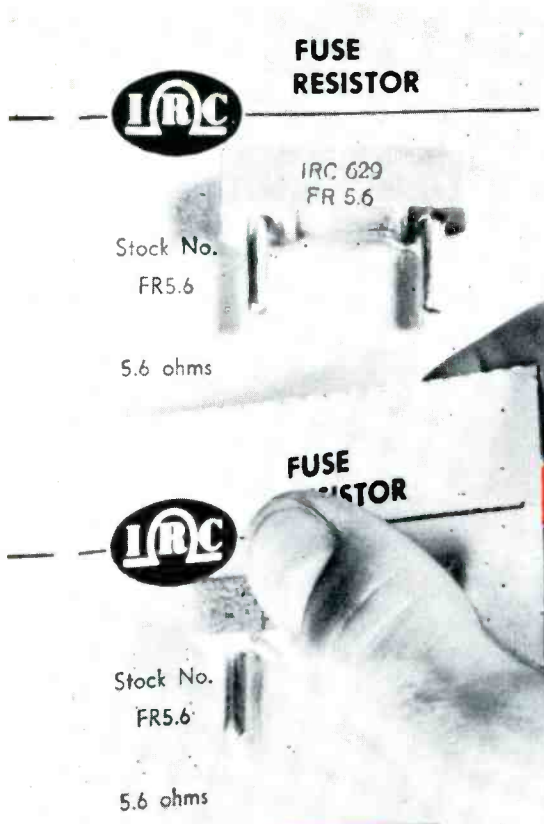
JANUARY · 1957
25 CENTS

PF PHOTOFACT REPORTER

FOR THE ELECTRONIC SERVICE INDUSTRY

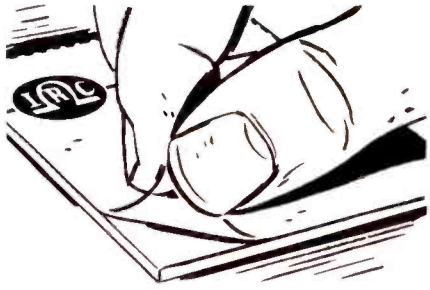
This Month's Highlights

even before the paint is dry
advertising has caught the eye

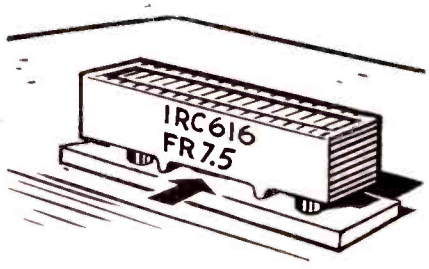


IRC® "Skin-Packed" Fuse Resistors

CONVENIENT TO BUY—Your IRC Distributor has IRC fuse resistors now on perforated display cards. You can buy one, a dozen or more—each on an individual "skin-packed" card section.



EASY TO STOCK—Heavy card helps prevent breakage or damage . . . "skin-packing" keeps every fuse resistor factory-fresh. Just peel off plastic skin, and you're all set.



HANDY TO USE—Sturdy terminal pins. Simply plug fuse resistor into receptacle. Projections on bottom of case leave air space so receptacle won't overheat.

- **Improved plug-in type for fast, easy replacement in the newer TV receivers. Terminal pin holes facilitate attaching leads where necessary.**
- **Featuring sturdy terminal pins—both attached inside a rugged ceramic case.**
- **"Skin-packed" cards protect each fuse resistor from dirt and handling.**
- **Available in 2 types—FR5.6 at 5.6 ohms and FR7.5 at 7.5 ohms to meet popular TV requirements.**
- **Type and range clearly identified on both fuse resistor and "skin-packed" card.**

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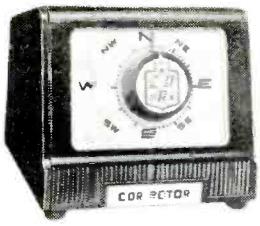
Wherever the Circuit Says— IRC®

INTERNATIONAL RESISTANCE CO.

Dept. 361, 401 N. Broad St., Phila. 8, Pa.

In Canada: International Resistance Co. Ltd., Toronto, Licensee



AR-22

TR-2

TR-4

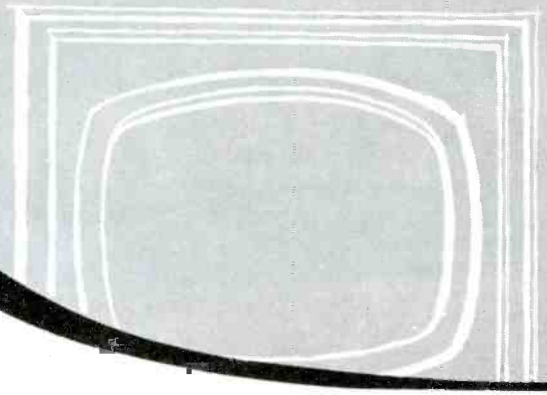
5-star feature...

1 the best color TV picture

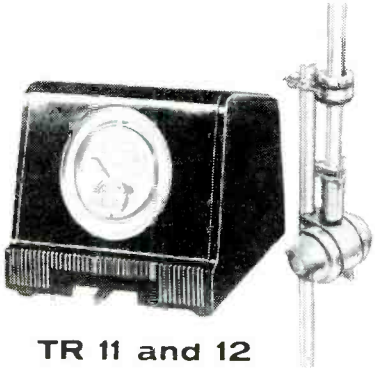
the growth of color TV means an even greater demand for CDR Rotors for pin-point accuracy of antenna direction.

2 a better picture on more stations

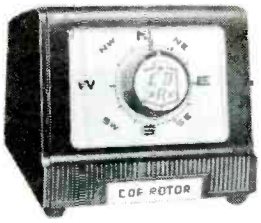
CDR Rotors add to the pleasure of TV viewing because they line up the antenna perfectly with the transmitted TV signal giving a BETTER picture . . . and making it possible to bring in MORE stations.



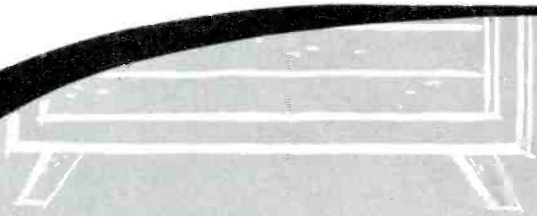
CDR ROTORS



TR 11 and 12



AR 1 and 2



3 tested and proven dependable

thousands and thousands of CDR Rotors have proven their dependability over years of unfailing performance in installations everywhere in the nation. Quality and engineering you know you can count on.

4 pre-sold to your customers

the greatest coverage and concentration of full minute spot announcements on leading TV stations is working for YOU . . . pre-selling your customers.

5 the complete line

a model for every need . . . for every application. CDR Rotors make it possible for you to give your customer exactly what is needed . . . the right CDR Rotor for the right job.

CORNELL-DUBILIER
SOUTH PLAINFIELD, N. J.

THE RADIART CORP.
CLEVELAND 13, OHIO

VOL. 7 · No. 1

PF REPORTER
for the Electronic Service Industry

JANUARY · 1957

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THIS MONTH'S COVER

Even before the paint is dry,
Advertising has caught the eye.

ADVERTISING SALES OFFICES

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PF REPORTER,
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Clifford 1-4531

EASTERN
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San Francisco 5, Calif. EXbrook 2-3365.

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A limited quantity of back issues are available at 35c per copy.

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☐ 1 Year $3.00 ☐ 2 Years $5.00 ☐ 3 Years $7.00

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02 ☐ Dealer with Service Shop 37 ☐ Student
38 ☐ Other_____

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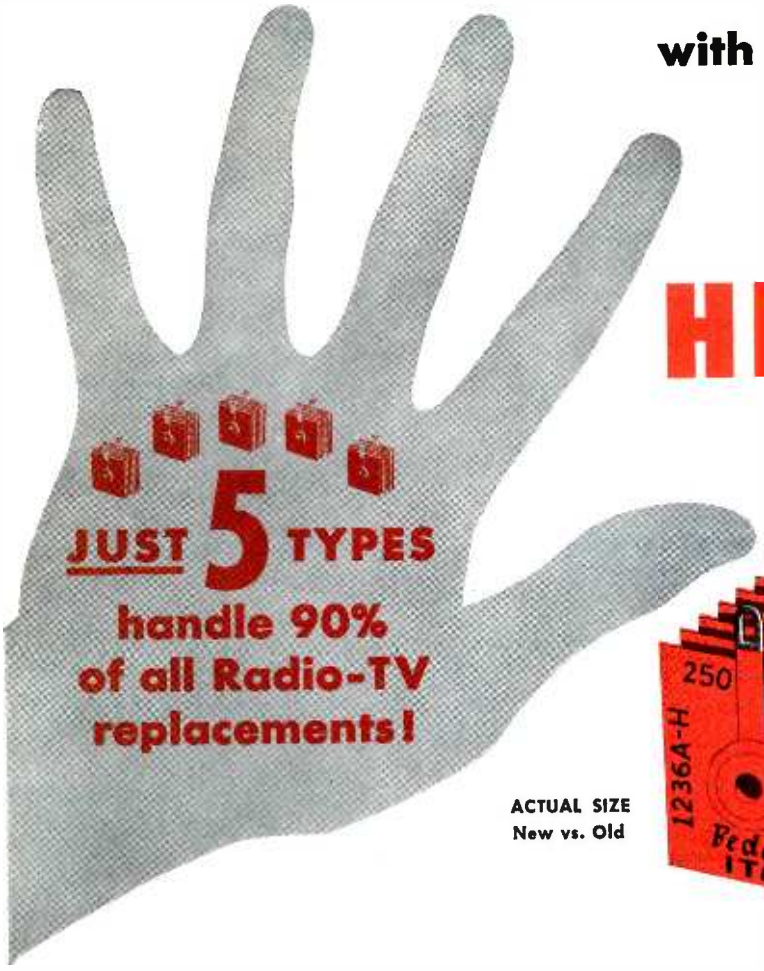
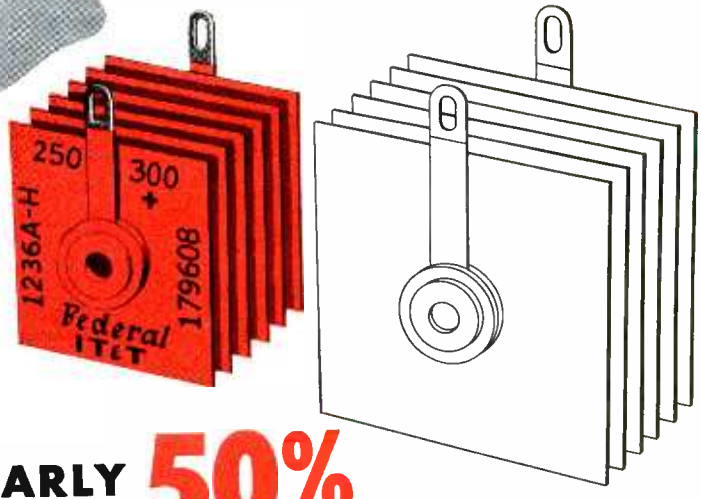
Simplify Rectifier Servicing

with **Federal's** miniaturized

HI-DENSITY

Selenium Rectifiers





ACTUAL SIZE
New vs. Old

UNIT SIZE REDUCED NEARLY 50%

—by unique, time-tested production process!

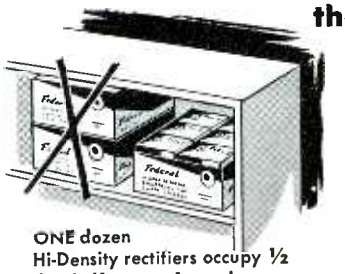
Federal's HI-DENSITY Rectifiers mark one of the most significant advances in miniaturized types since Federal originated them in 1946!

Manufactured by an entirely new, exclusive-with-Federal process, the efficiency, dependability and long life of these lighter, *smaller-plate,* high-temperature rectifiers have been proved-in by the most rugged service testing.

Just 5 types ranging from 65-100 MA to 600 MA handle 9 out of 10 radio-TV replacements.

Call your Federal Distributor today about Federal's specially-processed Hi-Density rectifiers ... simplify rectifier servicing ... get the same top profits with fewer types and less bother...!

Smaller size permits packaging that saves up to 50% in shelf space:



ONE dozen Hi-Density rectifiers occupy ½ the shelf space of one dozen former types!

Now there's no need to carry a big variety of rectifier types to meet today's replacement requirements.

Federal's Hi-Density rectifiers make servicing simpler than ever...save shelf, bench and kit space ... save time on calls ... make calls more profitable ... all with just FIVE types ...!

Order Federal's Hi-Density Rectifiers today through your Federal Distributor!

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In Canada: Standard Telephones and Cables Mfg. Co. (Canada) Ltd., Montreal, P. Q.
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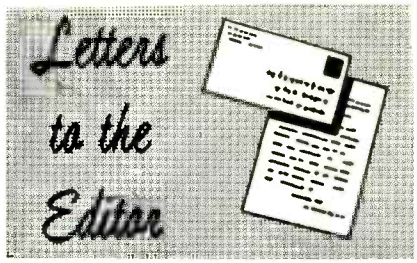


Dear Editor:

In reference to your article "Voltage Measurements" in the October issue, why are different readings sometimes obtained between a point and chassis ground as compared to that between the same point and the common negative line?

JOSEPH COLLAZO
Union City, N.J.

This difference in readings will occur in chassis using a negative supply line or those which isolate the common negative line from chassis ground. In either case, the highest positive reading will be obtained when the negative line is used as a reference. In many receivers, the common negative or B— supply may be as high as 100 volts negative with respect to chassis ground. If B+ is measured with respect to this common negative line, it will be 100 volts higher than when measured from chassis ground.—Editor

Dear Editor:

I received my first issue of PF REPORTER and find it very interesting, with subjects that I would like to know about such as "Analyzing Lissajous Patterns." Can we have more on this subject, please? Will you have more on printed circuits?

Your magazine sure gives out the info and keeps us up with the latest. Thanks for doing this for the serviceman.

EVERETT LA CHANCE
Oakville, Conn.

Printed circuits will continue to receive regular coverage as more and more sets use them.—Editor

Dear Editor:

Here is a slight variation of the good idea expressed by Mr. Morris Gerber on page 9 of the October issue. Instead of using solder to hold the cord of my soldering iron and other cords in my tube caddy, I use rubber bands cut from a bicycle inner tube.

NORMAN R. DARGEL
Gulfport, Miss.

Dear Editor:

I do not agree with the comments on "comebacks" on page 27 of the October issue. The customer should be educated to understand that "comebacks" are an integral part of

television servicing and that he should be expected to pay for them if they are not associated with a recent service call. If a serviceman replaces a high-voltage rectifier on Monday, he should not be expected to replace an RF oscillator tube on Friday just for the price of the tube. It is true that many of us do not handle this situation as we should, thus losing a considerable amount of revenue that is justly ours. If we do not charge for "comebacks," we have no one to blame but ourselves. As long as our dealings with a customer are straight-forward and businesslike, he is not going to go elsewhere.

The dollar value of entertainment the customer receives from his TV set is staggering. One football game for man and wife is worth a minimum of $10.00, a boxing match about the same. How many of us could afford to attend the World Series for seven games each year? The customer should be made to realize that we do not "fix TV sets," but provide entertainment. Realizing this, the serviceman should not be hesitant in charging what he knows to be honest fees.

C. S. BRYANT

Miami, Florida

Reader Bryant has a very convincing argument. We wonder what our other readers may have to say on this subject.—Editor

Dear Editor:

While the article "Selenium Rectifiers" in the October issue is very well written and covers much of the information required by servicemen, we feel that some mention should have been made under the manufacturing processes of the electrical forming of these stacks. By having made this mention in your manuturing description, you could have then pointed out that some sparking is normal in the forming process and could have then gone on to the fact that a selenium rectifier, like an electrolytic capacitor, has a limited shelf life, since it will deform on the shelf. Such rectifiers that may have slightly deformed will form up almost instantaneously when placed in use and service. However, there will be some slight sparking.

We point this out since we have had some questions from dealers regarding such instantaneous sparking and in each case, on tracing down the cause of difficulty, have found that it is a rectifier several years old which is first being placed in service.

ALLEN NELSON

Manager, Distributor Sales
International Rectifier Corp.
El Segundo, Calif.

"I cut testing time in half" ..."doubled our tube sales" *

"Adds to my income and saves me unprofitable call-backs."

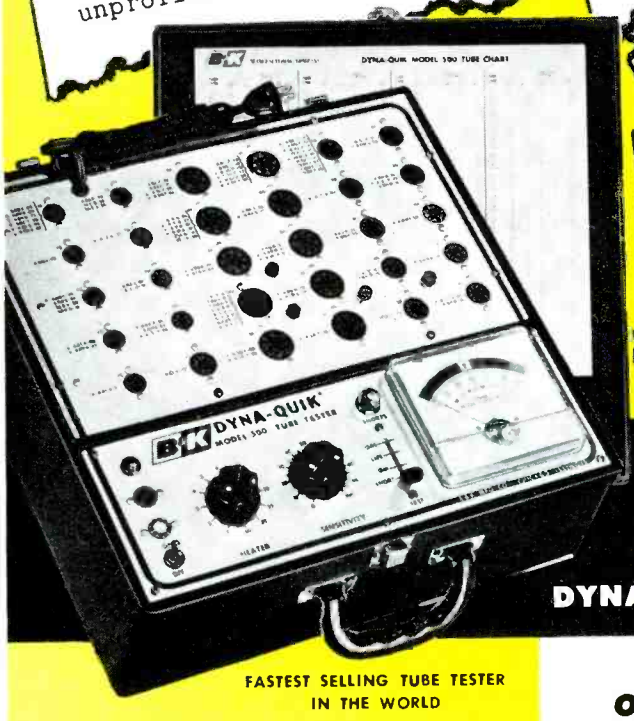
"We have two...one for the shop and one for house calls."

"Paid for itself several times. Really indispensable."

"Best tube tester I've ever owned. Simple to operate. Saves time."

"Makes lots of money for us. Wonderful instrument."

"Serves my purpose best for speed and dependability."



B&K MODEL 500 DYNA-QUIK

DYNAMIC MUTUAL CONDUCTANCE TUBE TESTER

FASTEST SELLING TUBE TESTER IN THE WORLD

Tests over 95% OF ALL POPULAR TV TUBES — IN SECONDS

Accurately makes each tube test in seconds Checks average TV set in minimum minutes

Tests each tube for shorts, grid emission, gas content, leakage, and dynamic mutual conductance.

Ingenious life test detects tubes with short life expectancy.

One switch tests everything. No multiple switching. No roll charts.

Shows tube condition on "Good-Bad" scale and in micromhos. Large 4½-inch plastic meter has two highly accurate scales calibrated 0-6000 and 0-18,000 micromhos.

Automatic line compensation is maintained by a special bridge that continuously monitors line voltage.

Built-in 7-pin and 9-pin straighteners are mounted on the panel.

* NAMES ON REQUEST

One extra tube sale on each of 5 calls a day pays for the Model 500 in 30 days

Enthusiastic comments like those above* come from servicemen all over the country. *Actual experience shows an average of close to 2 additional tube sales per call.*

Instead of the "trial and error" method of substitution testing, the Dyna-Quik 500 quickly detects weak or inoperative tubes. Cuts servicing time, saves costly call-backs, shows each customer the true condition and life expectancy of the tubes in the set, and makes more on-the-spot tube sales. Helps keep customer good-will, give a better service guarantee, *and make more profit.*

The B&K Dyna-Quik 500 measures *true dynamic mutual conductance.* Completely checks tubes with laboratory accuracy under actual operating conditions right in the home *...in a matter of seconds.* Saves time and work in the shop, too. Simple to operate. Easily portable in luggage-type case. Weighs only 12 lbs. NET. **$109.95**

See Your B&K Distributor or Write for Bulletin No. 500-R

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Picture and Pattern Video Generator. Complete Flying Spot Scanner. Net, $199.95

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Cathode Rejuvenator Tester. Tests and repairs TV picture tubes. Net, $54.95

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Designed to check and adjust test instruments with laboratory accuracy. Net, $54.95

Shop Talk

MILTON S. KIVER

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

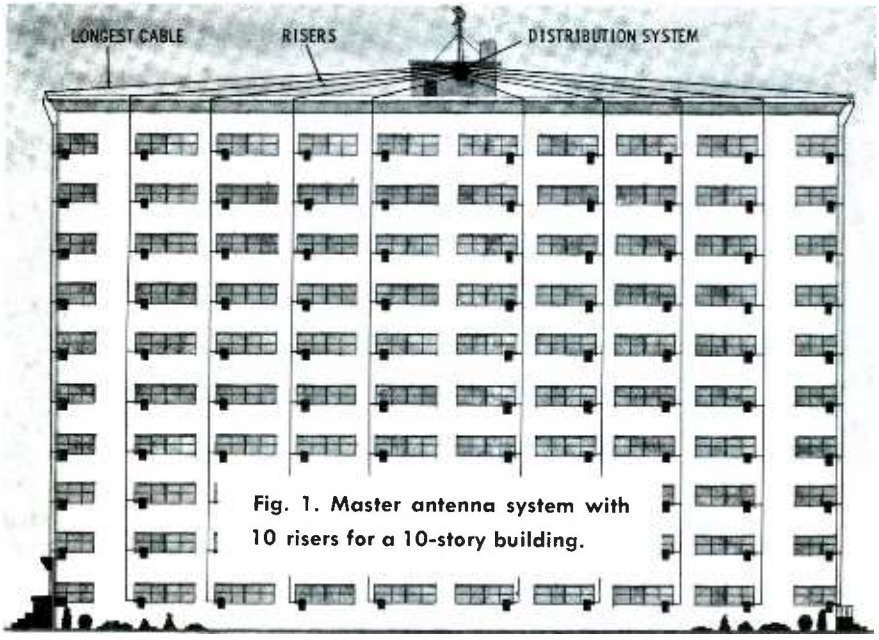


Fig. 1. Master antenna system with 10 risers for a 10-story building.

Planning a Master Antenna System

The best way to appreciate the problems of a master antenna installation is to lay out a system on paper and perform all the necessary calculations. This we will do for a case which may or may not be typical but which, at least, will demonstrate the procedure involved. For an example, we will assume that a master system is to be installed for a 10-story building and that 10 distribution lines or risers are to be employed. Not all of the lines will be equal in length, although by locating the antennas and the distribution amplifiers centrally, the differences in cable lengths may be kept small. In any event, even if the length difference between the shortest and longest is significant, we need only concern ourselves with the longest line since it will attenuate the signal the most. If we provide enough signal for this riser, we will have more than enough for the shorter cables.

In the vertical layout of the building shown in Fig. 1, each cable will feed one apartment per floor. Generally, these apartments are situated one above the other, such as 1A, 2A, 3A, 4A, etc. In buildings constructed horizontally, such as garden apartments, the various risers would extend horizontally. Since most apartment buildings are built vertically, this is the situation we will consider here.

The first step is to determine how much signal strength is required at the end of the longest cable. Let us assume that this is represented by the riser shown at the left in Fig. 1. A workable signal level at the receiver for a snow-free picture is 1,000 microvolts. Generally, however, between two to three times this amount should be available to take care of any contingencies. Hence, for our purpose, let us plan on having a minimum of 3,000 microvolts at the receiver for each channel to be received.

Now, if we want at least 3,000 microvolts at the end of a line, considerably more signal than this will be required at the distribution amplifier mounted on top of the building. First, we must determine what losses exist between these two points. The over-all length of a cable, here assumed to be RG-59/U, is 100'* from the ground to the roof and 50' along the roof to the distribution amplifier. This would make the total length 150'. From Table I, the cable attenuation in db per 100' for each channel can be obtained. Let us assume that the TV channels to be dealt with in this installation are 2, 5, and 13. Since the cable losses are greater at the higher frequencies, those shown for channel 13 will be used in the computations and we see that the attenuation of RG-59/U at channel-13 frequencies is 5.8 db per 100'. For 150' of cable, the loss is 8.7 db.

