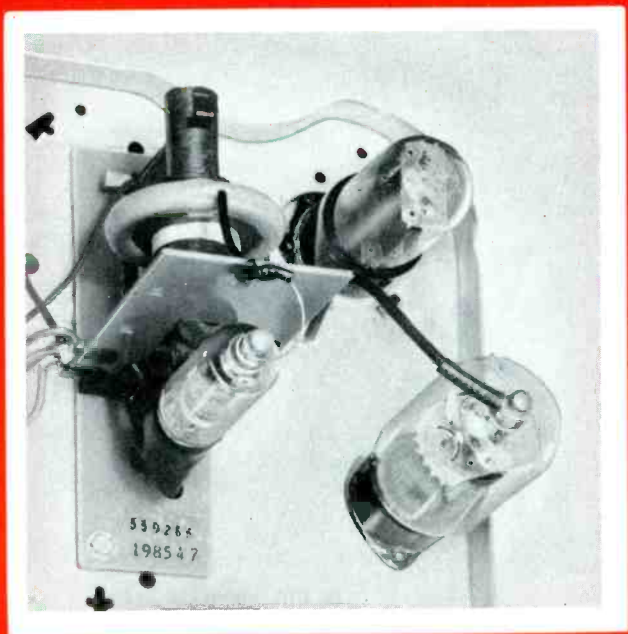
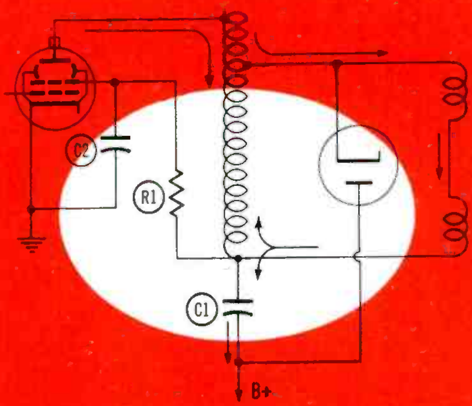
THE HORIZONTAL
Flyback System





A Theoretical Discussion of a Method Used to Obtain Horizontal Sweep and High Voltage

by VERNE M. RAY

The high-voltage and horizontal deflection circuit in a television receiver is a common source of service problems. In many cases, the service technician has a difficult time locating troubles in this circuit. It is logical to assume that the reason for this is that the circuit is somewhat critical in its operation. The technician who is thoroughly familiar with the theory of operation should have an easier task in servicing this circuit.

The schematic diagram in Fig. 1 shows a circuit which is typical of those encountered in modern receivers. From the simplicity of the drawing and the fact that relatively few components are used, one would think that the theory behind the operation of this circuit could not be too involved. To a certain extent, this is true; however, it should be remembered that several years of engineering practice were required to develop this circuit and that the operational theory is simple only to one who understands the various principles involved.

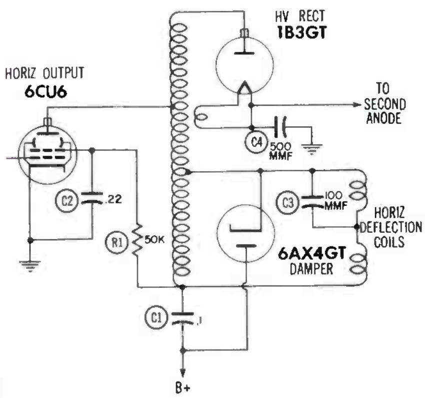


Fig. 1. Schematic Diagram of Typical High-Voltage and Horizontal Deflection Circuit Based Upon the Flyback Principle.

Requirements of the Circuit

To begin, let us consider what is required of the circuit. We know that it has two functions: (1) to produce a magnetic field for horizontal beam deflection, and (2) to produce a voltage for the second anode of the picture tube.

The time specified for the circuit to complete one horizontal trace and retrace is 63.5 microseconds. Of this time, approximately 53 microseconds should be utilized as the trace period and about 10.5 microseconds as the retrace period. During the trace period, the beam must be deflected from the left to the right side of the screen at a steady rate. During the retrace period, the beam must be returned to the left side of the screen at a very rapid rate in order for it to be in position for the next horizontal trace.

Since beam deflection is to be accomplished through the use of an electromagnetic field, the strength of this field must vary in accordance with a sawtooth pattern. An ideal pattern is shown in Fig. 2. With no magnetic field to deflect it, the beam would concentrate on a spot at the center of the screen. A field of one polarity will deflect the beam to one side of cen-

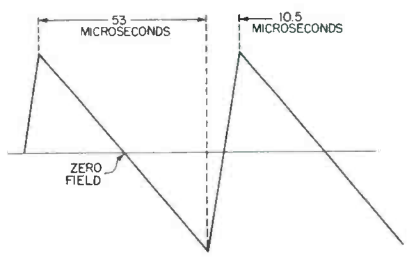


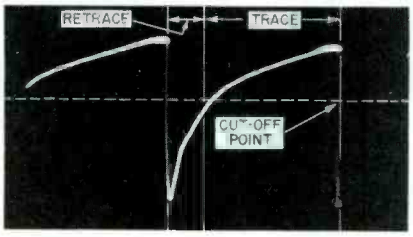
Fig. 2. The Ideal Variation of Magnetic Strength of a Horizontal Deflection Field.

ter, and a field of the opposite polarity will deflect the beam to the other side.

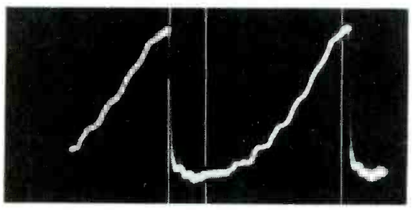
It is a known fact that the strength of a magnetic field produced around a coil will vary in proportion to the variations of the current through the coil. If the proper magnetic field is to be produced for horizontal beam deflection, a sawtooth current must pass through the deflection coils; furthermore, this current must flow in one direction and decrease at a linear rate during the first half of the horizontal trace and must increase at a linear rate in the opposite direction during the last half of the horizontal trace. The following discussion will explain how this current is developed and how the second-anode voltage can be developed as a by-product.

Waveform Analysis

The waveform in Fig. 3A shows the voltage at the grid of the horizontal output tube, and the waveform in Fig. 3B shows the current which is flowing through this tube.



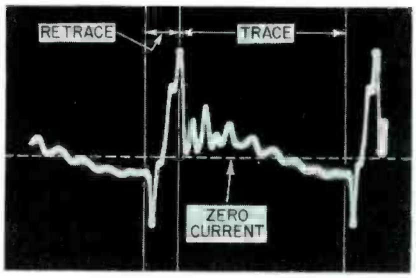
(A) Voltage at the Grid of the Horizontal Output Tube.



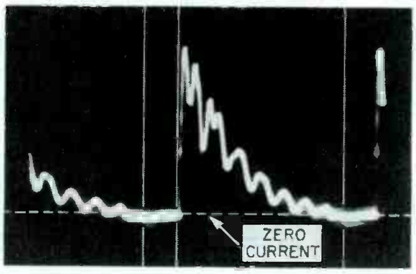
(B) Current Through the Horizontal Output Tube.

Fig. 3. Waveforms in the Circuit of Fig. 1.

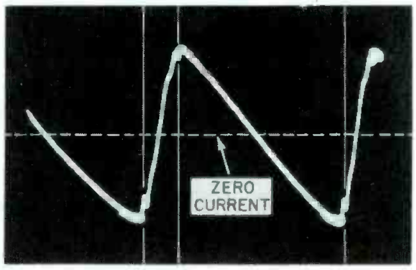
The current waveform indicates that the tube does not conduct during retrace time nor for the first 25 per cent of trace time. This is because the signal at the control grid biases the tube beyond cutoff from the beginning of the retrace time until approximately 25 per cent of the trace time has elapsed. Later in the discussion, it will be understood why no high



(A) Current Through the Deflection Coils.



(B) Current Through the Damper Tube.



(C) Current Through the Transformer Winding.

Fig. 4. Waveforms in the Circuit of Fig. 1.

voltage is developed when no signal is applied to the grid of the output tube.

The next waveforms to be analyzed are those of the currents through the horizontal deflection coils, the damper tube, and the transformer winding. These waveforms are shown in Figs. 4A, 4B, and 4C, respectively. During the first half of trace time, current flows up through the deflection coils and finds parallel paths through the damper tube and the transformer. The arrows in Fig. 5 show the directions of current flow in all parts of the circuit at this time. By referring to the waveform in Fig. 4A, it may be seen that the current through the deflection coils decreases from maximum to zero at a linear rate during the first half of trace time. The magnetic field produced by this current will cause the electron beam to scan the left half of the screen at a steady rate of speed.

The arrows in Fig. 6 show the directions of current flow in the circuit during the second half of trace time. Current flows down through the deflection coils and divides at the junction of capacitor C1 and the transformer. The current contributed by the horizontal output tube during this period is steadily increasing. (See Fig. 3B.) Very little current flows through the damper tube at this time. (See Fig. 4B.) As a matter of fact, by the time 75 per cent of the horizontal trace has been completed, current no longer flows through this tube. The reason for this will be explained shortly.

As shown in Fig. 4A, the current which flows through the deflection coils during the second half of trace time is in a direction opposite to that of the current which flows during the first half. The steadily increasing current produces a magnetic field which increases in strength at a linear rate. This increasing field has the proper polarity to deflect the beam from the center to the right side of the screen at a steady rate of speed.

At the end of trace time, the current supplied by the output

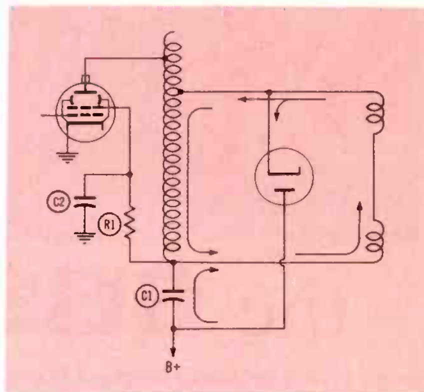


Fig. 5. Directions of Currents in the Circuit of Fig. 1 During the First Half of Trace Time.

tube has reached a maximum value, the voltage at the grid of this tube drops sharply, and tube current instantly ceases to flow. The current in the transformer winding and in the deflection coils cannot stop flowing instantly because a counter electromotive force (emf) is produced across an inductor when the current through this inductor tries to increase or decrease. This counter emf opposes the applied voltage and prevents any instantaneous

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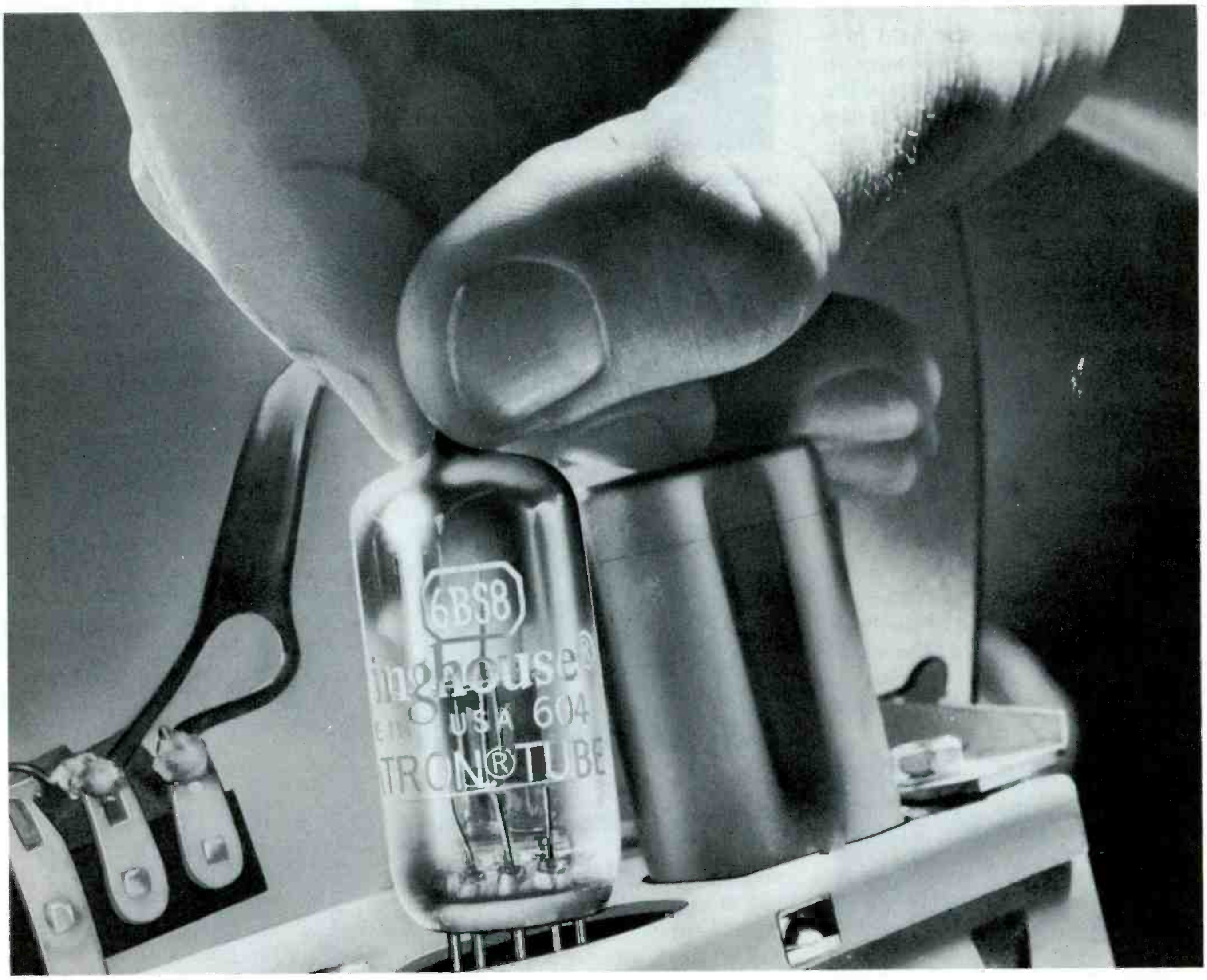

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Audio-Facts

RECORDS IN THE CAR

by ROBERT B. DUNHAM

The Highway Hi-Fi record player available for all 1956 Chrysler Corporation cars has been announced and discussed to some extent in many publications. Interesting details of construction and operation of the unit and some specifications of the extra-long-playing (XLP) records to be played on it were given in the column, "Examining Design Features," in the March 1956 issue of the *PF REPORTER.*

The Highway Hi-Fi player has received this attention and publicity because a practical unit that is designed to provide music and other program material from recordings for listening pleasure in passenger cars is a new and logical development. Some people may express the opinion that playing records in a car is not a new or unusual thing, and they may cite the use of recordings in a sound truck as an example. For a pleasure or passenger car, however, no system had proved to be satisfactory; and a new one had to be developed. This was done by CBS-Columbia when the Highway Hi-Fi player and the new XLP records were produced.

Some interesting points can be brought out if we examine why a new approach was required and if we discuss the way problems which were encountered in developing a system to play back recorded music in an automobile were solved.

Certain conditions had to be met if a playback system of any type was to prove satisfactory for use in a car. It had to be foolproof and easy to operate by anyone driving or riding in a car. The engineers had to select a system which could even be put into operation when the car was in motion and which could furnish music or other program material for long uninterrupted periods of time. It had to be one that could be stopped at any time when the listening had to be interrupted, and it also had to be one that could easily be restarted without loss or repetition of portions of the program material. Above all, it had to be a system that would operate consistently under all driving conditions and at the hands of all operators. No established player using either disc recordings or magnetic tape fulfilled the foregoing conditions.

Why Not Magnetic-Tape Recordings?

Although preferred because developmental work would have been reduced, what was wrong with magnetic tape for this application? It would appear that a recorded-tape playback unit would be very satisfactory because of the many features that have made tape so useful for other applications. The playing time of two hours, which is available on a 7-inch reel of dual-track tape that plays back at 3.75 inches per second, is a desirable feature. A tape playback unit can be started or stopped at any time. This is a convenience that is a necessity in a car because listening would have to be interrupted on certain occasions during a drive. The fact that a tape playback unit could be made rugged enough to stand up under the shocks and vibrations to which it would be subjected in a car is a point in its favor.

We could add more to the list of good features that have made magnetic-tape systems so useful, but several things have made them unsuitable for general use in automobiles. A practical unit would have to be too large, when the space in a car is considered, and too expensive. Seven-inch reels, which would be necessary for adequate playing time, take up space both when in the operating position on the playback unit and when in storage. All of us will have to admit that it is sometimes difficult to handle reels and to thread tape properly on any tape recorder. We know that threading tape would be much more difficult in a car, especially if the car were moving. Some type of self-threading tape cartridge could be developed for the purpose, but it would increase cost and would require considerable storage space. In a moving automobile, difficulty would be encountered when one tried to select a certain spot on the tape for playback.

· *Please turn to page 51*

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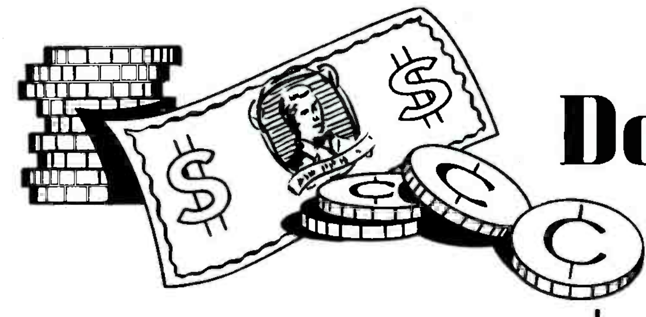

Dollar and Sense Servicing

by John Markus

Editor-in-Chief, McGraw-Hill Radio Servicing Library

SHORTAGE. Year-end shipments of color sets could well be held up for lack of color tubes, according to RCA executive vice-president W. W. Watts. Three reasons are cited—the expected holiday demand for color sets, a promised broadening of the RCA color receiver line to include models selling below the present $695, and the definite limits on tube production capacity.

Demand for color sets can grow only in a series of chain reactions. Good programs create a market for sets. As production goes up to meet this demand, prices come down and the market expands further. The resulting increase in sets in use brings more sponsors supporting more color programs, stimulates the market still more, and sets off the chain reaction that by the end of the year could be spiraling upward with the momentum of an explosion.

Prices on RCA color sets currently mean a loss on every sale, but the firm expects to start breaking even this summer and show a profit in the fourth quarter even with the promised lower-price table models scheduled for dealer showings in June. The present line includes five models ranging in price from $695 to $995.

Prices are not expected to go under $500 this year and may not even come near that figure. Reasons are many. Color-tube cost at manufacturer level is around $100, compared to around $19 for comparable black and white; a color set has around 2,000 parts compared to 1,200 for black and white; production alignment and testing are far more complex and costly for color; and cabinets are larger and correspondingly more expensive for color.

