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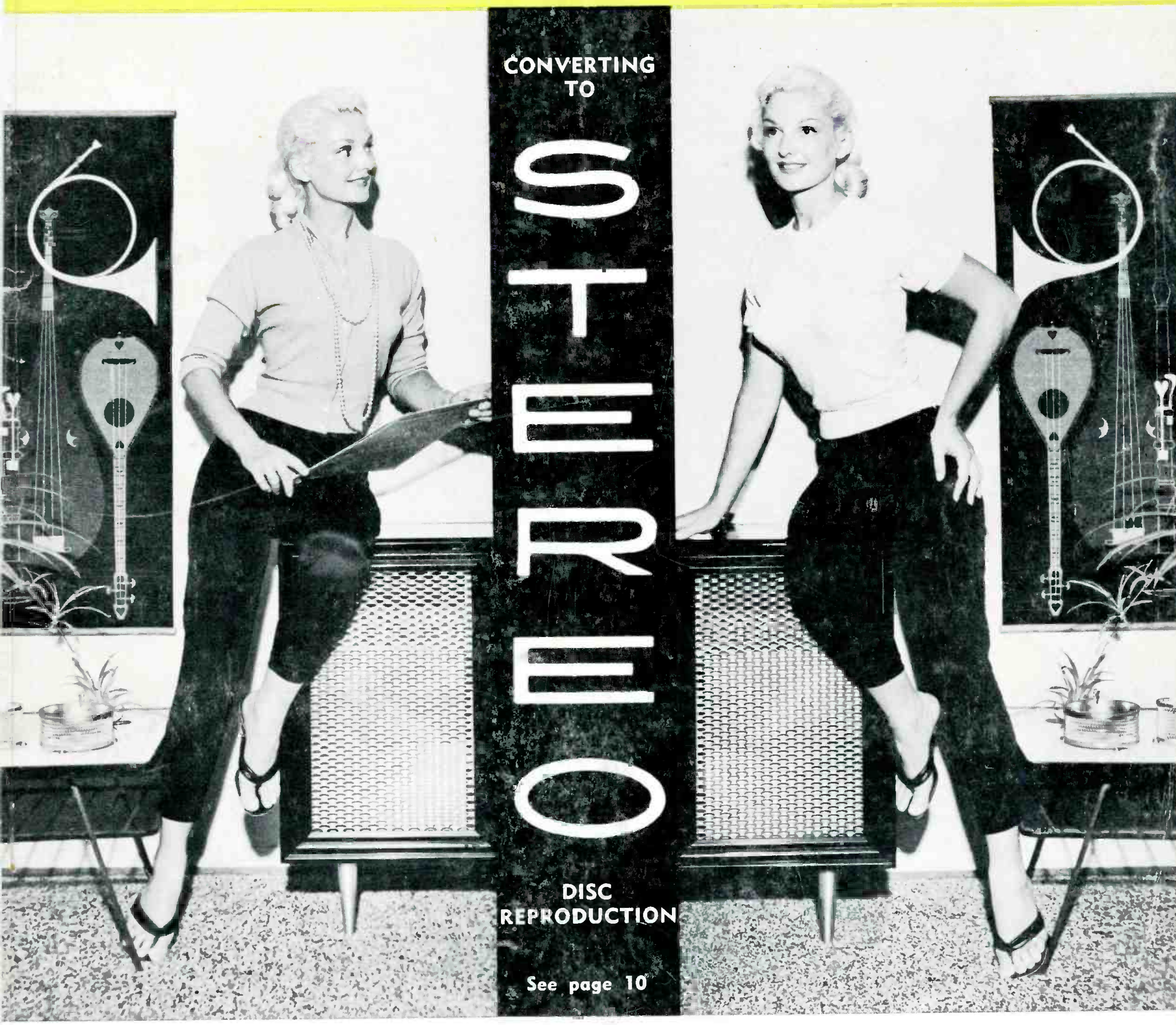
JULY • 1958 25 CENTS

PF REPORTER

FOR THE ELECTRONIC SERVICE INDUSTRY



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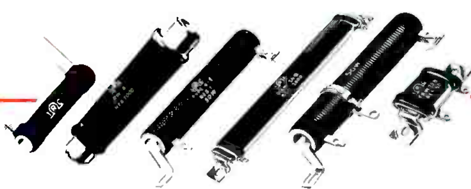

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next month

VERTICAL RETRACE-LINE ELIMINATION

Here's a feature that will help you become a big hit with customers who are troubled with retrace lines across their TV screens.

SERVICING ROOM AIR CONDITIONERS

For those of you who have been doubtful about servicing air conditioners, this article, written by an expert in the field, will provide the basic technical information you need to get started.

TECHNIQUES OF TRANSISTOR RADIO SERVICING

We've learned a lot about the practical servicing of transistorized units in our labs. This knowledge is passed along to you in this timely article. Don't miss this and the many other interesting items scheduled for next month's issue.

VOLUME 8, No. 7 JULY, 1958

PF REPORTER

FOR THE ELECTRONIC SERVICE INDUSTRY

CONTENTS

SUBJECT REFERENCE INDEX

USE HANDY CARD AT BACK TO ENTER YOUR SUBSCRIPTION

Letters to the EDITOR

Dear Editor:

Now that we are getting farther along into the transistor era, I am wondering why cross-reference data on different manufacturers' types cannot be put into book form and sold.

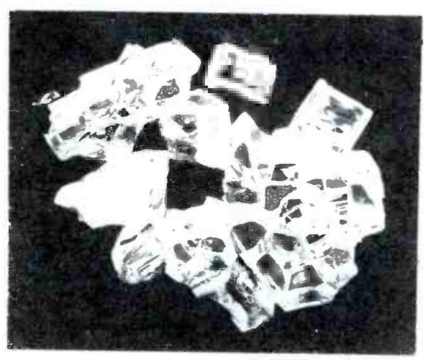
AUBREY H. JENKINS
Clearwater Electronics, Inc.
Clearwater, Fla.

Fact is, Mr. Jenkins, that the development of new transistor types makes a cross-reference guide even more of a problem than before. Let's face it—with very few exceptions, transistors just aren't interchangeable. Where these few exceptions do exist, manufacturers have already published cross-reference data. Rest assured that when and if it becomes practical, PF REPORTER will present its readers with an interchangeability guide.—Ed.

Dear Editor:

Can you give me some idea what might cause a TV safety glass to shatter into bits as shown in the enclosed picture? The glass broke suddenly, with a loud pop, while the set was in operation. My dad said one of the cowboys who was on at the time hit it with one of his stray bullets!

OLIVER V. JOHNSTON
O. V.'s Radio & TV Service
Clute, Texas



Chalk up another one for the cowboys! Seriously, our guess is that the glass was installed in such a way as to place it under excessive strain. After the receiver had been in operation for some time, heat evidently caused expansion of the frame holding the safety glass, thus increasing the strain on the glass to the breaking point.

It shattered as it did because it is of the new tempered type now being used in most automobiles. Experts believe that less injury is incurred if a pane of glass gives way as soon as it is struck, rather than resisting impact. Tempered glass is employed because it does not tend to splinter or scatter, but instead drops into a neat little pile of harmless crystals.—Ed.

Dear Editor:

I am an independent serviceman's wife and always enjoy your covers. However, if you can supply us with the Philco transistor radio pictured on the May cover for \$19.95, we'll take several. They happen to list for \$59.95, and they cost us \$39.30!

MRS. BETTY LEWARNE
Saratoga, Calif.

Dear Editor:

Why was the price on the radio shown on your May cover only \$19.95? Isn't that a Philco that sells for \$59.95 retail? It would be nice if good transistorized radios were really that low.

I do no service work in my husband's shop but do enjoy his magazines—pictures and all.

MRS. CLIFFORD H. JOHNSON
Dodgeville, Wisc.

Leave it to the girls to trip us up—guess we just can't fool 'em. Our prop man didn't goof—he was just carried away with the spirit of the occasion. Besides, he didn't think the piggy bank would hold that much.—Ed.

Dear Editor:

Here is something for honest technicians to try in areas where they are plagued with phony ads offering \$1.95 and \$2.50 service calls. We "bugged" a set by deliberately burning out a 6J6, and then set up a tape recorder and called in one of the cut-rate tube jockeys. He came in, turned on the set, flipped the channel selector, and then said, "Well, this set will have to go into the shop; it needs a new tuner." He was asked for an estimate, which we have in writing—\$39.50 plus \$10 for labor. He was paid \$1.95 for his call and then was told what we had done. You can guess the rest.

On another set, we burned out the high-voltage fuse and then called in a guy who charges \$2.50 per home call and guarantees all parts for one year. He removed the back from the set, took out a jumper wire he had rigged, and then remarked, "Yep, just as I thought—your picture tube is burned out." Of course it was, since he had plugged into the AC line and burned it out! He won't be pulling this stunt again for awhile.

NAME WITHHELD BY REQUEST
Los Angeles, Calif.

This one speaks for itself.—Ed.

Dear Editor:

We wish to make a field survey of FM reception in our local area. The station signals we wish to check are those from Boston and New York, up to 100 miles away. We plan to use strictly portable equipment, but it must be high-quality so we can check out this territory precisely. Components we intend to use are yagi antennas, a hi-fi FM tuner, a good low-drain audio amplifier, 8" loudspeaker, a DC-to-AC inverter with well-filtered output, and 6-volt storage batteries to furnish power. Having gained

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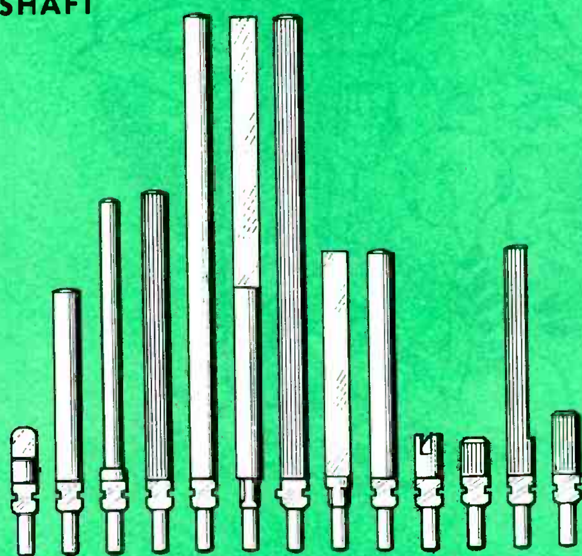
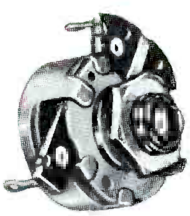
SHAFT



1. 3/8" long male for female fitting.
2. 2" round shaft.
3. 3" round shaft, 3/16" dia.
4. 3" knurled split shaft.
5. 5" round shaft.
6. 5" flatted shaft.
7. 5" knurled split shaft.
8. 3" flatted shaft.
9. 3" round shaft.
10. 1/2" double-flatted Philco-type shaft.
11. 1/4" fine knurled shaft.
12. 3" knurled flatted shaft.
13. 1/2" fine knurled flatted shaft.