Table I—Cable Losses

Chan.	db loss per 100 feet	
	RG-11/U	RG-59/U
2	1.60	2.50
3	1.70	2.64
4	1.80	2.80
5	1.90	3.00
6	2.00	3.13
7	2.70	5.20
8	2.75	5.30
9	2.80	5.40
10	2.85	5.50
11	2.90	5.60
12	2.95	5.70
13	3.00	5.80

In the installation of Fig. 1, vertical risers are being used, with one tapoff per floor. This means a total of 10 tapoffs per cable. Each of these tapoffs will remove some signal voltage from the line, and the attenuation thus introduced must be figured. This brings us to our next step.

In tapping off a signal from a riser, it is quite apparent that the signal level will be higher at the beginning of the line than at the end. Since we desire to provide each receiver fed from that line with approximately the same amount of signal, the tapoffs used at the start of the line should provide greater attenuation than

· *Please turn to page 48*

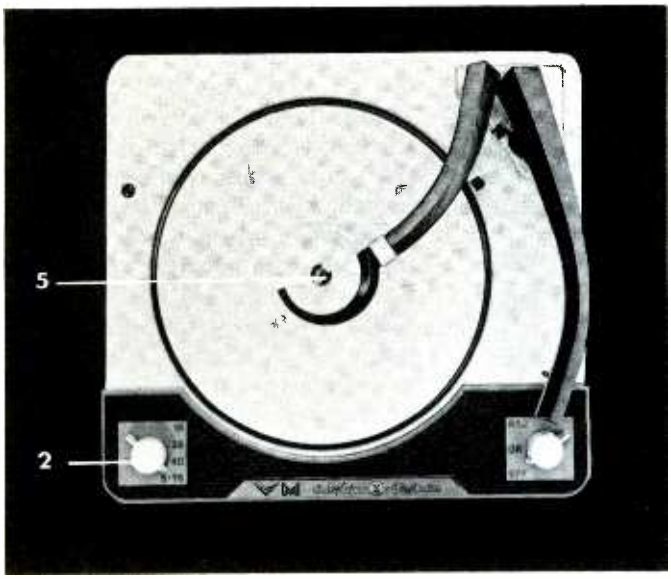
* As a rule-of-thumb, figure 10' of cable per story of building.

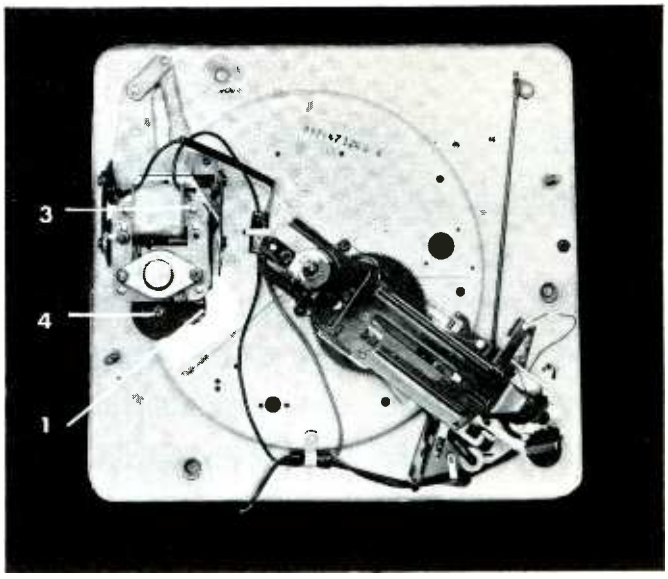
Make More Than Profit!

SELL THE...

'Super-Fidelis' 4-Speed Changer!

Make More Than Profit... Replace with V-M! Upgrade with V-M! Install New with V-M!





Everybody loves profit, and we all think it's great. But there are other things that are important too. You get them in generous measure when you sell and install the sensational V-M 'Super-Fidelis' Changer with Siesta-Matic. Here's what you get: lasting customer satisfaction and repeat business; simple, fast installation without annoying callbacks; a manufacturer that stands four-square behind its product and V-M's expert, nation-wide service facilities. With all these V-M pluses, profit takes care of itself.

S...E...L...L V-M 'Super-Fidelis' Model 1200! See Your V-M Rep!

*Slightly higher in the West.

the Voice of Music®

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WORLD'S LARGEST MANUFACTURER OF PHONOGRAPHS AND RECORD CHANGERS

V-M "Make More Than Profit" FEATURES...

1 Exclusive V-M Siesta-Matic preserves changer's hi-fi characteristics indefinitely! It automatically retracts and protects the precision drive idler to retain its perfect contour for constant speeds. Siesta-Matic can even shut off everything—power and amplifier—after last record plays... wonderful convenience feature.

2 Four-Speed Control . . . to play everything on records—automatically plays 78, 45 and 33 rpm records plus the 16 rpm speed.

3 Patented Drive Motor (Pat. No. 2655812) assures constant speed at all times with minimum wow.

4 Low-Torque Mechanism gives twice the life, half the wear.

5 Exclusive Tri-o-matic® Spindle protects records, makes them last longer. Records are gently lowered (not dropped) to spindle shelf.

6 Excellent V-M Styling. All-metal construction in smart charcoal gray and antique white. Rubber turntable mat protects records—keeps them dust- and lint-free.

V-M 'Super-Fidelis' Changer Model 1200, $46.50 List.* — Audiophile Net, $37.20.*

TRANSISTOR APPLICATION CHART

Introduction

Many service technicians are asking for more information on transistors—so, we have taken a survey of 25 of the first transistorized, or hybrid tube-transistor, radios that have appeared on the market. The results of this survey, conducted exclusively for this article, show what transistor types are being used and the sets they are in.

In the column headed "Radio Models Surveyed," each model has been assigned a key number to simplify cross-reference between columns. If the key number for a particular set appears to the right of a transistor type number, one or more transistors of this type are used in some or all versions of the set. Two or more transistors of the same type are often used in different stages of a single radio, but this fact has not been taken into consideration in the preparation of these lists in order to avoid the complexity of a frequency-of-use chart. Such a chart is impractical at the present time—not only because of the relatively small demand for replacement transistors, but also because of the lack of standardization among transistor circuits.

Miscellaneous Notes

1. Standard replacement transistors are not listed for radios 1, 3, 4, 14, or 21. Refer to manufacturers' part or type numbers for suitable replacements.

Radio Models Surveyed

KEY NO.	MAKE & MODEL
1	Regency TR-1
2	Raytheon 8TP1
3	Emerson 838 (hybrid)
4	Mitchell 1101
5	RCA Victor 7-BT-9J
6	Dewald K-701-A
7	General Electric 675
8	RCA Victor 7-BT-10K
9	Raythean T2500
10	Raytheon T-100-1
11	Emerson 842
12	Motorola 6TAS8 (hybrid auto)
13	Crosley JM-8BG
14	Regency TR-1G
15	Raytheon T-150-1
16	Motorola 56T1
17	Magnavox AM-2
18	Truetone D3614A
19	Dewald K-544
20	Roland 6TR
21	Philco T-7
22	Arvin 9562
23	Zenith 800
24	Westinghouse H587P7
25	RCA Victor 8-BT-10K

RF-IF Applications

TYPE	ORIG. MFR.	USED IN SETS
2N94	Sylvania	22
2N112	Raytheon	10 15 18 19
2N112A	Raytheon	19
2N135	G-E	7
2N136	G-E	7
2N137	G-E	7
2N139	RCA	25
2N140	RCA	25
2N145	T-I	6 17 24
2N146	T-I	11 16 17 24
2N147	T-I	6 16 17 24
2N168	G-E	23
2N168A	G-E	23
2N169A	G-E	23
2N172	T-I	16 17 24
2N211	Sylvania	22
2N212	Sylvania	22
234		5 8
235		5 8
830	T-I	6 11 24
CK760	Raytheon	2 9 18 19
CK760A	Raythean	19
GT760	G-T	20
GT761	G-T	20

Audio Applications

2N35	RCA	22
2N44	G-E	7
2N78	G-E	7
2N109	RCA	5 8 13 25
2N130	Raytheon	9
2N132	Raytheon	10 15 18 19
2N133	Raythean	9
2N138	Raytheon	9 10 15 18 19
2N176	Matarala	12
2N185	T-I	24
2N187A	G-E	23
2N190	G-E	23
2N214	Sylvania	22
310	T-I	6 11 17 24
353	T-I	6 11 17
354	T-I	16
CK721	Raythean	2
GT20	G-T	20
R35	T-I	16

2. The "orig. mfr." listed for each transistor is the manufacturer who first marketed it or registered it with RETMA and is usually, but not necessarily, the only one now producing it. The following abbreviations apply in the "orig. mfr." column:

G-E . . . General Electric Co.
T-I . . . Texas Instruments, Inc.
G-T . . . General Transistor Corp.

3. The numbers having the prefix "2N" are standard RETMA registration numbers for triode transistors. The figures following the prefix are assigned in serial order as the transistors are registered, and they have no particular significance.

4. The 2N172 supersedes the 830, and the 2N112 supersedes the CK760.

5. The 2N135, 2N136, and 2N137 and also the 2N145, 2N146, and 2N147 form two series of IF transistors which have very similar characteristics but which are not meant to be freely interchanged for replacement purposes. Different combinations of transistors within either series are picked to suit the peculiar requirements of each radio produced. For instance, the two IF stages of some individual sets in a model run may contain two 2N146 transistors each having medium power gain, while other sets of the same model may have one lower-gain 2N145 and one higher-gain 2N147 in place of the 2N146 transistors.

6. Matched pairs of power-output transistors are frequently selected at the factory for use in push-pull audio stages. If these units must be replaced, another matched pair should be obtained.

7. In the majority of the radios in the list, a crystal diode is used as a second detector. All sets except 2, 3, 4, 7, 12, 13, 16, 21, and 24 use a diode of the 1N295-1N64-1N60-CK706A family. Set 21 uses a 1N527 diode, and set 24 uses an 880. In the remaining radios, a transistor or tube is used as a detector. ▲

for the expanding independent service-dealer

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SILICON RECTIFIERS

Something New for TV and Radio Power Supplies

by Thomas A. Lesh

Fig. 1. Type M500 silicon diodes made by Sarkes Tarzian, Inc.

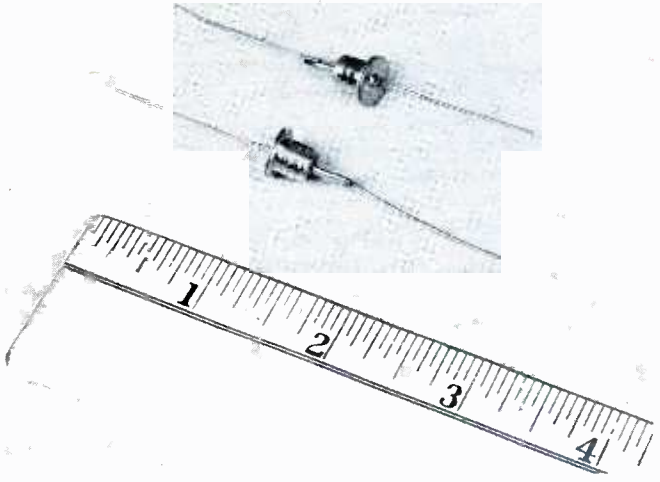


Fig. 2. Silicon rectifier for military and industrial use. (International Rectifier Corp. Type 3FS1.)

If someone handed you the components shown in Fig. 1 and asked you to identify them, what would be your guess? Fuses? Oscillator crystals? Ceramic capacitors? Their appearance is deceptive, for they are actually silicon diode rectifiers designed for use in the low-voltage power-supply circuits of TV receivers. We have been testing these new units in our editorial labs by installing them in a number of television sets. The results of our experiments will be described in this article.

Before presenting the test data, we might mention some facts about the construction and operation of the new rectifiers. Silicon, the material of which they are made, is a semiconductor widely used in transistors. In fact, the diode rectifier is physically similar to one half of a junction transistor. In the construction of one typical silicon rectifier, one lead is connected to a tiny slab of crystalline silicon which contains a trace of an electron-rich (N-type) impurity. The other rectifier lead is in contact with a thin layer of silicon into which an electron-deficient (P-type) impurity has been injected by either an alloying or a diffusion process. This P-layer is formed in a small area within one surface of the main crystal.

Silicon diodes rectify current in somewhat the same way as selenium rectifiers and are very efficient because they have a high ratio of reverse to forward resistance. The reverse leakage current of some silicon rectifiers is as low as a few microamperes; moreover, they have a very low internal dissipation of power and therefore generate little heat in operation. For this reason, diodes with moderate current ratings do not require cooling fins and they can be made very compact in form.

Silicon diodes for low-current applications have been on the market for some time, but only the most recent technical developments have made it practical to produce silicon power rectifiers with high enough current ratings for use in power supplies. During the past year, a number of companies have introduced fused-junction rectifiers similar to the ones shown in Fig. 2. Units of this type generally have output DC current ratings of approximately 300 ma when cooled by normal air circulation. If a heat sink is used, it becomes possible to increase the current rating to more than 1 ampere. One king-size diode (with a body size of about one cubic inch) has been developed by General Electric Co. and is capable of rectifying enough current to operate a 15-hp DC motor.

Although rectifiers of the type shown in Fig. 2 would operate satisfactorily in many TV sets, they were designed and marketed especially to satisfy military, aircraft, and industrial requirements. The first silicon rectifier to be sold specifically for the direct TV re-

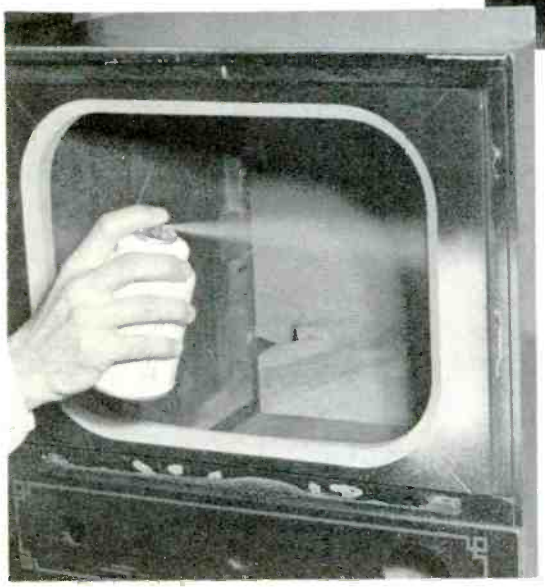
• *Please turn to page 54*

DRESSING UP TRADE IN'S

1. THE TRADE-IN

This particular TV cabinet needs much more than ordinary cabinet touch-up techniques to make it appeal to the average buyer. There is much that can be done with a little ingenuity and 2 or 3 hours' time. Naturally, a dealer has to consider how much of his own money he can tie up in each trade-in, but with a little forethought and a head for figures, a good merchandiser can make a profit on all those old sets he took in prior to the holiday season.

What can be done to improve the resale value of TV trade-in's having old or damaged cabinets? One way is to improve the outward appearance, since that's what attracts a prospective buyer's eye. A badly marred or stained cabinet can be covered with a self-adhesive vinyl material or a regular plastic veneer. If needed, the decorative picture tube mask can be cleaned or sprayed with a new coating. Knobs and excutcheons can be replaced or refinished to match the cabinet covering. Adding wrought iron legs or combining the set with a table or stand should help to make a beat-up trade-in a very salable item.



2. CABINET PREPARATION

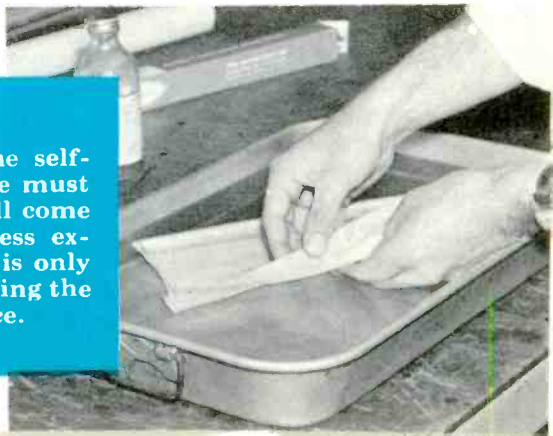
Blemishes or irregularities on the cabinet surface may be noticeable after the new covering has been put on. Therefore, the wood should first be sealed and sanded as smooth as possible. If the cabinet is completely covered with scratches or small cracks in the finish, it may be easier to coat the entire surface with paint or varnish and then sand until smooth. Sections of veneer which are split away from the frame can be tacked down with small finishing nails which should be driven below the cabinet surface and the holes filled in with a wood or fibre filler.

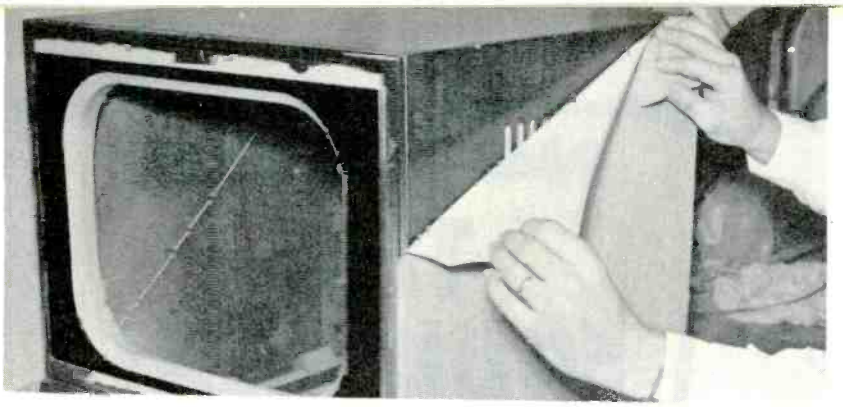
3. PICTURE TUBE MASK

On some sets the face molding and safety glass can be removed, but the mask itself is actually part of the cabinet. A new coating of paint, sprayed or brushed on, will help the over-all appearance. For this particular set, a light grey was used for the beveled edge of the mask and a flat black paint for the remaining mask surface. The flat black lends a modern contrast to the limed oak wood grain chosen as the cabinet covering in this example.

4. COVERING MATERIAL

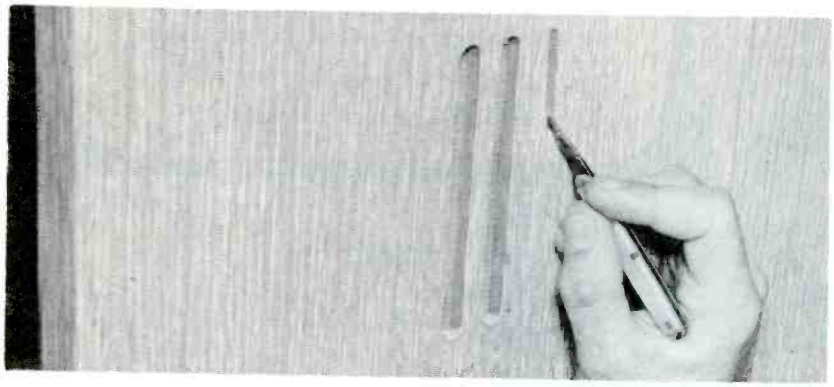
Paper backing is easily removed from the self-adhesive material. The plastic veneer type must be soaked in water before the backing will come off. Although the adhesive material is less expensive and somewhat easier to apply, it is only available in 18-inch widths, thus necessitating the use of two pieces to cover any larger surface.





5. APPLYING THE VENEER

Plastic veneer is first applied to the cabinet with a wet sponge, and a small squeegee is then used to remove the air bubbles. Complete instructions are given with either type of material.



6. CABINET CUTOUTS

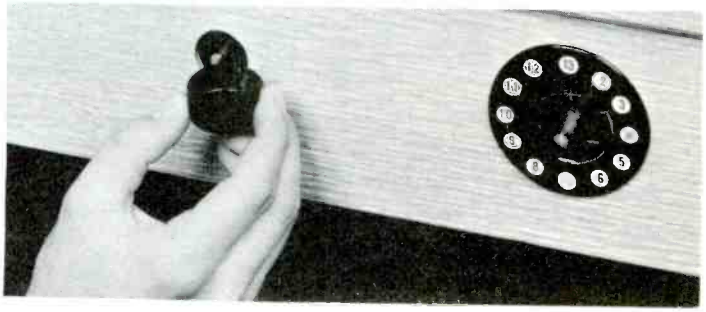
A sharp pen-knife or razor blade can be used for cutting out the speaker grille openings and the holes for control shafts. If plastic veneer is used, this operation should be performed after the covering has dried.

7. SPEAKER GRILLE CLOTH

Spray paint can be used to decorate the speaker grille cloth. In some console and combination models, more than 50% of the cloth may be visible. In such cases, you may want to replace it with one having a color pattern which blends with the new veneer.

8. KNOBS

Knobs and escutcheons which are missing, worn, or of an undesirable color may be replaced or redecorated with spray paint. Paint will cover better if the knobs are first gone over with a medium-grade sandpaper. If a flat or soft-finish paint is used, it should be coated with clear lacquer or plastic to protect against wear. If you feel it necessary, new decals may be obtained for channel numbers, control identifications, etc.



9. THE FINISHED PRODUCT

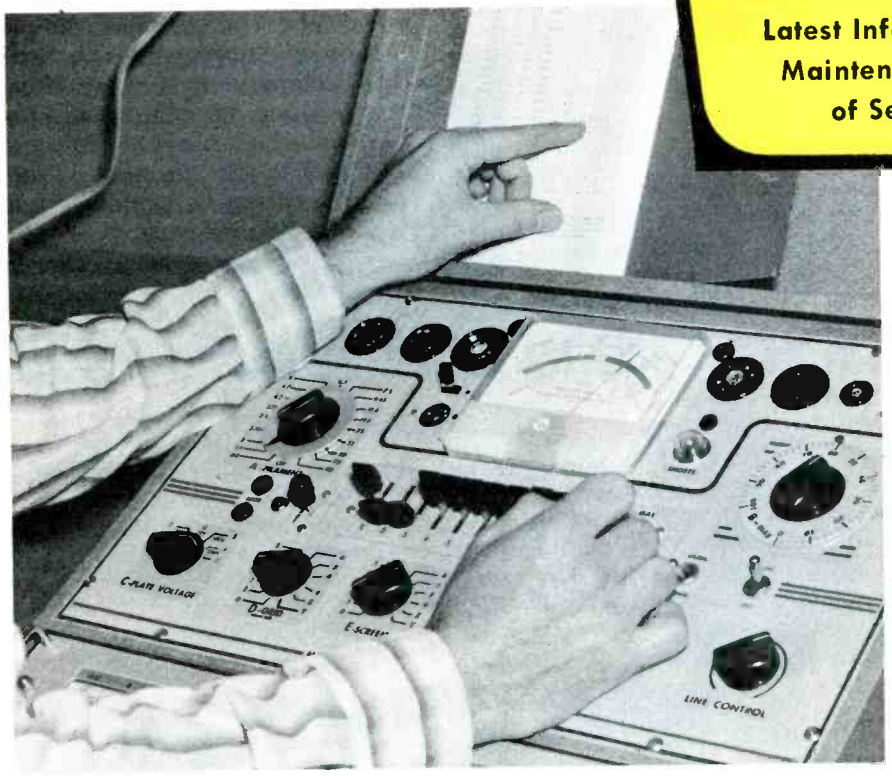
Hard to believe this is the same set shown in picture 1, isn't it? Cost of materials for dressing up this set, including paint, new wrought iron legs, and the more expensive plastic veneer, totaled approximately $9.00. Actual time spent on the job was about 3 hours. Of course, every set won't require the time and energy expended on this job, but you should be able to at least roughly estimate your costs from the data presented here.