Production facilities for the type 21AXP22 three-gun color tube are now being duplicated and mechanized at RCA's Lancaster, Pennsylvania, plant at a cost of nearly $10 million. When completed by midsummer, this will give one-shift production of about 30,000 tubes per month. Expecting this to be way short of the industry's year-end needs, RCA has passed tube-making know-how on to other tube makers and has actually ordered color tubes from some of them for stock-piling. Such orders also serve to encourage the other tube-makers to lay out the large capital investment required for color-tube production machinery.

All this does not mean that service organizations should start hoarding new color tubes. This would not be economically sound as yet because of the present limited demand and high cost of the tubes. Furthermore, technical improvements (chiefly in white purity) are still being made in the tubes; so tubes saved now could well be inferior to those made this fall.

Rather, the present situation with regard to color TV should be taken as a warning to get ready for what could well be a hectic windup of the year for service technicians. Urge customers to order their color sets and to get them installed well before the holidays. Speed up your staff training programs so that you can handle initial installations of color sets smoothly under pressure. Check over your needs for special color test equipment, and place orders for needed equipment by summer because a sudden increase in equipment demand this fall could quickly clear out jobber stocks and leave you helpless while test-equipment manufacturers try to catch up with orders.

Last year, you got *ON YOUR MARK* for the color race by studying and training. This is *GET SET* year. If RCA is right, the gun will go off and color will *GO* late this year or sometime next year.

MIRROR. The accident hazard inherent in the rear-view mirror above the windshield of an auto is eliminated by television in one of the dream cars now being shown by General Motors in its Motorama. A television camera mounted in the trunk compartment looks backward to pick up an even better rear view than did the mirror. This is transmitted to a 5-inch cathode-ray tube mounted at the center of the dash, just below the windshield. The driver can thus see backward with scarcely any lowering of vision from the road ahead.

With such ITV systems currently costing close to $1,000, this is really a dream for the future. It is technically sound and a contribution to safe driving; therefore, the dream may convert to reality sooner than we think. Mass production can do wonders costwise. Who knows but that some year the auto salesman will be asking, "Will you have it with or without TV mirror, sir?"

TAPE. Along with hi-fi, tape recorders are going over big with home owners. Figures indicate that well over a million recorders are currently in use.

Unusual uses for recorders make news, but in Detroit recently the lack of news induced some people to buy tape recorders. These were used during a newspaper strike to record radio commercials put on by local stores as a substitute for newspaper advertising. By recording the commercials and playing them back later after all had been broadcast, people would decide where the shopping bargains were that day without taking a lot of notes.

In the Midwest, a professional exterminator baits his rat traps with the taped mating call of the female rat instead of with cheese.

Men whose jobs take them away from home for months at a time exchange taped conversations with their family by airmail to keep in touch, thereby eliminating the agony and tedium of letter-writing.

A student housebound by illness can send a tape recorder to class as his substitute so that he will not miss a single lecture.

An architect concealed a recorder in a room of his latest ultramodern residence during open house then scrapped plans to build more of that design after playing back visitors' comments.

This last item reminds us of some lines of poetry about seeing ourselves as others see us. Can't locate the quotation, but what if a technician could leave a tape recorder running under the TV set for a half hour after a service call?

HOGS. At the stroke of midnight on one Iowa farm, porkers are awakened by a tape-recorded rendition of hogs grunting at a feeding trough. The farmer's idea is to fatten his hogs in a hurry by coaxing them into taking an extra feeding. Never thought the day would come when electronics would be needed to make hogs eat.

by John Markus

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In The Interest Of Quicker Servicing

(Continued from page 21)

The strip contacts did not line up with the tuner contacts, and the tuner contacts were therefore adjusted so that they would line up. This was done by loosening the four mounting screws and slipping the tuner contacts a small amount. The tuner covers were temporarily installed, and the picture seemed to flash rather badly on all channels; in fact, the picture seemed to flash even when the tuner was not disturbed.

The technician stopped and thought a few moments, and then he remembered that the second IF amplifier tube had been defective when he had gone on the service call to the home. It had had a heater-to-cathode short which caused a black bar over about a half of the picture, and there had been almost complete loss of the sound. To determine the effects of this short, a check of the schematic diagram for the Chassis 20J21 was made; and it revealed that the second video IF stage formed part of a voltage-divider network. This type of network is illustrated in Fig. 3.

The heater-to-cathode short in the second IF stage placed the cathode at ground potential instead of at 125 or 130 volts which should normally be on this element. This in effect placed almost 300 volts across the tube and the resulting excessive current flow damaged the decoupling resistor R32. In fact, this resistor was intermittent. The resistor was discolored and would have been noticed if the bottom of the chassis had been turned up for servicing. Since it was not necessary to turn up the chassis to service the tuner, the visual check was overlooked; and a longer service job was the result.

This brings out the point that heater-to-cathode leakage in a tube can cause other damage and that when a tube is replaced because of such leakage, the circuit diagram should be consulted to see if additional damage could have occurred. The dual-triode type of RF amplifier tube used in many tuners can cause failure in the B+ network of the tuner if a heater-to-cathode short or leakage should develop.

Glass Allowance for 24-Inch Tubes

Sylvania has announced that they have added to their glass-allowance price list which was effective January 10, 1956 the following 24-inch all-glass picture tube types: 24CP4, 24CP4A, 24DP4, 24DP4A, 24VP4, 24VP4A, 24QP4, 24TP4, 24XP4, and 24YP4.

New Tubes in Series-Filament Strings

New receivers with vertical chassis have been coming out with series-filament strings, and these create a problem for the service technician. In order to make sure that the necessary tubes will be available on service calls, you should question a new customer and get the make and model number of his television receiver. In addition, question him closely about the trouble he is having with the set. When you have this information, you can consult the service data and make sure that the correct tubes are available in your tube caddy.

If the customer happens to have one of these receivers that requires the new types of tubes, this can create an additional problem because the tube caddy may already be filled with the required stock of conventional tubes. If this is true, then you can either get a separate caddy for the newer series-string types of tubes or you can get one of the large de luxe caddies that have room enough for the conventional tubes as well as for the new ones.

Improved Reception in Crosley V-Series Receivers

An improvement in the sound reception in the Crosley Super-V, Advance-V, and Custom-V receivers in fringe areas can be attained by readjustment of the quadrature coil to the point of best sound. This improves the noise rejection of that network. Adjusting the sound IF transformers to produce maximum sound may also help in fringe areas. The proper procedure (outlined in the service literature) should be followed to ensure the accuracy of these adjustments.

Demagnetizing Color Picture Tubes

Demagnetizing or degaussing of a color picture tube may be necessary if good purity cannot be obtained after a careful setup of the purity magnet, deflection yoke, and edge magnets.

To construct the degaussing coil, wind approximately 400 turns of insulated No. 20 gauge wire on a coil form that is 12 to 14 inches in diameter. The coil should be wound as thin as possible. Connect a 10-foot power cord to the ends of the coil. The line drawing shown in Fig. 4 gives the approximate dimensions of a finished coil wound with No. 20 DCC wire.

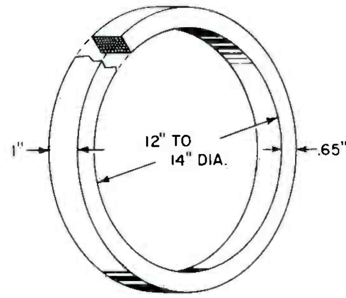

Fig. 4. Approximate Dimensions of Degaussing Coil.

The degaussing procedure using the coil is as follows:

1. Pull out all of the edge magnets located at the outer rim of the picture tube.
2. Plug the power cord of the degaussing coil into a 110-volt AC power source.
3. Slowly move the degaussing coil around the bell of the picture tube while keeping the coil parallel to the bell.
4. Slowly move the coil about the front of the picture tube while keeping the coil parallel to the face plate.
5. Slowly back away from the receiver to a distance of about six feet, turn the degaussing coil so that it is perpendicular to the face plate of the tube, and then remove power from the coil.
6. Reinstall the edge magnets, and repeat the purity setup procedure outlined in the service literature.

Calvin C. Young, Jr.

PRODUCTION TECHNIQUES:

for the manufacturing of High Reliability Capacitors

To produce capacitors free from any possibility of latent defects, for use in the most critical applications, the Sangamo Electric Company has recently intensified its high reliability program of fabrication and inspection methods.

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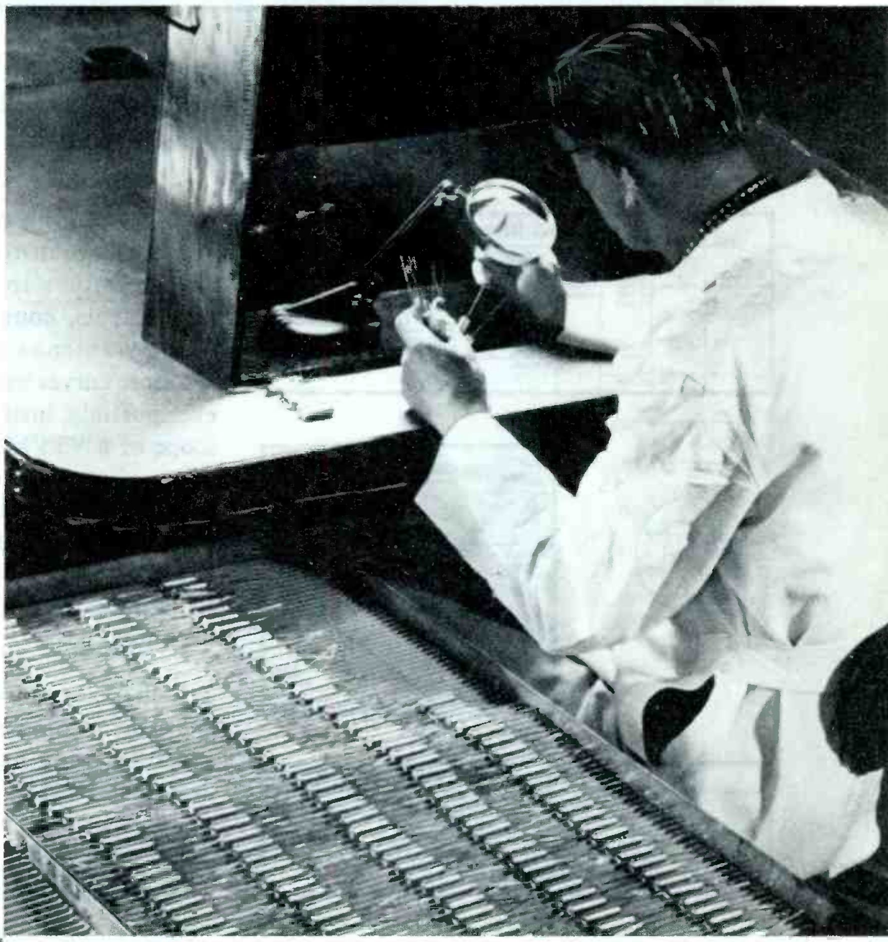
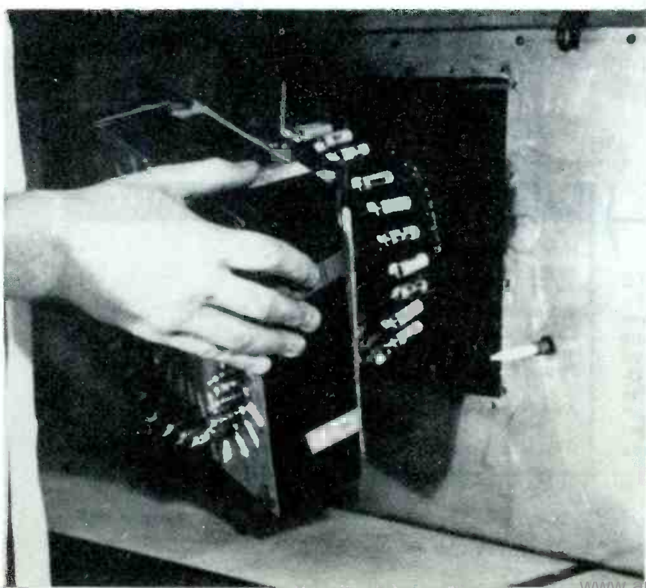
Complete production histories are kept on the basis of small capacitor lots. X-raying of individual units, heat tests, vibration tests, altitude tests, and total destruction tests of a given percentage of all finished units assure components with an extremely low AQL. Testing facilities and resultant performance characteristics are far in excess of military specifications. Specify these high reliability capacitors for your critical applications.

SANGAMO ELECTRIC COMPANY
MARION, ILLINOIS

Separate facilities are maintained for the exclusive processing and manufacture of high reliability capacitors. Only specially trained, highly skilled operators, who wear special clothing to prevent any possible source contamination, work here.



Oil-filled capacitors are subject to vacuum under elevated temperatures, then are individually examined to insure complete hermetic seal.



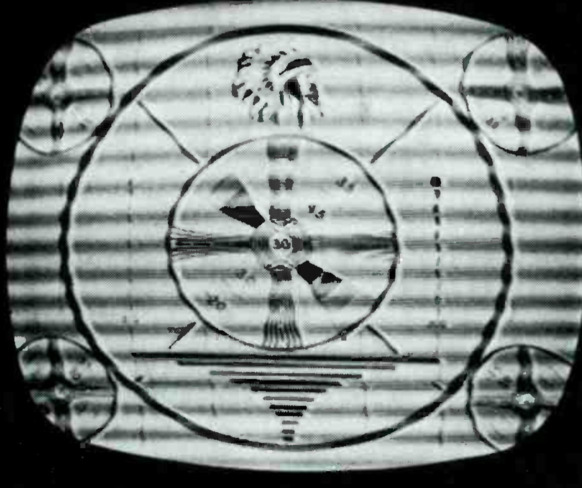
High temperature test ovens are used to check insulation resistance of Sangamo high reliability capacitors under sustained temperatures of 125° C.

This vibration testing machine brutally punishes Sangamo high reliability capacitors at accelerations up to 10 G's to determine their ability to resist vibration without damage to leads or elements.

SC56-2

how long would it take *you* to solve this service problem?

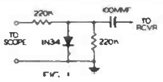
SYMPTOM: Sound bars in the picture. Bars vary in intensity and position according to the audio being transmitted. Need for alignment has been established.

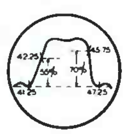


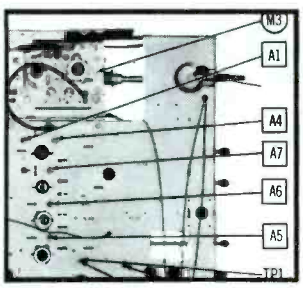
Valuable time can be spent searching for alignment points, adjustments and frequencies if you are relying on hit-or-miss methods or incomplete service data. With a PHOTOFACT Folder by your side you have all the information in just minutes. Here's why:

ALIGNMENT INSTRUCTIONS

SWEEP GENERATOR COUPLING	SWEEP GENERATOR FREQUENCY	MARKER GENERATOR FREQUENCY	CHANNEL	CONNECT SCOPE	ADJUST	REMARKS
to loosen and from grid of tube. Low channels.	43. 5MC (10MC Swp.)	41. 25MC 42. 25MC 45. 75MC 47. 25MC	Between any two channels	Vert. amp. thru detector (Fig. 1) to pin 5 (plate) of 6CB6 (V3). Low side to chassis.	A1 A2 A3 A4	Adjust for response curve similar to Fig. Adjust A1 to place 41.25MC marker in notch. Adjust A2 to place 47.25MC in notch. A3 to place 42.25MC marker on frequency side of curve. A4 to place 45.75 at 70% on high frequency side of response curve.
"	Not used	44. 0MC Unmod.	"	Use VTVM DC probe to point Ⓐ. Common to chassis.	A5	Adjust for maximum deflection.
"	"	42. 35MC	"	"	A6	"







In just seconds, you find the complete Alignment Instructions. It's in *every* PHOTOFACT Folder, in the form of an easy-to-use chart*, with step-by-step instructions. It gives frequencies, adjustments, connection points for oscilloscope or VTVM, dummy antenna and detectors required, and oscilloscope response curves with marker frequencies and placement. Whenever possible, instructions are given for using either an oscilloscope or a VTVM.

Adjustments called for in the alignment chart are readily located by reference to chassis photographs* with call-outs keyed to alignment chart and Standard Notation Schematic*. In minutes, you make the video IF alignment and eliminate the sound bars.

SERVICING IN THE FIELD

SOUND IF DETECTOR BUZZ ADJUSTMENT

To eliminate sound IF detector buzz, adjust the ratio detector secondary slug (A11) located on top of chassis. (See tube placement chart).

To eliminate the buzz, you can either follow the alignment chart for a complete sound IF alignment or, as advised in the Field Servicing notes on this model, merely adjust the ratio detector, A-11. For speedy reference to this adjustment as well as to other service adjustments and picture tube removal or safety glass cleaning, see the Servicing In the Field* notes. They save you even more time.

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A STOCK GUIDE for TV TUBES

The following chart has been compiled to serve as a guide in the establishment of proper tube stocks for servicing TV receivers. The figures have been derived by combining: (1) a production factor based upon the number of models and upon an estimate of the total number of receivers produced by all manufacturers, and (2) a depreciation factor based upon an average life of six years for each receiver and with the figures reduced accordingly every two months.

The figures shown are based upon a total of 1,000 units. This was done in order to eliminate percentages and decimals. A listed figure of 100 would therefore imply that that particular tube type constitutes 10 per cent of all tube applications in TV receivers.

Some consideration should be given to the frequency of failure of a particular type of tube. A tube used in the horizontal output stage will fail much more frequently than one used as a video detector. As a result, even though the same figure may be given for both tubes, more of the horizontal output tubes should be stocked.

The column headed '46-'56 is intended for use in those areas where television broadcasting was initiated prior to the frequency-allocation freeze. Entries in this column include all tubes used since 1946 except those having a figure of less than one per thousand—the minimum entry in this chart. The '52-'56 column applies to the TV areas which have been opened since the freeze. Because the majority of receivers in these areas will be of the later models, only the tubes used in these newer sets are considered in this column. The minimum figure of one per thousand also applies to this column.

The listing of a large figure for a particular type of tube is not necessarily a recommendation for stocking that number of tubes. It does indicate that this tube is used in many circuits and emphasizes the necessity for maintaining a stock sufficient to fill requirements between regular tube orders.