CONTROLS

Series A 47: 1/2-watt, 15/16" diameter controls. 500 ohms to 10 megohms.



Series A 47F: 1/2-watt, 15/16" diameter controls, with taps located at 30%, 50% or 70% of rotation, depending upon resistance value. 50K to 3 megohms.

Series AD 47: 1/2-watt, 15/16" diameter dual controls for audio, radio, TV and industrial uses. Various taps available. 50K to 5 megohms.

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much information from your many field surveys in the past, we would appreciate your comments on our plan.

C. C. Pool

Montauk Point, L. I., N. Y.

The job you propose to undertake is no small thing. As you probably realized from studying our UHF field survey reports of a few years back, the reception conditions in any given area can be determined only by a block-to-block coverage of the area to be checked.

In our opinion, you would save a great deal of effort by making a preliminary check of signal strength with a simple rig consisting of a battery operated field-strength meter and a portable antenna tower. This test would pinpoint your potential "problem" locations where you would be most interested in making more elaborate checks.

Quite possibly, these final tests could all be made in or near buildings, using regular AC line current. Such checks would be vastly simpler than full-scale field tests. In our UHF surveys, we employed a gasoline-powered AC generator with an output capacity of about 750 watts at 117 VAC. This would supply plenty of power to operate all the necessary gear without special modifications, but its noise level (both electrical and mechanical) might be too high to suit your special needs.—Ed.

Dear Editor:

Some time ago, one of your readers suggested that you publish an article regarding the danger of X-ray radiation from CRT's, and I'm wondering why you haven't done so.

CRT manufacturers state that precautions must be taken whenever high voltage exceeds 16 kv, but they don't say what the precautions are. While I haven't yet encountered voltages higher than 15 kv, I'm afraid that one of these days I will come across a set with voltage up in the danger zone.

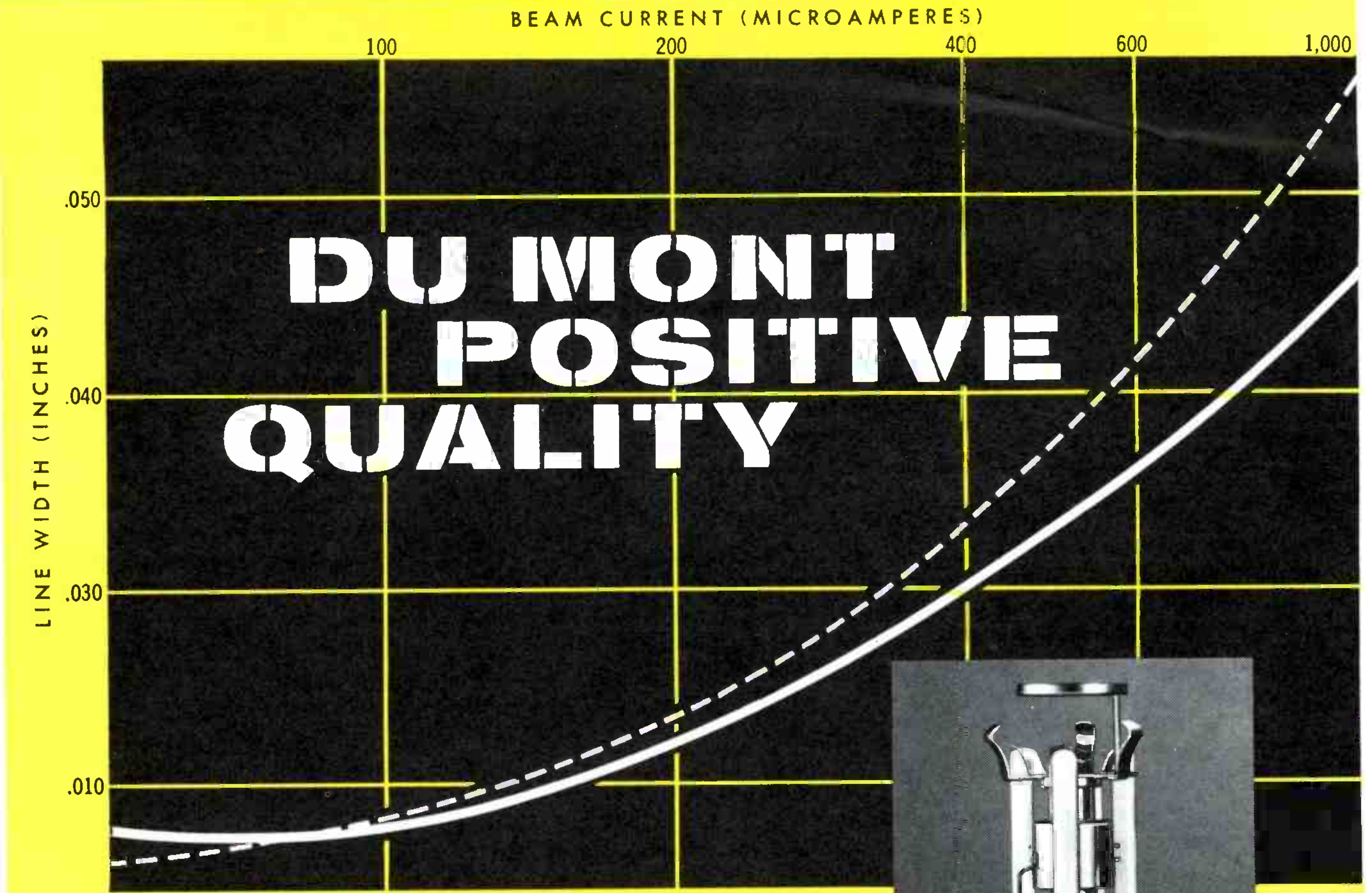
Does X-ray radiation originate only from the face of the CRT, or from the envelope as well? Does it also emanate from the chassis?

Gonzalo Esquivel

Miami, Fla.

Most X-rays radiate from the front of the picture tube, where electron bombardment takes place. It also occurs at the high-voltage rectifier because of the amplitude of the pulses applied to its plate.

Judging from all information obtained to the present time, the TV service technician is relatively safe from radiation danger. Scattered cases have been reported where technicians were burned by X-rays, but these have involved daily, continuous exposure to picture-tube screens over a long period of time. These cases usually involved direct contact with the screen, such as grasping the front end of the picture tube while making rear-panel adjustments to sets on a production line. On the whole, however, we see no reason for technicians to be unduly alarmed about the amount of X-ray exposure involved in their normal work routine.—Ed.



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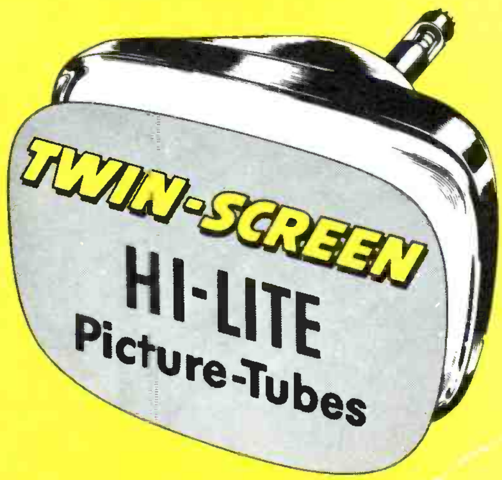
***Send for your free copy of the Du Mont Picture Tube Data Chart.**



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Shop Talk

MILTON S. KIVER

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

Every television antenna engineer starts with the same basic antenna elements and each is impelled forward in his research toward the same goal, i.e., to develop an array that will work uniformly well over the low and high VHF bands with good directivity and high gain. In the end, there are as many different antenna combinations as there are engineers, and each claims some advantages.

In this, the last of the current series, several popular wide-band antennas will be examined in some detail.

The "Sleeve Dipole"

An interesting approach to wide-band antenna design is the JFD *Satellite-Helix* array shown in Fig. 1. The front-end helix section has already been described in the previous installment of this series; the back section, consisting of seemingly conventional dipoles (both folded and straight rod) is the part that contains the novel design. To understand the variations in this back section, let us examine the approach followed by JFD engineers.

The basis of the low-band element design stems from what is known as the "sleeve dipole." The sleeve dipole evolves from the vertical-whip and ground-plane array, a basic type of communications antenna (see Fig. 2A). In this array, there is considerable inefficiency and narrow bandwidth due to the sharp break between the dipole and the ground plane. In Fig. 2B, the dipole has been broadened and tapered so that there is a more gradual transition between the two. Figs. 2C and D show the evolution to the more familiar type of sleeve dipole.

Letting D equal the diameter of the outer sleeve, and d the diameter of the inner conductor, the ratio D/d is one of the major determining factors in the operation of the unit. The other important factors are the length of the sleeve versus the length of the dipole and the electrical shape of the termination.

As used in the *Satellite-Helix* antenna, the sleeve dipole varies from the above in several respects. Initially, due to the requirements of television receivers, it is a balanced array. Furthermore, since television signals are horizontally polarized, a complete cylindrical sleeve is not required (see Fig. 3). This has the advantage of being relatively insensitive to polarized waves other than horizontal. Rods "ff" in Fig. 1 form the sleeve around dipoles "bd."

For low-band operation, neither rods "ff" or crossbars "cc" have any effect, and "bdb" acts as a half-wave dipole. However, over the high band, rods "ff" function as a sleeve, and the portion of the low-band dipole included between the "ff" rods is effectively prevented from receiving any incoming signals. Only the portions of the low-band dipole designated "eb" in Fig. 3 are effective in picking up any signals. Both of these sections are essentially one-half wavelength long on the high band.