NOTES ON TEST EQUIPMENT

Latest Information on Application, Maintenance and Adaptability of Service Instruments

Testing a transistor in a modern tube checker. Transistor can be seen in the subminiature socket directly to the left of the panel meter.

by Leslie D. Deane



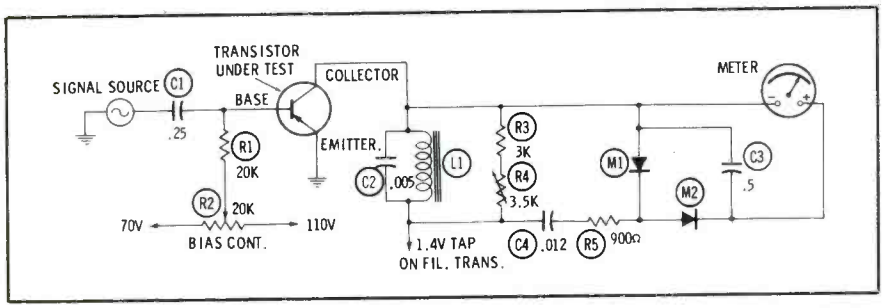


Fig. 1. Simplified schematic of the transistor test circuit in the Triplett Model 3423.

How Transistors Are Tested in Modern Tube Checkers

The service technician is aware by now that transistors differ from ordinary vacuum tubes in many ways. He can not look at a transistor and determine if a filament is lit, nor can he tap on the unit and expect any change in its operation as is often done with vacuum tubes.

Heat is not generated within a transistor as in most tubes; therefore, a dead stage can not be located by merely feeling the transistor. In addition, the old screwdriver test of momentarily shorting a grid to ground may permanently damage a transistor. Many transistors are soldered directly into the chassis wiring, thus making it more difficult for a quick substitution. Because of these different characteristics, new techniques and procedures must be followed when servicing transistorized equipment.

Transistors are operated at relatively lower potentials than tubes and are physically designed to withstand considerable shock and vibration. Unless a transistor is damaged by excessive heat or voltage, its life should outlast that of a comparable tube. Regardless of this fact, the technician will at some time or another suspect a transistor of being defective, in which case he must either make a direct substitution or test the transistor by some reasonably accurate means.

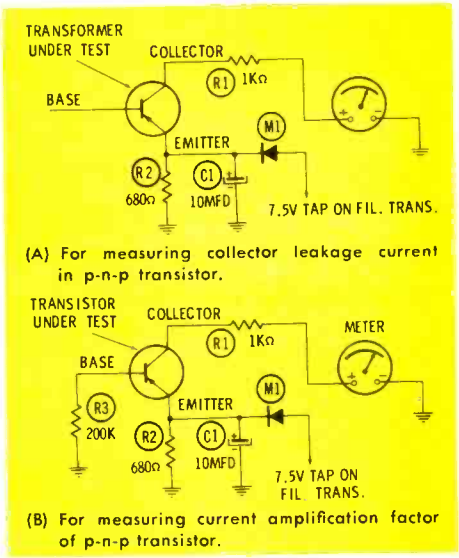


Fig. 2. Simplified transistor-test connections in EICO Model 666 tester.

Here then, are facts aimed at familiarizing the technician with some of the basic methods used for testing transistors in modern tube checkers. Keeping in mind that transistors are essentially current amplifiers, let us examine a couple of the available commercial instruments for testing them and find out how they do it.

Triplett Model 3423 Tester

In this particular instrument,

Fig. 3. Checking accuracy of a VTVM by using B & K Model 750 calibrator as a standard voltage source.

Fig. 4. Calibrating a marker generator with B & K Model 750 calibrator, 4.5-mc crystal and head phones.

the transistor to be tested is placed in the 7-pin subminiature tube socket provided on the front panel. (Certain transistors may require that the base element be connected to the "X" grip-cap lead which is also provided on the front panel.) To distinguish between the base, emitter, and collector leads for various transistors, refer to the manufacturer's transistor data sheets.

In the Triplett Model 3423, the quality of a transistor is determined in one simple operation. After all controls and levers are set according to the roll-chart supplement, the value lever is held in the VALUE position. The current amplification factor of the transistor is then measured on a linear scale of the meter. Current amplification factor, Beta, is represented by the change in collector current caused by a slight change in base current.

The schematic diagram of Fig. 1 illustrates the basic set-up for testing a p-n-p type transistor in the Triplett Model 3423. A test signal of either 1.2 or 0.6 volts is supplied from within the instrument. Normally, the 1.2-volt signal is used when testing transistors. The emitter element of the transistor is grounded while R1 and R2 form a fixed bias network for the base element. The collector returns to a 1.4-volt tap on the filament transformer through a reactive load. Inductor L1 develops the AC signal present in the collector circuit and this signal is rectified and applied across the meter. All transistors listed in the Triplett manuals, except type X-23, will have a normal meter reading of 70 on the 0-to-100 scale.

EICO Model 666 Tube-Transistor Tester

The EICO instrument has a special socket to accomodate both n-p-n and p-n-p type transistors. Checking a transistor in this instrument requires two separate test operations. The first test measures leakage current of the collector with the emitter grounded and no signal applied to the base. This test is illustrated in the schematic of Fig. 2A where a p-n-p type transistor is used as an example and the transistor test selector is placed in the PNP1 position. The meter is in the collector circuit in series with the current-limiting resistor R1. With the emitter grounded and no base signal, the leakage current will be indicated by the meter reading.

If the transistor is in satisfactory condition, the meter will read between 0 and 40 on the 0-to-140 scale. If the reading is higher than normal, it usually indicates that the surface of the germanium is contaminated or that the transistor has been exposed to extreme heat or excessive voltage. A shorted transistor may cause the meter to read past full scale deflection in which case the selector switch should be returned to TUBE position immediately.

During this first test, the polarity of the bias voltage applied between the collector and emitter elements depends on whether an n-p-n or a p-n-p type unit is being tested.

In the second test, illustrated in Fig. 2B, a 200K-ohm resistor R3 is connected between the base and B— or ground. This puts current into the base, thus increasing the collector current. The meter then reads the current amplification factor, Beta. A good transistor will read within the specified range given in the tester's roll-chart supplement.

If no tube is left in a tube socket, the settings of adjustments other than the transistor test selector, line-adjust control and line push-button are immaterial when making a transistor test with this instrument.

At the present time, manufacturing tolerances of transistors are relatively broad; therefore, if a transistor test reading on any of these instruments deviates from a specified value, it still may be satisfactory for use in certain applications. The decision, of course, must be left to the individual technician. Special transistor checkers are now available to the service industry, and we will discuss some of these instruments at a later date.

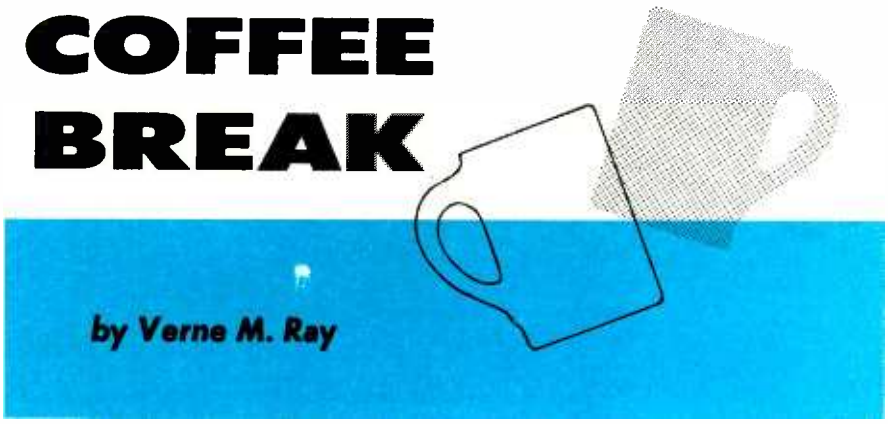
B & K Model 750 Test Equipment Calibrator

This instrument is a recent product of the B & K Mfg. Co. of Chicago. It is of particular interest to service technicians because it is designed to be used in colibrating and testing the accuracy of test instruments found in the average radio and TV service shop.

Available calibrating standards are:

• *Please turn to page 60*

COFFEE BREAK



by Verne M. Ray

Bud McMahon was quite preoccupied as he drove to work one bitter January morning. Since it was the start of a new year, he had been thinking of what the future held for him. During the past few years, he had worked and studied diligently to become a good technician. It hadn't been easy, and although he felt satisfied with his accomplishments, he looked forward to a time when he might rest on his laurels. Yet, from the looks of things, that time seemed to be a long way off.

Tony was unlocking the door to the shop when Bud drove up. By the time Bud got out of the car and walked in, Tony was already sorting through the calls for the day. "Hi Bud," he called in greeting. "Ready for a big day? Looks like we're going to have one."

"Yeah—I guess so," replied Bud. This didn't sound like the usually cheerful, enthusiastic Bud. Tony paused, turned around, and looked at him inquiringly.

"Hey boy, what's eating you?" he asked. "Not feeling well?"

"Huh? Oh! I feel okay," said Bud coming out of a daze. "I've just been turning a few things over in my mind. I don't mind telling you, Tony—I'm a little worried."

"Worried, eh?" mused Tony. "Okay—let's go next door and have an early cup of coffee and you can tell me all about it."

At the coffee shop, they settled down at a small table over in the corner and called their orders to the waitress behind the counter. Then Tony said, "All right, Bud, let's have it—what's on your mind?"

"Oh, I don't know, Tony. I'm a little confused, I guess. You know, I've studied and worked pretty doggone hard to become a technician. I thought that by this time I'd know radio and TV, but somehow I can't help feeling that new developments are coming too fast for me to keep up with. First, it was transistors—I'm still not too clear on them. Then, out comes color TV—more new stuff to learn. On top of this, we have modules, printed wiring boards, new tube types, series-string filaments, transformerless sets, jam-packed portables, and other modern designs which seem to make servicing more difficult and complicated. Just last week, I read that mural TV had been introduced over in London, England. Pretty soon we'll have it, too—and more service problems to boot! Darn it, Tony—how does a guy keep up in this business?"

This amused Tony, but he didn't show it. His outward appearance was one of dead seriousness. "Let me ask you something, Bud. When you first came to work here, weren't you the one who was so eager? You had to be the first one in the shop to figure out how a new circuit worked, or to tell the rest of us about the first of a new model. And you were still wet behind the ears."

"Sure," answered Bud, "I felt that I had to prove my ability. I guess I did some stupid things, too. But TV was in its early stages then. I always had a feeling that the industry would settle down—like radio did. Who could foresee the turmoil we're involved in now?"

"Now hold on a minute," Tony interrupted. "Settle down like radio did? You seem to forget that just a few years ago, FM was introduced in radio broadcasting. More recently, transistors have been developed to replace tubes in portable and auto radios. And printed wiring boards were first used in radios. All this—more than 25 years after regular radio broadcasting began. Talk about tricky little portables! How about those pocket-size radios that aren't much bigger than a pack of cigarettes? Compared to radio, I'd say that progress in the TV field was running in second place."

Bud scratched his head. "Yeah—I guess you're right as usual," he said, "but it still seems as though we have to spend too much time keeping abreast of the newest developments."

"Isn't that the very reason why TV—and the entire electronics field is so interesting?" asked Tony pointedly. "Why—if everything stayed the same, this business would become dull. We'd be bored to tears. And that's not all—what would manufacturers have to compete with if they didn't improve their products and develop new ones. After all, progress comes about as a result of the competition that is bound to exist under our free-enterprise system. I'm sure you don't want to see that changed."

Bud conceded. "I guess you're right, Tony. I've just been feeling sorry for myself—and a little lazy, too. I feel much better now that you've shown me more of the picture."

"I know just what you've been going through," said Tony as he gave Bud a sound but friendly whack between his shoulder blades. "Felt that way myself a couple of times. There's an important lesson we can learn, though. A man is happiest when he's learning. Sound use of your grey matter will make you healthier and wiser, too. I think we're fortunate to be in this field. We *have* to stay on our toes if we want to earn our bread and butter. Which reminds me—we'd better get going if we want to stay in business." ▲

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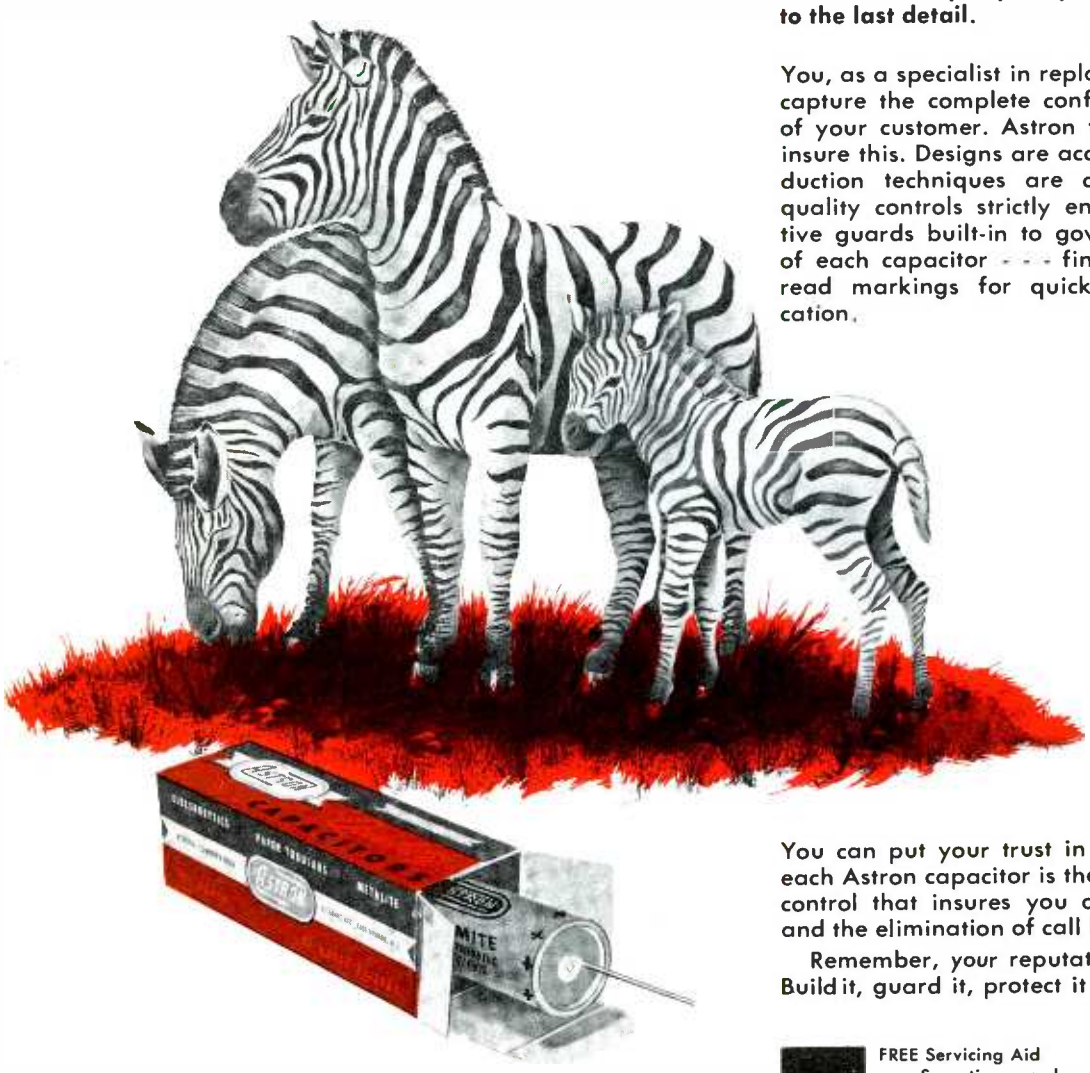

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Audio-Facts

An Introduction to Commercial Sound Systems

A Typical Installation Planned to Meet the Customer's Needs

by Calvin C. Young, Jr.

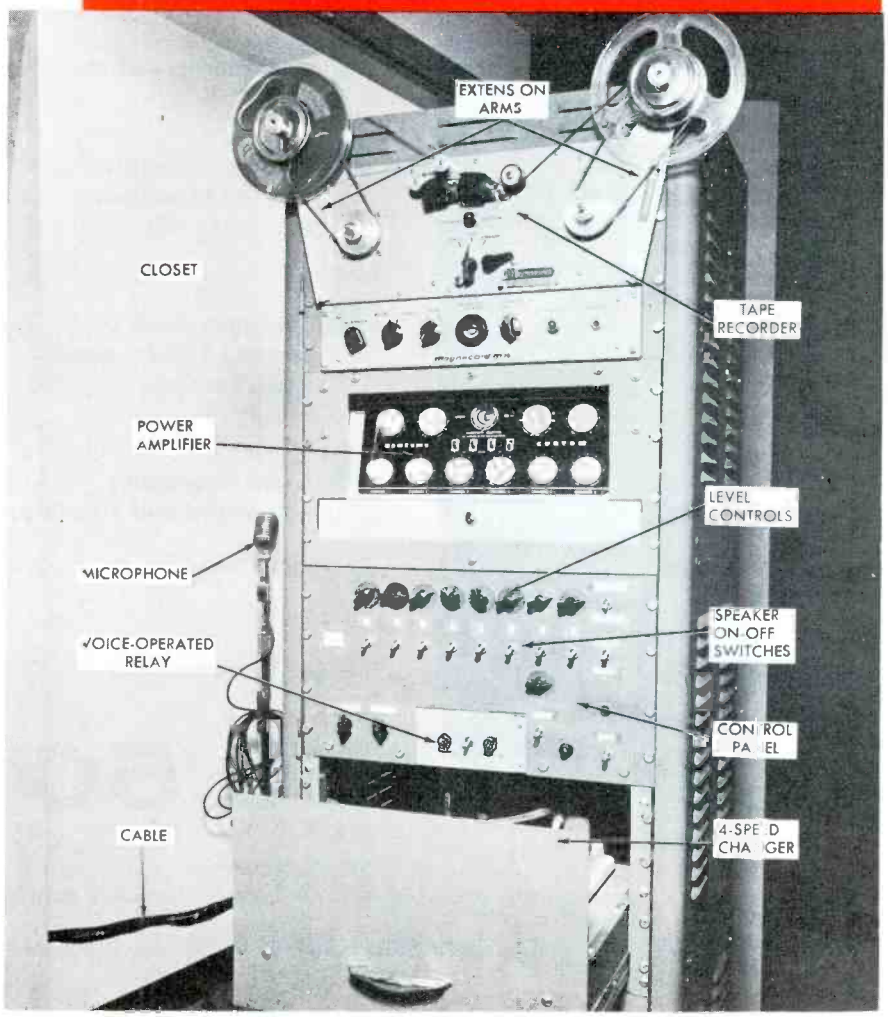

Fig. 1. A representative commercial sound installation.

While there has been a great deal of discussion recently about hi-fi audio systems, there has been relatively little discussion about high quality commercial audio installations. This article presents some of the practical aspects of the commercial sound systems which might be installed in business buildings such as night clubs, auditoriums, funeral parlors, office buildings, etc. These systems can be classed as high quality audio units because they have a frequency range and an absence of distortion that allows them to reproduce music and voice to the satisfaction of the average listener.

To obtain practical material for this article the author went to Anderson, Indiana, and inspected a typical installation which is the "pride and joy" of the installer, Mr. Roy Shepherd of that city.

The photograph in Fig. 1 shows the equipment console, which was wheeled into the hall for the photograph. The equipment, consisting of a tape recorder, power amplifier, control panel and four-speed record player, is housed in a standard metal relay rack cabinet which is equipped with casters. The tape recorder, with extension arms for large reels of tape, is mounted at the top of the cabinet and the power amplifier, complete with five microphone channels and one phonograph channel, is located just below. The control panel has level-set controls and on-off switches for each speaker, in addition to various other selector switches. This panel is located just above the four-speed record changer which is contained in a pull-out drawer.

The speakers are installed at various points away from the console in flush ceiling mountings which are painted to match the respective ceilings. The wiring cable from the amplifier to the speakers can be seen in Fig. 1, and it is long enough to permit the equipment console to be moved out of the closet for service.

Microphone outlets are provided at four points in the building, and a separate microphone channel complete with matching transformer and jack is used for each location. One of the microphones can be seen in Fig. 1 in a corner of the closet that houses the equipment console.

As mentioned earlier, the tape recorder is equipped with extension arms which makes it possible to play or record on large 10" reels of tape. This permits a much longer recording time without changing tape.

The control panel incorporates several interesting features—for example, a voice-operated relay, a

· *Please turn to page 57*

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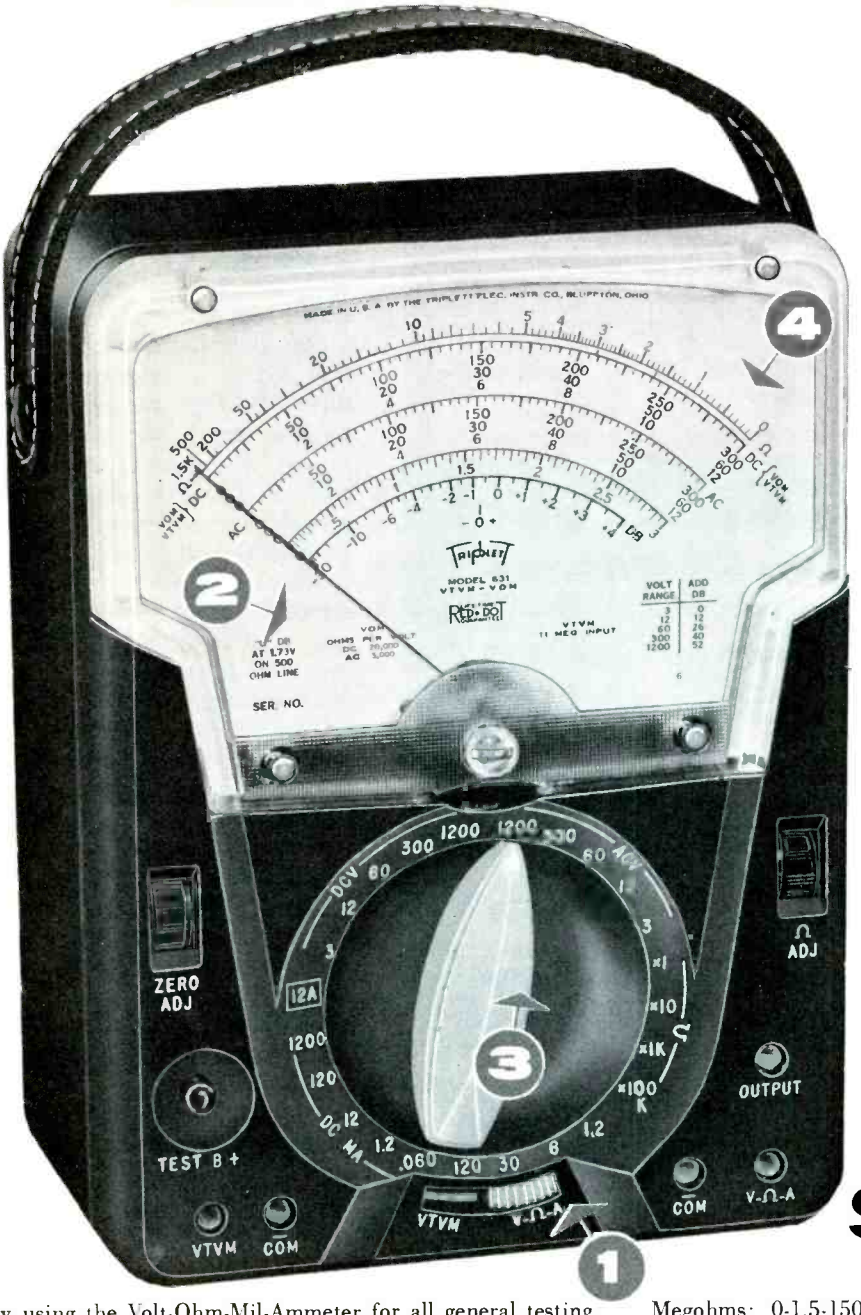

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2 Standard sensitivities as used in servicing manuals.

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BY JOHN MARKUS

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

TOO LONG. Three to four months is normal waiting time for radio repairs in Russia, according to reports received by *Electronic Week*. Chief reason is the difficulty in getting replacement parts. For this reason, many customers buy a complete assortment of spare parts along with the new radio. With the needed parts available, repairs can be made just about as promptly as in this country.