TUBE TYPES	46-56 Models	52-56 Models
c0A2	–	–
c1AX2	–	–
c1B3GT	41	44
1X2	4	1
1X2A	3	4
c1X2B	2	2
#2AF4	–	–
c3A2	–	–
c3A3GT	–	–
3BN6	1	1
3CB6	3	3
*3CF6	–	–
*5AQ5	–	–
*5AS4	–	–
*5AU4	–	–
*5BE8	–	–
*5BK7A	–	–
*5T8	–	–
c5U4G	44	46
5U4GA	2	2
5U8	1	2
5V4G	5	–
*5V6GT	–	–
5Y3GT	3	2
6AB4	2	2
6AC7	6	6
c#6AF4	3	3
#*6AF4A	–	–

TUBE TYPES	46-56 Models	52-56 Models
6AG5	25	7
6AG7	2	2
c6AH4GT	3	4
c6AH6	8	7
6AK5	3	3
c6AL5	71	71
6AL7GT	4	–
c6AM8	2	1
#6AN4	–	–
c6AN8	4	4
c6AQ5	14	14
6AQ7GT	2	2
6AS5	3	3
c6AS6	–	–
6AT6	4	3
c6AU4GT	1	1
6AU5GT	3	3
c6AU6	116	109
6AV5GT	2	3
c6AV6	16	17
c6AX4GT	13	12
6AX5GT	1	2
c6BA6	12	9
6BC5	9	7
c6BC7	–	–
c6BD4A	–	–
6BE6	6	7
c68G6G	10	5

TUBE TYPES	46-56 Models	52-56 Models
6BH6	5	–
c6BJ7	–	–
c6BK4	–	–
c6BK5	3	3
6BK7	2	4
c6BK7A	2	2
c6BL4	–	–
c6BL7GT	4	7
c6BN6	6	6
6BQ6GA	1	1
6BQ6GT	17	23
6BQ7	5	10
c6BQ7A	7	9
c6BY6	–	–
c6BZ7	8	4
c6C4	9	8
c6CB5	–	–
c6CB6	111	135
c6CD6G	9	10
6CF6	1	1
c6CL6	1	2
c6CS6	3	3
c6CU6	2	2
*c6DC6	–	–
6J5	3	3
6J5GT	1	–
c6J6	29	27
6K6GT	13	9
6S4	8	9
c6S4A	–	–
6SH7GT	1	–
6SL7GT	2	2
c6SN7GT	63	68

TUBE TYPES	46-56 Models	52-56 Models
c6SN7GTA	8	8
6SN7GTB	2	2
6SQ7	2	2
6SQ7GT	2	2
c#6T4	1	1
c6T8	13	13
c6U8	11	13
6V3	2	3
c6V6GT	18	17
6W4GT	23	25
6W6GT	7	11
c6X8	6	8
6Y6G	2	1
7N7	2	–
c12AT7	13	12
c12AU7	44	33
c12AV7	2	3
12AX4GT	2	4
12AX4GTA	1	1
12AX7	4	5
12AZ7	–	1
c12BH7	11	13
c12BY7	8	9
12BZ7	2	–
12L6GT	1	1
12SN7GT	5	4
*25BQ6GA	–	–
25BQ6GT	3	4
*25BQ6GTB	–	–
25L6GT	5	5
25W4GT	1	1
5642	1	1
c6505	–	–

A stock of these tubes should be maintained in UHF areas.

* New tubes recently introduced.

c These tubes have been used in color television receivers.

Changes In Tube Design

(Continued from page 11)

25BK5 audio output tube, and a dropping resistor. The filaments of the other tubes in the receiver are connected in parallel across a filament transformer. The 25-volt tubes have heater-current ratings of 300 milliamperes.

Recently, the widespread adoption of picture tubes which have a deflection angle of 90 degrees has spurred the development of improved types of horizontal output tubes. Since very high voltages are present in the sweep circuits in a 90-degree deflection system, the voltage ratings of the original 6BQ6GT are not considered fully adequate for long and trouble-free service in a 90-degree system.

Various approaches to the problem of redesigning the 6BQ6GT have resulted in several types of tubes which have higher ratings than the original but which can be used as direct replacements for it.

6BQ6G

The 6BQ6G tube was an early variation of the original design.

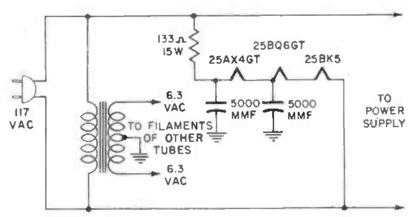


Fig. 5. Schematic Diagram of 300-Ma Series-Filament Circuit which Utilizes a 25BQ6GT Tube.

The bulb of this tube closely resembles those of prewar tubes, and the total height of the tube is 4⅜ inches. (See Fig. 4.) As a result of the greater area of the bulb, the 6BQ6G dissipates heat more readily than the prototype.

6BQ6GTA
†12BQ6GTA
25BQ6GTA

The three tubes in this group are less than ¼ inch taller than the corresponding BQ6GT tubes, but the BQ6GTA tubes incorporate some internal changes which permit an increase in certain peak voltage ratings. A heat radiator is included in the supporting structure of the grids. A beam-confining plate protects the bulb of the tube from electron bombardment. In order to prevent a loosening of the plate cap at high operating temperatures, the cap is attached to the tube with solder that has a high melting point. The general construction of the tube promotes rapid dissipation of heat.

The rated maximum value for positive pulse voltage on the plate was increased to 6,000 volts. The maximum rated DC voltage on the plate was also increased from 550 to 600 volts. These higher ratings provide a satisfactorily wide margin between operating voltages and minimum rated voltages when the tube is used in a 90-degree deflection system.

6CU6
†12CU6
25CU6

The 6CU6, †12CU6, and 25CU6 tubes in this group are recommended as replacements for any of the aforementioned horizontal output tubes which have the same filament-voltage rating. The electrical ratings of the CU6 group of tubes are similar to those of the BQ6GT group, but the tubes in the CU6 group are rated to withstand pulses of plate voltage up to 6,000 volts. The mechanical construction of the CU6 tubes is more rugged than that of the BQ6GT group; and the former are enclosed in large, straight-sided envelopes. (See Fig. 4.) The large area of the bulb enables the tube to dissipate heat efficiently.

6BQ6GTB/6CU6
†12BQ6GTB/12CU6
25BQ6GTB/25CU6

These tubes are similar in size and electrical ratings to those in the BQ6GTA group but have further changes in internal construction. The dual type number indicates that the tubes with the final letter B are intended to be interchangeable with the corresponding tubes in the CU6 group.

6BQ6GA/6CU6
†12BQ6GA/12CU6
25BQ6GA/25CU6

The tubes in this group have practically the same electrical specifications as those in the BQ6GTB and CU6 groups. The BQ6GA tubes differ from the conventional CU6 tubes in that the former are enclosed in envelopes of slightly smaller diameters.

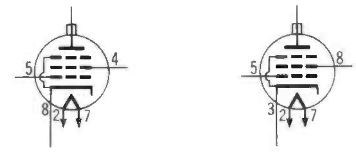
6DQ6
†12DQ6
25DQ6

These tubes have appeared only in some of the most recent models of television receivers. Physically, they appear similar to the corresponding CU6 tubes; but further increases have been made in electrical ratings. The maximum plate dissipation of these new tubes is 15 watts, although all the aforementioned horizontal output tubes which were developed from the 6BQ6GT have been rated at 11 watts. In addition, the rating for the maximum negative pulse voltage on the plate has been increased from −1,250 to −1,375 volts.

TABLE IV

Comparative Ratings of Two Horizontal Output Tubes

TUBE TYPES	CHARACTERISTICS			
	Transconductance (micromhos)	Peak Cathode Current (milliamperes)	Plate Dissipation (watts)	Filament Current (milliamperes)
6BG6G	6000	400	20	900
6CD6G	7500	700	15	2500



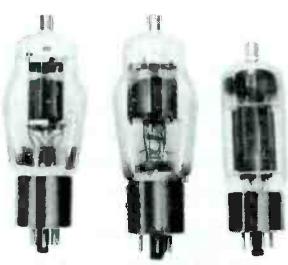
(A) 6BQ6GT (B) 6BG6G

Fig. 6. Basing Diagram of Two Horizontal Output Tubes.

The basing diagram shown in Fig. 6A applies to all of the tubes patterned after the 6BQ6GT; therefore, the tubes are interchangeable to a great extent. In fact, the CU6 tubes may be used as almost universal replacements for the older types. It is not recommended that the 6BQ6GT and 6BQ6G tubes be used as replacements for any other types of tubes.

Tubes Based on the 6BG6G

The 6BG6G tube is the prototype of a second large classification of horizontal output tubes. None of these are interchangeable with the tubes that have already been discussed in the first classifi-



6BG6G 6CD6G 6CD6GA

Fig. 7. Comparison of Three Closely Related Tubes.

cation because the base connections are different. (See Fig. 6B.) Tubes in this second main classification are designed especially to yield a satisfactory amount of plate current at a relatively low DC plate voltage.

The prototype tube 6BG6G and two related tubes, the 6CD6G and 6CD6GA, are shown in Fig. 7.

6BG6G
19BG6G

Some of the ratings of the prototype tube 6BG6G are as follows. The maximum plate dissipation is 20 watts, and the tube is rated to withstand positive pulses of plate voltage up to 6,000 volts. Filament current is 900 milliamperes. A large, curved bulb is used on BG6G tubes in order that heat dissipation may be facilitated; therefore, the tubes have a final letter G instead of GT in the type number. The total height of the BG6G tube is $5\,{}^{17}\!/_{32}$ inches.

The 19BG6G tube was designed for 300-ma series strings; and for the proper power input to the filament, the voltage applied must be 18.9 volts. The 19BG6G, like the 25BQ6GT, is used in filament circuits that employ series-parallel connections.

6BG6GA

The 6BG6GA is similar to the 6BG6G in electrical specifications, but the modified tube uses a straight-sided bulb. Since this envelope is somewhat taller than the similar one which is used on the 6CU6, the over-all height of the 6BG6GA is 5 inches. The 6BG6GA is more rigidly constructed than its prototype, the 6BG6G.

6CD6G
25CD6G

The 6CD6G and 25CD6G are superficially similar to the 6BG6G and 19BG6G in appearance (see Fig. 7), but the two pairs of tubes are not interchangeable because the electrical ratings are considerably different. Some of these differences are shown in Table IV.

†25CD6GA

The †25CD6GA tube is similar to the 25CD6G except that it has been redesigned for use in 600-ma series strings. The two types are not interchangeable.

6CD6GA
†25CD6GB

These tubes are companion types even though one has the final letter A in its type number and the other has the final letter B. The specifications are identical except for the heater ratings. A number of physical modifications have been made for the purpose of increasing the electrical ratings. The plate is larger, and the mica supports have been redesigned so that the possibility of arcing will be reduced. The tube is enclosed in a tall straight-sided envelope, and its total height is 5 inches. The difference in appearance between the 6CD6G and the 6CD6GA is shown in Fig. 7.

The 6CD6GA has a plate dissipation of 20 watts and a rating of 7,000 volts for maximum positive pulse voltage on the plate.

6DN6
†25DN6

The 6DN6 and †25DN6 are recently designed tubes. They are of the same size and shape as the 6CD6GA. The electrical ratings correspond closely to those of the 6CD6G, except that the DN6 tubes have an unusually high transconductance rating of 9,000 micromhos.

The interchangeability of the tubes in the second main classification is sharply restricted because the BG6 types cannot be substituted for the CD6 types. The BG6GA and CD6GA tubes may be substituted for their respective prototypes, however.

The 25CD6G and the 25CD6GA are not interchangeable because the current ratings of their filaments are different. This rating is critical in both cases.

In the near future, manufacturers plan to introduce picture tubes that have deflection angles of 110 and 120 degrees. Additional modifications will probably be made to the designs of horizontal output tubes in order to meet the increased power requirements of the sweep circuits that will come into use. Then an understanding of the differences between the various types of horizontal output tubes will be more helpful than ever.

THOMAS A. LESH

Notes On Test Equipment

(Continued from page 17)

Other Features

The indicating device for all voltage and resistance measurements is a revolving three-digit counter similar in appearance to the mileage indicator of an automobile. Input resistance, 11 megohms for DC voltage; frequency response for AC voltage, 30 cps to 3 megacycles with direct probe and 50 kilocycles to 250 megacycles with crystal probe; accuracy, 1% for DC voltage and resistance and 2% for AC voltage; polarity-reversal switch for DC voltage; size of case, 8½ by 11 by 7½ inches.

Jackson Electrical Instrument Co.

JACKSON MODEL 709 TELE-VOLTER

Ranges (28)

DC voltage and *AC rms voltage*, 0 to 1000 volts in 7 ranges each; *AC peak-to-peak voltage*, 0 to 2800 volts in 7 ranges; *resistance*, 0 to 1000 megohms in 7 ranges.

Other Features

Input resistance, 11 megohms for DC voltage and .2 megohm for AC voltage; frequency response for AC voltage essentially flat to 4.5 megacycles for ranges up to 100 volts; combination probe serves for DC and AC-OHMS readings; polarity-reversal switch for DC voltages; zero-center scale; illuminated windows to show function and range being used; meter mounted on a sloping front panel; 7-inch meter; size of case, 8¾ by 8¼ by 7¼ inches.

Phaostron Company

PHAOSTRON MODEL 777

Ranges (28)

DC voltage and *AC rms voltage*, 0 to 1500 volts in 7 ranges each; *AC peak-to-peak voltage*, 0 to 4000 volts in 7 ranges; *resistance*, 0 to 1000 megohms in 7 ranges.

Other Features

Input resistance, 11 megohms for DC voltage; accuracy, ±3% of full scale for DC voltage and ±5% of full scale for AC voltage; polarity-reversal switch for DC voltages; zero-center scale; 4.87-inch meter; instrument case of unbreakable metal; over-all size of VTVM in leather carrying case, 3¾ by 6⅝ by 7½ inches.

Precision Apparatus Company, Inc.

PRECISION MODEL 68

Ranges (20)

DC voltage and *AC rms voltage*, 0 to 1200 volts in 5 ranges each; *AC peak-to-peak voltage*, 0 to 3200 volts in 5 ranges; *resistance*, 0 to 1000 megohms in 5 ranges.

Other Features

Input resistance, 13⅓ megohms for DC voltage, 0.65 megohm for AC voltage ranges up to 60 volts, 0.90 megohm for 300-volt AC range, and 1 megohm for 1200-volt AC range; accuracy, ±3% of full scale for DC voltage and ±5% of full scale for AC voltage; frequency response to AC extends beyond audio frequencies, use of accessory RF probe extends the response to 250 megacycles; combination probe serves for DC and AC-OHMS functions; polarity-reversal switch for DC voltages; zero-center scale; 5¼-inch meter; size of case, 5⅞ by 7¾ by 3½ inches.

PRECISION MODEL 78

Ranges (16)

DC voltage, 0 to ±1500 volts in 6 zero-center ranges; *AC rms voltage*, 0 to 1200 volts in 5 ranges; *resistance*, 0 to 1000 megohms in 5 ranges.

Other Features

The Model 78 operates from self-contained batteries; input resistance, 13⅓ megohms for DC voltage, 8 megohms for AC voltage; accuracy, ±3% for DC voltage and ±5% for AC voltage; frequency response to AC extends beyond audio frequencies, accessory RF probe extends the response to video and radio frequencies; combination probe for DC and AC-OHMS functions; condition of batteries may be checked without opening meter case; 5¼-inch meter; size of case, 5⅞ by 7¾ by 3½.

PRECISION MODEL 88

Ranges (29)

DC voltage and *AC rms voltage*, 0 to 1200 volts in 6 ranges each; *zero-center DC voltage*, 0 to ±1200 volts in 6 ranges; *AC peak-to-peak voltage*, 0 to 3200 volts in 6 ranges; *resistance*, 0 to 1000 megohms in 5 ranges.

Other Features

Input resistance, 26⅔ megohms for zero-center DC ranges, 13⅓ megohms for DC ranges, 3 megohms for AC rms voltage ranges up to 60 volts, 1 megohms for 300-volt AC rms range, 4 megohms for 1200-volt AC rms range, 6 megohms for AC peak-to-peak ranges up to 160 volts, 1 megohm for 800-volt AC peak-to-peak range, and 4 megohms for 3200-volt AC peak-to-peak range; accuracy, ±3% for DC voltage and ±5% for AC voltage; frequency response to AC extends beyond audio frequencies, vacuum-tube type accessory RF probe extends the response to 300 megacycles; polarity-reversal switch for DC voltages; combination probe for DC and AC-OHMS functions; 5¼-inch meter; size of case, 5⅜ by 7 by 3⅛ inches.

PRECISION MODEL 98

Ranges (44)

DC voltage and *AC rms voltage*, 0 to 1200 volts in 6 ranges each; *zero-center DC voltage*, 0 to ± 1200 volts in 6 ranges; *AC peak-to-peak voltage*, 0 to 3200 volts in 6 ranges; *resistance*, 0 to 1000 megohms in 6 ranges; *current*, 0 to 12 amperes DC in 8 ranges, lowest range 0 to 300 microamperes DC; *decibels*, −20 to +63 db in 6 ranges.

Other Features

Input resistance, 26⅔ megohms for zero-center DC ranges, 13⅓ megohms for DC ranges; accuracy, ±3% for DC voltage and ±5% for AC voltage; frequency response to AC extends beyond audio frequencies; accessory probe extends the response to 300 megacycles; polarity-reversal switch for DC voltages; combination probe for DC and AC-OHMS functions; AC rms and AC peak-to-peak functions selected separately by a switch; 7-inch meter; size of case, 11½ by 13 by 6⅝.

Radio Corporation of America

RCA MODEL WV-77A JUNIOR VOLTOHMYST

Ranges (15)

DC voltage and *AC rms volt-*

age, 0 to 1200 volts in 5 ranges each; *resistance*, 0 to 1000 megohms in 5 ranges.

Other Features

Input resistance, 11 megohms for DC volts, 0.2 megohm up to 60-volt AC range, 1 megohm for 800-volt AC range, 2 megohms for 1200-volt AC range; frequency response, flat within ±1 db from 30 cps to 3 megacycles on 3-, 12-, and 60-volt ranges when the voltage source has an internal impedance of 100 ohms; polarity-reversal switch for DC voltages; zero-center scale; size of case, 8 by 5⅜ by 4½ inches.

RCA MODEL WV-97A SENIOR VOLTOHMYST

Ranges (28)

DC voltage and *AC rms voltage*, 0 to 1500 volts in 7 ranges each; *AC peak-to-peak voltage*, 0 to 4200 volts in 7 ranges; *resistance*, 0 to 1000 megohms in 7 ranges.

Other Features

Input resistance, 11 megohms for DC volts; 0.83 megohm up to 150-volt AC range, 1.3 megohms for 500-volt AC range, and 1.5 megohms for 1500-volt AC range; frequency response, flat from 30 cps to 3 megacycles up to 500-volt range when the voltage source has an internal impedance of 100 ohms; accuracy, ±3% of full scale for DC voltage, ±5% of full scale for AC voltage; polarity-reversal switch for DC voltages; zero-center scale; size of case, 7⅞ by 5¾ by 4½ inches.

RCA MODEL WV-87A MASTER VOLTOHMYST

Ranges (37)

DC voltage and *AC rms voltage*, 0 to 1500 volts in 7 ranges each; *AC peak-to-peak voltage*, 0 to 4200 volts in 7 ranges; *resistance*, 0 to 1000 megohms in 7 ranges; *current*, 0 to 15 amperes DC in 9 ranges, lowest range 0 to 500 microamperes DC.

Other Features

Input resistance, 11 megohms for DC voltages, 0.83 megohm up to 150-volt AC range; frequency response, flat from 30 cps to 3 megacycles on ranges up to 500-volt range; accuracy, ±3% of full scale for DC voltage and ±5% of full scale for AC voltage; polarity-reversal switch for DC voltages; zero-center scale; $7\frac{1}{2}$-inch meter; size of case, 10 by $13\frac{1}{2}$ by 7 inches.