At this point, we might pause and note that the sleeve rods "ff" eliminate the central section of the antenna over the high band. Since it is this section which produces the out-of-phase current on the high band, the removal is beneficial.

Crossbars "cc" act as a transitional device between the abrupt termination of the sleeve rods and the exposed ends of the dipole. This is similar in action to the tapered section of the ground plane in Fig. 2B. It tends to extend the bandwidth over which rods "ff" are effective in producing a response pattern with very few side lobes.

The length of rods "ff" is chosen to present a 300-ohm impedance to feedpoint d. As a matter of fact, the entire enclosure between "ff"

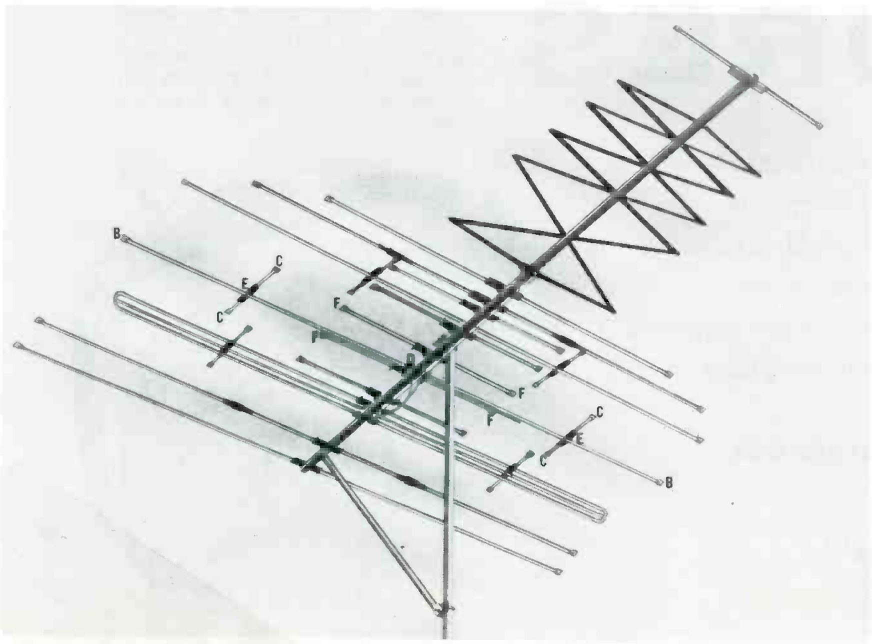


Fig. 1. JFD "Satellite-Helix" uses "sleeve dipole" to obtain broad-band response.

and "de" acts as an air-dielectric coaxial cable. Sections "be" are active on channels 7-13 while the lengths of sections "bd" are selected for optimum operation on channels 2-6.

The long rod at the rear of the array in Fig. 1 is a low-band reflector. In front of this is a three-section high-band reflector. Next comes a folded dipole, with an extra center rod to maintain the impedance of this driven element at 300 ohms in the presence of the other elements near it. In front of the folded dipole are two other simple dipoles. All three elements are interconnected and all three are stagger-tuned to slightly different frequencies to provide uniform reception over the low band.

Each driven unit has a short rod in front of it and a short rod behind it, as in Fig. 2, and each possesses a pair of crossbars. Note that each set of crossbars is placed in a different position to provide uniform reception over the high band. In front of the foremost dipole, there is a three-section high-band director and in front of this, a low-band director. Finally, a helix is added to increase further the high-band response.

The Wing Dipole

The heart of the *Zephyr* and *Color Royal* models, developed by Trio Mfg. Co., is the wing dipole. This element was developed from two half-wave dipoles, cross-connected as shown in Fig. 4A so that they are fed 180° out of phase from the same transmission line. The current relationships between the two sections are indicated by the arrows in the illustration. At this phase difference, a bidirectional response pattern will be obtained. Actually, the phase relationship between the two sections may vary from 90° to 180° and give a variety of directional patterns ranging from bidirectional (at 180°) to unidirectional (at 90°). Spacing between the two sections also affects bandwidth and gain; in general, gain is inversely proportional to bandwidth.

The over-all element lengths selected provide three half waves on the high band and one-half wave over the low band (see Fig. 4C). This particular ratio is chosen because it is the general frequency relationship between the high and low VHF television bands.

The arrangement shown in Fig. 4C will function satisfactorily on one high channel, but it does not possess sufficient bandwidth for broad band operation. The first step toward extending the coverage was to decouple the two sections, as shown in Fig. 5A, where the undriven section is magnetically coupled to the driven section. Spacing between the sections was experimentally determined to be 6.5", and this is maintained in the final array design.

The next step was to further decouple the two sections to achieve additional gain and improved directivity (see Fig. 5B). In this form, the center decoupled segment was found to serve as a director, and for this purpose it was shortened somewhat. The two end-decoupled segments, by the same token, tend to function as reflectors and are therefore lengthened.

The next problem encountered was the fact that the impedance of the driven array was quite low over the low band range. This was overcome by making it into a folded dipole, of which one section was veered forward (see Fig. 6). The added section improved the directional pattern on the low band and had only a minor effect on the high band.

Actually, in the *Zephyr Royal* and *Color Royal* models, the two rear-decoupled reflectors are omitted. This, however, tends to reduce over-all gain by about 2 db. (In some Trio models, these reflector elements are left in; however, over-all gain of the *Zephyr* and *Color Royal* models is sufficiently high that omission of the two reflectors is not important.)

With the foregoing as background, the operation of both units is readily understood. The *Zephyr Royal,* Fig. 7, has three wing dipoles. The shortest one, closest to the front of the antenna structure, is tuned to channel 6 on the low band. The third harmonic of this falls in the neighborhood of channel 13. Note that in this wing dipole (and the others, as well), the forward reflector element is held in position by insulators which keep it physically attached to the active sec-

· *Please turn to page 54*

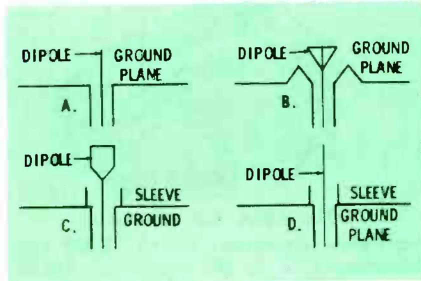


Fig. 2. "Sleeve-dipole" principle developed from whip-and-ground-plane array.

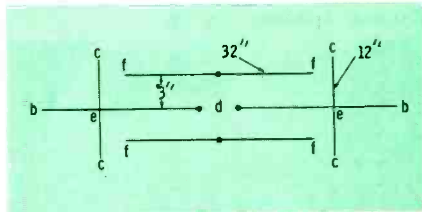


Fig. 3. Geometric characteristics of, and spacing between, "Satellite" elements.

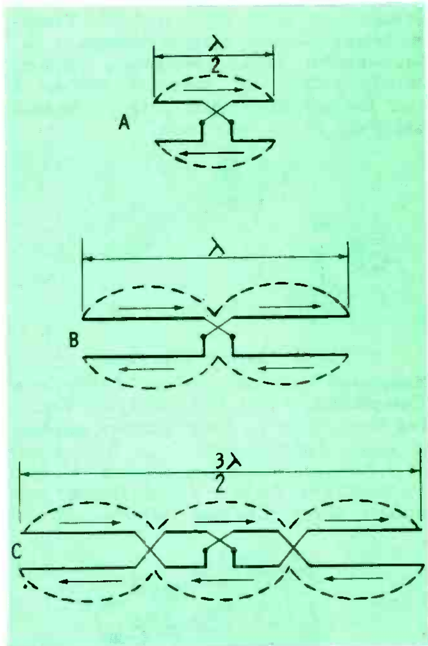


Fig. 4. Steps used in developing broad-band response for Trio's wing dipole.

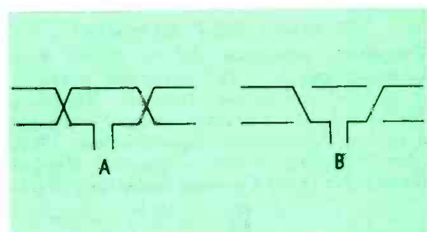


Fig. 5. Changing the coupling from physical to magnetic, extends the response.

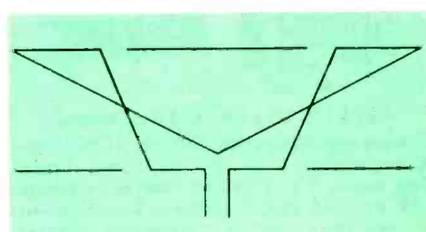


Fig. 6. Wing dipole in final form. Decoupled reflectors are sometimes omitted.

converting to STEREO-DISC REPRODUCTION

What is stereo? How is it different from regular hi-fi? Can we play our old records on a stereo player? Can we play the new stereo records on our present hi-fi? When can we get a stereo system? Can we add stereo to our hi-fi? If you are a "heads-up" technician and your customers know that you offer service and advice on TV, radio, phonographs and hi-fi, no doubt you have already been plagued with such questions. And quite possibly you have not been able to answer them all to the degree you would have liked.

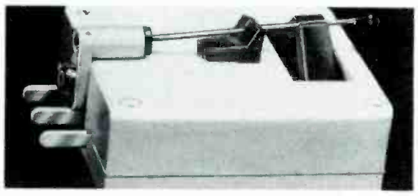
Stereo Recording Systems

To be able to understand and answer the questions asked of you regarding stereo, you must understand the basic system of recording as applied to stereo discs. At the present time, all stereo records are cut in accordance with the Westrex 45/45 system, although there are other systems under investigation. Undoubtedly, there will be considerably more laboratory work on these other systems, but since the present standards for stereo recording adopted by the recording industry parallel the Westrex system, it will be of primary concern in this discussion.