Old radios are routinely cannibalized to get desperately needed parts. Batteries are also scarce, and with most of the country unelectrified this means that properly operating radios are rare. Recognizing this problem, the government has made a serious attempt to speed up the production of radio equipment and components. As a result, the backlog of orders for parts has in some areas been cut from three years to less than one year.

$ & ¢

MEN WANTED. Electronic manufacturers are now looking abroad for engineers. Large U. S. companies have advertised in London, in Zurich, Switzerland, and in Italy for engineers. One even offers free passage to the United States, two years' training, and good pay to men who qualify. In general, however, such offers are available only to top scientists, approaching the genius category. Usually, the average engineering immigrant must work for peanuts in a non-military plant until he obtains his citizenship papers and his college degree in this country.

$ & ¢

RADIO BOOM. It now looks as if radio sales for 1956 will come close to 14,000,000, of which 6,000,000 are auto sets. In round figures, the year's sales of home radios divide into 3,000,000 table models, 2,000,000 clock radios and somewhere close to 3,000,000 portables. Transistor radios are proving much more popular than was expected, so look for them to play a more significant part in your servicing business. Console radios, on the other hand, have pretty much dropped out of the picture.

TV sales for the year are again expected to go over 7,000,000, with almost a million of these being the newly-popular portables. The 14-inchers predominate in portables, accounting for nearly nine out of ten sales in this category, so be cautious in stocking picture tubes for the smaller portables.

GUARDS. Closed-circuit industrial television equipment makes it possible for one guard to watch several doors in Philco's government plant. A TV camera is positioned at each door and hooked up to a monitor receiver at the guard's station. If the person visible on the screen is recognized or carries appropriate identification, the guard pushes a button that releases the electric lock on the door. Here is a logical electronic answer to the high cost of maintaining 24-hour guard surveillance in plants having contracts for classified military equipment.

$ & ¢

SWITCHES. In some motels the TV set is plugged into a wall outlet that is controlled by the light switch just inside the door. This helps to insure that the set gets turned off when tenants leave the motel, and may also be intended to keep them from watching TV in the dark when they go to bed. If you don't know about this switch arrangement, you can easily waste a bit of time on a dead-set complaint followed by a dead-outlet symptom.

$ & ¢

NEWS FLASHES. Professional football players make news because they can no longer be wired for sound, according to a ruling. Heretofore some of the teams had their home fields encircled by a buried loop antenna connected to a public-address system, with the captain and quarterback carrying tiny transistorized receivers inside their helmets. These picked up the audio electromagnetic signals radiated inside the loop. The coach on the sidelines could thus give instructions to his players without going through the formality of sending a new man into play. Opposing teams developed countermeasure receivers and techniques for intercepting the instructions, with indications that the good old game of football was being transformed into a battle of electronic engineering wits. The decision to outlaw electronics on the playing field restored the game to its pre-electronic form.

Making news also is the helicopter's new fat tummy designed to hold a huge search radar antenna which, when carried to an altitude of 1,000 feet or more, can detect low-flying enemy planes. Normal search radars on towers can pick up high-flying planes as far as 400 miles away, but have a blind region close to the ground in all directions, a fact well known to the enemy. When civilian defense spotters announce planes coming in low, the helicopters can be sent up to track their progress and radio instructions to defensive forces.

$ & ¢

TRAVELERS. Who sells the most radio sets in the world? East or West, it's Philips, more formally known as N. V. Philips' Gloeilampenfabrieken of Holland. Most of this firm's business is done outside of its home country. Whereas GE, Philco, RCA, and other big U. S. setmakers concentrate on their huge and profitable domestic market, Philips has dived right into the headaches of economic and political barriers and learned how to do business with the rest of the world. So that's the set you'll see most of when you travel.

$ & ¢

CAR ANTENNAS. Indications are that car radio antennas are moving from the front cowl to the rear deck. Chief reason is to get complete visibility as windshields widen. There should be no change in service problems, unless the lead-in is run under the floor in such a manner that it is exposed to damage by stones or vibration.

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QUICKER SERVICING

(left) Transistor portable radio.

(right) Hybrid transistorized auto radio.

by Calvin C. Young, Jr.

Servicing Hints for Transistor Circuits

Transistorized portable radios are rapidly coming into their own. Two reasons for this trend are: (1) the transistor portable is smaller and lighter than previous portables and (2) it uses only one small battery which has a prolonged life mainly because transistors draw such a small amount of current.

Transistorized automobile radios are also increasing in popularity. Such radios do not have vibrators, and the transistors and special low-voltage tubes used in them operate satisfactorily with the 14.7 volts DC available in many 1955, '56 and '57 model cars.

With the increasing number of these transistorized receivers appearing on the market, many of them will soon be coming into repair shops for service. Here are some practical hints and precautions which will help you service this type of set.

First of all, transistors are current-sensitive devices, and any excessive current flow through them can cause considerable damage. Several things which could result in excessive current flow through a transistor during a servicing procedure are:

1. Leakage current from a defective soldering iron.
2. Current from an ohmmeter.
3. Induced current from a soldering gun.
4. Signal currents introduced by the AC component of the output voltage from a battery eliminator. (NOTE: Some battery eliminators are currently being made with low ripple content and good regulation so as to permit their use with hybrid auto radios.)
5. Charging currents from line filter capacitors in signal generators.

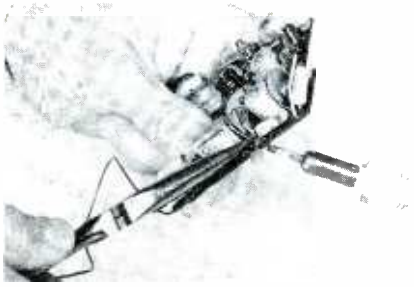

Fig. 1. Long-nosed pliers used as heat sink during removal of transistor.

To avoid possible damage from these extraneous excessive currents, the following precautions should be observed when working with transistor circuits:

1. Never use test instruments that employ transformerless power supplies unless an isolation transformer is first placed between the instrument and the AC line.
2. An ohmmeter that passes more than 1 ma with the test leads shorted on any range should not be used to make measurements.
3. Use battery power to operate transistorized equipment unless otherwise stated by the manufacturer.
4. Interconnect the ground terminals of all test equipment with a common ground wire.
5. Never ground the base element of a transistor.

In addition to the ill effects of excessive current, a transistor can also be permanently damaged by excessive heat. If a transistor socket is used, remove the transistor from any circuit that requires work with a soldering iron. If the transistor is soldered into the circuit, each lead of the transistor should be gripped with a pair of long-nosed pliers whenever an iron is applied to the solder joint associated with that lead. (See Fig. 1.) The pliers will act as a heat sink, and the heat will be dissipated before it reaches the body of the transistor.

(A) Connecting the probe.

(B) Built-in terminal board.

Fig. 2. Hook-on test probe made by E-Z Hook Test Products.

Hook-On Probe

Often, a test lead must remain connected into a circuit for long intervals of time; however, it is inconvenient to have to hold the probe in position by hand. The probe unit shown in Fig. 2 permits a test lead to be clipped into a circuit with only one hand, and the fingers need not come in contact

with the tip of the probe. The plastic tip cover being pushed back in Fig. 2A is spring loaded. Forward pressure of the tip against the connection point bares the metal hook to permit its connection to or withdrawal from the circuit. Fig. 2B shows that a terminal board is provided within the probe to allow the addition of a resistor, capacitor, or crystal diode in the test lead. The metal loop may be clamped around the body of the test lead and thus prevent strain from being applied to the connections of the terminal board. This probe unit is manufactured by E-Z Hook Test Products and is available through radio and TV parts distributors.

Water in Auto Antennas

There is one trouble that often plagues the auto antenna. Water runs down the antenna whip and may eventually get into the coaxial lead to the receiver input. When a customer complains that he can't seem to get stations after a heavy rain, this is most likely his trouble. Replacement of the antenna and the coax lead will solve the problem.

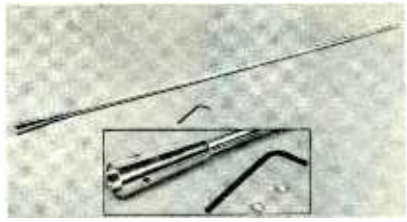

Fig. 3. Replacement "whip" element for auto antenna, made by Snyder Mfg. Co.

Speaking of auto antennas, Snyder Mfg. Co. has marketed a replacement "whip" element (Fig. 3) which can be fastened to the stub of an antenna that has broken off. The stub must be at least one inch long so that the new element can be secured to it by means of the set screws furnished with the element.

Tube Check

A receiver was recently in the shop for a picture tube replacement. After the new tube was installed, the receiver was adjusted and then given an operational check for a few minutes. The receiver seemed to be operating satisfactorily, but the technician decided to test the tubes and replace any that might cause future troubles. As a result of this test, three of the four 6CB6 video IF tubes were found to be defective (one proved to have a short) and the 6AU6's used in the sound IF and AGC keyer stages were extremely gassy. These defective tubes, had they not been detected and replaced, could have resulted in expensive callbacks and, even worse, a dissatisfied customer. Whenever a television receiver is in the shop for extensive repairs, it will always pay to test *all* tubes. ▲

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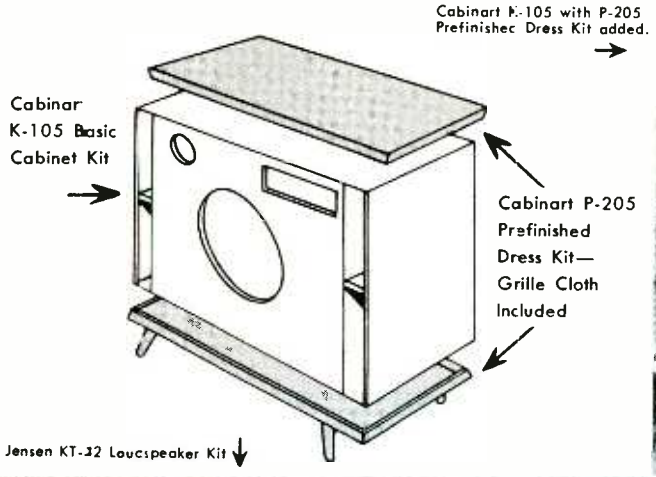

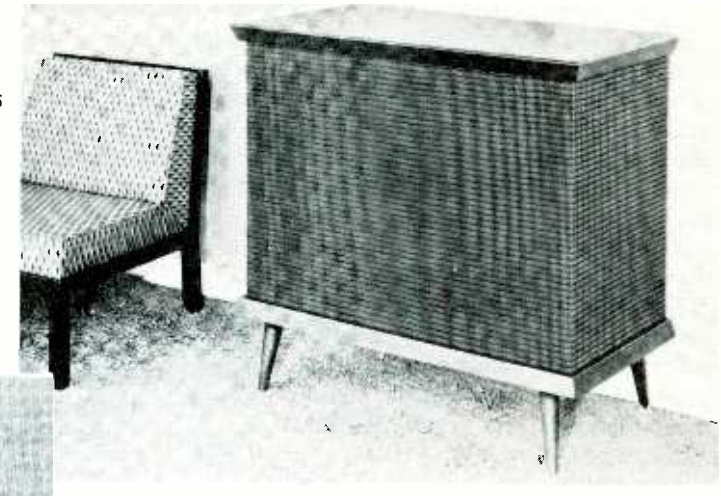

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2-Way†	15"	——	KT-21	99.50	Corner* Bass-Ultraflex	K-103	48.00	P-203	39.00
2-Way†	15"	——	KT-21	99.50	Low Boy Bass-Ultraflex	K-105	48.00	P-205	39.00
2-Way†	12"	Concerto	KT-22	73.00	Corner* Bass-Ultraflex	K-107	39.00	P-207	36.00
2-Way†	12"	Concerto	KT-22	73.00	Low Boy Bass-Ultraflex	K-109	39.00	P-209	36.00
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the COLOR KILLER CIRCUIT

How It Works and How to Trouble Shoot It.

by Ken Kleidon*

The color killer circuit used in many of the present color receivers is somewhat different in design and operation from those employed in earlier models. The function of this circuit, however, still remains unchanged—it disables the chrominance circuits during monochrome reception. When the color killer circuits of several major makes of current color receivers were recently analyzed, they were found to be almost identical in every respect. This particular fact makes the service technician's task of understanding circuit operation much simpler, since only one basic type of circuit requires consideration.

Purpose

The color killer circuit provides automatic control of the chrominance circuits of the color receiver. During the reception of a monochrome signal, it prevents the chrominance circuits from passing undesirable signals which would appear on the face of the picture tube as a form of colored confetti. Yet it allows passage of the chrominance signal during the reception of a color transmission.

Without the action of the color killer, the chrominance amplifier would pass monochrome signal frequencies which fall within the chrominance channel bandpass of at least 3.1 to 4.1 mc. These signals would be amplified and coupled to the chrominance demodulators. The monochrome signals from the chrominance amplifier would be demodulated and applied to the picture tube and would appear as random color noise in the monochrome picture. The noise would be seen as objectionable low-frequency interference because of the low-frequency passband of each demodulator. This objectionable interference is prevented by employing a color killer stage to automatically bias beyond cutoff one or more stages in the chrominance channel during monochrome reception.

Operation

A typical color killer circuit is illustrated in Fig. 1. The pulse coupled to the color killer grid is usually obtained from the HV deflection transformer, is negative in polarity, and occurs during the horizontal blanking interval (see Fig. 2). This pulse is applied to the color killer grid through capacitor C1. During monochrome reception, the color killer stage is allowed to conduct and amplify the pulse. Because of the phase reversal from grid to plate, a voltage pulse of positive polarity appears in the plate circuit (see Fig. 3).

The positive pulse is coupled through capacitor C2 to the control grid of the chrominance amplifier and prevents it from conducting thusly. When the pulse is going positive, during the blanking interval, a positive potential is placed on the control grid of the chrominance amplifier. This causes the stage to draw grid current and to charge capacitor C2 in the polarity shown in Fig. 1. At the end of the blanking interval, the positive pulse no longer appears and capacitor C2 discharges through resistor R4. The negative potential thus developed is sufficient to bias the chrominance amplifier to cutoff. The time constant of R4 and C2 is long enough to keep the stage from conducting until the next positive pulse occurs, at which time the procedure is repeated and the amplifier is held at cutoff during the next line-scanning period.

During color reception, however, the chrominance amplifier must be operating; therefore, the

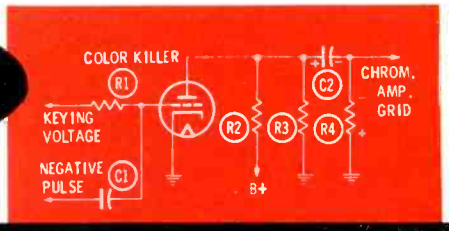

Fig. 1. Typical color killer circuit.

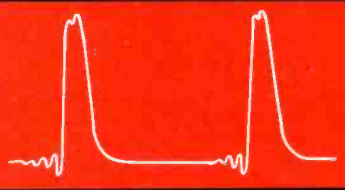

Fig. 2. Negative pulse applied to the grid of the color killer.

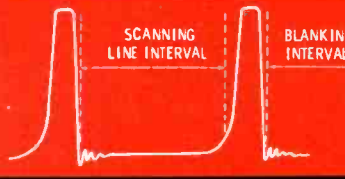

Fig. 3. Positive pulse at color killer plate during monochrome reception.

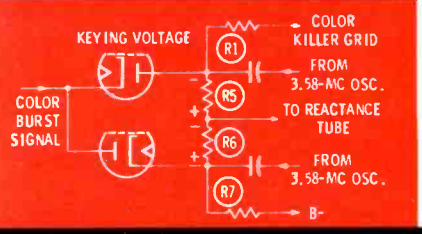

Fig. 4. Typical color phase detector.

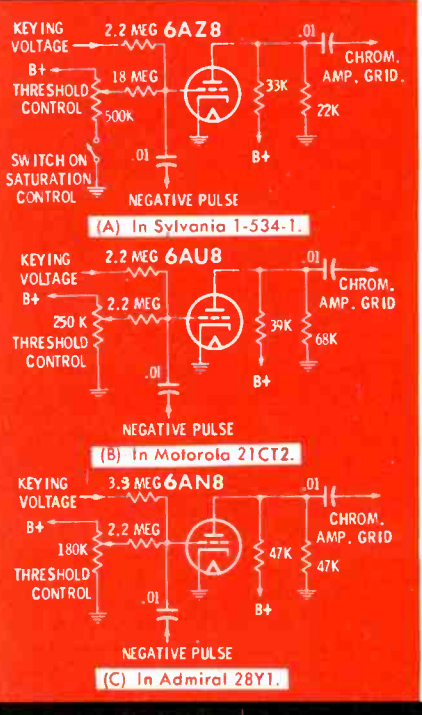

Fig. 5. Commercially used color killers.

* Mr. Kleidon is National Color Television Manager of Hycon Electronics, Inc.

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color killer stage must be prevented from amplifying the pulse. Also shown coupled to the color killer grid in Fig. 1 is a keying voltage which in effect tells the color killer stage when and when not to amplify the pulse. This keying voltage is usually a negative bias voltage which is supplied from the color phase detector circuit.

If the transmitted signal is suddenly changed from monochrome to color, the chrominance and color burst signals will appear at the grid of the chrominance amplifier. This stage is being held at cutoff during trace time, but is being pulsed into conduction during the retrace period. Since the color burst signal is transmitted during the latter period, the burst will be amplified and allowed to reach the phase detector circuit.

As shown in Fig. 4, the phase detector consists of two diodes which serve to compare the phase of the local reference oscillator signal with the phase of the burst signal. An error in the phase of the locally generated signal causes a correction voltage to be developed at the junction of R5 and R6. The magnitude of the total voltage developed across R5 and R6 varies directly with the amplitude of the color burst signal. If the burst amplitude increases, the developed voltage increases; likewise, if the burst amplitude decreases, the developed voltage decreases. The negative voltage at the junction of R1 and R5 is utilized as the keying voltage for the color killer stage.

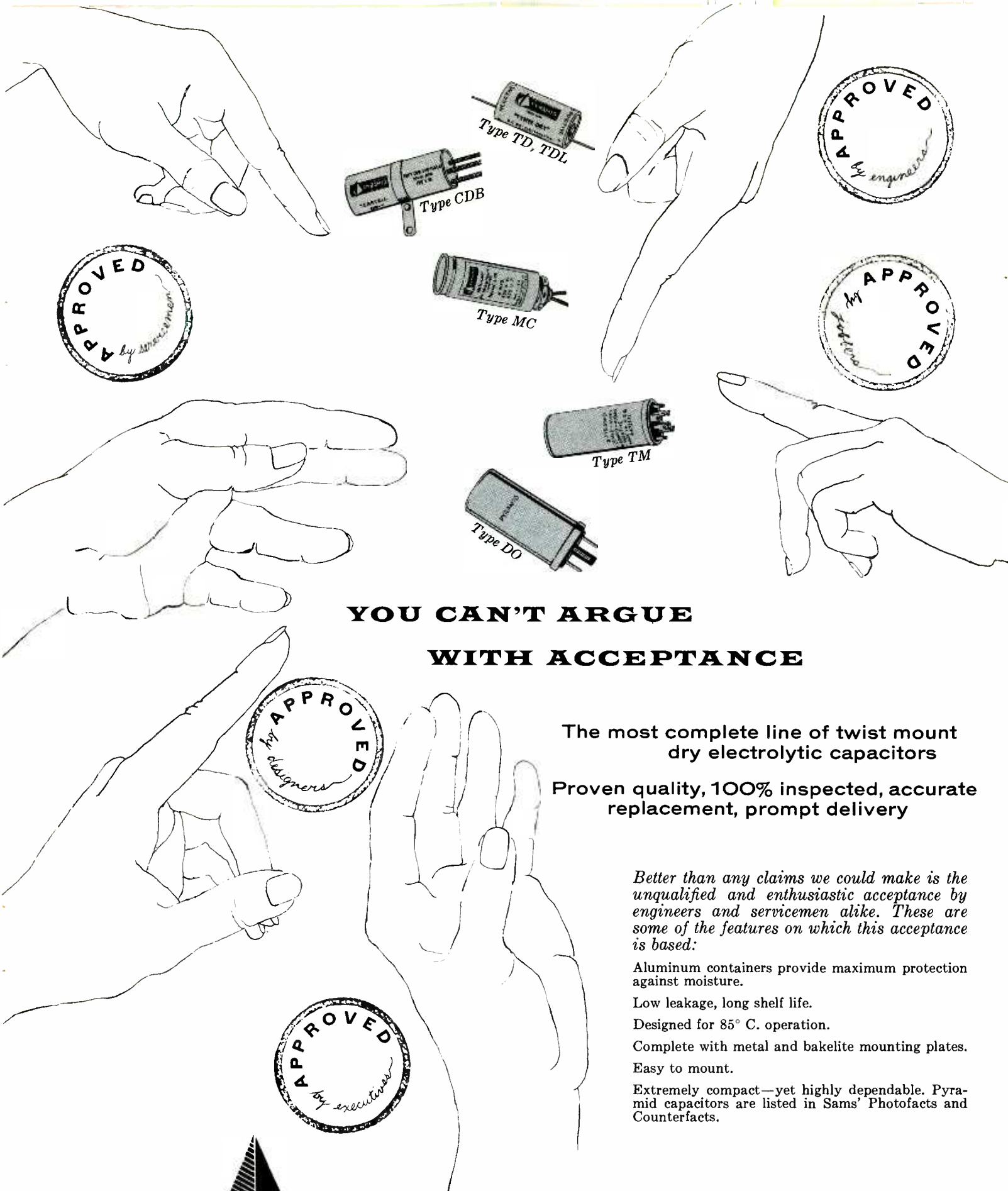
During monochrome reception, the color burst signal will be absent and the negative voltage developed at the color phase detector will be reduced. With the low bias voltage on the grid, the color killer will operate and amplify the pulse coupled to its grid, and the chrominance amplifier will be cut off.

During reception of a color signal, the color burst signal is transmitted and causes a considerably higher negative voltage to be developed across R5 and R6 in the phase detector circuit. The negative voltage is coupled through resistor R1 to the color killer grid and prevents the killer stage from conducting. The negative bias voltage developed at the color phase detector is therefore a keying voltage for the color killer stage and its presence determines whether or not the color killer will operate.

If the chrominance signal, which includes the color burst, is reduced in amplitude due to poor antenna response, transmission-line attenuation at the color subcarrier frequency, etc., the negative voltage developed at the phase detector circuit will also be reduced. The keying voltage applied to the color killer grid will therefore be reduced and the killer stage may possibly conduct. The color killer stage does not cut off completely until a prescribed value of bias voltage is present. If a keying voltage less than this prescribed value is applied, the color killer will conduct slightly, increase the chrominance amplifier bias, and reduce the amplitude of the chrominance signal applied to the demodulators. A reduction in the saturation of the colors on the face of the picture tube will result.

To compensate for reception conditions of this type, a color killer "threshold" control is provided as shown in the circuits of Fig. 5. Notice the similarities between the circuits of Fig. 5 and that of Fig. 1, the main difference being the use of the threshold control. This control is connected to the B+ source and varies the positive voltage applied to the color killer grid; thus the operating point of the circuit may be varied to compensate for differences in reception conditions. For the reception condition mentioned above, the threshold control would be adjusted to decrease the positive voltage applied to the color killer grid and permit cutoff of the killer stage. A switch provided in the ground lead of the threshold control may be actuated by turning the color saturation control completely counterclockwise. This will positively assure conduction of the color killer stage during weak-signal monochrome reception, since it is possible that noise pulses present during retrace time could simulate a burst signal and inactivate the color killer.