Simpson Electric Company

SIMPSON MODEL 303

Ranges (23)

DC voltage and *AC rms voltage*, 0 to 1200 volts in 5 ranges each; *AF voltage*, 0 to 60 volts in 3 ranges; *resistance*, 0 to 1000 megohms in 5 ranges; *decibels*, —20 to +63 db in 5 ranges.

Other Features

Input resistance, 10 megohms for DC voltages, 0.275 megohm for AC voltages; frequency response, flat to 100 kilocycles on 1.2-, 12-, and 60-volt AC ranges, flat from 20 kilocycles to 100 megacycles for RF voltages with accessory probe; accuracy, 3% for DC voltage and 5% for AC voltage; polarity-reversal switch for DC voltages; zero-center scale; rigid handle to prop up instrument for viewing; $4\frac{1}{2}$-inch meter; size of case, $5\frac{1}{4}$ x 7 x $3\frac{1}{8}$ inches.

Sylvania Electric Products Inc.

SYLVANIA TYPE 301 POLYMETER

Ranges (36)

DC voltage and *AC rms voltage*, 0 to 1000 volts in 6 ranges each; *AC peak-to-peak voltage*, 0 to 2800 volts in 6 ranges; *resistance*, 0 to 1000 megohms in 6 ranges; *current*, 0 to 10 amperes in 6 ranges; *decibels*, —20 db to +61.4 db in 6 ranges.

Other Features

Input resistance, 17 megohms for DC voltages and 2.7 megohms for AC voltages; polarity-reversal switch for DC voltages; zero-center scale; size of case, $8\frac{3}{4}$ by $11\frac{3}{16}$ by $6\frac{15}{16}$ inches.

SYLVANIA TYPE 302 POLYMETER

Similar to the Type 301 but equipped with an RF input and a vacuum-tube RF probe.

Triplett Electrical Instrument Co.

TRIPLETT MODEL 631

Ranges (4)

DC voltage, 0 to 120 volts in 4 ranges.

Other Features

Combination VOM and VTVM; VOM features were discussed in the January issue of *PF REPORTER;* VTVM battery operated; input resistance, 11 megohms on all VTVM ranges; accuracy, ±4% with battery voltage of 22.5 volts; a push button on the front panel to check condition of battery; zero-center scale; size of case, $3\frac{7}{32}$ by 5½ by 7½ inches.

TRIPLETT MODEL 650

Ranges (25)

DC voltage, 0 to 1000 volts in 7 ranges; *AC rms voltage,* 0 to 500 volts in 6 ranges; *AC peak-to-peak voltage,* 0 to 700 volts in 6 ranges; last range gives peak-to-peak value of sine wave to 1400 volts; *resistance,* 0 to 1000 megohms in 6 ranges.

Other Features

Input resistance, 11 megohms for DC voltage; 1.4 megohms for AC voltage to 1 megacycle; accuracy, ±3% for DC voltage and resistance and ±5% for AC voltage; frequency response for AC voltage, 15 cps to more than 110 megacycles; decibels measured through use of chart in instruction manual; polarity-reversal switch for DC voltages; zero-center scale; 5½-inch meter; size of case, 3¾ by 5½ by 7½ inches.

Weston Electrical Instrument Corp.

WESTON MODEL 982

Ranges (28)

DC voltage and *AC rms voltage,* 0 to 1600 volts in 7 ranges each; *AC peak-to-peak voltage,* 0 to 1600 volts in 7 ranges; *resistance,* 0 to 1000 megohms in 7 ranges.

Other Features

VTVM is operated by self-contained batteries; input resistance, 10 megohms for DC voltage and 2.8 megohms for AC rms voltage; 1 megohm for AC peak-to-peak voltage; accuracy, ±3% for DC voltage and ±5% for AC rms values of sinusoidal waveforms; one shielded test lead serves for all measurements; polarity-reversal switch for DC voltages; zero-center scale; 4.63-inch meter scale; size of case, 10 by 7.38 by 3.63 inches.

PAUL C. SMITH

Audio Facts

(Continued from page 29)

Preamplifier stages would be required in addition to the usual amplifiers to drive the loudspeaker because of the low signal output obtained from a playback head. If all things are considered, we find that a tape playback unit would have to be a relatively complicated piece of mechanism. Something simpler had to be used for a passenger car.

Although tape recorders are coming into widespread use, many people are still almost totally unfamiliar with them and their operation. So, some system that was familiar to and accepted by the majority had to be used.

Why Not Standard Records and Players?

The familiar 78-rpm records were rejected because they are being discontinued by many recording companies and because they are too large and heavy for use in an automobile anyway. They take up a lot of space and provide a very short playing time per side. Even if the large player or changer required to play 78-rpm records could be designed to operate in a car, no space could be found in which to install it in the average automobile.

Small 45-rpm records about 7 inches in diameter are available with a practically unlimited variety of selections. A 45-rpm player might seem the logical choice, but the playing time of even an extended-play record is only about 8 minutes per side. A minimum of four records (eight sides with one turnover of the stack) would have to be used for one hour of playing time. This would require a record changer, and a record changer would take up space and in addition would be difficult to keep in proper operation with the car in motion. Record storage would also be a problem because, with at least four records needed per hour, a large stack would have to be carried in the car.

Long-playing 33⅓-rpm microgroove records provide a maximum of about 30 minutes of playing time per side of a 12-inch disc. It would be very difficult to make a large $33\frac{1}{3}$-rpm player shockproof enough for use in a moving passenger car. Anyone who has worked on an auto radio knows how difficult it would be to find space enough for a $33\frac{1}{3}$-rpm player and additional space to store the 10- and 12-inch records.

A new and practical system was developed by CBS-Columbia for use in the 1956 Chrysler Corporation cars. This is the new Highway Hi-Fi player with its new XLP records. The player is a single-play unit that mounts under the dashboard of the car. The turntable is turned by a small induction motor which obtains its power from a vibrator supply powered by the car battery. The signal developed by the special ceramic cartridge is fed through a phono switch to an audio input provided on the car radio. A small turntable accommodates the new $16\frac{2}{3}$-rpm XLP records with extra-fine grooves.

Why Was the 7-Inch XLP Record Chosen?

These new XLP records are 7 inches in diameter and are cut with approximately 550 grooves per inch. This is twice as many as there are on an LP microgroove disc. One side of one of these 7-inch records can provide one hour of recorded speech or 45 minutes of recorded music. If variable pitch were used when the record is being cut, no doubt one hour of music could be recorded on a side. With between $1\frac{1}{2}$ to 2 hours of playing time on a 7-inch record, the problems of size, storage space, frequent changes, and cost have been substantially solved.

Why was a 7-inch record with such fine grooves and such slow speed developed for use in the Chrysler cars? We know that a small long-playing record was desired, but the quality of reproduction and the durability of the record are factors that had to be considered.

We will now take up a subject which has seldom been mentioned in these columns, and we will discuss some of the things that must be considered when a record is being designed. The quality of reproduction to be obtained from the finished disc is influenced by speed, groove size, radius of stylus, and stylus force.

Three of the ratings or characteristics that are basic in determination of the performance of a record are: (1) frequency response, (2) signal-to-noise ratio, and (3) tracing distortion. All three of these are interrelated and depend upon such things as the diameter of the record, the speed at which the record revolves, the size of the grooves, the level of modulation, and the size of the playback stylus.

Important factors in determining the frequency response, distortion, and amount of noise obtained when a record is played are: linear groove velocity and groove deviation. Linear groove velocity means the speed at which the record or groove moves in relation to the stylus at the point of contact with the stylus. Groove deviation means the amplitude of the lateral waves or wiggles of the modulating signal that is cut into the groove.

Tracing distortion—the distortion caused by the inability of the playback stylus to follow the groove at all times—depends upon the radius or sharpness of the curvature of the modulated wave which is cut into the groove and upon the effective size of the playback stylus. Tracing distortion is increased drastically when the radius of the playback stylus is larger than the radius of the modulated wave which is cut into the groove. For any certain frequency, the resulting radius of the modulated wave in the groove depends upon the diameter of the record (or upon the diameter of the circle formed by the groove in which the stylus is moving) and upon the speed of the record at the point of contact with the stylus.

Most of us are aware that if the speed of a turntable is reduced one half, for instance from 33⅓ rpm to 16⅔ rpm, the frequency of a musical tone being reproduced will be reduced one half. Middle C (256 cps) would drop an octave to the next C (138 cps). For a particular signal, therefore, twice as many waves per unit length of groove would have to be cut on a 16⅔-rpm record than on a 33⅓-rpm record. See Fig. 1. A point on one of the outer grooves of a record moves at a much higher speed than a point on a groove near the center of the record because of the much smaller circle traced by the inner groove. It is therefore difficult to maintain good high-frequency response and high levels of modulation on the inner grooves of a large record or on the grooves of a small record. To overcome this degenerating effect, the speed of the record would have to be increased or finer grooves would have to be cut on the record and a stylus with a smaller tip radius would have to be used for playback.

Fine grooves are used when a record is cut at a slow speed so that the sharp deviations of the modulated wave can be cut in the grooves. Microgroove 33⅓-rpm and 45-rpm discs are cut with fine grooves, as the term microgroove implies, and are played with a 1-mil (.001-inch) stylus. The small (about 7-inch) 45-rpm records maintain frequency response and handle the necessary levels of modulation because of the increased speed of 45 rpm.

The Highway Hi-Fi XLP record is 7 inches in diameter and revolves at a speed of 16⅔ rpm. We can gather from the preceding paragraphs that something had to be done to offset the effects of the small diameter and slow speed in

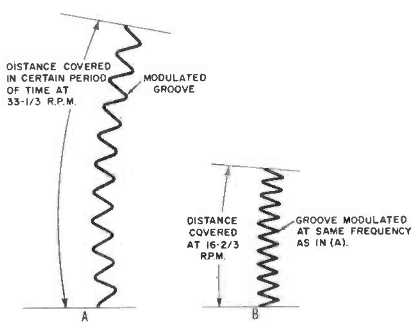


Fig. 1. Modulated Grooves Representing a Particular Signal. (A) On a 33⅓-RPM Record. (B) On a 16⅔-RPM Record.

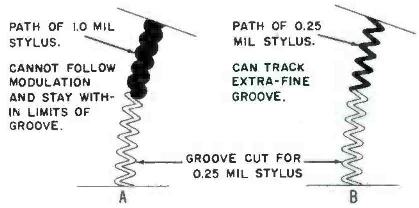


Fig. 2. Two Sets of Fine Grooves and the Path Taken by a Stylus in Each Groove. (A) Path of 1-Mil Stylus. (B) Path of 0.25-Mil Stylus.

order to obtain a reasonably wide range of frequencies and modulation from these small slow records. The very fine grooves designed for use with the 0.25-mil (.00025-inch) reproducing stylus compensate for these effects in addition to extending the playing time.

Fig. 2 illustrates two sets of fine grooves. Each shaded area shows the path taken by the stylus being used. The stylus in Fig. 2A is four times larger than the one in Fig. 2B. The grooves in the figure bear little resemblance to any grooves ever cut on a record, but they can give some idea of why a large stylus cannot be used to cut or play a fine groove.

The inside grooves of an LP microgroove record have a diameter of about 5 inches. The inside grooves of an XLP 16⅔-rpm record are a little less than 4 inches in diameter. By using the extra-fine grooves and the 0.25-mil stylus, the necessary small and sharp deviations of the modulated wave can be both recorded and played back on the small discs. The 0.3-mil stylus has been found to be satisfactory when used with an amplifier-speaker combination possessing a limited frequency range.

Because of the extra-fine grooves used on the new XLP records, the deviation of any signal wave is not permitted to exceed 61 per cent of the maximum deviation used on standard LP microgroove records. The tracing distortion is about equal for both types of records when the deviation is kept within these limits. In actual practice, the recording level on an XLP record is kept approximately 6 decibels below the level used on an LP microgroove recording.

Even though the signal output from an XLP record is about half of the output from an LP microgroove disc, the signal-to-noise ratio is just about the same because of the small contact area of the 0.25-mil stylus on the record and the low stylus pressure of not more than 2½ grams.

Life tests show less wear on the small stylus for the same playing time on XLP records than the wear on a 1-mil stylus on LP microgroove records at 6 to 8 grams of pressure.

Although the frequency range obtained from the 16⅔-rpm XLP records is somewhat restricted when compared to the results obtained with standard LP microgroove records, the reproduction from these small XLP records is very gratifying. It will be interesting to see if they will also be developed for the reproduction of music in the home.

XLP Records Not for Present Home Players

Many late-model record changers and players for the home will operate at the 16⅔-rpm speed. These machines have been designed for playing the talking-book records and are not suitable for playing the XLP Highway Hi-Fi records. The heavy 6- to 12-gram pickup and the .001-inch stylus cannot play the extra-fine grooves of the XLP records which were designed only for use with the Highway Hi-Fi player. Since up to one hour of playing time can be obtained from one side of a record, the small manually operated single-play player is used. The record can be placed on the turntable, turned over, or removed very easily.

The pickup is placed on or moved off the record manually by the operator. A finger is placed on a red button provided for that purpose on the arm, and the arm is moved in the desired direction until a preset stop halts its movement. See Fig. 3. One stop indexes the pickup on the starting grooves of the record. The other stop locks the arm in the rest position off the record. If the pickup should be accidentally pushed across the surface of the record, no audible scratch will be made on the grooves because the pickup cartridge is in such a protected position under the vertically immovable arm that no more than the force of 2½ grams can be placed on the stylus.

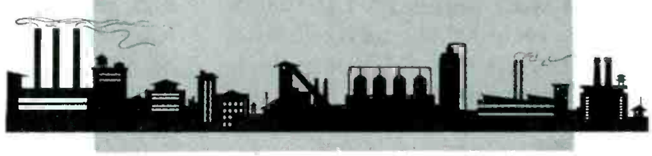
Fig. 3. Moving Pickup Arm to Setdown Point on Record.

Fast movement of the arm is damped by a liquid of high viscosity. The arm cannot swing or jump around on the record, but it can follow the extra-fine grooves with practically no effort. The cartridge is so light and is counterbalanced so well that it does not bounce in the grooves.

The Highway Hi-Fi player and the XLP 16⅔-rpm records are well-designed practical items made for the purpose of furnishing recorded programs in a moving or parked car. They are very good examples of the way in which a basic system has been modified and engineered to fit into a certain application.

ROBERT B. DUNHAM

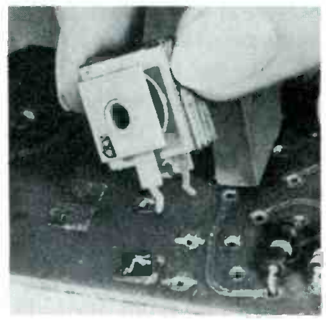
Product Report



Editor's Note:

The material appearing in this column has been taken from literature supplied by the manufacturers of the various products. The *PF REPORTER* cannot assume responsibility for claims of originality or application.

SELENIUM RECTIFIERS



The Radio Receptor Co., Inc., has announced the availability of selenium rectifiers designed expressly for printed-wiring boards.

The terminals of the new rectifiers snap into the holes in the board and hold the rectifier in place while the soldering is being completed. The Types 8Y1B and 8J1B, rated at 30 and 65 milliamperes respectively, are currently available.

TRANSMISSION LINE

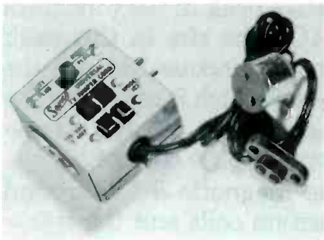
A new TV transmission line is being offered by the Channel Master Corp., Ellenville, N. Y., in two styles: the "Twin Twenty" and the "Challenger." Both styles feature the use of 20 strands of No. 33 copper wire in each conductor instead of the commonly used 7 strands of No. 28 wire or 10 strands of No. 30 wire.

These new lines are claimed to be easier to work with and to have greater resistance to breakage than any other transmission line. Each is marked with an impression every 10 feet so that a certain length of line can be quickly unrolled.

CAPACITOR-REPLACEMENT GUIDE

The Sprague Products Company announces a new *Auto Radio Replacement Capacitor Manual* which provides complete information about the electrolytic capacitors used in every automobile receiver manufactured from 1946 through 1955. Each brand of receiver is listed alphabetically. The proper Sprague replacement capacitors are fully described in terms of the capacitance, voltage rating, and list price and are then cross-referenced to the original part numbers.

JUMPER CORD



A new universal jumper (or cheater) cord has been announced by Service Instruments Company, 171 Official Road, Addison, Illinois. This cord is designed to be plugged into the interlock socket on the back cover of the TV receiver after the cover has been removed instead of into a wall socket.

The cord will fit any receiver because it has two male and two female connectors. A double-pole, double-throw switch is provided so that power will be removed from the unused male connector and so that shock hazard will be eliminated. Two power outlets are provided for accessory equipment such as a soldering iron.

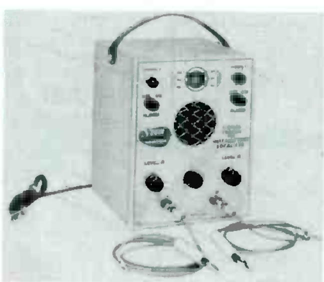
The universal cord Model JC2 has a net price of $1.95.

TURNTABLE

The Starlight, a high-fidelity turntable, has been announced by the Metzner Engineering Corporation, Dept. 26, 1041 North Sycamore Avenue, Hollywood 38, California.

This turntable is of the center-drive type and will accommodate records of all sizes and speeds. The speed is adjustable, and a built-in hub provides centering for 45-rpm records. The drive motor is of the 4-pole type and is fully shielded for minimum hum pickup when a magnetic cartridge is used. The motor is encased in lead in order that mechanical vibration will be eliminated. An illuminated stroboscope is built into the turntable. The retail price is $49.50.

CIRCUIT MONITOR



A new piece of test equipment has been introduced by the Seco Manufacturing Co., 5015 Penn Avenue South, Minneapolis, Minnesota.

The Seco Monitron is designed mainly for the servicing of receivers which have intermittent troubles. The technician can use it for monitoring two different circuits simultaneously, for tracing signal paths, and for making point-to-point gain measurements.

The instrument is sold nationally through parts distributors, and the list price is $119.50.

Horizontal Flyback Systems

(Continued from page 27)

change in the value of current. The applied voltage overcomes the counter emf at a rate which is determined by the value of the inductance. As a result, the current in the deflection coils and the transformer will decrease at a rate determined by the combined value of the inductances of these components.

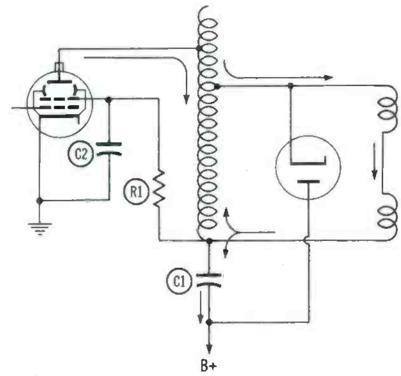


Fig. 6. Directions of Currents in the Circuit of Fig. 1 During the Second Half of Trace Time.