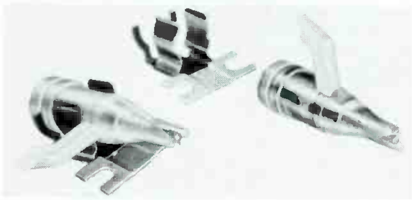
The first consideration in stereo disc recording is the impression of two separate sound tracks into a single groove. As you know, a conventional LP is a lateral recording; that is, the audio modulation is cut into the record in a side-to-side motion, while the vertical cut or depth of the groove is held constant. If you can remember back far enough, you may recall the old drum recording. These were vertical recordings in which the modulation was cut into the drum in an up-and-down or vertical direction; the lateral cut was constant.

If we combine these two recording techniques on a single-groove disc recording, we have the vertical-lateral stereo system. However, if the vertical cut is equal to the lateral cut (necessary for true stereo) and the cartridge has sufficient vertical compliance to follow the vertical modulation, the transmission of rumble from the

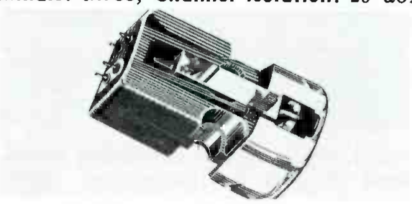
COLUMBIA CD (Ceramic)
Frequency Response: *30 to 20,000 cps;* **Compliance:** *2 × 10^{-6} cm/dyne;* **Tracking force:** *5 to 7 grams;* **Output Voltage:** *.4V at 1,000 cps;* **Equalization:** *RIAA;* **Mounting centers:** *7/16" and 1/2";* **Stylus:** *.8-mil diamond;* **Output terminals:** *three;* **Channel Isolation:** *20 db.*



DUOTONE Model GPS 80-1 (Acos Hi-g)
Frequency response: *20 to 17,500 cps;* **Compliance:** *2 × 10^{-6} cm/dyne;* **Tracking force:** *6 grams;* **Output voltage:** *1.7V;* **Equalization:** *RIAA;* **Mounting centers:** *Standard EIA (1/2" centers);* **Stylus:** *.7 mil;* **Output terminals:** *three;* **Channel isolation:** *20 db minimum.*



ERIE Sterieo (Ceramic)
Frequency response: *30 to 15,000 cps;* **Compliance:** *1.7 × 10^{-6} cm/dyne;* **Tracking force:** *5 to 6 grams;* **Output voltage:** *.4 volts;* **Equalization:** *7 db bass boost at 1,000 cps;* **Mounting centers:** *1/2 and 7/16 standard;* **Stylus:** *.7 mil;* **Output terminals:** *three;* **Channel isolation:** *20 db.*



GE Model GC-7 (magnetic)
Frequency response: *20 to 17,000 cps;* **Compliance:** *2 × 10^{-6} cm/dyne vertical, 3 × 10^{-6} cm/dyne lateral;* **Tracking force:** *3.5 to 7 grams;* **Output voltage:** *6 mv at 5.5 cm/sec;* **Equalization:** *100K ohms;* **Stylus:** *.7-mil diamond;* **Output terminals:** *four;* **Channel isolation:** *20 db.*

ASTATIC Model 13TB (Ceramic)
Frequency Response: *30 to 15,000 cps;* **Compliance:** *1 × 10^{-6} cm/dyne;* **Tracking force:** *5 to 7 grams;* **Output voltage:** *.5V at 1,000 cps, 5 cm/sec;* **Equalization:** *2 meg plus cable C;* **Mounting centers:** *.437" and .5";* **Stylus:** *.7-mil LP and 3-mil 78;* **Output terminals:** *four;* **Channel isolation:** *about 20 db.*

ELECTRO-VOICE 26DST (Ceramic)
Frequency response: *20-16,000 cps;* **Compliance:** *2 × 10^{-6} cm/dyne;* **Tracking force:** *6 grams;* **Output voltage:** *.5V rms (Westrex 1A);* **Equalization:** *RIAA;* **Mounting centers:** *1/2" and 7/16";* **Stylus:** *.7-mil diamond LP, 3-mil sapphire 78;* **Output terminals:** *three;* **Channel isolation:** *20 db.*

RONETTE Binofluid (ceramic)
Frequency response: *20 to 15,000 cps;* **Compliance:** *3.5 × 10^{-6} cm/dyne;* **Tracking force:** *4 to 6 grams;* **Output voltage:** *.35 V at 1,000 cps, 1 cm/sec;* **Equalization:** *RIAA;* **Mounting centers:** *adapter bracket with 1/2" centers;* **Stylus:** *.75-mil sapphire;* **Output terminals:** *three;* **Channel isolation:** *26 to 28 db.*

by Calvin C. Young, Jr.

Specs on the recording systems and special cartridges, plus amplifier and speaker requirements

turntable becomes a problem.

The Westrex 45/45 system combines the vertical and lateral systems of recording in such a way as to retain the most desirable features of each, while minimizing the undesirable. To understand this system, consider that the instantaneous combination of left- and right-channel input signals can result in any of four separate output signals: left channel signal only, right channel signal only, two signals in phase, and two signals out of phase. Naturally, there will be varying degrees of in-phase and out-of-phase conditions because of differences in the input frequencies to each channel.

In the Westrex 45/45 system, these signals produce the cuts shown in Fig. 1. However, the signals are applied to the recording cutter so that in-phase signals produce out-of-phase coil movement and lateral cuts, while out-of-phase signals produce in-phase coil movement and vertical cuts. For random phase differences, a complex groove with both vertical and lateral components will be recorded. This is possible because of the way in which the coils in the recording head are wound.

Fig. 2 is a drawing of a basic recording head showing the physical relationship between the two drive coils and the cutting stylus. Notice that the two drive coils are mounted at 45° angles from vertical and are attached to the same stylus. This physical relationship is why movement of a single coil causes the stylus to etch one side of the groove at 45° and movement of the other coil causes the stylus to etch the other side of the groove at 45°. If both coils move toward or away from the stylus in unison, the stylus will move up or down. If one coil moves toward the stylus and the other coil moves away, the stylus will move side-to-side, or laterally.

Fig. 3 is a photomicrograph of grooves recorded with a single frequency input signal applied to first one channel and then the other. Notice that one side of the groove on each channel is essen-

· Please turn to page 51

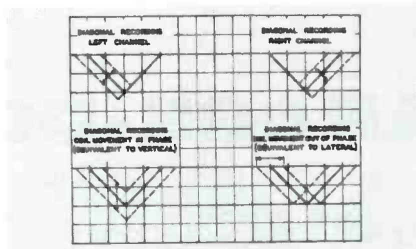


Fig. 1. Basic record cuts using the Westrex 45/45 system of stereo recording.

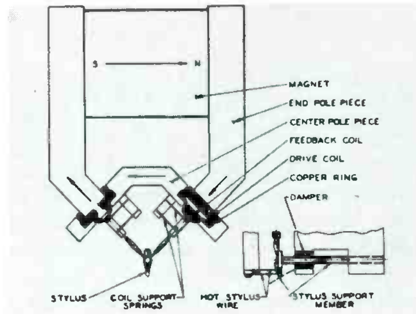


Fig. 2. Basic recording head showing coil placement and attachment to stylus.

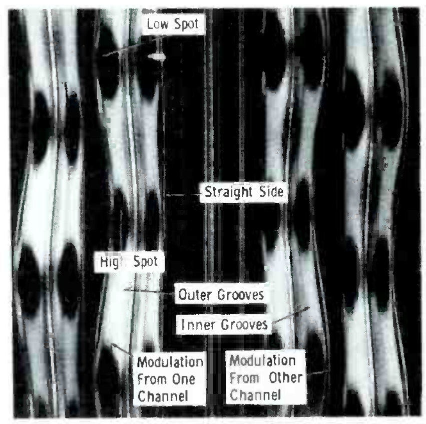


Fig. 3. Photomicrograph of stereo grooves cut with single modulation frequency.
(Courtesy of Westrex Corp.)

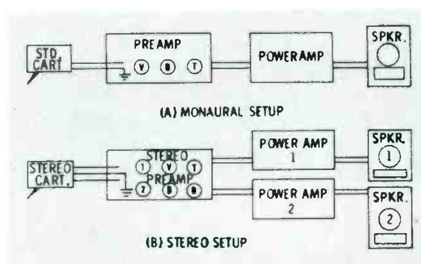


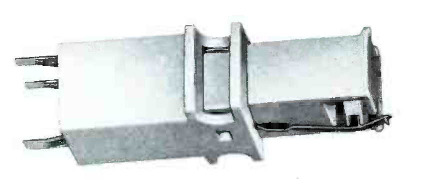
Fig. 4. Block diagram comparison between monaural and stereo playback systems.

SHURE Model M3D (magnetic)

Frequency response: *25 to 15,000 cps;* **Compliance:** *2 × 10⁻⁶ cm/dyne;* **Tracking force:** *3 to 6 grams;* **Output voltage:** *5 millivolts at 1,000 cps;* **Equalization:** *50,000 ohms;* **Mounting centers:** *½";* **Stylus:** *.7-mil diamond;* **Output terminals:** *four;* **Channel isolation:** *20 db minimum.*

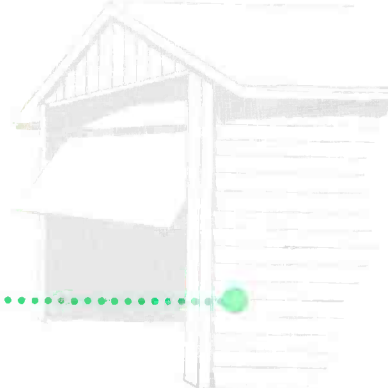
SONOTONE Model 8T (ceramic)

Frequency response: *20 to 12,000 cps with roll-off to 20 kc;* **Compliance:** *2 × 10⁻⁶ cm/dyne;* **Tracking force:** *5 to 7 grams;* **Output voltage:** *.3V;* **Equalization:** *1 to 5 megohms;* **Mounting centers:** *½" and 7/16";* **Stylus:** *.7-mil LP and 3-mil 78 (turnover);* **Output terminals:** *three or four;* **Channel isolation:** *20 db.*

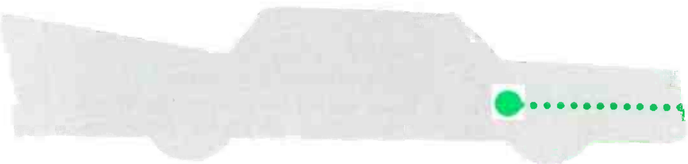


WEBSTER ELECTRIC SC-1D (ceramic)

Frequency response: *30 to 15,000 cps;* **Compliance:** *2 × 10⁻⁶ cm/dyne;* **Tracking force:** *5 to 7 grams;* **Output voltage:** *.5V at 1,000 cps;* **Mounting centers:** *½" and 7/16";* **Stylus:** *.7-mil diamond or sapphire LP, 3-mil insert for 78;* **Output terminals:** *three;* **Channel isolation:** *20 db min.*



ELECTRONIC GARAGE-DOOR OPENERS

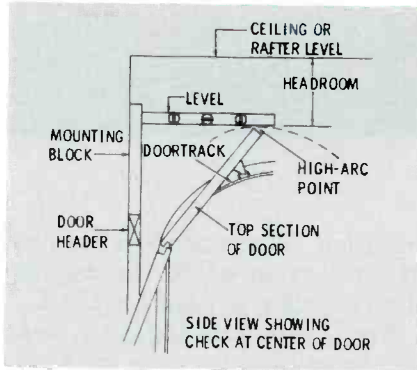


Before you begin an actual installation of a garage-door opener, here are some hints that will save you time and trouble. First of all, almost any door-operator mechanism has a minimum headroom requirement. By headroom, we mean the space above the high-arc point (highest point in the door's travel). Check this clearance and make sure it is sufficient for the unit you plan to use.