The circuit illustrated in Fig. 5A is the color killer stage used in Sylvania's 1-534-1 chassis. During



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monochrome reception, the voltage reading at the grid measures −6 volts. With 100 volts on the plate, the tube amplifies the negative 7-volt peak-to-peak pulse (Fig. 2) coupled to the grid. The positive pulse (Fig. 3) appearing at the plate measures 28 volts peak-to-peak and is coupled to the grid of the chrominance amplifier. During color reception, the voltage reading at the grid of the color killer measures −12 volts which is sufficient to prevent this stage from conducting. The plate voltage at this time should measure 117 volts.

The circuits of Figs. 5B (Motorola 21CT2) and 5C (Admiral 28Y1) are identical to that of Fig. 5A except for the saturation-control switch, component values and the tube types employed. The circuit in Fig. 6 (RCA 21-CS-7815) employs a slight modification in that a positive pulse is applied to the cathode. (This provides the same action as a negative pulse at the grid.) Fig. 7 shows the color killer circuit employed in the Emerson 120296-D. Notice that a threshold control is not used and the grid is coupled to a fixed B+ source. This type of circuit is also used in the Raytheon 21CT1, Hoffman 704, and Sentinel 816.

Servicing

When service is attempted in the color circuits of a color receiver, the operation of the color killer stage is an important consideration and must not be overlooked. The chrominance amplifier, burst gate or amplifier, color phase detector and color killer circuits are an integral part of the color circuitry and are all interrelated. When trouble develops in one circuit, the operation of the other circuits is affected because of the action of the automatic chrominance control (ACC) circuit. Suppose, for example, that trouble develops in either the burst amplifier or phase detector circuits—the burst signal will be lost, the negative keying voltage from the color phase detector will be reduced, and the color killer stage will then operate and cut off the chrominance amplifier. A loss of color reproduction will result. If the color killer stage itself fails, it will have no effect during color reception, as it is normally inoperative at this time. The only effect during monochrome reception will be the appearance of color snow in the picture.

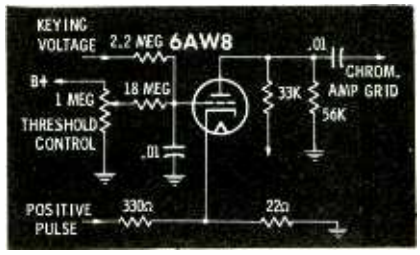

Fig. 6. Color killer circuit used in RCA Victor 21-CS-7815.

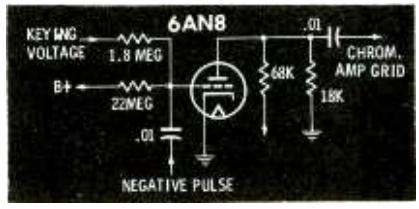

Fig. 7. Color killer circuit used in Emerson 120296-D.

Another important consideration when servicing is the adjustment of the threshold control. Varying reception conditions of different antenna systems and at different geographic locations necessitate adjustment of this control to obtain color reproduction after the receiver has been moved. Also, if color is available on two channels in an area, a compromise setting of the threshold control may be necessary.

The use of a color bar generator will prove to be a time-saving asset when servicing the color killer circuit. This instrument is designed to produce a signal which simulates either a color or monochrome signal. When a condition of "no color" exists and a normal black-and-white picture is obtained, the trouble is usually in the color circuits of the receiver. As mentioned previously, the color killer stage may be operating if the trouble is in either the burst amplifier or color phase detector circuits. The color killer is a dividing point in the color circuitry and should be the first circuit checked when a "no color" condition exists.

The RF output of the color bar generator should be connected to the antenna terminals, and the waveform at either the plate of the color killer or grid of the chrominance amplifier should be observed. If the waveform of Fig. 3 is observed, the color killer stage is operating and it will then be a matter of determining why it is

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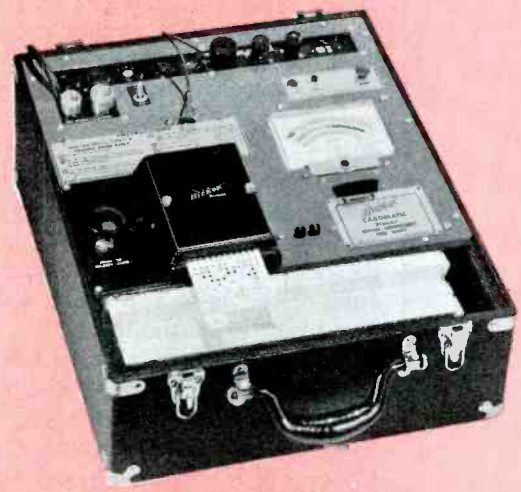

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doing so in the presence of a color signal. A VTVM reading at the color killer grid compared with that specified in the service literature will indicate whether the threshold control requires adjustment or if the keying voltage supplied by the color phase detector is improper.

If the keying voltage is low, a sufficient negative voltage externally supplied to the grid of the color killer will prevent it from conducting. The keying-voltage lead to the color killer grid may be disconnected to prevent unbalancing of the phase detector circuit.

An alternative method of disabling the color killer stage is to remove the color killer tube from its socket and substitute a dummy tube of the same type with either the plate or cathode pin of the color killer section clipped off.

With the color killer disabled, a trouble can be more easily located since the chrominance amplifier will be operating and color should appear on the face of the picture tube. The trouble will be more apparent and can be traced with less difficulty.

If the waveform of Fig. 3 is not observed with the color signal applied, the color killer stage is not operating (normal condition) and the trouble is then between the chrominance amplifier grid and picture tube.

If the appearance of color snow is noticed during monochrome reception, the color killer is not performing its function and the setting of the threshold control should be checked. To do this, the color bar generator is connected to the antenna terminals as before and the generator controls are set so that a monochrome signal will be produced. To determine why the color killer stage is not conducting, the plate and grid voltages and the waveform at the grid should be checked.

The color killer circuit is designed to be entirely automatic, and it should therefore not be necessary to turn down the color saturation control when viewing a monochrome program. When color is transmitted, the circuit will automatically respond to allow the receiver to reproduce a color picture. ▲

ALUMINIZED PICTURE TUBES

by Leslie D. Deane

What You Should Know About These Highly Publicized CRT's

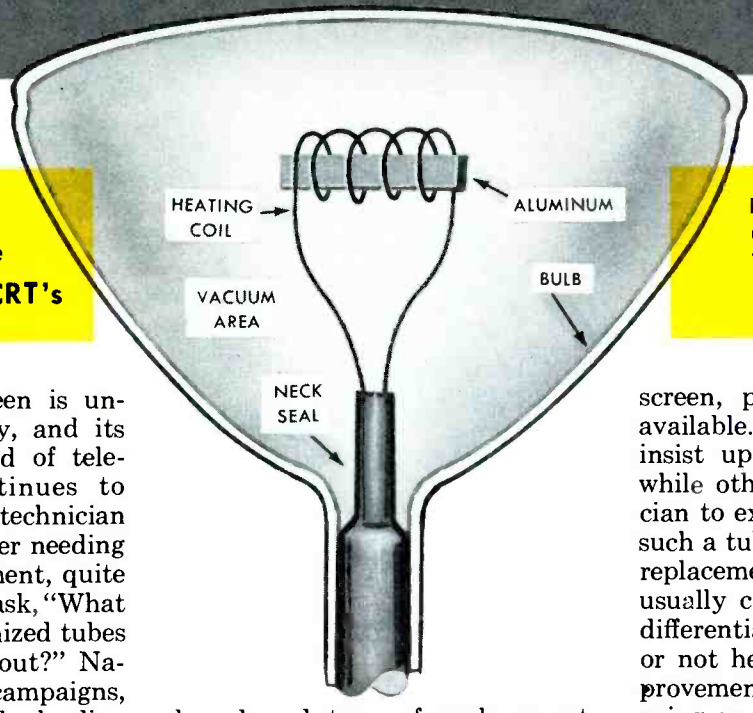

Fig. 1. Vaporizing process used to aluminize TV picture tubes.

The aluminized screen is undoubtedly here to stay, and its prominence in the field of television servicing continues to mount. When a service technician encounters a TV receiver needing a picture tube replacement, quite often the customer will ask, "What about these new aluminized tubes I've heard so much about?" Nation-wide advertising campaigns, sponsored by some of the leading tube manufacturers, have now brought the aluminized tube to the attention of the general public. As a result, the average customer willing to invest in a new picture tube has become interested in the brand and type of replacement tube the technician intends to install.

In other instances, the service technician may ask the customer whether he prefers an aluminized tube or one with a conventional screen, provided that both are available. Many set owners may insist upon an aluminized tube while others will ask the technician to explain the advantages of such a tube over a nonaluminized replacement. The customer is usually concerned with the price differential involved and whether or not he will recognize any improvement in picture quality by using an aluminized tube. So, let us see what an aluminized picture tube is, how it is constructed, its advantages, how it can be identified, and a few general replacement considerations.

Table I—Aluminized Tube Classification

Group I			Group II	Group III	Group IV	Group V	
10FP4	17LP4	21AVP4	17BP4	10BP4	10BP4	10FP4	21BNP4
12KP4	17QP4	21JP4	17HP4	12LP4	20CP4	10RP4	24TP4
12ZP4	21ACP4	21WP4	20CP4	19AP4	20HP4	12KP4	24YP4
14QP4	21ALP4	21XP4	20DP4	20DP4		12ZP4	24ZP4
14RP4	21AMP4	21YP4	21ALP4	2HP4		21ATP4	27EP4
16KP4	21ANP4	24AP4	21AUP4A	21FP4		21AWP4	27LP4
16RP4	21AQP4	24CP4	21AVP4A			21BAP4	27MP4
17ATP4	21ARP4	24DP4	21EP4			21BCP4	27RP4
17AVP4	21AUP4	24VP4	21ZP4			21BDP4	27SP4

NOTE: All tubes in Group I bearing the suffix letter "A" have aluminized screens. ("A" does not necessarily stand for aluminized.) All tubes in Group II bearing the suffix letter "B" have aluminized screens, all tubes in Group III bearing the suffix letter "C" have aluminized screens, and all tubes in Group IV bearing the suffix letter "D" have aluminized screens. The picture tubes listed in Group V represent those not bearing any suffix letters, but which have aluminized screens. These aluminized tubes were therefore the first of their particular type to be registered with the RETMA. One can safely assume that any tube in Group V, regardless of suffix, would have an aluminized screen.

What Are They?

Suppose a customer asks the direct question, "What is an aluminized tube?" The technician should try to give an intelligent, straightforward answer to such a question, explaining the facts in as much detail as possible.

Actually, the aluminized or metal-backed screen was developed years ago through extensive research in the field of light optics. At that time, the problem of obtaining brighter pictures from larger television screens received considerable attention. During this period of research, it was found that the application of a mirror-like backing to the phosphor screen caused a substantial increase in light output.

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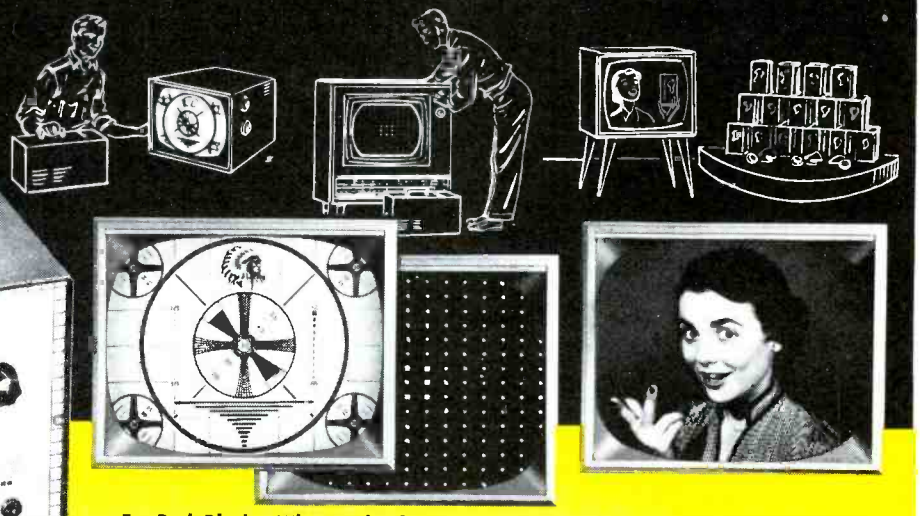

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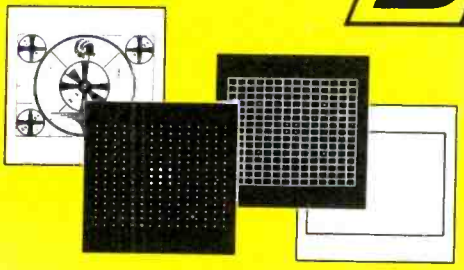

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weight, it was selected as a likely material for the reflecting surface. A thin layer or film of metallic aluminum was deposited directly behind the phosphor-coated screen of certain picture tubes, and tubes featuring this type of screen became known as aluminized tubes.

How Are They Made?

Before applying a metallic film behind the phosphor screen, the tube manufacturer must take certain factors into consideration. The aluminum coating, for instance, must be sufficiently thin to enable accelerated electrons to penetrate the coating and thus excite the screen phosphors. In addition, the coating must be smooth, opaque, and possess a high degree of reflectivity.

The aluminum cannot be deposited directly on the screen because of possible damage to the phosphor crystals and because the surface formed would be much too rough for good reflection. With these basic factors in mind, let us examine the manufacturing steps required.

The aluminizing process begins shortly after the fluorescent screen has settled and dried on the inner surface of the faceplate. The method of depositing the metal is accomplished by vaporizing a controlled amount of pure aluminum under a vacuum. Each tube is first carefully inspected for any imperfections and then a protective solution of either plastic or lacquer is applied to the screen surface. One method used to apply this protective coating includes a water cushion. In this process, a film of water is used to cover the phosphor screen prior to the application of the protective solution. The water forms a smooth surface upon which the lacquer is deposited. Then the water is carefully poured off and the lacquer coating settles and dries. The lacquer provides a smooth surface on which the aluminum film may be applied and prevents the hot metal vapor from coming in direct contact with the phosphor crystals.

The metal coating is deposited by first inserting a small piece of pure aluminum into the tube as pictured in Fig. 1. The aluminum pellet is supported by a coil of wire which acts as a heater or filament.

The neck opening is then sealed and the air in the bulb exhausted. When the proper degree of vacuum is reached, current is passed through the coil, heating it to an extremely high temperature. The aluminum reaches a melting point and because of the reduced pressure in the bulb, it vaporizes. The vapor particles then condense on the relatively cool surfaces of the bulb. Thus, a thin mirror-like film of aluminum is deposited on the back of the screen and inner surfaces of the bulb. After this process has been completed, the plastic or lacquer coating, which had protected the phosphor screen, is burned or baked out. This actually completes the aluminizing

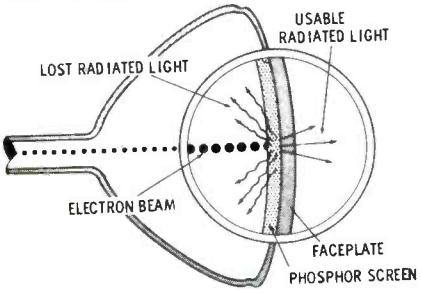


Fig. 2. Light loss in a tube with non-aluminized screen.

process although there are a number of other operations necessary before the tube becomes a finished product.

Advantages

Picture tubes with aluminized screens afford several advantages over those without metal screen backing. The aluminum coating or reflector serves two major purposes. First, it increases light output, and second, it aids in the prevention of ion burns on the phosphor screen.

In a conventional picture tube, about one half of the light emitted from the screen is radiated back into the bulb (Fig. 2) and the other half is radiated out toward the television viewer. Approximately 15 to 20% of this light, however, may be absorbed by the glass faceplate in front of the screen. Thus, only 30 to 35% of the total light emitted from the phosphor is actually utilized.

In an aluminized picture tube, the metal film behind the phosphor screen is so thin that it contains thousands of microscopic openings. These openings permit the passage of accelerated elec-

trons which energize the phosphor crystals without appreciable loss of energy. The metal film is thick enough, however, to reflect the light normally radiated back into the bulb. This is illustrated in the line drawing of Fig. 3. The aluminized tube effectively utilizes nearly all of the light generated by the phosphor screen and will produce brighter pictures than tubes with conventional screens.

Most technicians are well acquainted with the term "ion burn." This undesired effect usually reveals itself in the form of a yellowish-brown spot near the center of the picture tube screen. The burn, or spot, results from a

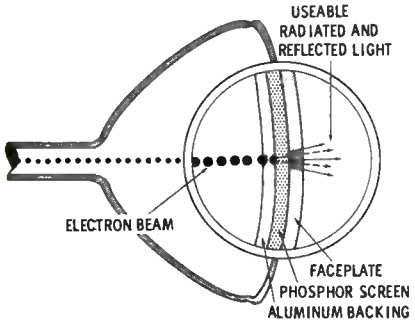


Fig. 3. Aluminized screen reflects light toward TV viewer.

continued bombardment of ions in a limited area of the phosphor. Ions in a CRT are either gas molecules or molecules of the coating material found on the tube's cathode. They are much heavier and more massive than electrons, and when negatively charged will be attracted toward the fluorescent screen by the accelerating anodes. Because of their mass, these negatively charged ions are not easily deflected by the magnetic field of the yoke and will concentrate on the center portion of the screen. It is this concentration of relatively massive ions that results in damage to a small area of the phosphor.

Tube manufacturers have faced this problem in every magnetically deflected CRT yet designed. Several methods have been devised to remove ions from the electron beam. The technician is undoubtedly familiar with the combination of a bent or tilted gun and a single-magnet ion trap, or a slashed gun and a double-magnet ion trap. These methods have proven successful in the prevention of ion bombardment of the phosphor screen provided the ion

trap has been properly adjusted.

When the aluminized screen was first developed, it was believed that the metal backing would act as a stone wall to the large ions and no ion trap would be necessary. This was true to a certain extent, but it was also found that in order to completely block the ions, it was necessary to construct the metal backing slightly thicker than originally planned. This, in turn, required a higher second-anode voltage, especially for the larger picture tubes.

The aluminized screen of today definitely aids in the prevention of ion burns, but the majority of aluminized tubes still call for a single-magnet ion trap. Several aluminized tubes not requiring an external or internal ion magnet are:

10DP4	10SP4	21BCP4
10FP4	12KP4	21BDP4
10FP4-A	12KP4-A	21BNP4
10RP4	16AFP4	24ZP4
	21BAP4	

There are other types of aluminized tubes such as the 21ARP4-A and 21JP4-A which also require no external ion trap. These tubes, however, have small ion and focus magnets built within the neck of the tube itself. From this, we can see that only about 25% of approximately 60 or 70 aluminized tube types can actually be operated without the use of an ion trap.

Another advantage of the aluminized screen is the improvement in picture contrast. This is more of an indirect result of aluminizing, but it still is an important feature. Picture contrast is usually determined by the degree of difference between the brightest and darkest picture elements. In a nonaluminized tube, the light given off by the electron-excited phosphor will radiate back into the bulb. This light is then reflected from the inner walls of the tube and will backlight the entire screen area. Under these conditions, the black elements of the picture may appear gray, resulting in reduced contrast.

Screen backlighting is eliminated in the new aluminized tubes because the metal coating prevents light penetration from either

side. The white elements of the picture are also brighter due to the increase in light output by the mirror-like surface directly behind the phosphor. It stands to reason that with darker blacks and brighter whites the aluminized tube offers improved picture contrast.

From an electrical standpoint, the aluminum coating improves the secondary emission characteristic of the screen. In all picture tubes, the beam of electrons striking the screen will cause other electrons to be released. These electrons must find their way to the inside aquadag coating and return to the second-anode supply if the electrical circuit is to be completed. If the secondary electrons are allowed to accumulate, the screen will become negatively charged. This condition is often referred to as "sticking," which actually limits the number of electrons that reach the screen and results in limited brightness and contrast. The metal backing in an aluminized tube is highly conductive, thus providing a path for the return of the secondary electrons.

Tube Identification

The technician will generally find it easy to identify an aluminized tube by its physical characteristics. As mentioned previously, the aluminum film not only covers the screen area but also the inner walls of the bulb. Most of the newer 90° glass tubes have only a portion of their outer bulb surfaces coated with aquadag. This makes the silvery, mirror-like coating readily visible if the tube is aluminized.

The older glass tubes have aquadag covering over most of their surfaces. In these instances, the shiny aluminum may only be detected around the high voltage connector or close to the face of the tube. In the case of a metal cone, the coating may be visible around the rim or somewhere along the neck. At present, however, the 19AP4-C, 24AP4-A and 27MP4 are the only popular aluminized metal tubes available.

From another viewpoint, the technician will find it difficult to completely identify an aluminized tube by its type number. Many tubes will have an additional let-

ter after the basic type number, such as 21YP4-A. As of now, only "A" through "D" have been used for these suffix letters. The suffix designation indicates that there has been a change in the design of the original tube type but not enough of a change to warrant a completely new number. There have been no set standards adopted for these additional letters, and the technician may find this rather confusing. The suffix letter following the familiar type number usually indicates a change in faceplate, screen structure, or the addition or omission of an external conductive coating. In order to help the technician identify aluminized picture tubes by their suffix letter, they have been classified in Table I.

Replacement Considerations

The aluminized picture tube has now become a very popular replacement item in the field of television servicing. Advantages of the new screen design far overshadow the additional cost involved. Service technicians are, however, sometimes hesitant to use an aluminized tube as a replacement. This is true especially when physical or electrical differences exist between the original tube and the aluminized tube. Actually, very small differences in deflection angle, neck length and anode voltage are of no major consequence from a replacement standpoint.

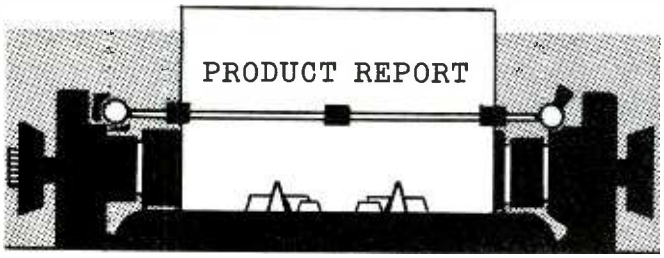
The technician might keep in mind that replacement is not recommended if the faceplates of the tubes are differently shaped. In addition, an electrostatically focused tube is not considered interchangeable with a magnetically focused tube; however, with proper circuit changes, such a replacement could be made. For detailed information on the replacement of various tube types, the technician should consult one of the many aluminized tube replacement charts or guides made available by all leading picture tube manufacturers.

Conclusion

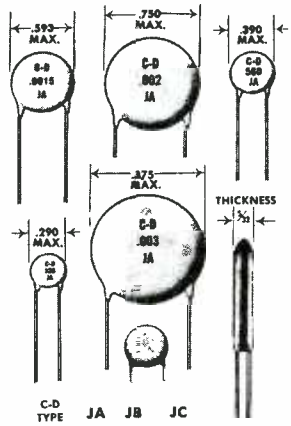
The general public will usually consider that an aluminized picture tube has the advantage of increased picture contrast. The aluminized screen, plus a gray or tinted faceplate, makes picture viewing much easier even under bright sunlight. Aluminizing a tube also increases the useful life of the viewing screen by protecting the phosphor coating and improving the electron conduction from its surface.

One of the latest additions to the family of aluminized picture tubes is a new rectangular series of tubes having a deflection angle of 110° and using a straight gun, no ion trap, and an improved electrostatic focusing system. The wide deflection angle results in a shallower bulb design as compared to conventional tubes of equal screen area.

Perhaps the next thing to hit the TV picture tube market will be larger panoramic screens, followed eventually by mural TV. It is hoped that with an up-to-date replacement guide and the facts mentioned in this article, the technician will be able to answer any and all customer questions concerning aluminized tubes—and perhaps at the same time feel confident in recommending them whenever they can be used. ▲



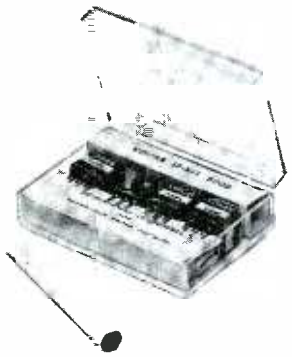
STABILIZED CERAMIC CAPACITORS



Three new types of general-purpose ceramic disc capacitors with highly stable capacitance values over a wide temperature range are being produced by Cornell-Dubilier Electric Corp., South Plainfield, N.J.