Since the output and damper tubes are cut off during retrace time, the energy stored in the inductive components will set up an oscillating current at the natural resonant frequency of the circuit. This circuit consists of: (1) the deflection coils, (2) that portion of the transformer across which these coils are connected, (3) any capacitors which may be in series with the loop formed by these two components, and (4) the distributed capacitances of the circuit.

The arrows in Fig. 6 indicate that, during the second half of horizontal trace, some of the current from the deflection coils returns to the power supply and that the rest of the current flows up through the transformer winding. By referring to the waveform in Fig. 7, it may be seen that the current which returns to the power supply resembles that supplied by the horizontal output tube. Note that the current to the power supply decreases to zero almost instantly after the initiation of retrace time. As previously stated, the current from the deflection coils cannot decrease as rapidly; consequently, it flows up through the transformer as indicated by the negative peak in the waveform of Fig. 4C. The rise in this peak is not instantaneous because the counter emf which is set up by the changing current in the transformer opposes the change.

As the magnetic fields around the deflection coils and the transformer collapse, the current flowing down through the coils and up through the transformer decreases and allows the beam to return to the center of the screen. By the time this current ceases to flow, the capacity of the resonant loop has become charged. A discharge current will flow up through the deflection coils and down through

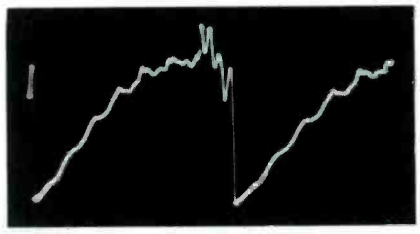


Fig. 7. Waveform of the Current Returned to the Power Supply in the Circuit of Fig. 1

the transformer, and expanding magnetic fields will be produced around these two components. The expanding field around the deflection coils deflects the beam to the left side of the screen, and the retrace cycle is thereby completed.

Circuit Theory

In order to achieve proper beam retrace, the deflection field must collapse and expand within the allotted time of 10.5 microseconds. Since the collapse and expansion of the deflection field will occur at the resonant frequency of the output circuit, this circuit is specifically designed to be resonant at a frequency which is at least three times that of the horizontal sweep.

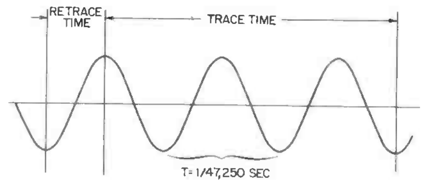


Fig. 8. The Rapid Change From Negative to Positive of This 47,250-CPS Sinusoidal Waveform Would Produce the Proper Deflection Field for Beam Retrace.

The sine wave in Fig. 8 represents a frequency of 47,250 cycles per second (3 × 15,750). During the period allotted for beam retrace, this signal changes from a maximum negative to a maximum positive value; consequently, if the horizontal output circuit is resonant at such a frequency, beam retrace can be completed in exactly one fifth the time used for the trace. Because of the wide deflection angles and high second-anode voltages used in modern receivers, it has been found to be advantageous to effect beam retrace in less than 10 microseconds; therefore, the resonant frequencies of modern circuits are higher than that expressed in the foregoing example.

The fact that the deflection coils are a part of a resonant circuit presents a minor problem in providing a linear horizontal sweep. If no precautions were taken, an oscillatory current would flow through the deflection coils. It is the purpose of the damper tube to keep this from happening.

Another glance at Fig. 5 will show that the current from the deflection coils is divided between the damper tube and the transformer winding during the first half of trace time. The current through the damper tube causes a potential to build up across capacitor C1. The polarity of this potential is such that it adds to the B+ voltage and is commonly referred to as the B+ boost voltage. Note that this additional potential will increase the voltage at the cathode of the damper; therefore, this tube is gradually cut off because of its own current.

The current supplied to the circuit by the output tube during the second half of trace time reduces the charge across capacitor C1. Were it not for the fact that a high pulse voltage is developed across the transformer during retrace time, the charge across this capacitor would have decreased sufficiently to allow the damper tube to conduct. A waveform of the pulse voltage developed across the lower portion of the transformer is presented in Fig. 9. This pulse represents the potential energy stored in the deflection coils at the instant the output tube is cut off.

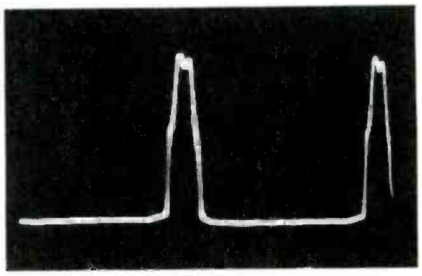


Fig. 9. Waveform of the Pulse Voltage Produced During Retrace Time Across the Lower Portion of the Transformer in Fig. 1.

Since the damper tube is cut off during retrace time, an oscillatory current flows in the loop formed by the transformer winding and the deflection coils. If it were possible to remove the damper tube during retrace time, the current in the circuit would continue to oscillate for several cycles. With each succeeding cycle, a portion of the energy would be dissipated and the distance which the beam is deflected each side of the center of the screen would decrease. Many technicians have seen the condition shown in Fig. 10 when the output or damper tube has failed. Note that horizontal sweep is occurring at a sinusoidal rate. This condition appears only momentarily after the failure has occurred because second-anode voltage is no longer being developed and beam current does not reach the screen.

Because of the action of the damper tube, the current in the resonant loop is allowed to oscillate for only a half cycle. At the end of this half cycle, the current

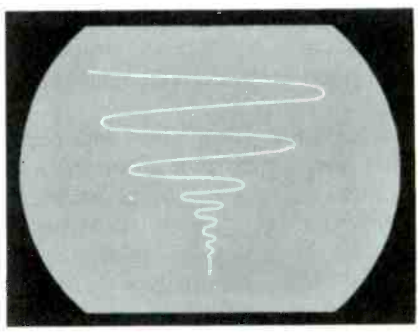


Fig. 10. Pattern Produced on the Screen As the Energy in the Resonant Loop Dissipates After the Damper Tube Fails or Is Removed.

flowing up through the deflection coils starts to decrease. The collapsing magnetic field represents a potential of a polarity that makes the cathode of the damper tube negative with respect to the plate, and this tube conducts heavily.

Refer again to Fig. 5, and note that current from the damper tube flows to one side of capacitor C1 and from the other side back up through the deflection coils. The current through the deflection coils tries to decrease at the resonant frequency of the loop, but the current is being added to by current from the damper tube. As a result, the current through the coils decreases at the charging rate of capacitor C1.

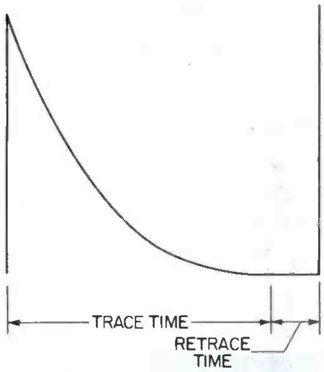


Fig. 11. Rate of Decrease of the Current in the Deflection Coils. This Decrease Is Caused by the Charging of the Filter Capacitor on the Boost B+ Line.

The drawing in Fig. 11 shows the rate of decrease in the current through the deflection coils. The decrease is due to the charging of C1. It can be seen that the change of current is linear for only 25 per cent of the trace time. If an opposing current from the output tube is introduced at the proper time, the current through the coils will decrease at a more linear rate. In many instances, the voltage at the grid of the output tube can be varied by a change of the setting of a trimmer capacitor or a potentiometer. Such a component is known as the horizontal drive control, and its setting controls the time at which the output tube begins conducting and therefore controls the maximum current supplied to the deflection coils by this tube.

Second-Anode Voltage

It was previously stated that the flyback system had two functions. In addition to providing the proper magnetic field for horizontal deflection, the flyback circuit is used in the production of second-anode voltage for the picture tube. The flyback circuit which was shown in Fig. 1 utilizes an autotransformer. The total inductance of the winding is at least five times the value of that across which the deflection coils are connected.

The pulse voltage produced during retrace time by the energy stored in the deflection coils appears across the lower portion of the autotransformer. (See Fig. 9.) Because of the step-up action of the circuit, a pulse voltage which is several times the value of that supplied by the deflection coils is applied to the plate of the high-voltage rectifier. This large pulse causes the tube to conduct, and the 500-mmfd capacitor charges to the peak value of the pulse.

Except for the extremely small leakage in the capacitor itself, the only discharge path for this charge is through the picture tube. Normal beam current varies between 0 and 50 microamperes and reduces the charge across the capacitor by as much as 15 per cent during trace time. This charge is replenished during each retrace period when the high pulse voltage developed across the transformer causes the rectifier to conduct. No voltage is produced for the second anode of the picture tube when the horizontal oscillator does not provide the proper drive signal to the output tube.

Circuit Action in Step Form

The following is a step-by-step explanation of the circuit action throughout one period of horizontal trace and retrace.

1. After an initial warm-up period, the damper tube is in a conductive state and B+ voltage appears at the plate of the horizontal output tube.

2. The modified sawtooth voltage at the grid of the output tube allows this stage to supply a steadily increasing current to the deflection coils. The expanding magnetic field produced by this current

deflects the beam to the right side of the screen.

3. When the voltage at the grid of the output tube drops sharply, the tube is cut off and the magnetic field around the deflection coils starts to collapse.

4. The magnetic field which exists at this time causes a peak voltage to appear across the lower portion of the transformer. The peak value of this pulse is stepped up because of transformer action, and a pulse having a very high peak value appears at the plate of the high-voltage rectifier.

5. The rectifier conducts and causes the high-voltage filter capacitor to charge to the peak value of the pulse.

6. The collapse of the magnetic field around the deflection coils occurs at a rate determined by the resonant frequency of the loop formed by the deflection coils and the lower portion of the transformer.

7. The collapsing field allows the beam to return to the center of the screen. At the same time, this collapsing field causes an induced current to flow in a direction opposite to that of the current which produced the field. This induced current charges the distributed capacitances present in the resonant loop.

8. As soon as the field has completely collapsed, the capacitances in the resonant loop discharge. The direction of the discharge current is opposite to that of the charge current. A magnetic field builds up around the deflection coils and deflects the beam to the left side of the screen.

9. When the beam has been returned to the left side of the screen, the voltage across the damper tube is of such a polarity that this tube conducts.

10. Although the magnetic field which exists around the deflection coils at this time tries to collapse at the resonant rate of the loop, the current flows through the damper tube and returns to the coils to slow the rate of collapse.

11. As the damper tube conducts, the current through this tube increases the charge across the B+ boost filter. The current through the damper tube and the strength of the deflection field both decrease at the charging rate of this capacitor.

12. After approximately 25 per cent of the horizontal trace has been completed, the voltage at the grid of the output tube has risen to a value which allows the stage again to contribute current to the circuit.

13. This current opposes that supplied by the collapsing field. The current through the deflection coils decreases to zero at a linear rate and increases to maximum in the opposite direction at a linear rate.

14. The voltage at the grid of the horizontal output tube drops sharply, and the cycle is repeated beginning with step 3.

VERNE M. RAY

A New Development Toward Automation

(Continued from page 23)

paper-based phenolic material. This is the same type of base plate that is used for printed-wiring boards. Sprocket type holes are punched in the base plate to facilitate mounting of the pins. Fastened in these holes are specially designed clips which resemble miniature fuse clips. These are for the purpose of holding the components in place.

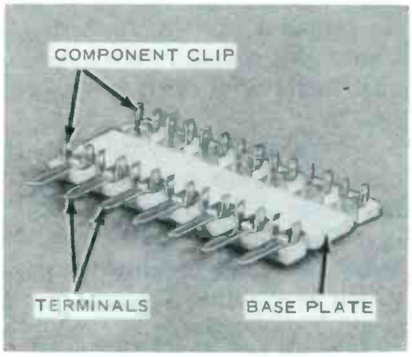


Fig. 2. Base Plate With Component Clips Attached.

A base plate with the component clips attached is shown in Fig. 2. This one is designed to form a circuit that contains seven components. The over-all dimensions of this base plate are 1.4 inch by .75 inch. The length of a base plate is determined by the number of components that are placed on it. For n number of components, the length is equal to $.2n$ inch; therefore, if the pin assembly contains 12 components, the length of the unit would be 2.4 inches.

Terminals are provided along one edge of the board so that the unit can easily be plugged into a printed-wiring board. In this way, connections between components of the pin assembly and the external points of the circuit are provided.

After the individual components are inserted into the clips, the edges of the boards are dipped into melted solder so that there will be noise-free contact between the components and the component clips. A unit which has gone through this stage of construction is shown in Fig. 3.

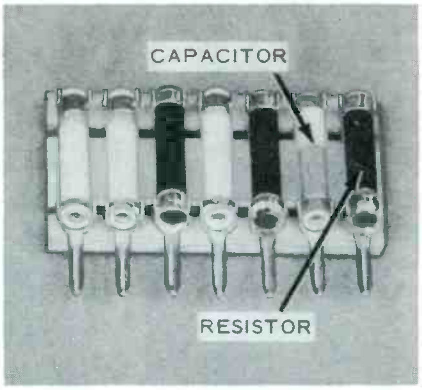


Fig. 3. Base Plate With Components Permanently Mounted.

Connections between the components are made on the back of the base plate. The manufacturer intends to use printed copper wiring for these connections although the unit shown in Fig. 4 has conventional wiring.

After the circuit is formed and the components are permanently placed in the clips, the entire as-

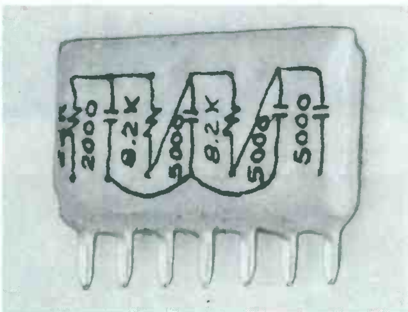


Fig. 5. A PAC Unit in Its Final Form.

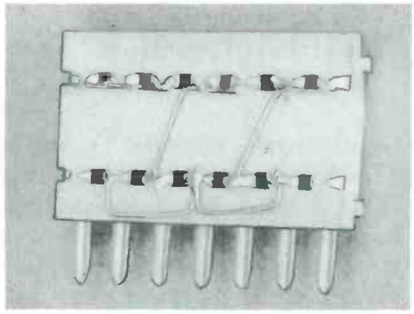


Fig. 4. Back Side of Base Plate Showing Connections Between Components.

sembly is dipped into a plastic compound which forms a protective coating. This coating of plastic provides an electrical insulation and a moisture seal. A PAC unit in its final form is shown in Fig. 5.

Notice in this figure that the circuit diagram is printed on the back side of the completed assembly. The unit which is shown contains an integration network which is composed of a total of seven components.

Applications

The use of Erie PAC units enables a relatively large number of components to be mounted in a limited space. Up to 92 components can be included in a single PAC unit.

The photographs in Fig. 6 illustrate the simplification that is afforded through the use of pin assemblies. Fig. 6A is a circuit that

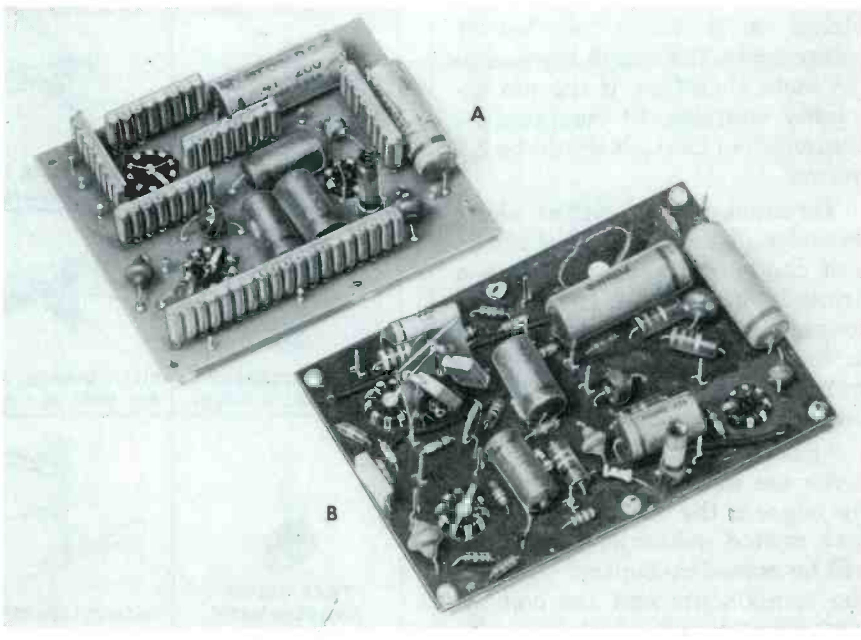


Fig. 6. Conversion of a Circuit With PAC Units. (Photographs Courtesy of Erie Resistor Corporation. (A) After Conversion. (B) Before Conversion.

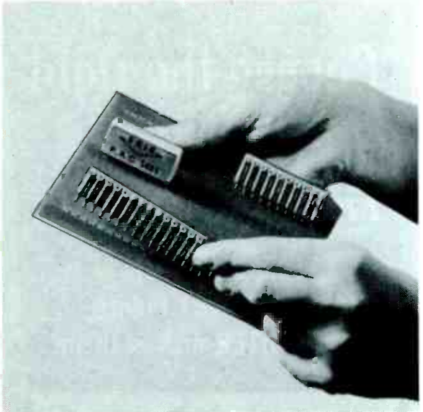


Fig. 7. A PAC Unit Being Inserted Into a Printed-Wiring Board. (Photograph Courtesy of Erie Resistor Corporation.)

has been converted with Erie PAC units, and Fig. 6B is the same circuit before the conversion. Both boards are electrically the same. Before being converted, the circuit contained 69 individual components. After being converted with Erie PAC units, the number of individual components was reduced to 16. Six pin assemblies were used to replace 59 conventional components. Since the six assemblies did not require as much mounting area as did the 59 conventional components, the over-all size of the printed-wiring board was reduced. Besides the fact that there is a reduction in the size of the board, the layout of the components is neater and more compact. The photograph in Fig. 7 shows a pin assembly being inserted into a printed-wiring board.

C. P. OLIPHANT

Installing Home Intercoms

(Continued from page 20)

ing the complete tube complement should be prepared and filed. Then if the customer has trouble, this list can be consulted and the proper tubes carried on the service call. A sheet containing the customer's name and address, the date of installation, and any other pertinent data should be included in the file for each installation.

Installation and Mounting

The location of each master and each station unit will be determined chiefly by the customer's needs and wants, but there are certain suggestions that can be made to help the customer decide on the proper locations. One very good suggestion is that the intercom units could be located near the telephone outlets whenever possible. This makes it easy to call some one to the phone. Another good suggestion is to locate the units in such a manner that they will be readily accessible for use without creating decorating problems. As mentioned earlier, this information will have to be obtained before the electrical contractor does his roughed-in wiring.