The next concern is electric power. The AC circuit into which you connect the operator should be "hot" 24 hours a day to avoid those cases of "hubby" arriving home at midnight and finding he can't open the garage doors.

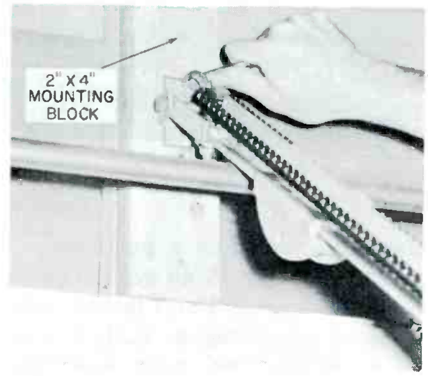
The third point is to disable the existing door lock, or remove it entirely. It isn't needed, and it may accidentally become locked and prevent the doors from opening. Finally, take time to read and understand the installation instructions provided with the door opener of your choice.

Editor's Note: Alliance and Perma-Power units were used in preparing this article. Both were found very satisfactory in the operation of overhead doors of the sectional, curved-track type used in many residential installations.



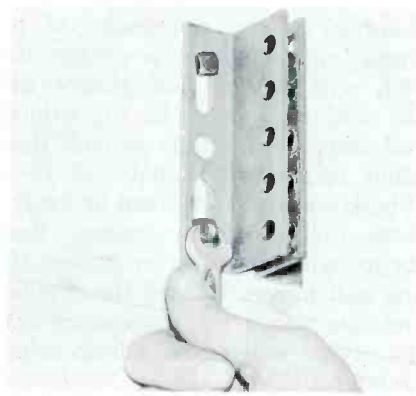
Determining High-Arc Point of Door

Because the operator mechanism is mounted above the door, the high-arc point of the door's travel must be determined. A 2′ carpenter's level is needed in order to make this check.

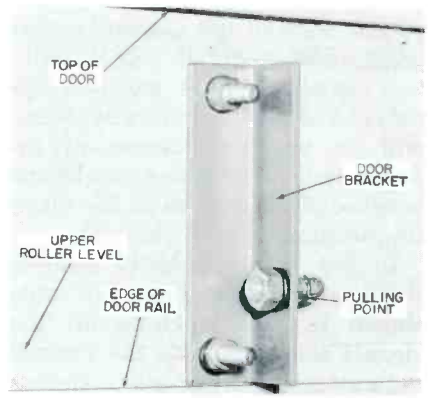


Mounting the Door End of Operator

Position the end of operator over center of door and directly above the high-arc point. The wooden member on which it mounts should be at least 2" thick and rigidly fastened to a structural member.

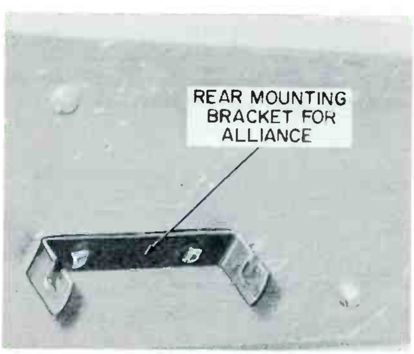


Alliance Door Bracket



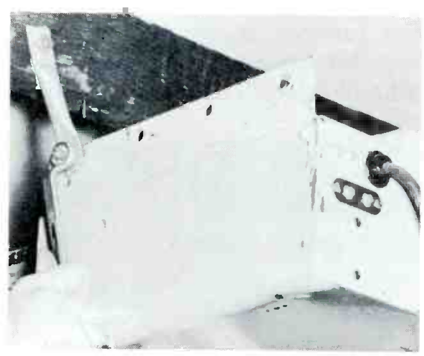
Perma-Power Door Bracket

To eliminate binding of the door in the up cycle, the door brackets should be mounted so that the pulling point is as even as possible with the upper pair of door rollers.



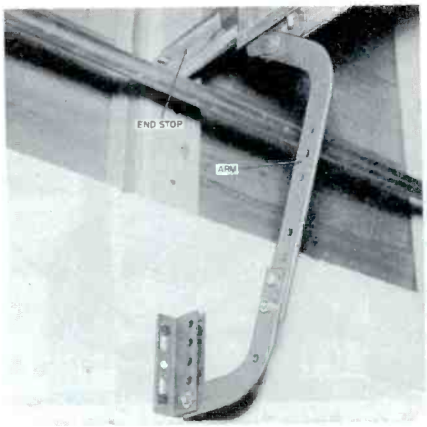
Alliance Rear-Mounting Bracket

Joining Alliance Drawbar and Slide Rail



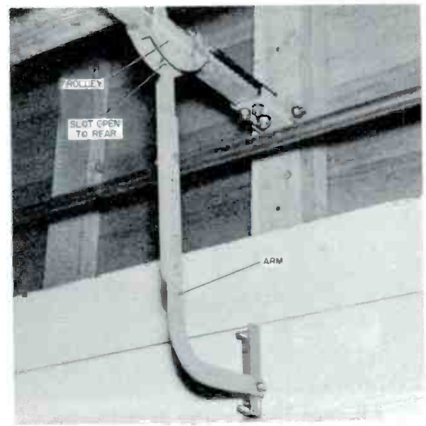
Securing Perma-Power Motor to Beam

When positioning the "business end" of the operator mechanism, be sure that adequate clearance is allowed to permit the door to be completely raised. (Check positioning with the door open.) The beam or beams to which the operator is fastened should be braced to the rafters with a 1" × 6" board on either side of the operator mounting point. This will distribute the load and prevent overtaxing any one supporting member of the garage roof. Before you attempt to locate the correct rear-mounting position for the Alliance unit, the drawbar-and-slider unit must be assembled and attached to the motor. The assembly can then be raised and the correct mounting position marked.

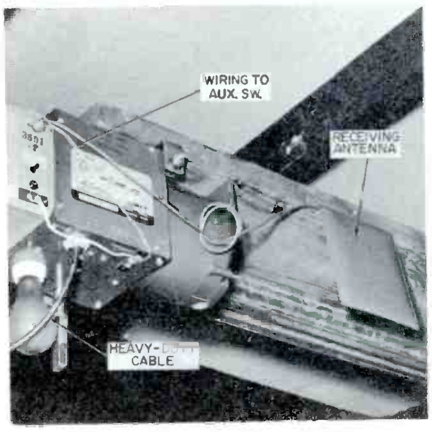


Alliance Operaror-to-Door Connection

The door should be in the down position and the operator at the forward end of its travel before you connect the actuator arm between the door bracket and the operator. The actuator arm must hook on the trolley of the Perma-Power unit in the manner shown; otherwise, the arm will disengage on the first down cycle.

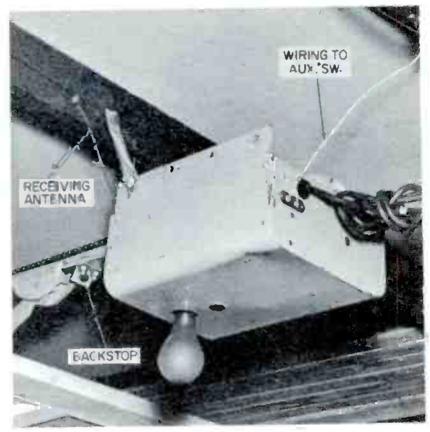


Perma-Power Door Connection



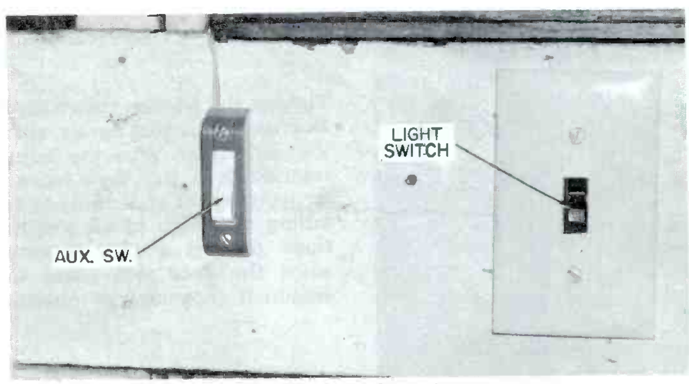
Alliance Operator Installation

Mount the receiving antenna according to the following rule: If the driveway runs straight into the garage, the length (or broadside) of the antenna should run at right angles to the garage door as shown for the Alliance unit. If the driveway makes a right-angle bend just outside the garage, the broadside position of the antenna should be parallel to the door, as shown for the Perma-Power unit. Do not shorten the antenna or antenna lead on either unit.