Type JA capacitors vary no more than ±5% from their 25° C. value at any temperature from −55° to +125° C. Type JB units are stabilized to within ±10% of the 25° C. value over the same temperature range. Type JC are also stabilized to within 10%—but over the more limited temperature range of +10° to +85° C. Maximum values available are 3,800 mmfd (JA); 5,000 mmfd (JB); and 7,500 mmfd (JC).

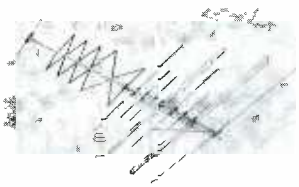
TRANSISTOR TRANSFORMER KIT



Vokar Corp., 7300 Huron River Dr., Dexter, Mich., is furnishing a new IF-KIT 5000 containing three 455-kc IF transformers and one 455-kc oscillator coil for use in transistorized circuits. These same components are being produced by the company for several brands of transistorized portable radios.

A suggested superheterodyne circuit and a parts list are included in each kit, to aid the technician or experimenter in building a radio using the transformers.

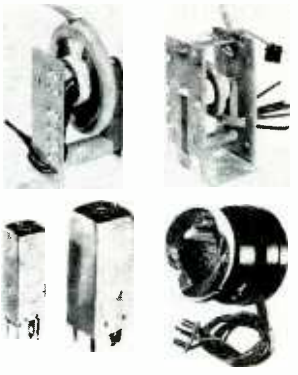
ALL-CHANNEL FRINGE ANTENNA



The Wonder-Helix Colortenna developed by JFD Mfg. Co., Inc., 6101-16th Ave., Brooklyn, N.Y., is an all-channel antenna for deep fringe areas, especially designed for improved low-band performance.

Two 600-ohm folded dipoles are used as double-driven elements for low-band reception. Different sections of the flat-plane helix are separately tuned to various high-band channels. The Wonder-Helix is said to have a good 300-ohm impedance match which results in low VSWR, a front-to-back ratio of at least 10 to 1, and a narrow polar pattern.

NEW YOKES AND TRANSFORMERS



Merit Coil and Transformer Corp., 4427 N. Clark St., Chicago, Ill., announces the following additions to its line of exact replacement parts. MDF-78 and MDF-80 are 70° cosine yokes for over 200 models of Motorola, Hoffman, and Hallicrafters receivers. MDF-79 is a cosine yoke with plug for over 50 Motorola models.

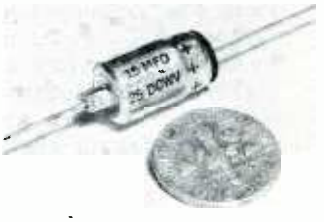
HVO-59 and HVO-61 are flybacks which replace General Electric parts RTO-125, -6, -7 and RTO-129, -30. New flyback HVO-62 replaces Magnavox parts 360580-1, 360604-1, and 360610-1.

BC-356, -7, -8, and -9 are new 455-kc IF transformers for use in printed circuits.

VACUUM TUBE VOLTMETER

Anchor Products Co., 2712 W. Montrose Ave., Chicago, Ill., is manufacturing a vacuum tube voltmeter, Model V500. With the unit, AC and DC volts can be measured on 4 scales having full-scale readings of 3, 30, 300, and 1200 volts. Calibration in decibels is also provided. Four resistance scales, including R x 1 meg, are furnished. Other features include zero centering for FM alignment, a neon pilot lamp, a polarity reversal switch, and overload protection on all ranges. The meter has a carrying case with detachable cover and storage compartment for test leads and line cord.

MINIATURE ELECTROLYTICS



Miniaturized capacitors of the hermetically sealed aluminum-can electrolytic type are being made by Aerovox Corp., New Bedford, Mass. These units, designated Type XPP, are only 3/16" to ⅜" in diameter and ½" to ¾" in length. They are available in values of 1 to 50 mfd. at working voltages of 3 to 25 VDC, and the standard range of operating temperatures is −20° to +65° C.

SCREWDRIVER KIT

The CK-20 kit sold by Xcelite, Inc., Orchard Park, N.Y., contains two double-ended, reversible screwdriver shafts and a detachable handle, all packaged in a zippered bag of transparent plastic. One of the shafts has 3/16" regular blade at one end and a #1 Phillips point at the other and the second shaft features a combination of ¼" regular and #2 Phillips tips. A 7/16" hex bushing, imbedded in the handle, grips a shoulder which is fastened to the center of each shaft. The kit lists at $4.40 less trade discounts.

DUAL VOLTAGE CONVERTER

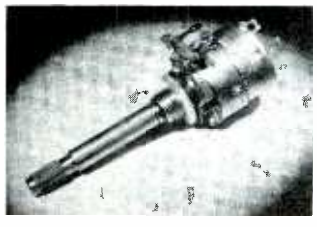
A new DC-to-AC power converter made by Terado Co., 1068 Raymond Ave., St. Paul, Minn., will operate from either a 6- or 12-volt automobile electrical system without requiring any switching or modification in the converter circuit. The user simply plugs the input lead into the cigarette lighter of any car.

Output of the Terado Trav-Electric "Automatic" converter is 110 volts at 60 cycles AC. The power capacity (continuous rating) is 55 watts when used in a 6-volt system and 85 watts in a 12-volt system. List price of the converter is $49.95.

POWER RECTIFIER TUBE

Amperex Electronic Corp., 230 Duffy Ave., Hicksville, L.I., N.Y., has released technical data on the GZ34 rectifier tube, one of a new series of nine "preferred" types for hi-fi audio use which were originally developed by Philips of the Netherlands and are now being produced by Amperex. The GZ34, which features 250-ma output current, low output impedance, and small physical size, can be used to replace several popular rectifier tubes such as the 5U4G and 5V4G. No circuit changes are necessary in the majority of amplifier power supplies.

PUSH-PULL SWITCH



A push-pull on-off switch that can be combined with a Series 47, 15/16" diameter volume control is now available from Clarostat Mfg. Co., Inc., Dover, N.H. The advantage of push-pull action is that a radio or TV set can be turned on and off without disturbing the volume setting.

The switches are available in three types having the following ratings: Series AG-17, .5 amp at 125 vdc or 1 amp at 125 vac; Series AG-18, .5 amp at 125 vdc or 3 amp at 125 vac; Series AG-19, .5 amp at 125 vac.

REPLACEMENT CARTRIDGE

The Astatic Corp., Conneaut, Ohio, has released a new Model 430 phonograph pickup cartridge. This unit is a direct replacement for Sonotone Models W7500, 7530, and 7540 cartridges which are no longer being manufactured. A considerable replacement market exists for this cartridge, which was employed in many Silvertone record players. List price of Model 430 is $7.50.

Shop Talk

(Continued from page 9)

those which are used near the end of the line.

Furthermore, coaxial cables (and most other transmission lines, too, for that matter) will attenuate higher signal frequencies more than the lower frequencies. Again, for the sake of equalization, it is desirable to have the tapoffs possess an inverse frequency characteristic, i. e., they should attenuate the lower signal frequencies more than the higher frequencies.

In recognition of these factors, the firms which design master antenna system equipment have developed tapoff units which to a large extent achieve the desired results. For example, Jerrold provides a chart which tells the serviceman the proper tapoff units to use for various applications and another which reveals the insertion and isolation losses each unit introduces at the various channel frequencies. The two charts are shown in Tables II and III.

Let us consider Table II and see what it tells us. Along the left-hand side, numbers 1 through 20 represent the total number of connections to a riser cable. In the present case, there are 10 such connections and so we would focus on this number. Then, running our eye to the right, we see that for the first four tapoffs, we should use yellow-coded units (Jerrold type 1401-Y). For the next three floors down, we should use green-coded tapoffs (Jerrold type 1401-G). The two floors below this should have blue-coded units (Jerrold type 1401-B). Finally, for the last tapoff, we should use a "T" unit which is actually a blue-coded unit with a terminating resistor for the line.

Each riser must be terminated with a resistor having a value equal to the characteristic impedance of the cable to simulate an infinite line condition and thereby prevent standing waves from developing. Not only do such waves cause large signal fluctuations to occur along a line, but they also lead to ghost formation.

The next step is to determine just how much attenuation each tapoff unit will introduce into the

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Full Photographic Coverage: Photos of all chassis views are provided for each model; all parts are numbered and keyed to the schematic and parts lists for quicker parts identification and location.

Alignment Instructions: Complete, detailed alignment data is standard and uniformly presented in all Folders. Alignment frequencies are shown on radio photos adjacent to adjustment number—adjustments are keyed to schematic and photos.

Tube Placement Charts: Top and bottom views are shown. Top view is positioned as seen from back of cabinet. Blank pin or locating key on each tube is shown. Charts include fuse location for quick service reference.

Tube Failure Check Charts: Shows common trouble symptoms and tubes generally responsible for such troubles. Series filament strings are schematically presented for quick reference.

Complete Parts Lists: Detailed parts list is given for each model. Proper replacement parts are listed (with installation notes where required). All parts are keyed to chassis photos and schematics for quick reference.

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Table II—Suggested Distribution of Jerrold Tapoff Units

TOTAL NUMBER OF CONNECTIONS ON RISER CABLE	CONNECTION NUMBER																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	T																			
2	Y	T																		
3	Y	Y	T																	
4	Y	Y	Y	T																
5	Y	Y	Y	G	T															
6	Y	Y	Y	G	G	T														
7	Y	Y	Y	G	G	G	T													
8	Y	Y	Y	G	G	G	B	T												
9	Y	Y	Y	G	G	G	B	B	T											
10	Y	Y	Y	Y	G	G	G	B	B	T										
11	Y	Y	Y	Y	Y	G	G	G	B	B	T									
12	Y	Y	Y	Y	Y	G	G	G	G	B	B	T								
13	Y	Y	Y	Y	Y	Y	G	G	G	G	B	B	T							
14	Y	Y	Y	Y	Y	Y	Y	G	G	G	G	B	B	T						
15	Y	Y	Y	Y	Y	Y	Y	G	G	G	G	B	B	B	T					
16	Y	Y	Y	Y	Y	Y	Y	Y	G	G	G	G	B	B	B	T				
17	Y	Y	Y	Y	Y	Y	Y	Y	Y	G	G	G	G	B	B	B	T			
18	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	G	G	G	G	B	B	B	T		
19	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	G	G	G	G	G	B	B	B	T	
20	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	G	G	G	G	G	B	B	B	T

Y = 1401-Y or 1402-Y units color-coded YELLOW—Do not insert "Y" units in riser cable past 250'.
G = 1401-G or 1402-G units color-coded GREEN. Do not insert "G" units in riser cable past 300'.
B = 1401-B or 1402-B units color-coded BLUE. Use "B" units in riser cable past 300'.
T = 1401-T or 1402-T units—*Terminate every riser cable with this unit.*

line. For this information we would go to Table III. Here we have the isolation and insertion loss of each unit for every VHF channel. Since we are dealing with channel 13, we will use the figures listed at the bottom of the table.

Before we continue, let us review what we mean by isolation and insertion loss. Isolation loss refers to the attenuation suffered by the signal in passing from the line through the tapoff to the receiver. Insertion loss is the attenuation suffered by the signal as it passes each tapoff on its way down the riser cable. Since we are concerned here with the signal level at the farthest receiver, i. e., that positioned on the ground floor, we figure the insertion loss for all tapoffs from the top floor down and then add to this only the isolation loss of the tapoff on the lowest floor.

To start, we have four yellow-coded units and these introduce an attenuation of .37 db each on channel 13. Four times this figure gives us a total loss of 1.48 db. For the next three green-coded units, the total insertion loss is 3 times .70 or 2.10 db. And for the last three blue-coded units (taking into consideration the final unit), we have 3 times 1.50 or 4.50 db.

So much for the insertion loss. Now we must also add the isolation loss of the final tapoff since we are concerned with the signal at the farthest receiver. Table III tells us that the isolation loss of a blue-colored tapoff on channel 13 is 6 db. Thus, gathering all our attenuation figures, here is what we have:

8.70 db cable loss
1.48 db yellow tapoff insertion loss
2.10 db green tapoff insertion loss
4.50 db blue tapoff insertion loss
6.00 db isolation loss (blue or T unit)
22.78 db

Table III—Isolation and Insertion Losses for Jerrold Tapoff Units

Chan.	Unit Color Code	Isol. Loss (db)	Insert. Loss (db)
	Y	22	.06
2	G	19	.12
	B	16	.17
	Y	21	.08
3	G	18	.14
	B	15	.22
	Y	20	.10
4	G	18	.16
	B	14	.25
	Y	19	.11
5	G	17	.18
	B	13	.29
	Y	18	.12
6	G	16	.20
	B	13	.34
	Y	15	.25
7	G	11	.54
	B	8	.91
	Y	15	.28
8	G	11	.57
	B	8	1.03
	Y	14	.30
9	G	10	.60
	B	7	1.15
	Y	14	.32
10	G	10	.62
	B	7	1.22
	Y	14	.33
11	G	10	.64
	B	7	1.29
	Y	13	.35
12	G	9	.67
	B	6	1.38
	Y	13	.37
13	G	9	.70
	B	6	1.50

We can raise this to 24 db to provide some leeway; also, 24 is an easier figure to work with. Men who work with decibels generally like to break up any large number into multiples of 6 db. For every 6 db loss, the signal voltage is halved. In 24 db, we have 4 times 6 db. The voltage loss is equivalent to $\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2}$ or 1/16. Hence, if 3,000 microvolts are required at the farthest receiver, then 16 times 3,000 or 48,000 microvolts are needed at the input of this riser line. For the sake of simplicity, let us round this figure off to 50,000 microvolts. Thus, we require this much signal for channel 13 at the input of each of the risers. If we have more than 3,000 microvolts at the receiver, so much the better, but we want at least this amount.

Note that we used the longest riser in our computation and also that we figured the signal attenuation to the farthest set. Furthermore, we computed the loss for the highest channel frequencies the system must handle. For signals on other channels, a similar procedure would be followed. It is suggested that the reader work the computations on other channels in order to become familiar with the procedure. The method is simple and straight forward. Just be sure that every attenuation figure has been taken into account.

The results for channels 2 and 9 are:

Channel 2

3.75 db cable loss
.24 db yellow tapoff insertion loss
.36 db green tapoff insertion loss
.51 db blue tapoff insertion loss
16.00 db isolation loss
20.86 db

Channel 9

8.10 db cable loss
1.20 db yellow tapoff insertion loss
1.80 db green tapoff insertion loss
3.45 db blue tapoff insertion loss
7.00 db isolation loss
21.55 db

By studying Table III, you will note that the yellow-coded tapoff units introduce greater isolation loss than the green or blue units. Also, that the green-coded units introduce more attenuation than the blue-coded ones. This is done, as indicated previously, to equalize the signal received at each set. Furthermore, the isolation loss varies inversely with frequency. This is to offset, to some extent, the riser cable loss which varies directly with frequency. All this has been worked out by the design engineers of master antenna systems. We are merely pointing these features out to give the reader a better insight into the operation of the system.

The next step is to choose an amplifier which is capable of providing enough signal so that when it is divided among the 10 riser lines, each riser will be fed at least 50,000 microvolts. It is relatively easy to get an amplifier capable of producing 50,000 × 10 or 500,000 microvolts.

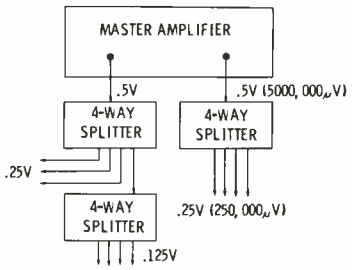


Fig. 2. Four-way splitters connected to provide the necessary number of riser signals. (Actually, 11 outlets are available, but only 10 would be used in our sample installation.)

As an example, let us say that the amplifier we choose can provide two output signals, each having an amplitude of .5 v. To obtain 10 separate signals, we could use several 4-way line splitters, as shown in Fig. 2. The output signals of each line splitter are 6 db lower than at the input, representing a 50% voltage reduction. The level at the output of each splitter is indicated, and it can be seen that each of the signal values exceed the 50,000-microvolt minimum specified. The fact that there are different levels is not important as long as an adequate signal is fed to each riser. What is much more important are the signal levels of the individual channels themselves on any one riser. These should be as nearly equal as pos-

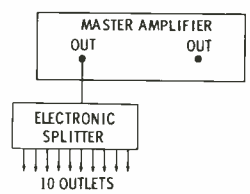


Fig. 3. Splitting arrangement which incorporates a single 10-way splitter.

sible in order to avoid cross-modulation.

There are, of course, other ways in which this signal distribution could have been achieved. One additional method is shown in Fig. 3. Here, one output of the main amplifier is fed to a signal splitter that provides 10 different outputs. Signal reduction for a typical splitter (such as the Jerrold ADO-10) is 3 to 4 db, giving an output signal at each outlet of approximately .7 volt if the amplifier provides a 1-volt output. Since .7 volt is far more than we need, with this arrangement we can use less amplification. This might permit us to use a more economical amplifier to start with. Of course, in this ADO-10 unit, there are ten 6AG5 tubes and one 5Y3. Not only does the unit require power, but also periodic maintenance. Hence, these are facts that should be weighed carefully.

There is one other consideration to keep in mind when using line splitters possessing tubes, and that concerns the amount of signal which can be fed to these units without causing them to overload. If, for example, the ADO units cannot be fed more than a .25-volt signal without overloading, then they would be unsuitable for the application specified above. This is a very important limitation and one that you should check personally to make certain that the equipment can handle your specified signal levels. With passive line splitters, signal level is not important and any level short of the voltage breakdown point can be used.

In passing, it might be stated that computations carried out as outlined above are remarkably close to what you will eventually find in the system after it has been installed. That is, if you do your figuring correctly and take all factors into consideration, you will end up with actual signal levels that are remarkably close to your computed values. This is definitely not a hit-and-miss affair.

Thus far, we have determined what signal level we need from the main amplifier in order to produce approximately 3,000 microvolts of signal at the receiver farthest away. Before a choice of amplifiers is made, we must probe the roof

to determine how much signal level is available from the station. This level then is compared to the amplifier input limits to see whether the signal can be fed directly to the amplifier or must be modified first in order to make it suitable. For example, if the signal is too strong, it will have to be attenuated to the desired level by pads. Conversely, if it is too weak, a preamplier will be needed to strengthen it. Most of the time, amplifiers possess fairly wide limits within which they will accept input signals without overloading or distortion. For example, most amplifiers will accept signals from 500 microvolts to 10,000 microvolts. This is a considerable range and it should work suitably in most locations without the addition of either attenuation pads or preamplifiers.

After a system has been installed, signal level checks should be made at each outlet, and recorded. When individual channel strips are used in the main distribution amplifier, signal level adjustments can be made, if required, to bring the various signal levels into line. Incidentally, this means along any one riser. It is perfectly permissible to have signal levels on different risers vary widely and this can readily occur in line-splitting combinations. However, on any one line, signal levels of different channels are preferably kept uniform and well below the point where they can cause a receiver to overload.

One further note on installation practice—many firms recommend that a 72-to-300 ohm matching transformer be employed to connect 300-ohm receivers to 72-ohm coax. The advantages of this transformer connection are four-fold: (1) tuners and AC-DC receivers are isolated from the line, (2) unbalanced to balanced transformation is provided, reducing noise pickup on coax braid, (3) ghosts or "ringing" due to line mismatch are prevented, and (4) signal strength to the tuner is increased. With these advantages, it is easy to see why these transformers are used.

Next month's "Shop Talk" will give some of the practical aspects of the installation work required for master antenna systems. ▲

Silicon Rectifiers

(Continued from page 13)

placement market is the Type M500 diode (Fig. 1) designed by Sarkes Tarzian, Inc. The ratings of this component (500 ma output current and 130 volts rms input voltage) make it suitable for use in TV power supplies.

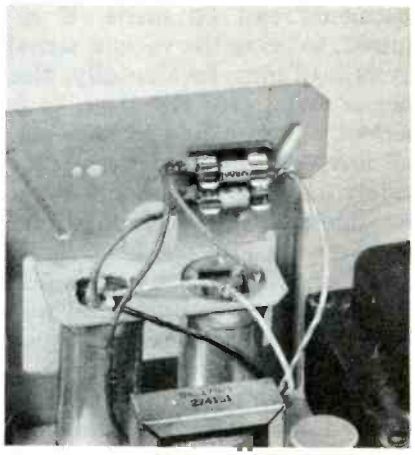
The cartridge-type body of the M500 is designed for mounting in a standard fuse clip, which is furnished together with two rectifier diodes in a kit supplied by the manufacturer. The clip has been modified so that the rectifiers can be inserted in only one way—with the correct polarity. Fig. 3 shows two installations in which these silicon diodes were used to replace defective selenium rectifiers. It is evident from the photographs that the silicon rectifiers take up only a fraction of the space previously occupied by the selenium stacks. This saving of space is of no particular benefit in most receivers now in use, but the advantage in future set designs is obvious.

In many receivers such as the one in Fig. 3A, the mounting block for the fuse clips can easily be bolted to the chassis through one of the holes originally drilled to receive the mounting studs of the selenium rectifiers. If the silicon diodes are placed in an exposed part of the chassis—for instance, near the rear of the receiver—the technician may wish to cover them in some manner in order to reduce the shock hazard. In the installation shown in Fig. 3B, the plastic box in which the rectifiers were packed is utilized as a protective covering for the rectifiers and their terminals. Holes were drilled in the box to provide ventilation.

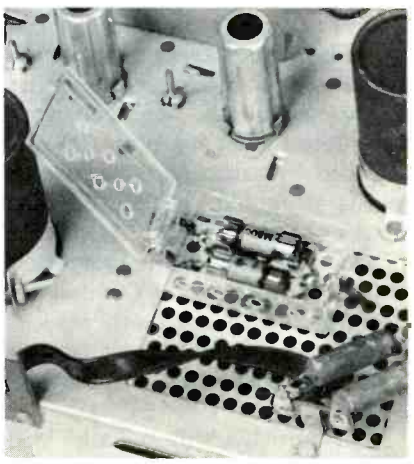
What tests have been made with silicon rectifiers? One manufacturer reports that samples of silicon rectifiers were operated under load continuously for over 5,000 hours with no noticeable drop in output voltage. In another test, silicon and selenium rectifiers were both operated for a total of 720 hours, in two-hour periods separated by two-hour rest intervals. Humidity of the atmosphere during the second test was 95%. The output voltage of the silicon units had not changed by the end of this test, but the selenium rectifiers had undergone a 5% decrease in output voltage after 500 hours of operation.

Sarkes Tarzian, Inc. states that a silicon rectifier can be operated in hotter ambient temperatures than ordinary selenium types; for instance, the M500 can safely deliver its full rated current even when the temperature of the surrounding air is 100°C. Nevertheless, the silicon rectifier (like a transistor of the same material) can be permanently damaged by junction temperatures of approximately 200° C. or greater. For this reason, the technician must use care when soldering in the vicinity of one of these rectifiers.

Testing silicon power rectifiers presents many of the same problems that are encountered during tests of other solid-state devices. An ohmmeter gives an inconclusive check because the resistance across the rectifying junction changes according to the value of the applied voltage. We have even observed different readings



(A) In RCA Victor Model 17T155.



(B) In Tele-King Model 201.

Fig. 3. Sample installations.

with the same rectifier and meter at different times, depending upon the condition of the ohmmeter battery. As in the case of selenium rectifiers, crystal diodes, and transistors, the most satisfactory test is the substitution of a unit known to be working properly for the unit suspected of being faulty.

Results of Experiments

Since the silicon power rectifiers are claimed to be more efficient than the selenium type, we expected that both the output voltage and the current of a television B+ power supply would be increased when silicon rectifiers were used to replace seleniums. The purpose of our experiments was to get an idea of how much increase would be obtained, and to see the effect of such an increase upon receiver operation.