When the drops and outlet boxes are installed, long runs of intercom cables should be kept apart from AC wiring. See Fig. 3. This is done in order that undesirable hum pickup in the intercom system will be avoided. For the sake of appearance, the intercom outlets should be installed at the same level with the AC outlets.

The flexible tubing for the intercom cables should be 3/4 or 1

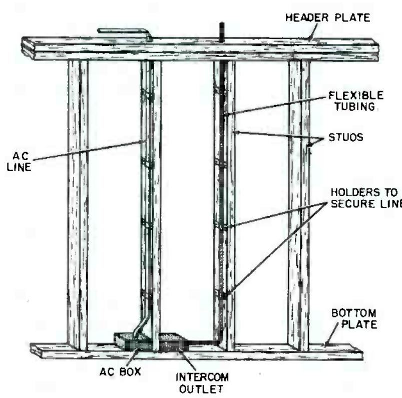


Fig. 3. Separation of AC and Intercom Cables for Reduced Hum Pickup.

inch in diameter. This is large enough so that the required cable can be pulled through the tubing without danger of damaging the cable. The outlet boxes should be large enough to accommodate the required sockets. Sockets and plugs of the Cinch-Jones 300 series are recommended because they are available with as many as 33 contacts and because they are polarized.

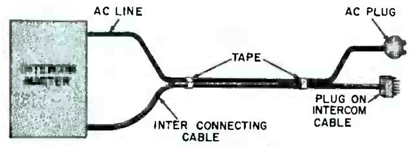


Fig. 4. Cords from Typical Intercom Master Unit.

In the drawing of Fig. 3, notice that the AC and the intercom outlet boxes are located very near each other. This is a very important consideration for any location where a master or other unit that requires AC power is to be installed. Wherever it is possible, this type of setup is desirable because a minimum number of wires will be necessary. Fig. 4 shows the AC power cord and the interconnecting cable for just such a location. Since the interconnecting cable is shielded and the two are run together for only a short distance, hum pickup is not a problem.

Most of the units, both remote and master, will be of the desk type. There are two exceptions—those outside the front and rear doors. These will be remote units and will be flush mounted. In fact, only a grille and a buzzer button will be visible. Actually, these units can be made up very easily. It is only necessary to get a suitable grille and a 3½- or 4-inch speaker to match the balance of the system electrically. If 3.2-ohm speakers are used in the system, then 3.2-ohm units should be used for the front and rear doors. If the remote units for the front and rear doors are to be at locations exposed to the weather, then weatherproof speakers should be used.

The wire size is also important. This is especially true when there are long runs involved. For runs of less than 100 feet, use No. 20

wire; for runs between 100 and 200 feet, use No. 18 wire; and for runs of more than 200 feet, use No. 16 wire or larger. By using wire that is large enough, the loss of volume between stations will be kept at a minimum.

In new homes, the intercom wiring should be run in the attic if possible. This gives the best installation because the wire is out of the way and will not be covered up during some future building changes as easily as if the wiring were in the basement. When running wires in the attic, always use two men. In hot weather, provide some form of ventilation, if possible; and take regular break periods at least once each hour to prevent possible heat prostration.

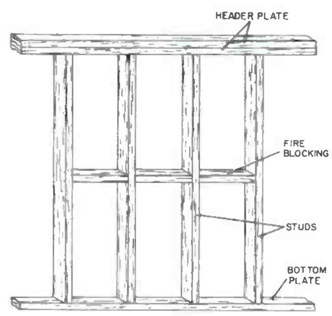


Fig. 5. Fire Blocking in Walls.

In older homes or in those that have been completed before the installation of an intercom system is considered, it will usually be necessary to run the wiring in the basement because of the fire blocking which is always put in the walls. Fig. 5 shows the position of the fire blocking between the studs. If the wiring is run in the basement, it is probably a good idea to drill holes in each floor joist and to thread the cable along the desired path if that path runs crosswise of the joists. Fig. 6 shows several joists drilled and the cable threaded. Notice how the cable is passed through the holes which are located so that nails used in any future construction work will not pass through the intercom cable.

If it is necessary to run wires within the rooms around the baseboard or up the wall, then a neutral color such as gray should be used unless the room color can be matched by the wire. The customer should be told that he can paint the wire the next time he redecorates the room.

Intercom wiring may be run as open wiring and still meet building and electrical codes, but it would be a good idea to verify this with the building commissioner in your particular area.

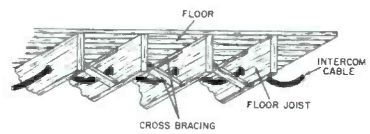


Fig. 6. Cable Threaded Through Holes in Joists.

Much of the installation work for the intercom system will be done in the house after the floor and walls are finished. For this reason, you should be very careful not to mar or otherwise damage them. Scrap wire should be carefully deposited in trash containers, and a drop cloth should be used at all work areas. This is especially true if soldering is to be done.

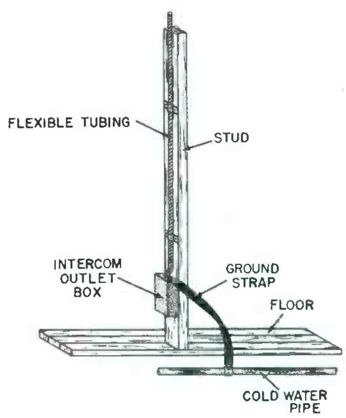


Fig. 7. Outlet Box Bonded to Cold Water Pipe.

It is very important that the units in utility rooms and bathrooms should be of the AC transformer type and that they should have a bond to earth ground. In fact, the outlet box itself should have a bonding strap to the cold water pipe. This bonding strap can be installed by the electrical contractor when he is doing the preliminary installation work. An outlet box that is bonded to the cold water pipe is shown in Fig. 7. The outside braids on the intercom cables should all be connected together. This gives the entire system a common ground.

As previously mentioned, most intercom units are of the desk type; but some manufacturers have suitable built-in units for use in locations such as the bathroom, kitchen, and recreation room. When the circumstances warrant modification of a desk unit for a built-in installation, such modification should be made in a workmanlike manner to give a professional appearance. The customer is charged for all modifications and therefore should authorize them.

Pitfalls

If you wish to enter the intercom business, there are several things which must be considered if you intend to make money. By far the largest pitfall is pricing a job too low. The best way to avoid this is to know accurately how long it will take to do each part of the installation work and to base the estimate accordingly.

The next real pitfall is that the customer may change his mind concerning the locations of some of the units. The customer should be informed when he contracts for the work that extra work or delay caused by changes not in the original proposition will be charged to him at the specified rate for services or that any changes will make necessary a refiguring of the entire job in order to take care of the changes. Since you cannot always keep the customer from changing his mind, the best thing to do is charge him separately for any additional labor or material which a change might require.

The last major pitfall is that there may be unexpected obstacles such as those which might be encountered when a system is being installed in an older home or in one that has already been completed. To help offset such unexpected trouble, figure the cost of the job and then add to it about 15 per cent. Give this figure as an estimate. If no trouble is encountered, the customer can be given the benefit of the savings.

It might be a good policy to avoid a hard-and-fast contract for an installation in an older home or in one that has been completed; but if the customer insists on a definite price such as a bid would be, then be sure that the price you give him will be high enough to give you a fair margin of profit even if some unexpected difficulty should arise.

How to Price a Job

The price to charge is a very important phase of any job, and there are many different approaches which can be used to arrive at a price which is fair to both customer and installer. It would be impossible to outline every system of pricing which might be satisfactory, but we are presenting a sample of a system used by a successful company in Indianapolis. This is intended to serve only as a reference to give you some idea of one system.

Equipment, including wiring and any other material, is sold at a price that is equal to its cost plus 10 or 15 per cent for profit. This is a recognized practice when dealing with building contractors. A labor charge of $22.50 is made for installation of each master and $17.50 for installation of each remote unit. A charge of $5.00 per hour is made for time spent for running the wiring and connecting up the system. It can be seen from these charges that an installation company has to have a fairly accurate estimate of the amount of time required to do each part of the job.

To get the estimated cost of installation, the company adds the selling price of the equipment, the installation charges for the remote and master stations, and the total hourly labor charges. Then a contractor's fee of 10 to 15 per cent is added. The total will be a figure which can be used as a bid for the job.

Guarantee

The guarantee of an intercom system is a matter of company policy. Since the manufacturer guarantees the equipment, no other guarantee need be given except as a sales point. As an added sales point, the actual wiring could be guaranteed over a long period. This would be a safe practice because the wiring should not fail under ordinary circumstances. Whatever the type or term of guarantee given on the system, it should be made clear to the customer. This will avoid any possible misunderstanding later.

Service

Servicing an intercom system is not too much of a problem if the proper data is on hand and if there are enough men assigned to this function. Two men should always be used for an intercom service call because it is often necessary to trace circuits between units located in different rooms and because it takes two to operate any system. The customer should not be required to help you to repair his system. The literature which will prove most helpful is a layout and wiring diagram of the system, a schematic diagram of the master and remote units, and a tube list. This material should be taken on each intercom service call.

We wish to extend our thanks to Mr. Jan Eden who furnished us with much helpful information during the preparation of this article. Mr. Eden is associated with the Radio Distributing Company of Indianapolis, Indiana.

CALVIN C. YOUNG

Examining Design Features

(Continued from page 25)

iable, air-dielectric capacitor; and the capacitors are ganged. The plates of the capacitors can be seen through holes in the bottom of the UHF unit shown in Fig. 1B.

Injection voltage is coupled from the oscillator to the mixer by means of a loop of wire which extends into the oscillator compartment. A UHF test point which is located on the front face of the UHF unit can be reached through a hole in the side of the tuner cover. The output lead of the UHF unit is brought out to a special contact which can be seen in Fig. 1B. This contact is not oriented in a straight line with the other contacts on the body of the tuner; instead, it is arranged so that it will brush against the butt ends of the channel strips.

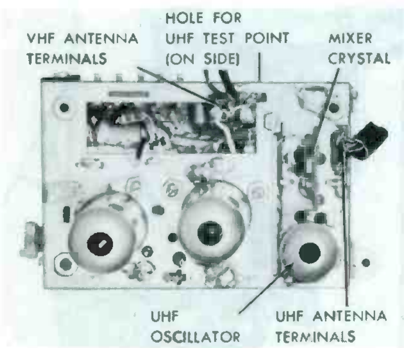
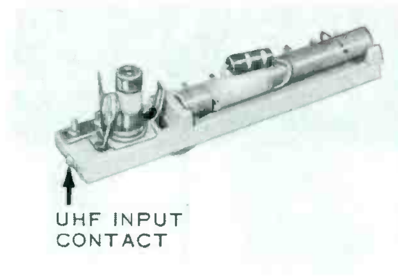


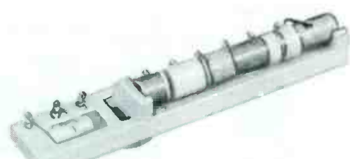
Fig. 3. Top of UHF Unit of Standard Coil TE Tuner.

Besides the strips for the 12 VHF channels, the all-channel tuner contains a special UHF strip which is shown in Fig. 4A. The strip for VHF channel 3 is shown in Fig. 4B for the sake of comparison. A contact button on the end of the UHF strip completes the connection between the UHF unit and the rest of the tuner.

The output signal of the UHF mixer lies within the 41-mc IF range, and this signal therefore does not have to undergo any further frequency conversion within the tuner; consequently, the VHF local oscillator can be disabled and the rest of the VHF tuner can be utilized as an IF preamplifier during UHF reception. When the UHF strip is in use, the circuit connections of the VHF portion of the tuner are altered in



(A) For UHF.



(B) For VHF.

Fig. 4. Channel Strips for TE Tuner.

the following manner. Plate voltage is removed from the oscillator, the VHF antenna is shorted to ground, and the relatively large coils which are required for 41-mc operation are switched into the RF and mixer circuits. Schematic diagrams of UHF and VHF strips appear in Fig. 5.

The shaft of a TE tuner is shown in Fig. 6. There are actually three concentric control shafts. The outer one is used for fine tuning of all VHF and UHF channels. The middle shaft is connected to the turret and is used as a VHF channel selector. Continuous tuning of UHF channels is accomplished when the inner shaft is turned.

The UHF tuning capacitors are conventional air-dielectric units except for the fact that the movable plates travel in a straight line instead of rotating. The movable plates are attached to a plastic idler which extends from a slot on the front of the UHF unit. See Fig. 1B. A cam at the end of the tuning shaft presses upon this idler, and the capacitor plates are moved to a different setting when the position of the cam is changed. The idler is held firmly against the cam by spring tension.

The fine-tuning arrangement in the TE tuner is relatively complicated. Although the T-Series VHF tuners and older Standard Coil models employ a simple fine-tuning capacitor that is mounted outside the tuner cover, the TE tuner has an internally mounted capacitor. Its setting is controlled by a secondary fine-tuning shaft which is visible in Fig. 1B. One side of the shaft is flattened, and the other side is rounded. When the flat side is not facing the capacitor, the two plates are held tightly shut; but when the flat side of the shaft is turned toward the capacitor, the pressure on the capacitor is released and the plates spread apart.

The secondary shaft is driven by the shaft of the fine-tuning control through a link that is outside the body of the tuner. The connection is made in such a way that the secondary shaft will rotate through an arc of less than 90 degrees while the fine-tuning control is being turned through its range of almost 360 degrees.

The secondary shaft is linked to the UHF tuning cam through a lever arm and a friction clutch. When the fine-tuning control is rotated, the cam is driven very slowly through a limited range.

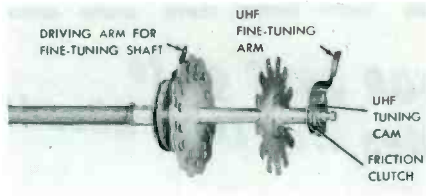


Fig. 6, Shaft of Standard Coil TE Tuner.

When replacing the turret of a TE tuner after the turret has been removed, the technician should take special care to install the fine-tuning linkage correctly. It is recommended that the UHF lever arm should be engaged while the turret is being pressed into place. The plastic pin at the rear end of the secondary shaft should be located so that the forked end of the lever arm can be guided onto the pin. When the turret is pushed down, the arm will shift its position but will stay in contact with the pin. The secondary shaft should still be free to rotate. After this arm has been put into proper working order, the front or VHF link may be connected.

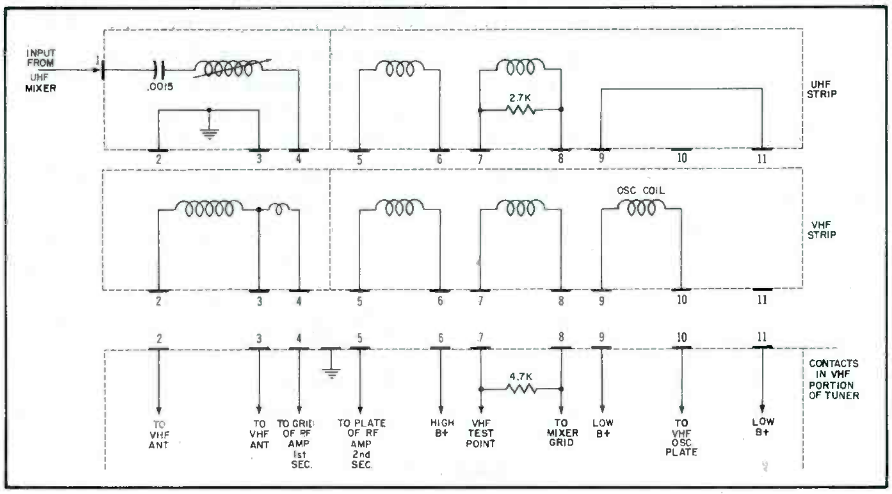
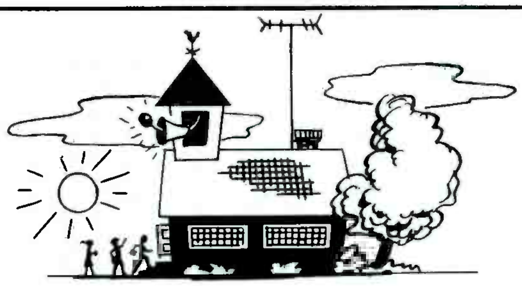


Fig. 5. Schematic Diagrams of UHF and VHF Strips for TE Tuner.

THOMAS A. LESH



Education. Over 60 schools and colleges now use closed-circuit TV to stretch out the supply of good teachers. Some installations serve up to 50 classrooms simultaneously. Costs for an installation start at around $2,000, well within reach of many schools; whereas, the costs for an educational TV station vary from $50,000 to $200,000 plus upkeep, operating, and programming costs. The closed-circuit setups also relieve crowding in schools by permitting temporary or permanent use of rooms away from the campus, just as long as wires can be run to them.

So far, there has been no noticeable difference in the progress made by students taking live courses and those assigned to TV classrooms.

Of the 258 channels reserved for educational TV, only 16 are now occupied. Commercial telecasters are eying the 67 unoccupied VHF channels hungrily; but so far, the FCC has given no indication of releasing any of them.

Among educators, the consensus of opinion appears to be that educational TV stations can be lumped with swimming pools as budget items that are desirable but not essential.

MARKUS . . *Dollar and Sense Servicing*

Shop Talk

(Continued from page 15)

Still remaining under the maximum ratings is emitter current, and the value given is 10 milliamperes. The highest recommended ambient operating temperature is 85 degrees centigrade which, is considerably above the average temperature of 27 degrees centigrade.

The next set of characteristics given include the average values at a temperature of 27 degrees centigrade. Note that the temperature occupies a prominent position in all transistor data, and this stems from the marked effect that temperature changes have on transistor operation. It is most important that a transistor be operated well below the maximum temperature specified for it.

The average collector voltage recommended is −6 volts, which is well below the indicated maximum value. The suggested operating emitter current is 1.0 milliampere. The next three items list the internal resistances of the collector, base, and emitter; and this information is actually of more use to the circuit designer than it is to the service technician.