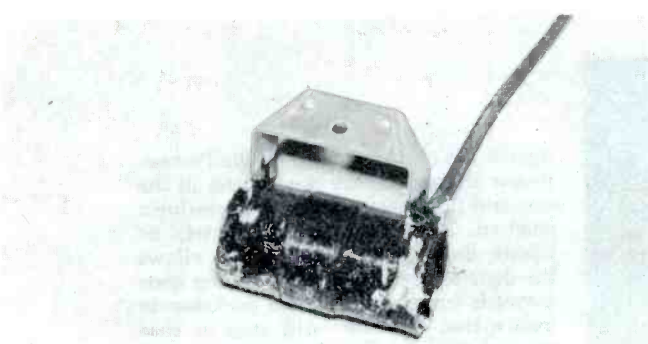


Perma-Power Operator Installation

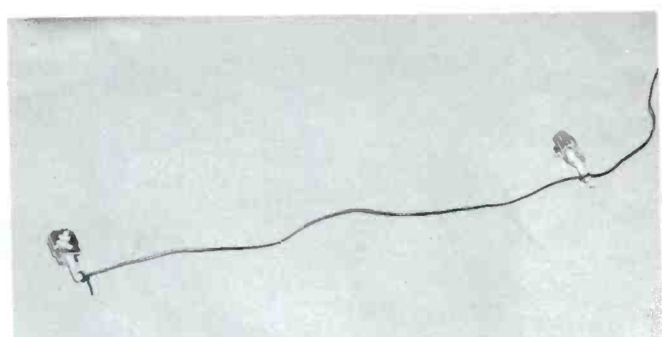
An auxiliary switch, which permits the user to open or close the door on entry or exit, should be mounted near the doorway into the house. This is provided so the mechanism can be actuated while the car is gone or without having to wait for transmitter warm-up.



Auxiliary Switch Location

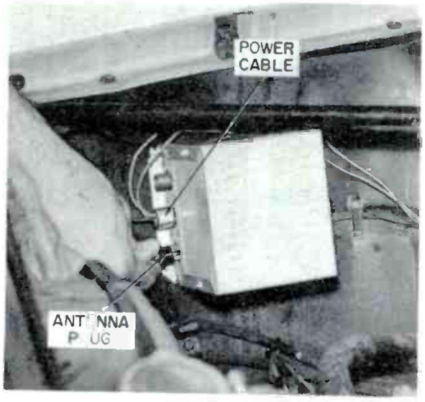


Alliance Transmitting Antenna



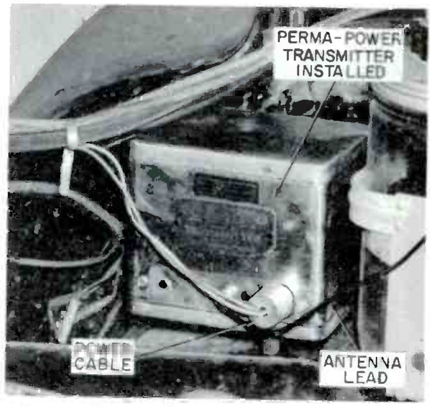
Perma-Power Transmitting Antenna

There are three possible locations for the transmitting antenna—under the gravel pan behind the front bumper, behind the grille (provided the structure is fairly well open and will not restrict signal radiation), or under the side of the car body. Allow at least a 2" clearance between the antenna and any part of the automobile, but don't allow it to project below the lowest part of the bumper. This latter precaution will protect the antenna from low ground obstructions.

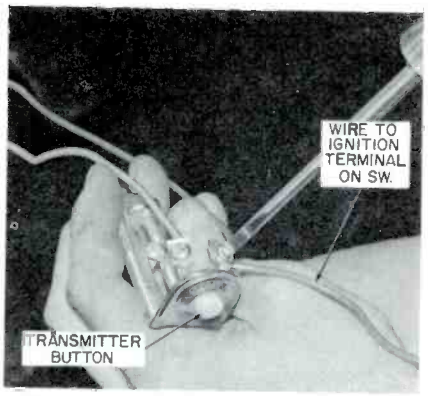


Alliance Transmitter Installation

When mounting the transmitter in the engine compartment, keep it as high as possible and away from the fan blades and belt. This will help to insure trouble-free operation even in very wet weather. Be sure the power cable is connected to the correct jack. Both 6- and 12-volt jacks are provided for universal application; connecting the cable to the 6-volt jack on a 12-volt car will cause damage to the transmitter.



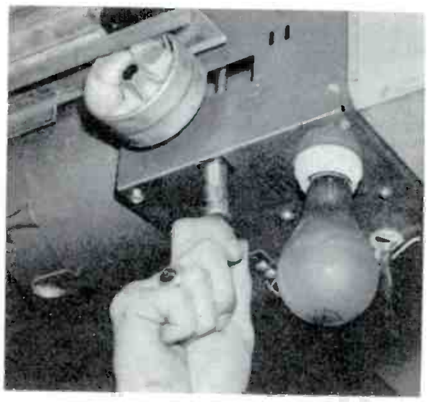
Perma-Power Transmitter Installation



Connecting the Transmitter Button

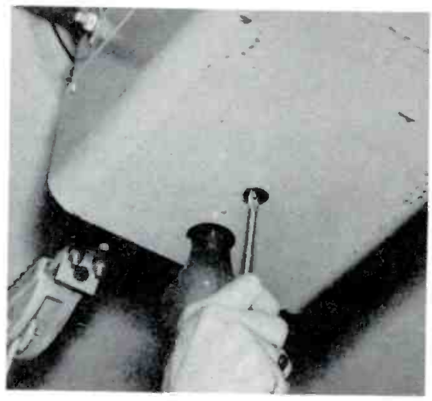
Route the power cable through the firewall and into the passenger compartment. You can usually find sufficient clearance through a rubber bushing alongside one of the control cables. A wire should be run from the transmitter button to the ignition terminal on the switch. This provides about 6 volts (courtesy of the dropping resistor in the car's ignition system) for the vibrator and modulator circuit of the transmitter. *Warning!* A direct connection to 12 volts can damage the transmitter—so be sure of your connection point.

Mounting Transmitter Button

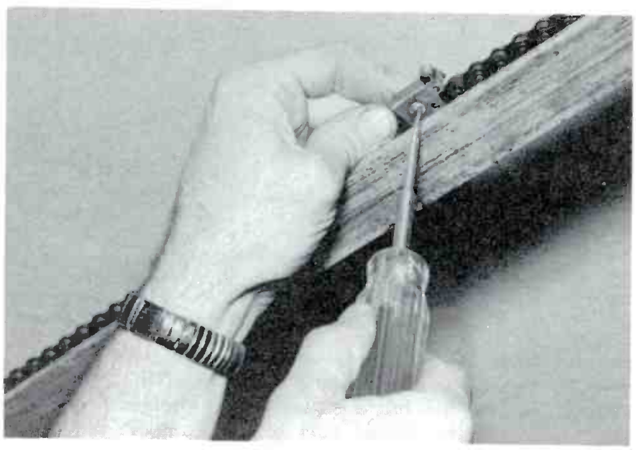


Adjusting Alliance Clutch

Tighten the friction clutch on the operator until it is just barely able to cycle the door, then give the adjustment a fraction to a full turn more (see instructions with your unit) to insure unfailing operation in all weather conditions. This is a safe operating point, since the door will cease to operate should it encounter an obstruction.



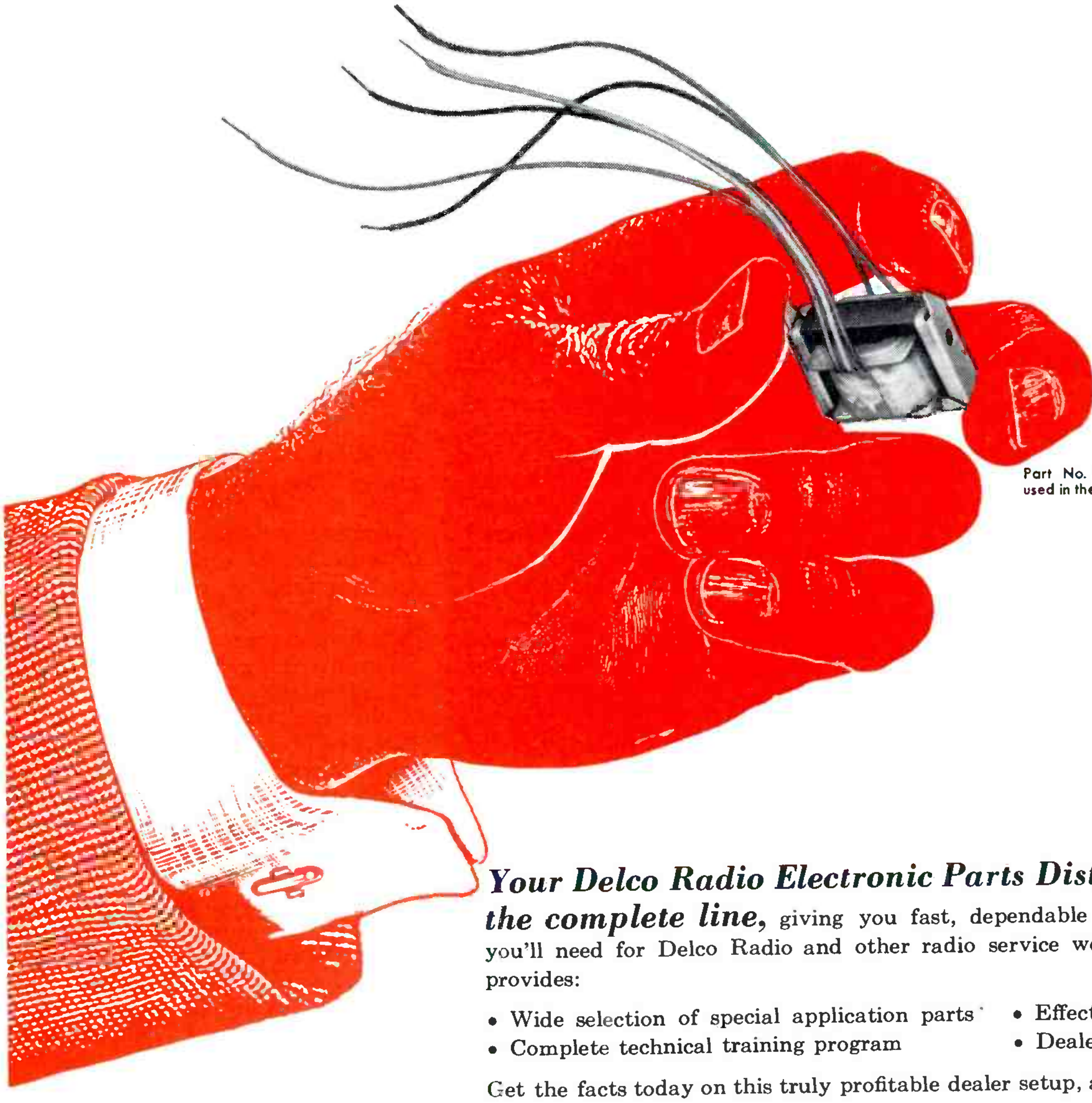
Adjusting Perma-Power Clutch



Adjusting Perma-Power Chain Dog

Adjust the electrical trips on the Perma-Power chain until the door opens all the way and just coasts to the complete down position. Moving the electrical trip or "chain dog" toward the trolley allows the door to open more fully. When door travel is correct, install the backstop to insure that the door will stop in case the dog fails to shut the mechanism off in time.