The first step in the tests was a comparison of the performance of silicon and selenium rectifiers in several sets employing the common half-wave voltage doubler circuit. Typical of the results obtained are the following figures, which refer to the Motorola Model 17T11EC receiver.

	Silicon	Selenium
B+ volts (no load)	325	310
B+ volts (normal)	282	260
B+ ma drain	195	180
Boost volts	480	420
Horiz. sweep ma	99	91

In all circuits tested of this type, the output B+ voltage was raised by 15 to 30 volts, and other current and voltage measurements showed proportional increases. Variations in the amount of increase occurred because the selenium rectifiers had been more heavily loaded in some sets than in others and were of different ages in the various sets. Some increase was found in every case, however.

Silicon rectifiers also increased the output of full-wave voltage doublers. An RCA Victor Model 17T155 having a circuit of this type had been equipped with oversize (400 ma) selenium rectifiers which had been in operation for about 300 hours. B+ measured 270 volts, and the rectifier current

drain was 320 ma DC. Installation of silicon diodes raised the B+ voltage to 288 volts and the current drain to 335 ma.

Voltages and currents were also increased when silicon replaced selenium in sets utilizing low B+ from a single rectifier. The following sample readings are from a brand-new Meteor Model 4103H.

	Silicon	Selenium
B+ volts (normal)	134	126
B+ ma drain	295	270
Boost volts	330	300
Horiz. sweep ma	120	113

High voltage applied to the anode of the picture tube also showed an increase. In a General Electric Model 9T001 portable TV receiver (with 9″ picture tube), the high voltage originally could be varied between the limits of 5 and 6.4 kv by adjustment of the brightness and height controls. A value of 5.5 kv produced normal raster height and a pleasing brightness-contrast ratio. When a silicon diode was placed in the B+ circuit, a high-voltage range of 5.7 to 7 kv could be obtained. A good balance between brightness and contrast was obtained at an anode voltage of 6 kv. In this same receiver, the B+ voltage was raised from 136 to 144 volts and the nominal boost voltage was increased from 260 to 275 volts.

What is the significance of these increases in voltage and current? When we replaced new selenium stacks of adequate current rating with silicon diodes, improvements in brightness, contrast, and raster size were slight. Of course, the replacement of aged selenium rectifiers with new silicon units resulted in considerable improvement in the TV picture. In one set which had especially weak selenium stacks, replacement with silicon diodes caused the voltages on the picture tube to change so much that the ion trap had to be readjusted. While we did not succeed in "hot-rodding" sets which were already in like-new condition (so that they pulled in distant stations for the first time, etc.), we noted that some silicon-equipped sets showed a greater ability to deliver a good picture under low line voltage conditions than identical sets using seleniums.

We made a temperature check on a 17″ portable TV receiver in order to see whether selenium and silicon rectifiers would operate at different temperatures under field conditions. Temperatures were taken by fastening a thermocouple to the rectifier and by suspending two other thermocouples in the air at different points inside the cabinet. Temperature readings obtained were between 50° and 52.8° C. in all cases. We concluded that the tubes had a far greater effect upon set temperature than either kind of rectifier did, and that the general ambient temperature in a set of this kind determined rectifier heating rather than vice-versa.

During our tests, we encountered no parts failures that could be attributed to the installation of the silicon rectifiers, even though B+ and boost voltages were sometimes pushed close to the maximum ratings of certain components such as input filter capacitors. Further field experience may turn up cases of old receivers in which the installation of silicon rectifiers hastened the failure of already weak parts; but the same problem is faced whenever an ailing B+ circuit is restored to full output—whether the new rectifier be a tube, a silicon diode, a selenium stack, or some other type of rectifier.

The major advantages arising from the use of silicon rectifiers in television receivers may be summarized as follows:

1. Silicon-equipped sets show promise of being relatively immune to rectifier failure or to a decline in B+ voltage, even over a long period of time.

2. Silicon rectifiers are very compact, and they can be mounted so that they can be easily serviced.

3. Silicon is plentiful. Although the scarcity of selenium has hampered the production of selenium rectifiers, no problem of this nature is foreseen in the case of silicon.

These advantages make it probable that you will be seeing plenty of silicon rectifiers in the future. ▲

Audio Facts

(Continued from page 21)

switching arrangement to permit recording from some locations using the speaker in that location as a microphone, and a switching system which permits the phono input of the amplifier to be utilized for several different devices.

The voice-operated relay enables the recorder to be used for long business meetings without the necessity of changing the tape at frequent intervals. This is possible since the recorder is operating only when someone is speaking and automatically turns off during intervals of silence. It is necessary to have the unit properly adjusted so that incidental background noise does not cause the recorder to operate. The voice-operated relay is equipped with an override switch which disables the unit, a sensitivity control which permits it to be adjusted for background noise, and a delay-interval control which determines how long the recorder will continue to run after the speech or material being recorded ceases. The same interval will exist between the moment the voice starts and the moment the recorder begins to operate; therefore, the control must be adjusted to a compromise position which will prevent unnecessary running of the recorder and at the same time keep the recorder from turning off and on again during slight pauses.

The level controls and on-off switches (one for each speaker) permit the material being sent out over the system to go to selected stations with the desired volume level at each one. Since this operation is very handy and may be a little difficult to visualize with only a word description, a schematic of the control panel is shown in Fig. 2. The on-off switches for the individual speakers are numbered SW-1 through SW-8, and the L-pads which serve as level controls for the speakers are numbered TP-1 through TP-8. The transformers T1 through T8 are isolating transformers which are necessary to maintain a match between the entire speaker load and the amplifier output. Since the amplifier output has a 250-

SAVING. The *Wall Street Journal* recently ran a story about a man who was nearly broke in 1932, has had an average salary of $3,400 since then, yet is today worth close to $100,000. This he achieved by careful managing of the pay check, by using a half-acre garden to the fullest extent, by resisting impulse buying, by investing savings wisely, and by keeping down entertainment expense.

"It's beer, mama and TV—not liquor, wild women and song," he says. Living in a do-it-yourself Ford-and-Chevvie neighborhood, about the only outside work contracted for is plumbing and roofing repairs. Average cost of a house-painting job is the $50 or $60 for materials, on the basis of "let me help you paint your house, then you can help me."

His present salary of $7,000 plus some $1,500 in income from invested past savings is more than double what he currently spends; continued saving on this basis will permit him to retire at 55 without lowering his standard of living a bit, now that his two girls are married.

This little human-interest story merits a bit of thinking. First, TV is given its due credit for helping to save money. TV service charges fall in this same category—a point worth bringing up when customers complain about service bills. When a TV set goes bad and can't be repaired immediately, their first thought in the evening is, "Which movie shall we go to?" It doesn't take many such movie treks to equal even the largest service bills.

Second, here, is the thinking ahead toward retirement. A serviceman is entitled to retirement at 65 or sooner, just as much as anyone else. Without automatic provisions for pension other than Social Security, however, such retirement is hard to achieve. The money for retiring workers in large companies comes out of the pay checks of the workers automatically, no matter how you look at it. In small companies and in most service shops, this money is paid out each week or month in the pay check, and it is up to the individual to set aside the cost of retirement and invest it appropriately for the future.

MARKUS . . *Dollar and Sense Servicing*

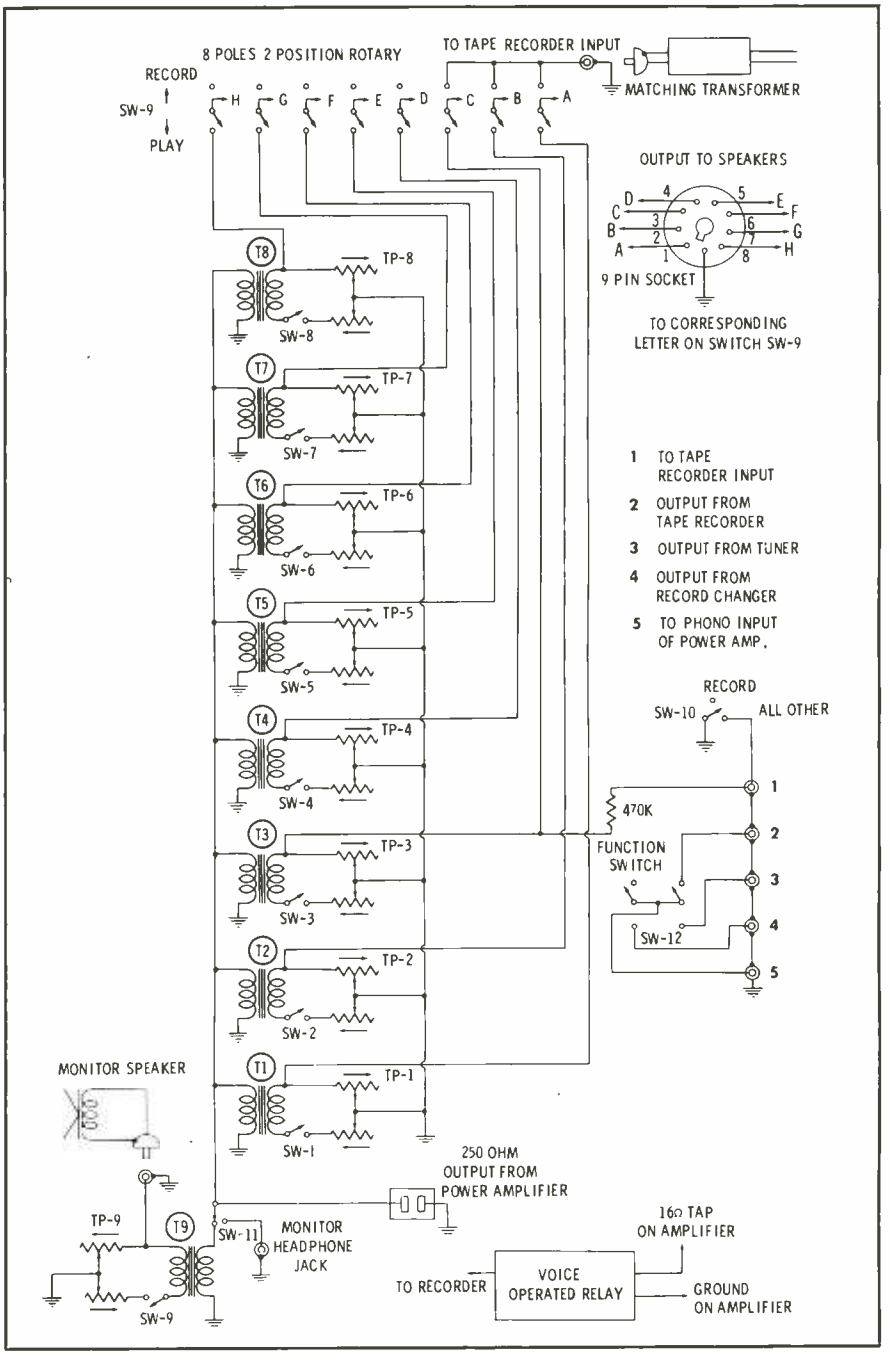


Fig. 2. Schematic diagram of control panel.

ohm impedance, the primary impedance of each matching transformer is 2,000 ohms. Since all eight transformers are connected in parallel, this results in a 250-ohm load to match the amplifier. The monitor position is used only to adjust or check the system, and therefore its impedance is not considered. The switch SW-11 is normally left in the "headphone" position to prevent any mismatch from occurring, but even if the monitor transformer were left connected, the mismatch would not be serious (222 ohms instead of 250 ohms).

The eight-pole two-position rotary switch SW-9 is the record-play master switch. In the "record" position, three speakers are connected to the input of the recorder. The connections to the other speakers are broken to prevent any interference. This switch was included because it was desired to record from only one room, using the speakers as microphones. A transformer is used between these speakers and the recorder input to achieve proper matching to the recorder input.

Switch SW-12 is used to connect the tuner, record changer or recorder to the phono input of the power amplifier. This switch was

necessary since the amplifier had only one input which was suitable for these devices. It is possible to connect the output from the amplifier to the input of the recorder so that programming from the tuner, the record changer or a microphone (connected to one of the mike inputs of the amplifier) can be recorded. To do this, switch SW-10 is switched to "record" position and the recorder started. The input control of the recorder and the gain control of the amplifier must be adjusted to achieve the proper recording level.

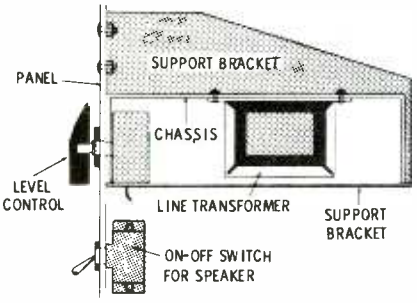


Fig. 3. Cross section of control panel.

The drawing in Fig. 3 shows how the control panel is assembled. You will notice that the level-control shaft passes through both the chassis and the panel and binds the two together. The on-off switch for the speaker is located below its respective level control, and the line matching transformer is mounted in the chassis to the rear of the level control and switch. Since several transformers are mounted in the chassis (one for each speaker used), additional support is provided to secure the chassis to the panel at each end in order to prevent excessive strain on the level controls.

The phonograph in this installation is a four-speed changer and is equipped with a turn-over ceramic cartridge. This makes it unnecessary to have a high gain preamplifier stage which would be required if a magnetic cartridge or other low-output cartridge were employed. Ball-bearing slides were used on the pull-out drawer of the changer to insure free and easy operation.

This description of one commercial installation is presented to serve as a background for a forthcoming discussion of the various phases of assembling and installing a sound system in a commercial location. ▲

Notes On Test Equipment

(Continued from page 17)

1. *Six precision type resistors—10, 100, 1000, 10K, 100K ohms and 10 megohms.*
2. *Five DC voltages within a ±1% tolerance—2, 5, 25, 100 and 300 volts.*
3. *Four AC voltages (RMS) within a ±1% tolerance—5, 25, 100 and 300 volts.*
4. *RF output—crystal controlled frequencies with better than 0.1% accuracy.*

I recently had the chance to check out one of these B & K calibrators in our own service labs. The first thing to catch my attention when examining the instrument was the meter scale on the front panel labeled "null indicator." It was unusual in that the scale was calibrated with markings of 5 and 10 on either side of a center zero point. I wondered exactly what part this played in the calibration procedure, but before twisting any knobs, I followed my usual practice when examining unfamiliar test instruments—I picked up the instruction manual.

By reading over the introduction section of the manual, I learned that the null indicator is actually a visual means of checking the operation of the instrument. By adjusting the CAL control, located just to the right of the panel meter, I could zero the null indicator and thus insure accurate operation regardless of line voltage conditions or possible variations within the unit itself.

The first piece of test equipment I decided to calibrate was one of our VTVM's. Following the operating instructions, I plugged the line cord of the calibrator into one of the bench outlets and allowed a five-minute warm-up period. I then placed the function selector switch in the DC position and rotated the range switch to the 25-volt setting. To insure an accurate voltage output, I adjusted the CAL control until the pointer on the null indicator was directly over the zero center line.

By this time the VTVM had warmed up, so I set it to read DC volts on the 50-volt scale and connected the test leads to the calibrator as pictured in Fig. 3. The calibrating voltage is available at two terminals on the front panel of the calibrator.

After making several voltage checks, I found that the VTVM was reading below normal on both AC and DC ranges. I consulted the manual on the VTVM and made some slight adjustments which immediately corrected this discrepancy.

Next, I decided to check the scale calibration on one of our marker generators. I fired up the generator, turned the modulation and marker switches on, and placed the range selector in the 4-to-8 megacycle position.

This test required the use of a suitable crystal and a pair of head phones, so I plugged a 4.5-mc crystal into the socket provided on the front panel of the calibrator and connected a set of phones to the phone jack as shown in Fig. 4.

Again following the operating instructions of the calibrator, I placed the function switch in the RF position and connected the generator output cable to the RF and ground terminals.

Incidentally, I found out (the hard way) that the tone switch on the calibrator should be in the OFF position when wearing the head phones. If the tone switch is turned on, a really strong audio signal comes through the phones.

To proceed, I slowly rotated the marker dial and found as the generator frequency approached the fundamental or any multiple harmonic of the crystal frequency I could detect a series of whistles. When the marker frequency was exactly equal to any harmonic of the crystal frequency, a null or a very low audio tone was produced. On either side of this null point, the tone would increase in pitch. In this manner, I checked the calibration of the generator and found it to be very accurate.

Precision Model E-420 White Dot-Bar Generator

The instrument pictured in Fig. 5 is manufactured by the Precision Apparatus Co., Inc. of Long Island, N.Y. It is designed specifically for color convergence and linearity testing.

Specification features are:

1. *RF Output — continuously tunable signal for channels 2 through 6; a maximum output*

Fig. 5. Precision Model E-420 white dot-bar generator, less test leads.

signal of 100,000 microvolts for all available patterns; coaxial output cable balanced at 300 ohms.

2. *Video Output—positive or negative signal polarity for all available patterns; maximum peak-to-peak output of 6 volts.*
3. *Synchronization — horizontal and vertical provisions for both internal and external sync.*

Patterns available are:

1. *Dot Pattern—number of vertical dots variable from 8 to 16; number of horizontal dots variable from 12 to 20; dot size continuously variable.*
2. *Vertical Bar Pattern—number of bars variable from 12 to 20, with control over bar thickness.*
3. *Horizontal Bar Pattern—number of bars variable from 8 to 16, with control over bar thickness.*
4. *Cross Hatch Pattern—vertical and horizontal bars with the number of cross hatches variable.*

A color television receiver happened to be in the lab the other day, so I took advantage of the opportunity and set up the Precision Model E-420 to check dot convergence.

In accord with the procedures outlined in the instruction manual, I set the generator up for an RF dot pattern on channel 4. After connecting the generator cable to the antenna terminals and positioning the tuner of the color set on channel 4, the dots appeared on the screen. Synchronization was a little poor, so I clipped both vertical and horizontal sync leads of the generator to the yoke cable and set the sync selector to external position. The vertical sync remained unstable until I adjusted the vertical hold control on the receiver. After adjusting the "Bar Thickness" controls, I obtained the very satisfactory white dot pattern shown in Fig. 6.

In my estimation, the most desirable feature of the instrument is its provision for varying the dot size and number. Each technician has a certain technique he usually follows when making dot convergence adjustments. Being able to vary the dot size permits him

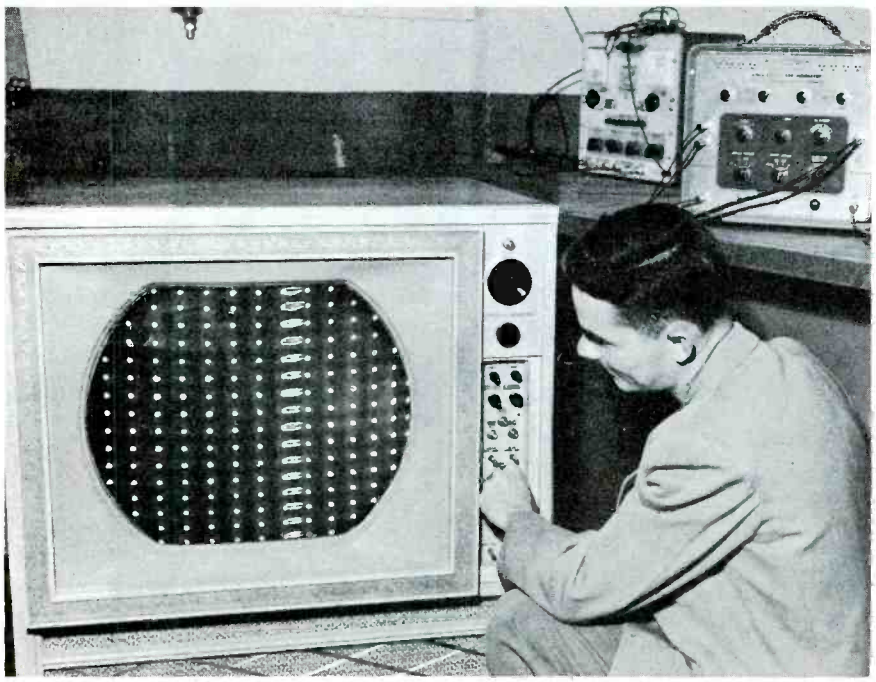


Fig. 6. Dot pattern obtained with Precision Model E-420 generator.

Fig. 7. Radionic "Pic-Probe."

to perform this operation with the kind of dot pattern he prefers.

Radionic "Pic-Probe" Model 300

The odd-looking device pictured in Fig. 7 is called a "Pic-Probe." Its manufacturer is Radionic Industries of Chicago.

Although the instrument has no similarity to a picture tube, it is actually used in combination with an oscilloscope to substitute for one. By making the proper connections to an oscilloscope and inserting the Pic-Probe into the deflection yoke of an operating TV receiver, the picture normally seen on the picture tube can be reproduced on the screen of the scope. This instrument thus provides an accurate means of checking the operation of a receiver without the need of its picture tube.

The photograph of Fig. 8 illustrates how I made use of this device in the lab recently. I found, by reading over the instruction sheet supplied with the instrument, that the only major requirement is that the scope must have a provision for Z-axis or intensity modulation. For the sake of convenience, I employed a scope having an intensity modulation terminal readily available on the front panel.

With the test pattern from our closed-circuit transmitter, I proceeded to check the operation of one of our older test chassis using the new Pic-Probe. Connecting the test leads to the scope and orienting the probe properly in the yoke and focus coil assembly was relatively simple.

Perhaps you may be as interested as I was to learn how this in-

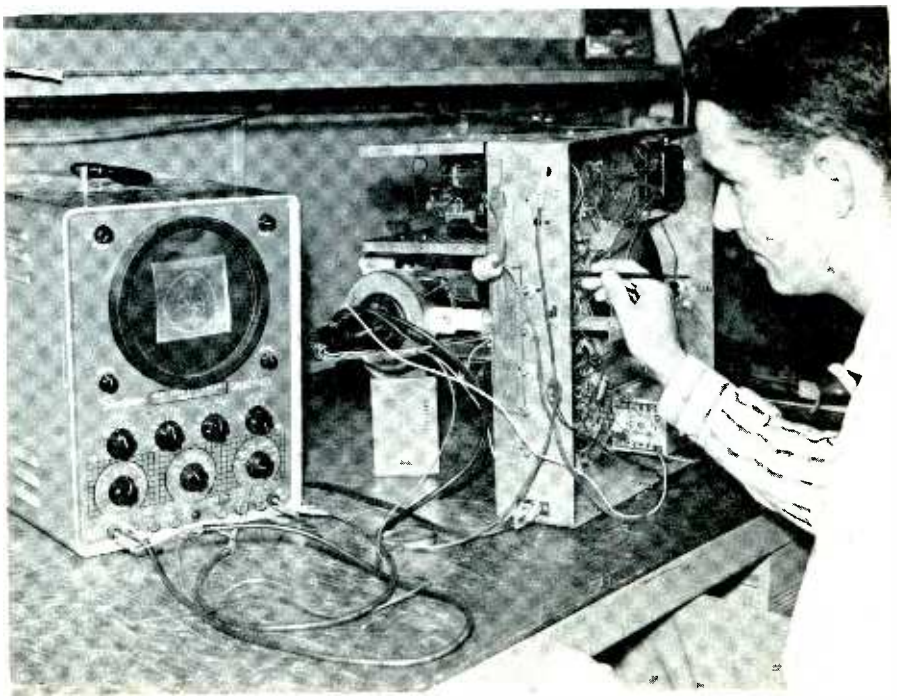


Fig. 8. "Pic-Probe" and scope together substitute for picture tube.

strument works. In brief, the probe consists of two specially wound coils and two series of integrating networks. Through inductive coupling, the coils pick off energy from the vertical and horizontal windings of the yoke. The signals are then integrated and the resulting sawtooth waveforms are applied to the vertical and horizontal inputs of the scope. When the scope is adjusted correctly, a raster of proper proportions can be obtained on its screen.