The next item is the base-current amplification factor, and its value is 90. Most readers who have followed this and prior articles on transistors will know what the current amplification factor from emitter to collector is, but the base-current amplification factor is something new. This factor tells us what effect a change in base current will have on the collector current. It is more important than the emitter-to-collector amplification factor (which is called alpha) because of the way most transistors are used. Most transistor amplifiers are connected with the emitter grounded, with the incoming signal applied to the base, and with the output signal obtained at the collector; hence, it is impor-

TABLE II

SPECIFICATION SHEET FOR THE TEXAS INSTRUMENTS TYPE 202 JUNCTION TRANSISTOR

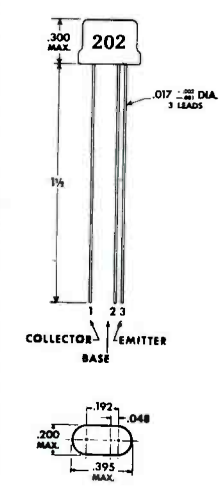
ELECTRICAL DATA

RATINGS, RECOMMENDED MAXIMUM:

Collector Voltage	30 volts
Collector Current	5 ma
Collector Dissipation (at 25° C)	50 mw
Ambient Temperature	50°C

AVERAGE CHARACTERISTICS (at 25°C):

Collector Voltage	5 volts
Emitter Current	−1 ma
Collector Resistance (minimum)	0.4 megohms
Base Resistance	200 ohms
Emitter Resistance	35 ohms
Current Amplification Factor* * (minimum)	49
Collector Cutoff Current (maximum)	10 μa
Collector Capacitance	19 μμfd
Noise † (V_c = 2.5 v, I_e = −0.5 ma)	20 db
Frequency Cutoff † (a_c)	1.30 mc



TYPICAL OPERATING CHARACTERISTICS‡ (AT 25°C)

	GROUNDED EMMITTER	GROUNDED BASE	GROUNDED COLLECTOR
Source Impedance	1250 ohms	60 ohms	15 K ohms
Input Impedance	1250 ohms	45 ohms	32 K ohms
Load Impedance	20 K ohms	0.1 megohm	500 ohms
Power Gain	43 db	31 db	17 db
Power Output¶	2.38 mw	.....	.....
Distortion	6%	.....	.....

* Socket Types: Cinch #11953, Mycalex 410-3T500 or equivalent.
** Emitter Grounded.
† Noise and frequency cutoff are average and individual units may vary.
‡ At test frequency of 1000 cps and V_c = 5 volts, I_e = −1 ma
¶ With load impedance of 5000 ohms and high source impedance.

tant to know what effect will be produced on the collector or output current when the base current is changed by the input signal. Actually, these two factors are related; and we will have more to say about them presently.

The cutoff current which is listed under average characteristics refers to the collector current which flows when the emitter current is zero. Its symbol is I_{co}, and it is important because it provides an indication of the lowest amount of heat that will be dissipated at the collector. This knowledge enables the designer to adjust the operating point of the circuit so that the collector dissipation will remain within limits for all normal values of current and voltage. I_{co} is temperature sensitive, and an increase in temperature will cause the value of I_{co} to rise. This rise, in turn, will increase the amount of heat dissipated at the collector and will lead to another rise in temperature. Again I_{co} will rise, with the ascending temperature eventually resulting in transistor burnout. For this reason, any current added to I_{co} under normal operating conditions must not cause the collector dissipation to exceed its safe limit.

The final item listed under average characteristics for the Raytheon Type 2N65 is the noise figure of this transistor. This value is high compared to that of a vacuum tube, but improvements being made in transistor manufacture give promise of lower noise figures to come.

The remaining three general headings under electrical data provide the average operating values for use of the Type 2N65 transistor as a grounded-emitter, grounded-collector, and grounded-base amplifier. Note how the various values change for each circuit. So far as power gain is concerned, the grounded-emitter circuit is best, followed in turn by the grounded-base and the grounded-collector circuits. The value for the latter is much lower than for the first two, and this is characteristic of this type of connection.

(At this point, it might be desirable for the reader to review the three transistor articles that appeared in the September-October 1953 issue and in the February and March 1954 issues of the *PF INDEX*.)

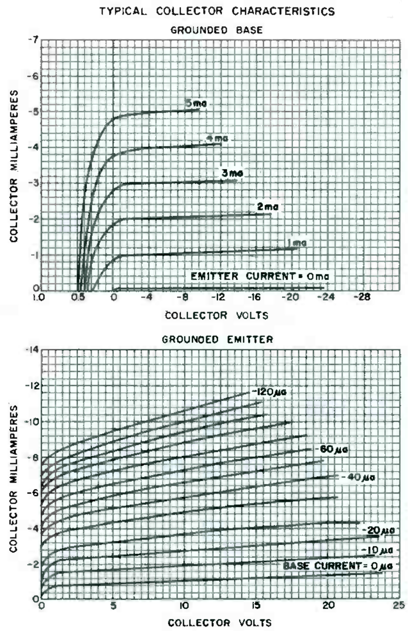


Fig. 1. Characteristic Curves for the Raytheon Type 2N65 Transistor.

The characteristic curves for the Raytheon 2N65 transistor are also part of the data which this manufacturer supplies, and these are shown in Fig. 1. When such information is included, the two most frequent sets of curves given are those for the grounded-base and grounded-emitter connections. Note that the curves differ in form, and this shows in part the difference in power gain for the corresponding amplifiers.

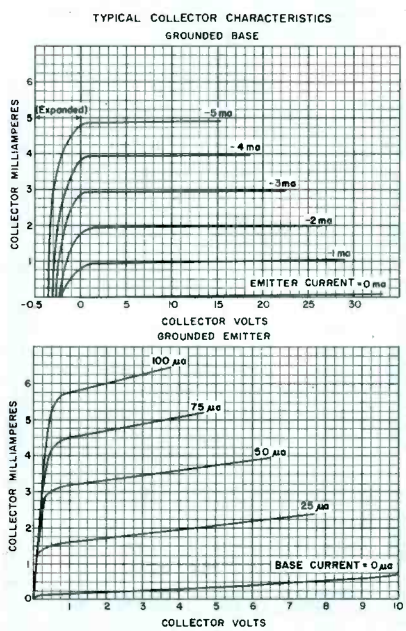


Fig. 2. Characteristic Curves for the Texas Instruments Type 202 Junction Transistor.

The mechanical and electrical specifications for the Texas Instruments Type 202 junction transistor are given in Table II. The information is for the most part similar to that in Table I; however, there are several additional items of information not given for the Raytheon 2N65. For example, under average characteristics, we find that the collector capacitance is 19 micromicrofarads and that the cutoff frequency is 1.30 megacycles. The latter represents the frequency at which the gain is .707 times its value at a certain test frequency, which is usually 1,000 cycles. Another test frequency commonly used is 270 cycles per second.

Typical operating values are specified for each of the three types of connections. Additional information in the form of power output and distortion are specified also for the grounded-emitter application.

Characteristic curves for this transistor are shown in Fig. 2.

Transistor Characteristic Curves

Now that we have some understanding of the information that is given on a transistor specification sheet, it might be desirable to examine characteristic curves of transistors in some detail. One difference in operation between transistors and vacuum tubes is that one is current operated and the other is voltage operated. This difference is reflected very clearly in the characteristic curves of these two devices. The plate-current versus plate-voltage curves for a series of grid voltages on a 6AG5 pentode are given in Fig. 3A. The corresponding set of curves for a transistor are shown in Fig. 3B in which collector current is plotted for various values of emitter current. Note the striking similarity in form of these two sets of curves. In the case of the 6AG5 pentode, the plate current is relatively independent of the plate voltage above approximately 50 volts. The only thing that determines plate current is the grid voltage. For the transistor, collector current is likewise independent of collector voltage above one volt or so and is wholly a function of emitter current.

Note that transistor curves retain their linearity over a range that extends down to very low collector voltages. This means that transistors can be operated over a range that is a higher percentage of the applied voltage before appreciable distortion will be encountered. This is one of the reasons transistors are more efficient than tubes.

An interesting feature of the transistor characteristic curve is the fact that when the collector voltage is reversed (as shown at the left-hand side of the graph in Fig. 3B) the collector current drops sharply to zero and then, if the graph had extended farther, would have rapidly reversed itself and started flowing in the opposite or forward direction. The latter condition is not desired since it would quickly lead to excessive current flow, overheating, and permanent damage to the crystal.

It is customary in the plotting of graphs to place the independent variable along the horizontal axis because it is the most important.

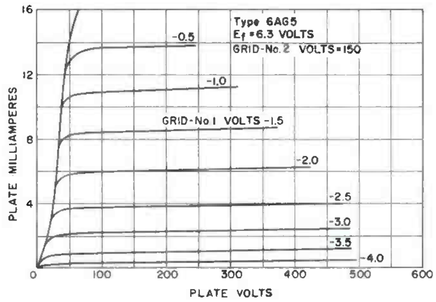


Fig. 3A. Plate-Current Versus Plate-Voltage Curves for a 6AG5 Pentode.

This should be done with the transistor curves. The collector-current axis should be placed horizontally, and the collector-voltage axis should be placed vertically. See Fig. 4. In practice, both types of presentation will be found, with perhaps greater emphasis given to the form shown in Figs. 1 and 2 because of its similarity to the more familiar vacuum-tube curves.

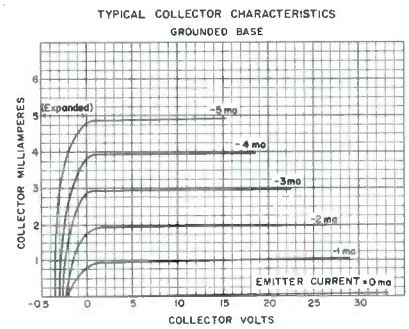


Fig. 3B. Collector-Current Versus Collector-Voltage Curves for a Junction Transistor.

Most manufacturers, when they give transistor characteristics, include the output characteristic curves for the grounded-base and grounded-emitter connections. Two such sets of curves were given with the specifications previously discussed. Comparison of these curves reveals that the collector voltage has a greater effect on collector current in the grounded-emitter connection than in the grounded-base arrangement. This indicates that the collector resistance is lower in the grounded-emitter circuit. In spite of this decrease, a grounded-emitter amplifier will provide higher voltage and power gains than the grounded base amplifier. We are now in a position to determine the reason for this behavior and incidentally to become more familiar with the

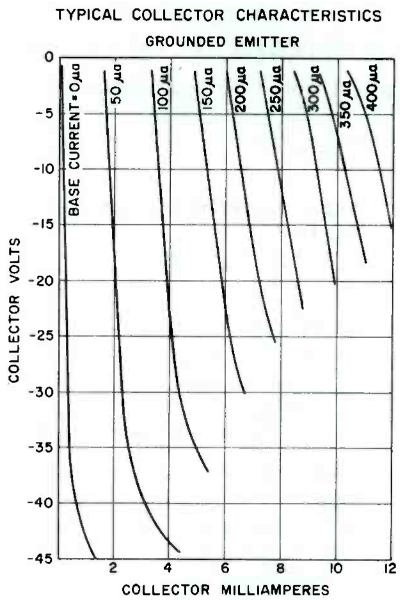


Fig. 4. The Shape of Transistor Characteristic Curves When the Collector Current Is Plotted Along the Horizontal Axis and the Collector Voltage Is Plotted Along the Vertical Axis.

significance of the base-current amplification factor.

When the base is grounded, the incoming signal is applied to the emitter and the output signal is taken from the collector. Voltage gain is given by the relationship: Voltage gain equals current gain times resistance gain.

Current gain is the ratio of the collector current to the emitter current, and this ratio ranges about 0.95. This value represents a current loss since it is less than 1. The fact that we end with an over-all voltage gain stems from the fact that the collector resistance is much greater than the emitter resistance. The reason for this is that the emitter is forward biased and the collector is reverse biased.

When the transistor is connected with the emitter grounded and when the input signal is applied to the base, the current-gain portion of the foregoing equation represents the ratio:

$$\frac{\text{Change in collector current}}{\text{Change in base current}} = \frac{\Delta I_c}{\Delta I_b}.$$

Note that we are no longer interested in the emitter current nor in the effect which a change in this current will have on the collector current. Now our attention is directed to the base current. If you examine the characteristic curves (Figs. 1 or 2) for a transistor with a grounded emitter, you will see that the collector-voltage versus collector-current curves are given for various values of base current rather than for emitter current.

The symbol alpha (α) was used to represent the ratio between a change in collector current and a change in emitter current:

$$\alpha = \frac{\Delta I_c}{\Delta I_e}.$$

In a corresponding manner, the symbol beta (β) is used to represent the ratio between a change in collector current and a change in base current:

$$\beta = \frac{\Delta I_c}{\Delta I_b}.$$

In contrast to alpha values, which are invariably less than 1 for junction transistors, beta values are always greater than 1 and frequently range as high as 50 or more. These high values stem from the fact that the base current is very small, and a small change in the base current produces a considerably larger change in collector current.

A beta value may be obtained in several ways. It may be found in the specifications, or it may be computed directly from the characteristic curves for the grounded-emitter connection. For example, in Fig. 2B, a change in base current from 25 to 50 microamperes produces a change in collector current from 2.1 to 3.75 milliamperes when the collector potential is five volts. Or,

$$\beta = \frac{(3.75 - 2.1) \times 10^{-3}}{(50 - 25) \times 10^{-6}}$$

$$\beta = \frac{1.65 \times 10^{-3}}{25 \times 10^{-6}}$$

$$\beta = 66.$$

In the data sheet, the manufacturer of this transistor states that the beta factor has a minimum value of 49, which means that it can and probably does go higher. Even though the resistance gain of a junction transistor with the emitter grounded is less than the resistance gain with the base grounded, the current gain obtained from the former is so much higher than the gain from the latter that both voltage and power gains for the former are considerably higher.

Since the formulas for alpha and beta concern essentially the same current flows in a transistor, it is natural to expect the two factors to be related to each other. This relationship is expressed by

$$\beta = \frac{\alpha}{1 - \alpha}.$$

It is apparent that the closer alpha is to 1, the larger beta becomes.

For some months, we have been discussing transistors; and to many readers, some of the things we have been saying undoubtedly appeared strange and even confusing at times. To these men and to any others who may have trouble becoming familiar with transistors, the writer would like to say that all this initial confusion is only natural. As time goes on and you begin to deal more and more with transistor-operated devices, terms like alpha, beta, grounded emitter, and the like will become part of your everyday vocabulary and, more important, part of your thinking. You will learn to consider circuits in terms of transistors, and you will become as conversant with them as you are now with vacuum tubes. You are actually learning a new language, except that you have a considerable head start in studying about transistors because you are already familiar with the circuits in which they are being used. Do not forget that grounded-grid, grounded-plate, or grounded cathode amplifiers are the counterparts of grounded-base, grounded-collector, or grounded-emitter stages. If you constantly keep in mind what you do know, that which is new will be assimilated and integrated into your store of knowledge more quickly. Always work from a position of strength (from what you do know) rather than from a position of weakness (from what you do not know). It pays off in other fields, and it will pay off in electronics.

MILTON S. KIVER

PF REPORTER

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PF REPORTER — CATALOG and LITERATURE SERVICE

valuable manufacturers' data available to our readers

1R. AMERICAN MICROPHONE (Electronics Division, Elgin National Watch Co.)
New general catalog covering complete product line of microphones, cartridges, tone arms and accessories. *See advertisement page 70.*

2R. ATLAS SOUND (Atlas Sound Corp.)
FREE Buyer's Guide tells you how to save money on Public Address Loudspeakers, Microphone Stands and Accessories. *See advertisement page 70.*

3R. B & K (B & K Manufacturing Co.)
Informative article titled: "Profitable TV Servicing in the Home," by Henry Gronski, Service Manager of Central Television Service, Chicago. Also Bulletin No. 500 describing newest B&K Dyna-Quik portable, quick-check, Dynamic Mutual Conductance Tube Tester; and Bulletin No. 104 on CRT Portable Cathode Rejuvenator Tester. *See advertisement* page 42.

4R. BUSSMANN (Bussmann Mfg. Co.)
Bulletin showing fuses and fuse-holders adapted to protection of TV and other electronic equipment (Form SFB). *See advertisement page 4.*

5R. STANCOR (Chicago Standard Transformer Corp.)
TV Library, consisting of Stancor's latest TV Transformer Replacement Guide and supplemental bulletins. *See advertisement Colorblock.*

6R. CLAROSTAT (Clarostat Mfg. Co., Inc.)
Pick-A-Shaft Wire Wound Controls Form No. 75177101B, 2, 3, and 4 watt Wire Wound Controls with field attached shafts. *See advertisement Colorblock.*

7R. CORNELL-DUBILIER (Cornell-Dubilier Electric Corp.)
CDR Rotors—Antenna Rotor Catalog CF904D. *See advertisement page 59.*

8R. EICO (Electronic Instrument Co., Inc.)
Free 1956 Catalog of all EICO Instruments for service technicians. *See advertisement pages 62 and 66.*

9R. IRC (International Resistance Co.)
Dealer Catalog CD-1, Form S-035. *See advertisement 2nd Cover.*

10R. JENSEN (Jensen Industries, Inc.)
Wall Chart—New 1956—completely illustrated; contains all up-to-date replacement needle information, including point size, point material, cartridge numbers, list price. *See advertisement page 74.*

11R. LITTLEFUSE (Littelfuse, Inc.)
Illustrated Price Sheet showing picture of products description and list price. Brochure on new LC (limited current) fuses showing the cross-reference on fuse-in-set. *See advertisement 3rd Cover.*

12R. MACMILLAN (The Macmillan Company)
Free Booklet "Books That Tell You How." Listing 35 informative and helpful technical, engineering, and business books. *See advertisement page 72.*

13R. MALLORY (P. R. Mallory & Co., Inc.)
New Vibrator replacement data for 1956 automobiles. *See advertisement pages 40 and 41.*

14R. PLANET (Planet Sales Corp.)
Complete catalog available on a wide range of sizes and varieties of capacitors including paper and electrolytics. *See advertisement page 71.*

15R. QUAM (Quam-Nichols Co.)
Catalog No. 78, new Quam Focalizer unit. Part No. QF-4, replaces part Nos. QF-1, QF-2, QF-3. *See advertisement page 55.*

16R. RADIART (The Radiart Corp.)
F-904 Rotor Catalog illustrating all models rotors manufactured by us. *See advertisement page 1.*

17R. RCA (Radio Corporation of America)
RCA Form 4F909 "Silverama" Aluminized Picture Tube Replacement Wall Chart. Lists RCA Aluminized type replacements for old picture tubes now in use. *See advertisements pages 6, 22, 51, and 3rd Cover.*

18R. RADIO RECEPTOR (Radio Receptor Co., Inc.)
Revised Rectifier Replacement Guide for Radio and TV, Bulletin No. 213. *See advertisement page 48.*

19R. RADIX (The Radix Wire Co.)
Complete information on Radix exclusive new STRIP-EASE 300 ohm low-loss Lead-In that is easier to rip back, faster to install than ordinary TV lead-in. Also catalog sheets on Radix 300 ohm Flat Twin Lead and Four Conductor Rotator Cable. *See advertisement page 34.*

20R. RAM (Ram Electronics Sales Co.)
FREE 1956 RAM TV Field Service Manual PF-4 features "PIX-A-FAULTS," "TROUBLE-FACTS," Circuit Diagrams, plus complete cross-reference replacement listings for flybacks, yokes, vertical osc. and output xfmrs, linearity and width coils—all authentic recommendations from TV manufacturers' specifications. *See advertisement page 63.*

21R. SPRAGUE (Sprague Products Co.)
C-452 Hanging Wall Catalog describing popular Sprague capacitors and resistors for TV servicing. *See advertisement page 2.*

22R. WEN (Wen Products, Inc.)
Catalog Sheet No. 28C32 ("The Latest WEN Heavy Duty Electronic Soldering Gun") gives outstanding features, specifications, etc. *See advertisement page 33.*

23R. XCELITE (Xcelite, Inc.)
Folder on new No. 62 Transverse Cutter for flush cutoff in miniature chassis; complete catalog on screwdrivers, nut drivers, and pliers. *See advertisement page 68.*

PHOTOFACT COLORBLOCK* Reference Chart No. 12

*Reg. U. S. Pat. Off.