Use Delco Radio Service Parts!



Part No. 7270804—output transformer used in the new Delco Portable Car Radio.

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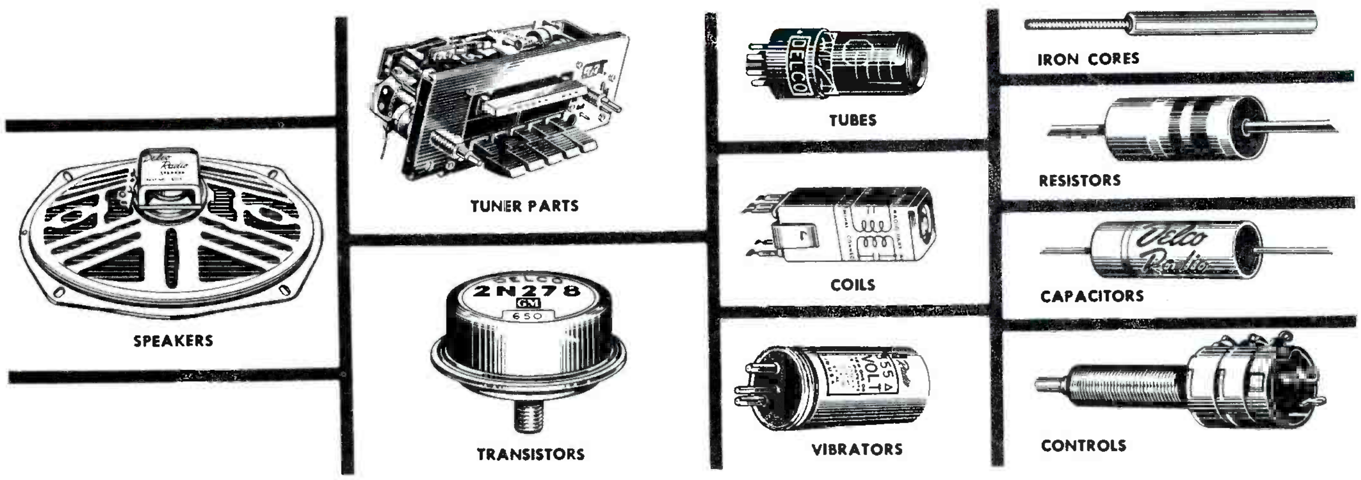

Special This Week Only. Having a hard time keeping busy during these summer months? If so, you might take a hint from the garages that advertise a special flat-rate charge for some combination of standard maintenance jobs such as brake adjustment and wheel balancing. Applying this idea to the TV field, you could offer to clean a TV chassis and safety glass and check all service adjustments for a fixed fee of $3.95 or $4.95. At this price, you obviously won't be hauling in big profits; but you'll be building good will and bringing in some cash instead of sitting around waiting for the phone to ring.

You could even make free courtesy calls to those customers on your list who haven't requested service lately. It might be that some of them are ready for a set of rectifiers or a new picture tube, and you could offer to install these at a lower price during the summer than during the fall rush.

This does not imply that you should follow a regular policy of offering cut-rate labor charges with the object of talking customers into unnecessary service work. To the contrary, this is a suggestion that you try various methods of keeping your work load up to a normal level during slack periods. Special offers should not receive any more advertising promotion that required to fill up the gaps in your schedule; if you get to the point where you have to hire another man to handle the flat-rate calls, it's time to let your offer expire!

$ & ¢

What's In a Name? Considering that an active imagination and a whimsical sense of humor are (or should be) typical traits of TV technicians, we are surprised that more original and distinctive names are not bestowed on service shops. Actually, most shop names are about as imaginative as the label on a feed sack. They run the gamut from Aaron's TV to Zilch TV, with occasional titles such as A A Active TV Service (first in the local phone book listing) thrown in for a little variety.

Various other businessmen, such as drive-in restaurant owners, seem to have a knack of thinking up store names that will make the public look, laugh, and *remember*. How about the "Dizzy Whizz" drive-in of Louisville, or the "MOO-O-O-O-O-O!" dairy bar of Pittsburgh?

We feel sure that there are many shop-owners in the country who have given free rein to their imagination when adopting names for their businesses. How about dropping us a line with your suggestions for catchy names which have been applied to TV-radio service organizations. The most interesting and original will be published in future issues.

$ & ¢

Test Your Tact—V. Talk about booby traps! Among the worst ones in the TV field are those simple defects that result from customer meddling or the negligence of some other serviceman. You've undoubtedly run into several such cases yourself. For instance, you may have been called in to service a set with no raster, only to find that the plate cap lead on the 1B3 was put on carelessly and had worked loose. Or maybe you once remedied a case of unstable sync by turning the AGC switch to its correct position.

You can usually find such troubles in a matter of seconds—but how do you handle a call of this type? Should you immediately correct the defect and begin to pack up your tools, perhaps mumbling something about your competitor's sloppy work?

Not if you want to collect your usual fee and leave a satisfied customer! If you're too speedy and make the trouble seem elementary, he will not be in much of a mood to pay you. Once you have started working on a receiver, it's good business to earn your full price by making a thorough check of set operation.

For instance, check the operation and settings of rear- and front-panel controls. See that the RF and horizontal oscillators are adjusted properly. Add the final touch by wiping off the cabinet and the safety glass. In this way, you convince the customer he is getting his money's worth. Remember, no customer feels like paying a $5 or $6 service charge for 2 minutes of your time. Save a call-back (or the loss of a customer) by doing a thorough job.

$ & ¢

Needs of Industry. The industrial electronics field is a world of opportunity for servicemen who are willing to work and study hard.

Let's face facts—it takes a lot of ambition to break into the industrial field. A technician can't expect to go in "cold," but must put in some time on advance study of industrial processes and controls. An independent technician might work out an arrangement whereby he could spend some spare time in a small industrial plant, familiarizing himself with its operation and preparing to take over its electronic maintenance.

Most industrial firms are still handling the bulk of their own service needs, but they would be glad to find outside sources of service in order to promote the growth of the field. Thus, many companies would give their blessings to an independent service contractor entering the business—once he proved himself to be thoroughly competent. Otherwise, nothing doing! The stakes are too high when the production of an entire factory depends on the proper functioning of electronic gear.

This is a good point to keep in mind when you're just getting started. Don't let your inefficiency or lack of knowledge hold up the works. If you don't feel you can complete the job in a reasonable length of time, let your customer know, or get some help.

The booming industrial field is too vast to be conquered by a broadside assault; however, if you're really interested in some specialized branch of the field, dig in and build yourself a solid background in that specialty. Experience is demanded — and rewarded.

THE FM SIGNAL

HOW IT RIDES THE AIR WAVES *by Thomas A. Lesh*

How much do *you* know about frequency modulation? For instance, can you explain the *exact* reasons why FM radio is better than AM for hi-fi music broadcasting? Or, do you know what kind of fringe-area performance to expect in FM? A thorough description of the basic properties of the FM signal will provide detailed answers to these and other practical questions.

The simplified waveform drawings in Fig. 1 point out the fundamental difference between amplitude and frequency modulation. In AM, the amplitude of an RF carrier wave is varied continually at an audio-frequency rate, but the carrier frequency itself remains constant. On the other hand, FM is a continual variation of carrier frequency without any change in amplitude. In both AM and FM, the fluctuations produced in the carrier will range from slight to extreme as the relative amplitude (volume) of the modulating audio signal varies from weak to strong.

Figs. 1B and 1C, respectively, show amplitude and frequency modulation of a carrier by the 1-kc signal in Fig. 1A. A change in the *frequency* of the modulating signal would cause the number of carrier fluctuations per second to change in both AM and FM, but the original patterns as seen in Fig. 1 could be restored to view simply by changing the sweep frequency of the scope. However, an *amplitude* change in the modulating signal would actually alter the shape of the patterns, indicating that the effect of the audio signal on the carrier had been increased or reduced.

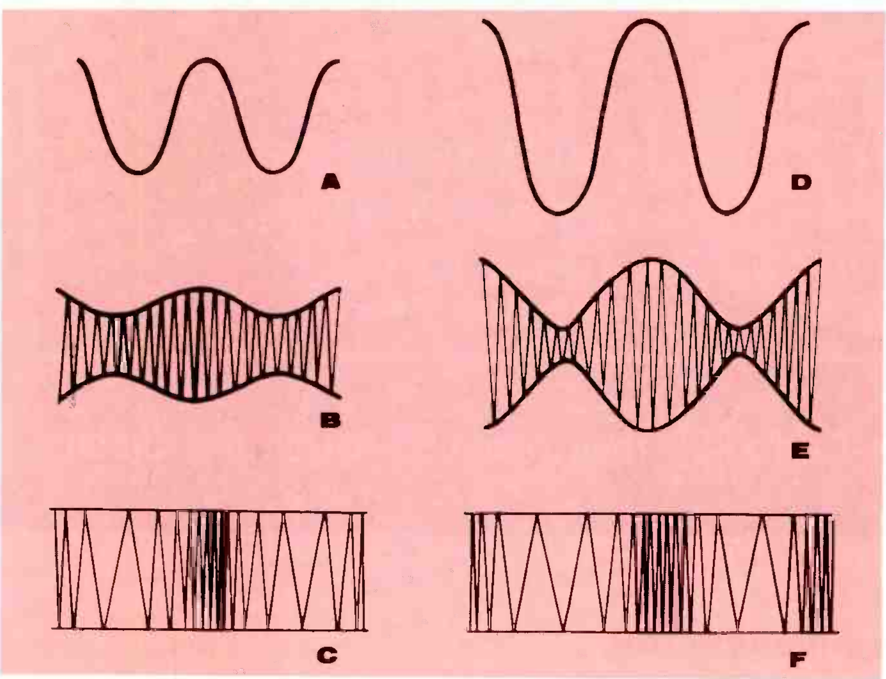

Fig. 1. Amplitude and frequency modulation of an RF carrier by 1-kc audio signals of two different strengths.