The picture information is channeled to the scope by means of beam or intensity modulation. A blue test lead is connected in the probe to the picture-tube cathode circuit while a yellow lead is connected to the grid circuit. One of these leads is attached to the intensity modulation terminal of the scope, depending on whether the receiver tested uses the grid or cathode as the driven element.

Incidentally, in describing the hookup arrangement to obtain the sweep and video signals for the scope, I failed to mention an additional black lead extending from the probe cable. This lead should be connected to a 1-volt AC source. If the scope being used has no provision for this voltage, a simple divider network may be connected to a conventional 6.3-volt filament supply in the receiver under test.

When a sweep signal is not developed within the probe, the 1-volt signal from the black lead is applied through a diode to the vertical input terminal of the scope and produces about a one-inch sweep. When a sweep signal is present, another diode back-biases the first and prevents the 1-volt signal from reaching the vertical terminal. This protection circuit eliminates the risk of burning a spot on the scope screen in case of sweep failure.

Although the Pic-Probe can now only be used on chassis having a parallel filament arrangement, the manufacturer is in the process of designing an adapter which will permit the instrument to be used in chassis employing series filament circuits. I can see how the Pic-Probe would be a great help on the bench if a suitable picture tube were not readily available. ▲

Let's Talk Business

by Verne M. Ray

Obtaining and Keeping Qualified Technical Personnel

One of the most serious problems confronting service shop owners today is obtaining and keeping qualified technical personnel. This month, we'll talk over some of the reasons for this problem and we'll outline practices which, if adopted, can help to overcome it.

Qualifications for New Personnel

Most shop owners prefer to hire a man who is experienced, technically sharp, capable of meeting people, and of creating good will for the business, who is steady, a good producer, and willing to work for the salary offered. Although there are certainly a fair number of men who have the right qualifications, the chances of hiring one of them are less than perfect.

Many shop owners and managers are willing to hire a man who can be trained to fit the job. What kind of man should he be? A service technician who is to become a credit to the business must have a certain amount of technical knowledge, a pleasing personality, and the ability to learn and grow. He may be a recent graduate of a technical school, or may have taken a correspondence course in radio and TV, or had appropriate training and experience while in military service. He may even be self taught, having studied the necessary subjects at home and practiced on his own set and/or others.

Although technical ability is important, there are other qualifications which should receive equal consideration. Being able to successfully deal with people is one, because dealing with people is an integral part of any sales or service organization. The ability to properly apply knowledge learned through experience and study is another; consequently, a technician should make a constant effort to keep up with the new developments which may have an effect on his trade.

Obtaining Applicants

After you have a fair idea of the qualifications your new technician should have, the next step is finding a man who fits the description. This won't be easy, but there are a number of people ready and willing to help. Local trade schools are excellent sources; however, their graduates are very often spoken for several months in advance. Remember, you are competing with large companies in many fields which also have an acute need for electronics technicians.

Applicants may also be obtained from local employment agencies, although if you hope to obtain a man in this way, there are a couple of factors to consider. Employment agencies charge a fee for their services. This fee may be paid by the employer, by the employee, or it may be split between them. If employment through an agency is to be successful, the employer must either pay the fee or make the job attractive enough so that an applicant is willing to pay all or part of it.

One of the most successful ways to obtain qualified applicants is through classified newspaper ads. If you advertise in this manner, make your ad attractive to prospective applicants and be sure that it doesn't convey any false impressions or make any rash promises. Use strong points effectively. For example, if you have been in business for a number of years, mention of this fact in your ad suggests security to potential prospects. If you have the biggest business or the most modern shop, these are also excellent points to mention. If none of these ideas appeal to you, use the ad copy to offer a challenge. Ask for a man who is willing to accept responsibilities and to learn the business. Other suggestions for classified ad copy can be obtained by looking through the newspaper to see what type of ad other companies are using. Ad takers employed by the newspaper can also be of help in composing your ad copy.

Evaluation and Hiring

Getting qualified people to apply for a job is only the beginning —the real task is selecting the right man for the job. This means that you will have to find out as much as you can about each individual. One of the most effective ways to do this is to have the person fill out an application.

The application, in addition to the usual information on schooling, past employment, military service, marital status, number of dependents and salary requirements, should ask a few questions concerning personal habits and health. (It might even be worth your while to pay for a physical examination before agreeing to hire a man.)

In determining the extent of the man's technical knowledge, you might devise a simple test which can be completed in 20 or 30 minutes. Ability can be more readily judged from the results of such a test than from answers to technical questions asked during a personal interview. In addition, it saves the shop owner a lot of time.

You should grant your applicants a personal interview when they have completed filling in the necessary papers. Ask the applicant what type of job he is looking for and why he feels qualified to fill the position you are offering. Briefly review his application and any tests at this time.

It isn't always the best policy to hire a person on his first visit. Appearances are sometimes deceiving, and you should discreetly check school and job histories before making up your mind. If an applicant seems well qualified, tell him so—but also advise him that you would like to talk to the rest of the applicants before making a final decision. Make arrangements to call him within a specified time to let him know what you have decided. Of course, some applicants

will definitely not be qualified. Instead of a fast brush off with the "Don't call us—we'll call you" attitude, courteously explain to a man why he is not qualified.

In order for the application to be of real value, you should use the information it contains to help obtain an evaluation of the applicant as a person. Contact each of his former employers, preferably by phone, and check on his employment dates, duties, salary, and reasons for leaving the job. Ask about his habits and what kind of worker he was. Find out what his strong points are and what kind of work he did well or liked the best. Try to determine his weak points, too. In contacting an applicant's former employers, you might ask if they would rehire the person. Should they say no; find out if there is a valid reason. Maybe you will find that because of his past record, you can't afford to hire him either.

In some instances, you may wish to check a man's school records. This may be done by making a personal visit or a phone call if the schools are local. Out-of-town schools may be sent a form letter.

Orientation and Training

For the first couple of days, a new man should work with someone who is familiar with your operations so that he can learn the ropes. If he has never worked for a service shop before, let him work inside for a short time. He can complete bench repairs by replacing units that someone has already found to be defective. He can put repaired chassis back in their cabinets and get them ready for delivery. Checking tubes and initial trouble shooting of sets brought in will allow a new employee to become better acquainted with the use of test equipment.

You should take him out on a couple of calls and show him the approach and the mannerisms you have found most successful. Then, let him make some deliveries and simple calls by himself and on his return to the shop, have him give you a full report of his activities. In this way, you can help him learn more about the work and how he should handle it. Encourage questions and phone calls from the field when he runs into difficulty or has doubts as to how a situation should be handled. Be fair with criticism—everyone makes mistakes, but intelligent people profit by them.

Many shop owners like their technicians to keep up with the latest developments, yet do little or nothing to encourage such activities. There are two schools of thought along this line and they represent the extremes—one favoring employer and the other, employee. On the employer's side, the feeling may be that a good technician should utilize his own time for reading and study if he wants to get ahead. The feeling in the case of the employee may be that

knowledge of new circuits, designs, servicing procedures, and theories should be obtained while on company time.

As with most differences of opinion, best results are obtained by compromising on a middle-of-the-road policy. Some things should be learned during working hours, perhaps by holding a periodic meeting in which each member contributes information on something he has learned recently. On the other hand, the employee might utilize his own time for magazines, books, and home-study courses; however, the shop might cooperate further by picking up the tab for some of these items. (The cost is especially worthwhile if the material benefits more than one man.) New lines of receivers often necessitate that the technician learn the locations of adjustments and tubes; disassembly procedures and special servicing techniques. This information should be imparted at the expense of the shop owner.

Naturally, it is to the advantage of the business for every technician to learn as much as he can. Wise employers encourage their men to do so by seeing that the best technical information is available, and by keeping the number of working hours within reason so that the men will have time enough for outside reading and study.

Hold that Man!

Now comes the biggest problem of all. How can a shop owner keep the men that have become efficiently trained technicians while in his employ? Very often a man comes to you with little or no experience, but within a year or two he becomes a valuable asset to your organization. By then he may have reached a point where he feels limited or that he is not getting anywhere. He may become disinterested, goof a couple of jobs, or lack enthusiasm for his work. Then, suddenly, out of a clear blue sky, he lets you have it —he wants to quit!

You ask him what's wrong; he can't give you a straight answer. Will he stay for more money? No, that's not it, but he does feel he's worth more. As a rule, there's not much you can do at this point. The man wants to quit, and you shouldn't beg him to stay. The sad part of the story is that he usually leaves to take a job that pays no more, and to top it off, he may start a repair business on the side and become a competitor. Eventually, he may amass enough capital to open a full-time business. A good many successful service establishments have been started in this way.

A job must satisfy the basic needs of an employee if he is to be happy in his work. His earnings must be at least on a par with what competition will pay, perhaps based on some incentive plan. He must have a feeling of security, and he should have working conditions that encourage him to do his best. Although these are very important to a man, they will be of no avail *if he does not feel important* in his job. Any psychologist will tell you that every human being wants most of all to be important in the eyes of his fellow man. Prove it to yourself by listening to people talk. Invariably, a person's conversation centers

around himself—it's human nature.

To some, the mere fact that they are able to delight a customer with the results of a particular repair job satisfies this need. For others, occasional words of praise from the boss will do the trick—compliments on his work, appearance, judgment, clothing, etc. Of course, these are only starters for more ambitious men. Periodic increases in salary have only a temporary effect. An ambitious and active mind must have new worlds to conquer—more responsibilities to handle.

How is this to be accomplished, you ask? It's not easy. In order to advance your men to greater heights, you and your business have to grow accordingly. This means either getting more business along the present lines, or branching out into associated fields. The latter is preferred for two reasons: (1) there is a demand for services in allied fields and (2) one man can be made responsible for the success of each particular division. Among the fields to be considered are two-way radio, hi-fi systems (including record changers and recorders), master-antenna systems, auto radios, and industrial electronics. By developing men into specialists, they will be made to feel important because they will be doing a job no one else in the organization can do as well.

Conclusion

The manager of a small business must really be a jack of all trades. Often he must be able to perform all of the functions from president on down to the janitor. Bookkeeper, accountant, personnel manager, advertising manager, technician, sales manager, and foreman or supervisor are among the positions he must master. In this respect, he is at a definite disadvantage in competing for qualified employees with large companies and corporations who employ experts in each of the categories mentioned.

Being employed by a small company has its advantages, too. An employee can show more individuality and has the opportunity of helping to build the business. He can become a big wheel in a little machine rather than a little wheel in a big machine.

If you are a shop owner and want to develop and hold key personnel, here are some suggestions which should be of help.

1. Choose new employees with care. Be as particular about a man's personality, habits, and plans for the future as you are about his skill as a technician.

2. Be as fair and as competitive as possible with respect to wages, working hours and conditions, salary increases or bonuses and company-paid benefits.

3. Make your employees' feel that they are important. Pay them compliments, but don't coddle them. If they make a mistake, talk it over in private. Don't bawl a man out for making an error—say that you know he is doing a good job under the circumstances and know he will do even better. In other words, try to be tolerant but firm. Treat your employees as you would like to be treated in their place.

You may feel that this is too much, but it's the way to success. Try it and see. ▲

PF REPORTER

INDEX TO ADVERTISERS

January, 1957

PF REPORTER

CATALOG and LITERATURE SERVICE

valuable manufacturers' data available to our readers at no charge.

1A. AMPEREX (Amperex Electronic Corp.)

Amperex "Condensed Tube Catalog" listing complete line of tubes and semiconductors for all applications. *See advertisement page* 58.

2A. B & K (B & K Mfg. Co.)

Bulletin 1000 describes new DYNA-SCAN picture and pattern video-generator. Explains its use in servicing black and white and color TV and how it acts as a closed-circuit TV. Bulletin 750 describes new, low-cost, lab-type Test Equipment Calibrator Model 750 that checks instrument accuracy. Also Bulletin 500 on Dyna-Quick Dynamic Mutual Conductance Tube Tester and Bulletin 400 on CRT Cathode Rejuvenator Tester. *See advertisements pages* 8, 37.

3A. BUSSMANN (Bussmann Mfg. Co.)

New and very comprehensive book on fuses and fuse mountings used by the electronics industries. *See advertisement page* 35.

4A. CHICAGO STANDARD (Chicago Standard Transformer Corp.)

1957 TV Transformer Replacement Guide Library. Also Hi-Fi Library. *See advertisement page* 18.

5A. CLAROSTAT (Clarostat Mfg. Co., Inc.)

FUZOHM protective resistors—Fuze type resistors—5.6 ohms and 7.5 ohms—Form No. 754115. *See advertisement page* 39.

6A. CLEVELAND INSTITUTE (Cleveland Institute of Radio Electronics)

Booklets showing how to increase income by installing and maintaining equipment like: 2-way radio, microwave relay, industrial electronics, radar, etc. *See advertisement page* 44.

7A. CORNELL-DUBILIER (Cornell-Dubilier Electric Corp.)

Guide to electrolytic replacement capacitors, XTR200D3-E. *See advertisement page* 26.

8A. DYNAMIC (Dynamic Electronics-New York, Inc.)

Booklet on accessories for TV, Hi-Fi and recorders with service aids and hints. *See advertisement page* 63.

9A. EICO (Electronic Instrument Co., Inc.)

Free 1956 Catalog shows how to save 50% on electronic test equipment in both kit and wired form: describes VTVM's, scopes, generators, tube testers, etc. *See advertisement page* 51.

10A. ERIE (Erie Resistor Corp.)

D-56 Catalog describing components. Includes Corning Glass capacitors, printed circuits, etc.

11A. HICKOK (Hickok Electrical Instrument Co.)

Full color catalog form SM-30 listing approximately 40 pieces of latest Hickok test equipment for black and white or color. *See advertisement page* 33.

12A. IRC (International Resistance Co.)

New Replacement Parts Catalog—DLR-57 (Form SO35-1). *See advertisement 2nd Cover.*

13A. JENSEN (Jensen Industries, Inc.)

Brand New 1957 Wall Chart; completely illustrated; shows all needles (foreign and domestic) by cartridge number; also, shows number of needles in cartridge; point size and point material of each needle; list price. *See advertisement page* 57.

14A. LUPER & SUNDBERG

Brochure describing complete line of UHF-VHF antennas, with technical information on operation. Includes charts, etc. *See advertisement page* 60.

15A. MALLORY (P. R. Mallory & Co., Inc.)

Battery Replacement Guide for portable radios. *See advertisement pages* 42, 43.

16A. PERMA-POWER (Perma-Power Co.)

Envelope Stuffer describing complete line of Perma-Power Tube Briteners including new Color-Brite for color sets.

17A. RADIO-ELECTRONIC MASTER (United Catalog Publishers, Inc.)

Descriptive literature on the new 1957 Radio-Electronic MASTER, Official Buying Guide of the Industry, detailing the 125,000 products cataloged. *See advertisement page* 55.

18A. R-COLUMBIA (R-Columbia Products Co., Inc.)

Bulletin 23: Describes Fono-Magic and how it is applied to stop phonograph turntables from slipping. Bulletin 24: New Weather Proof Humi-Kup 2-set coupler in three models that fit every type of installation. Bulletin 22: How to clean and lubricate TV-Radio Controls in 60 seconds with Trolmaster without removing set from the cabinet. *See advertisement page* 61.

19A. SAMS (Howard W. Sams & Co., Inc.)

Complete details on how to keep your Service Data library up to date with the Sams automatic monthly purchasing plan. Also complete details on the Sams popular Time Payment Plan. *See advertisements pages* 38, 49.

20A. SHURE (Shure Brothers, Inc.)

32-page pocket-sized Replacement Manual for Phono Cartridges and Magnetic Recording Heads. *See advertisement page* 7.

21A. SPRAGUE (Sprague Products Co.)

C-455 Service Catalog on popular radio and TV replacements. *See advertisement page* 2.

22A. TRIAD (Triad Transformer Corp.)

Catalog TV-56. *See advertisement page* 56.

23A. TRIPLETT (Triplett Electrical Instrument Co.)

New catalog of test equipment. *See advertisement page* 22.

24A. WELLER (Weller Electric Corp.)

Weller General Catalog. *See advertisement page* 40.

25A. WINSTON (Winston Electronics, Inc.)

Free literature on Color TV Test Equipment.

26A. XCELITE (Xcelite, Inc.)

Catalog on screwdrivers, nut drivers, pliers, reamers; folder on screwdriver kit with zipper. *See advertisement page* 45.

SUPPLEMENT No. 101-E

JANUARY 1957

SUPPLEMENT to SAMS MASTER INDEX No. 101

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NOTE: PCB Denotes Production Change Bulletin. ● Denotes Television Receiver. $ Denotes Schematic Coverage Only.

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NOTE: PCB Denotes Production Change Bulletin. ● Denotes Television Receiver. **S** Denotes Schematic Coverage Only.

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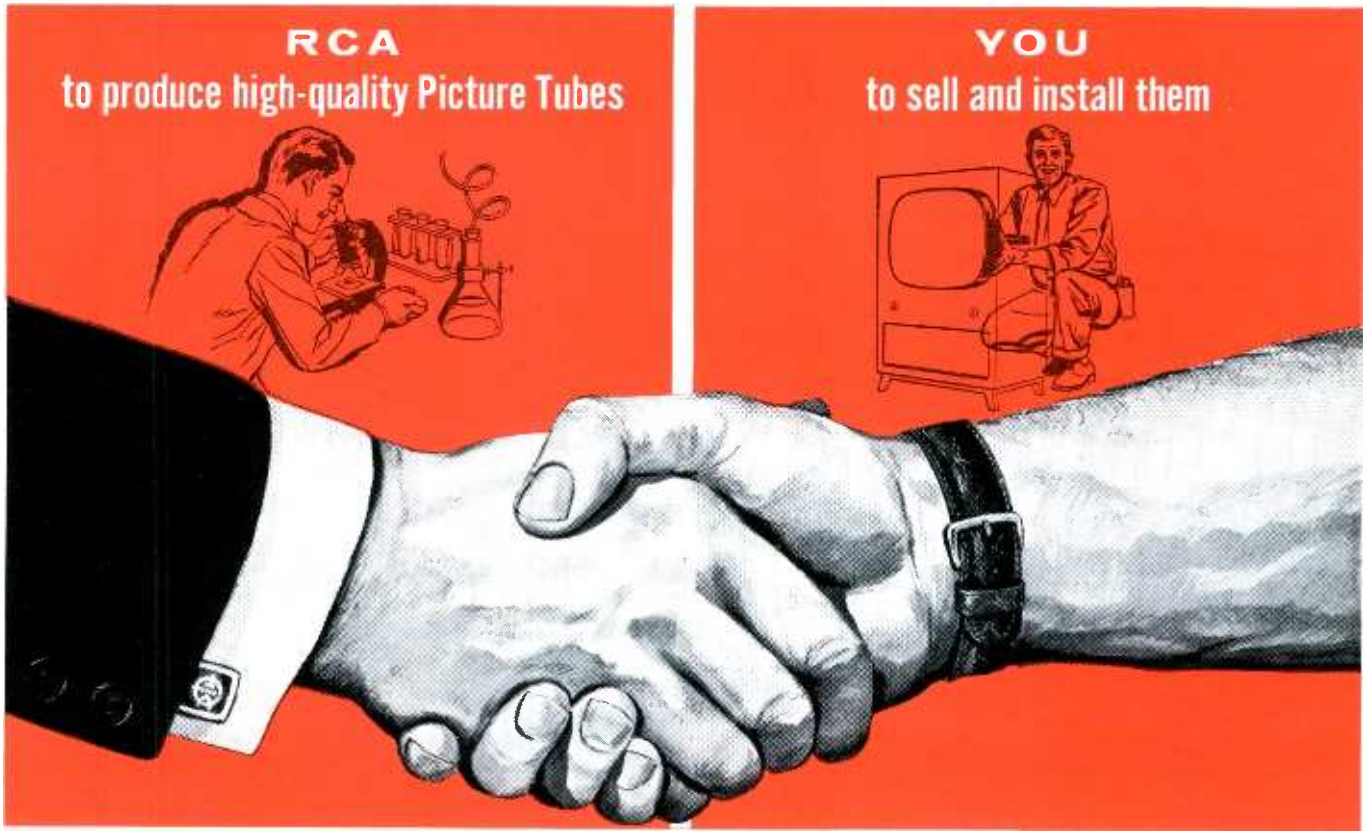

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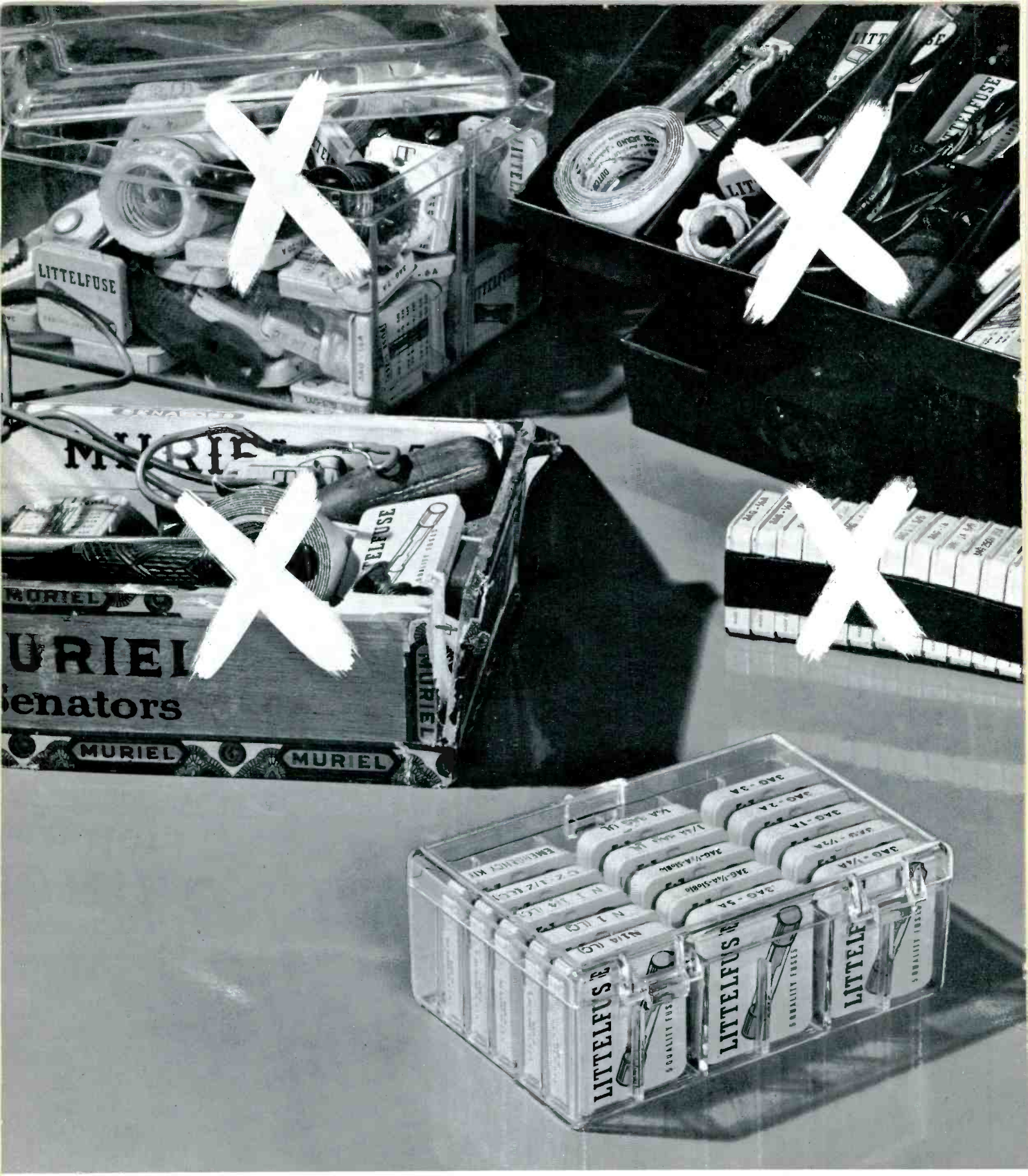

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