INSTALLING THE 21AXP22 COLOR PICTURE TUBE

The installation procedure for a color picture tube is more involved than that for a monochrome picture tube because of the larger number of external components associated with the color picture tube. For this reason, a procedure for the installation of the 21AXP22 color tube appears on this chart. This is presented step by step, and a photograph of each particular step either in progress or completed is shown.

It should be pointed out that the installation procedure is just the reverse of the removal procedure. When an old tube is removed in preparation for the installation of a new one, either mental or written notes on the positions of the various components should be made. The notes should prove to be very helpful while the new tube is being installed.

The cabinet may be in an upright position during removal of those components which can be taken out without removal of the supports for the picture tube. The cabinet should be placed face down on a soft pad while the tube is being removed or installed. The chassis is taken out of the cabinet before replacement of the picture tube is begun.

STEP 1. Attach the Ultor-Anode Lead to the Flange of the Picture Tube.

The ultor-anode lead is attached to the flange of the picture tube by a clip that is on one end of the lead. The clip must be attached at the correct place on the flange so that the lead will easily reach the connector on the high-voltage cage. In most cases, this lead is connected at a point on the flange in line with pin No. 5 on the tube base. If the spot is marked on the old tube where the clip was placed, the location of the corresponding spot on the new tube can be determined readily.

STEP 2. Place the Wide Insulating Band Around the Picture Tube.

This insulating band covers the rim, the flange, and a portion of the cone of the picture tube. It must be wrapped around the tube as tightly as possible. Start the wrapping under the ultor-anode lead and close to the point where the lead is clipped to the flange. This will ensure that too much of the lead will not be covered by the insulator. Make sure that the insulating band completely covers the rim of the picture tube.

STEP 3. Place the Narrow Insulating Band Between the Flange and the Rim of the Picture tube.

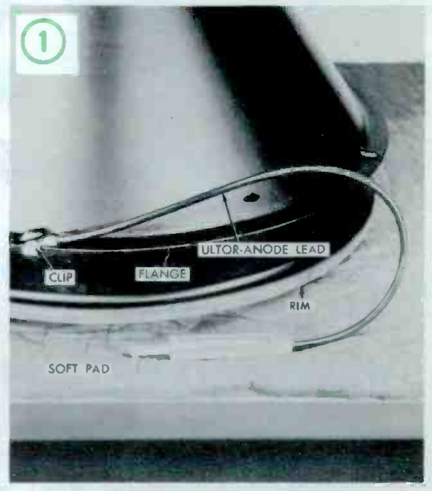
This insulating band is placed between the flange and the rim, and the edge that has ridges should cover the rim. The band should be wrapped around the tube as tightly as possible. The place at which the ends of the band overlap should be at the top of the tube. The top is determined by the location of pin No. 12 on the base of the tube or by a mark that appears on the faceplate.

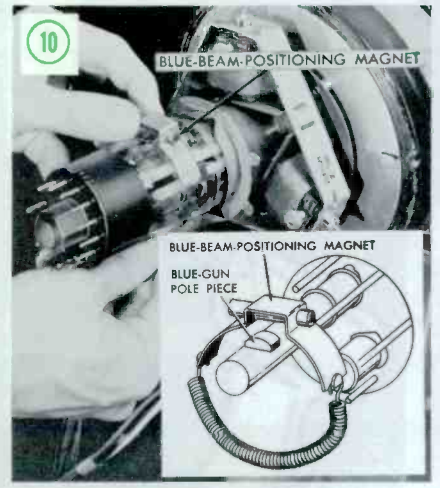
STEP 4. Place the Assembly of Field-Equalizing Magnets Around the Picture Tube.

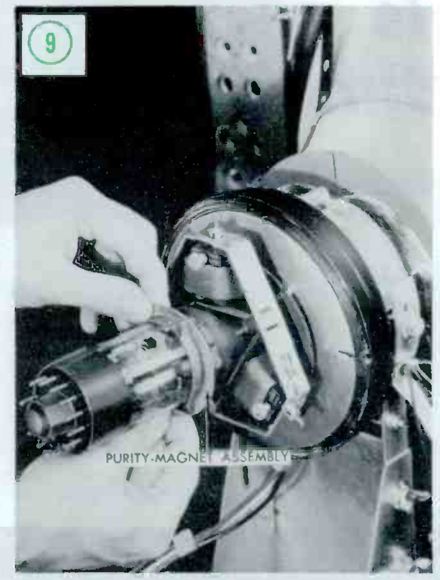
This assembly which is placed between the flange and the rim of the tube consists of eight magnets attached to a metal mounting band. The assembly is placed around the tube so that there will be four magnets along each side of the screen. The assembly is held securely by a nut and bolt. When the assembly is properly installed, the ends of the metal band will be positioned near the bottom of the tube. Before tightening the bolt, make sure that the two magnets which are farthest from the bolt are equidistant from the top center of the tube.

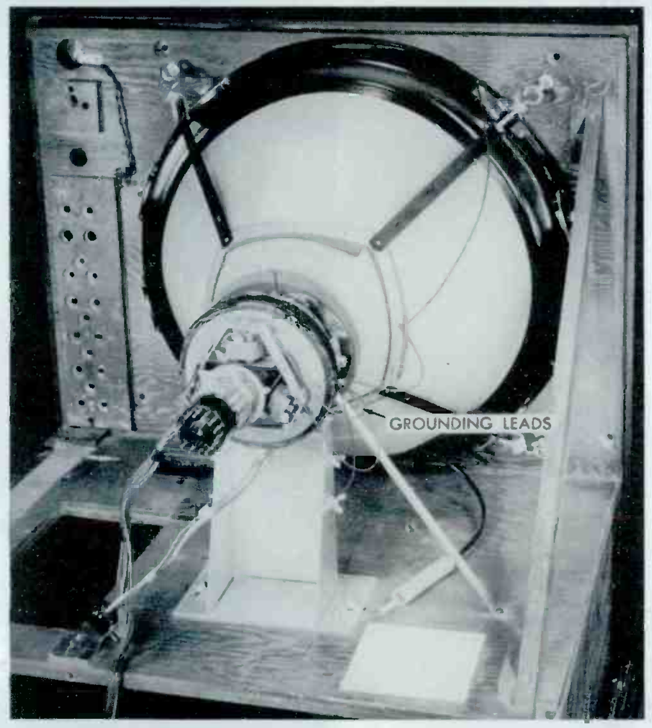
STEP 5. Place the Picture Tube and the Units Assembled Thus Far Into the Cabinet.

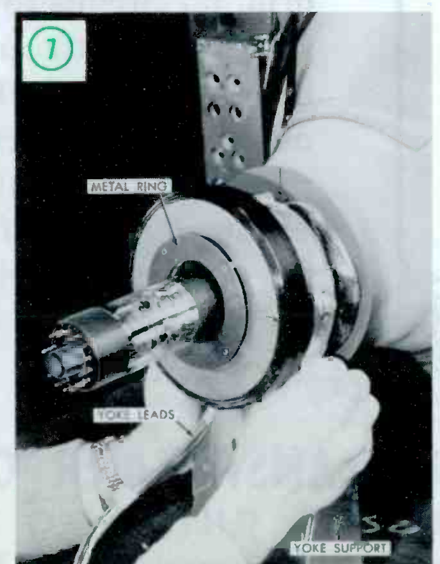
The picture tube is placed in the cabinet by grasping the flange and gently lowering the tube into the cabinet. Place the tube so that pin No. 12 will be positioned on top when the cabinet is in the upright position.











This will place the top of the screen at the top of the cabinet. Make sure that the tube is seated correctly in the opening of the cabinet.

STEP 6. Secure the Picture Tube to the Cabinet.

The cone shield is placed over the cone of the tube; then the mounting harness is put into place. The method of fastening the tube to the cabinet varies in different receivers. Shown in the illustration is one type of mounting harness. The harness should be just tight enough to hold the picture tube in place. The cabinet may be returned to an upright position after the picture tube has been secured. In some receivers, it is necessary to mount the deflection yoke before returning the cabinet to its upright position.

STEP 7. Place the Deflection Yoke Around the Neck of the Picture Tube.

The yoke is placed around the neck of the tube with the metal ring facing the rear. The leads should be located at the bottom of the yoke, and the yoke assembly is then attached to its supports. The neck of the tube should not be resting on any portion of the yoke. The yoke need not be permanently mounted at first because its exact position will be determined during the purity setup procedure.

STEP 8. Place the Convergence Coil and Magnet Assembly on the Neck of the Pictube Tube.

This assembly is slipped on the neck of the tube with the magnet adjustments pointing to the rear. The blue convergence coil must be placed over the blue gun with the pole pieces of the magnet centered directly above the pole pieces located at the front end of the blue gun. The insert in the photograph shows the exact placement of the pole pieces. Most convergence coils are color coded for correct identifiation of the blue convergence coil. If they are not color coded, the location of the blue convergence coil is determined by the direction in which the leads should aproach the chassis. The assembly is firmly mounted by tightening the screws at the top of each coil.

STEP 9. Place the Purity-Magnet Assembly on the Neck of the Picture Tube.

This assembly is positioned near the convergence coil and magnet assembly. The exact placement of the purity magnet will be determined during the purity setup procedure.

STEP 10. Place the Blue-Beam-Positioning Magnet on the Neck of the Picture Tube.

This unit is placed so that the magnet is located directly over the pole piece of the blue gun. The insert in the photograph shows the location of this pole piece.

COMPLETED INSTALLATION

After the blue-beam-positioning magnet has been placed on the neck of the tube, the installation of the picture tube is complete. The completed installation is shown in the center photograph. Make sure that any grounding leads that are used have been attached

The chassis can be placed back in the cabinet and bolted into position. Connect the yoke, convergence, and the speaker plugs; the ultor-anode lead; and the picture-tube socket.

PHOTOFACT COLORBLOCK*
*REG. U. S. PAT. OFF.
Reference Chart No. 12
A PHOTOFACT COLORBLOCK Which Outlines a Step-by-Step Procedure for the Installation of the 21AXP22 Color Picture Tube.
By C. P. Oliphant
PF REPORTER for the Electronics Service Industry
April 1956

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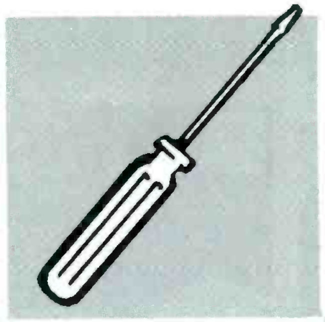

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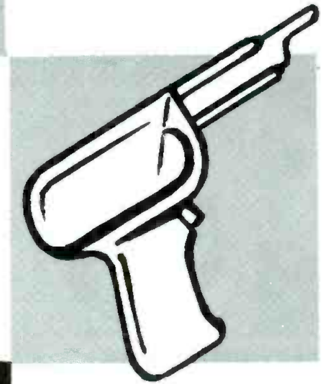

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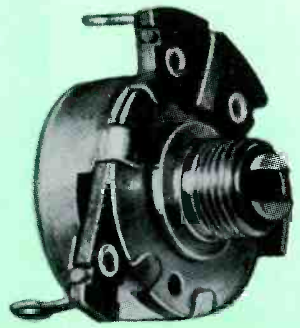

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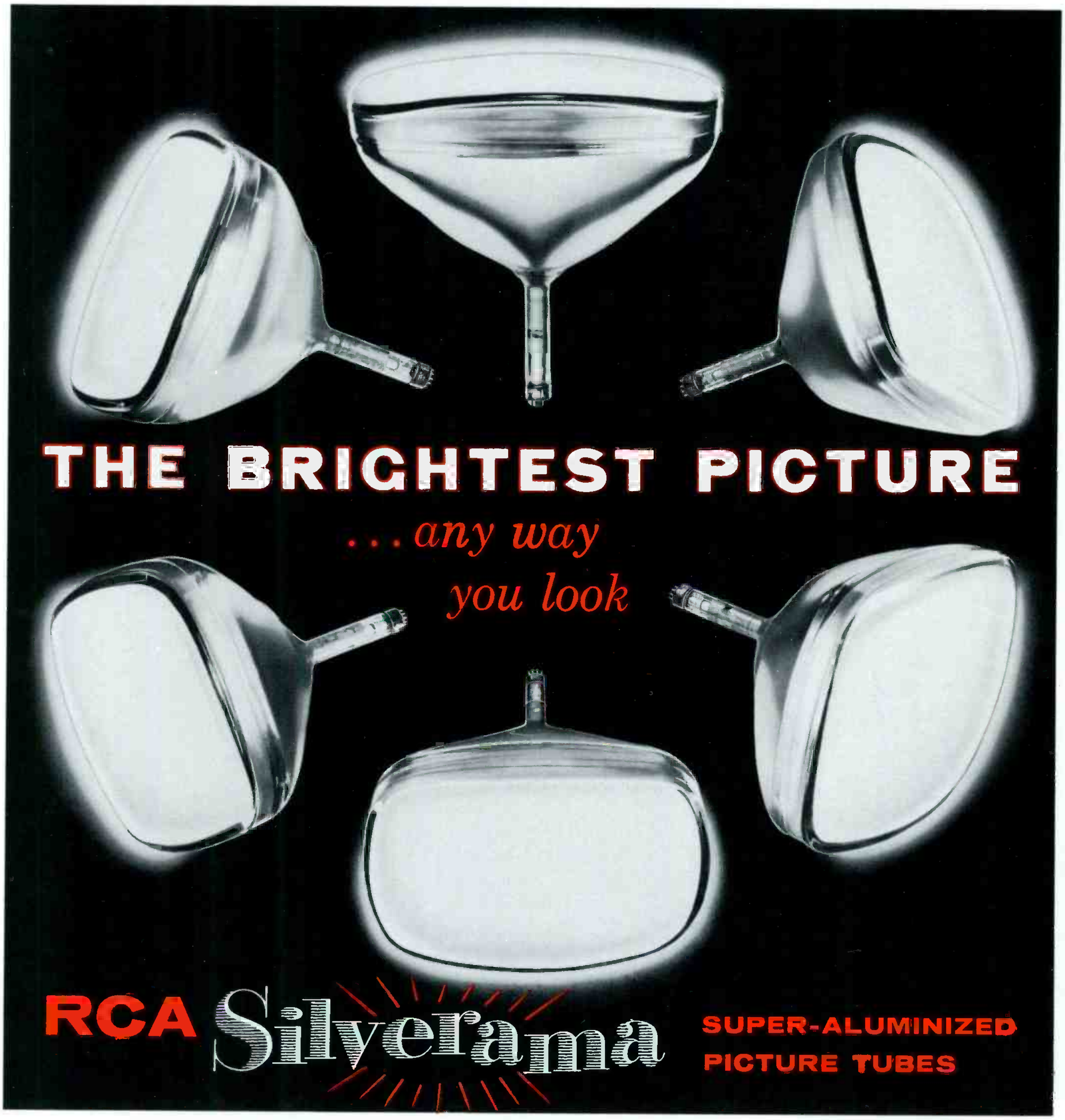

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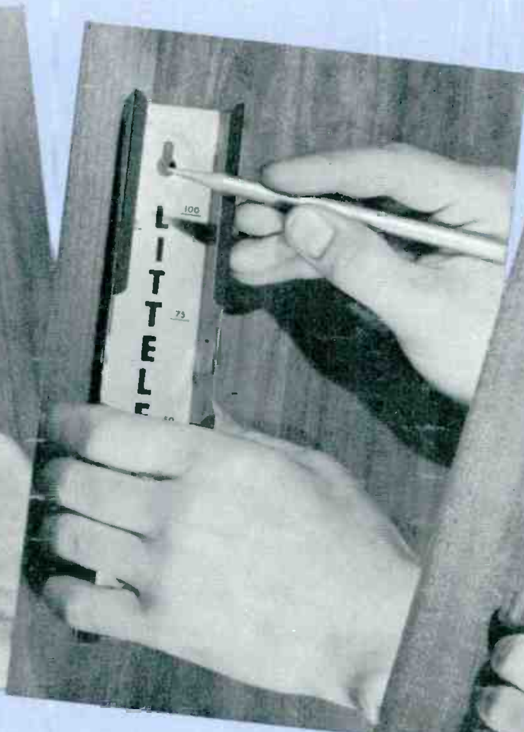

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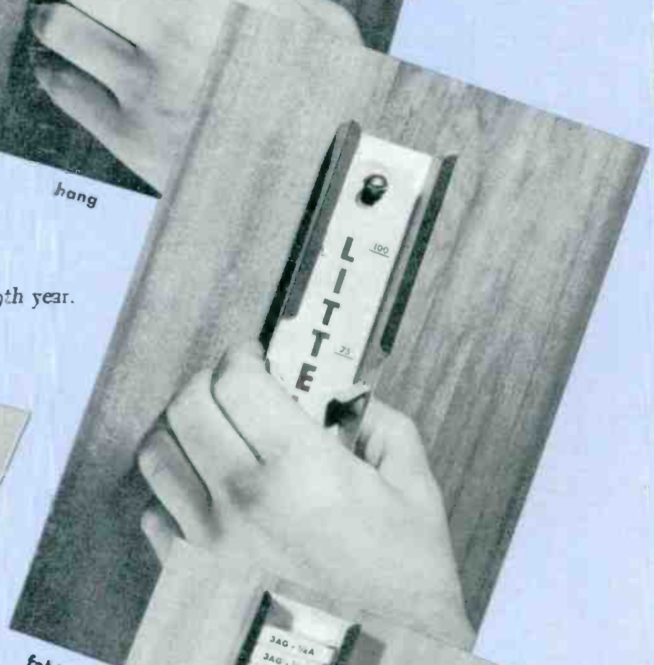
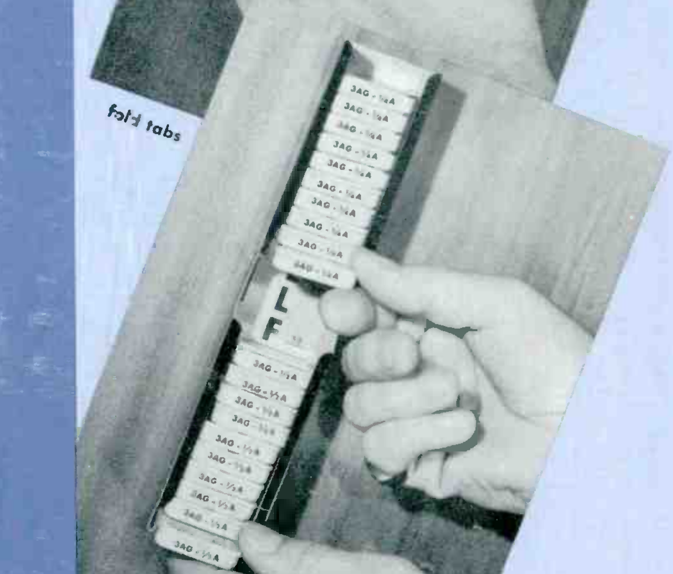


fold tabs



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