The effect of an increase in audio signal strength (Fig. 1D) is shown in Fig. 1E for amplitude modulation and in Fig. 1F for frequency modulation. Higher peaks and deeper valleys are produced in the AM signal, and more "bunching" and "stretching" of alternate groups of RF cycles is apparent in the FM signal; in other words, both signals undergo wider swings away from the unmodulated condition. There is a limit to the relative audio amplitude which can be permitted in each system, and the maximum level is termed "100% modulation." This point is reached in AM when the carrier level is reduced to zero at the negative peak of each audio cycle. Any further increase in modulation level results in carrier cutoff and distortion of the modulating signal.

In an FM system, an increase beyond 100% modulation will not result in distortion but will cause the bandwidth of the FM channel to be exceeded. The permissible limit is arbitrarily selected and varies from one FM system to another. A frequency swing of ±75 kc from the unmodulated or "center" frequency is considered 100% modulation in FM radio, but the corresponding figure for TV sound is only ±25 kc.

The fact that FM radio and TV sound both have the same upper audio frequency limit of 15,000 cps demonstrates that the bandwidth of an FM system does not directly determine the highest audio frequency that can be transmitted. The ratio between the maximum carrier-frequency swing and the highest reproducible audio

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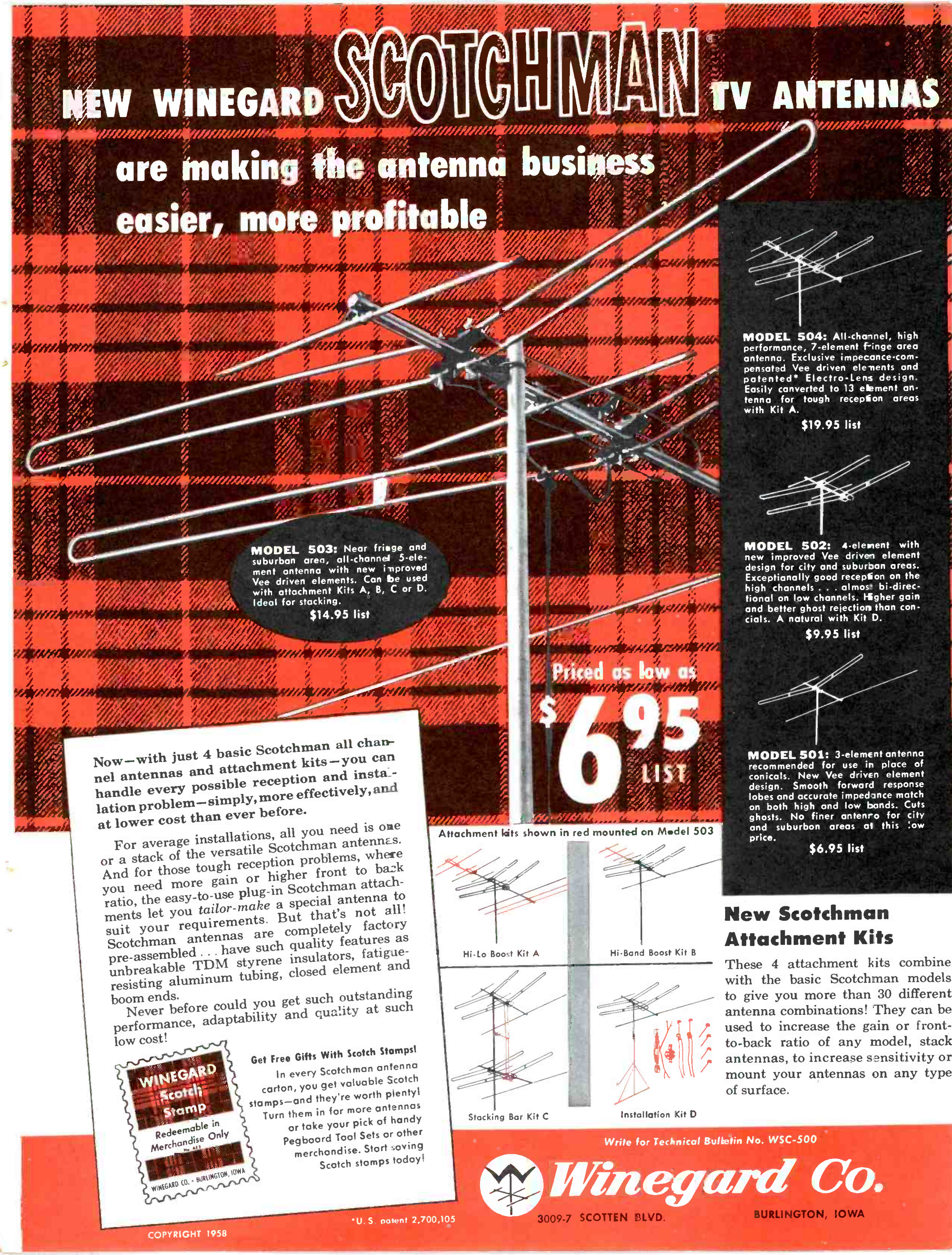
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POCKET-

Getting Familiar with
'58 Transistor Radios **by Les Deane**

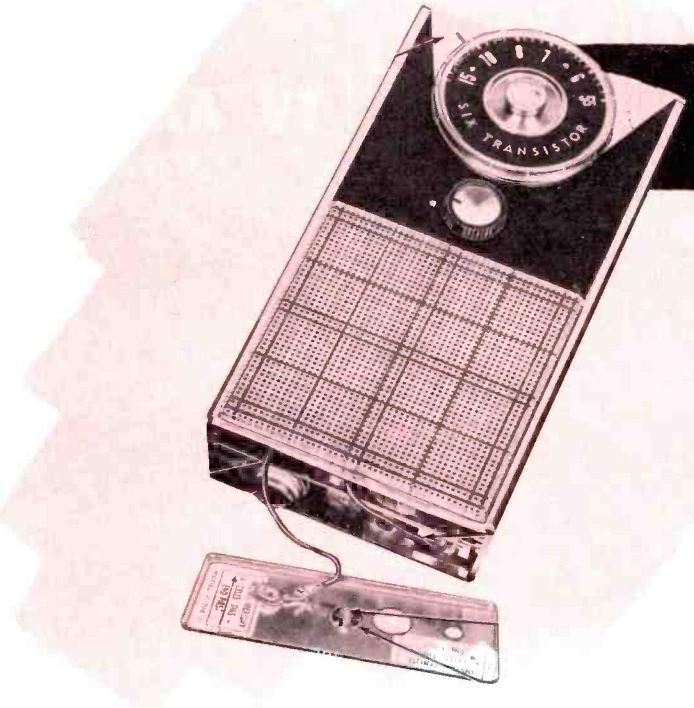


Fig. 1. G.E.'s Model 766A has removable plate on one end for replacing batteries.

Although the subject of disassembling a radio may sound rather elementary to the experienced technician, problems are bound to arise when you first encounter certain design features of new pocket-size receivers.

Familiarizing yourself now with the construction of these miniature units will save you embarrassment in front of a customer later on. It will certainly make future troubleshooting jobs on transistor radios much easier and, what's more important, it will also lessen your chances of damaging their delicate cases, components, and wiring.

Most receivers are housed in small plastic cabinets—some with attached carrying handles. Rough treatment of this assembly (such as prying on a plastic case with a screwdriver, dropping it, or twisting a handle in the wrong direction) will definitely put a crimp in your servicing activities and cause you to lose valuable time in procuring a special replacement for the damaged part.

To aid the technician, set manufacturers and PHOTOFACT folders often make mention of special procedures that must be followed in the disassembly of particular transistor radios. It's advisable to pay special attention to these hints — at least until you become better acquainted with the general construction of transistorized receivers and are accustomed to working with their small, fragile components. An examination of a few of these radios will show you what we mean.

Battery Replacement

Like any other portable equipment, transistor radios often fail due to weak or dead batteries. The first step in servicing, therefore, calls for a battery substitution or a check of the battery voltage under load. In the majority of cases, getting to the battery compartment requires little specialized skill; after all, the units are designed with the idea that the owner should be able to change batteries without difficulty.

Not to go off on a tangent—but do you have change for a buck? No, I don't need it; but you may, when removing a battery panel or rear cover from one of these new portables. It seems that many of them are held in place by a large brass screw having a wide groove in the head known as a coin slot. Actually, it's more desirable to use a coin in this application than an ordinary screw-

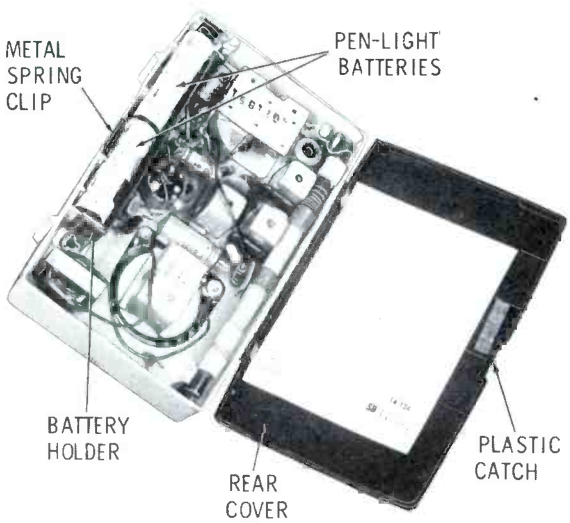


Fig. 2. In the Philco Model T-4, the case can be opened by prying out on clip and separating the two individual sections.

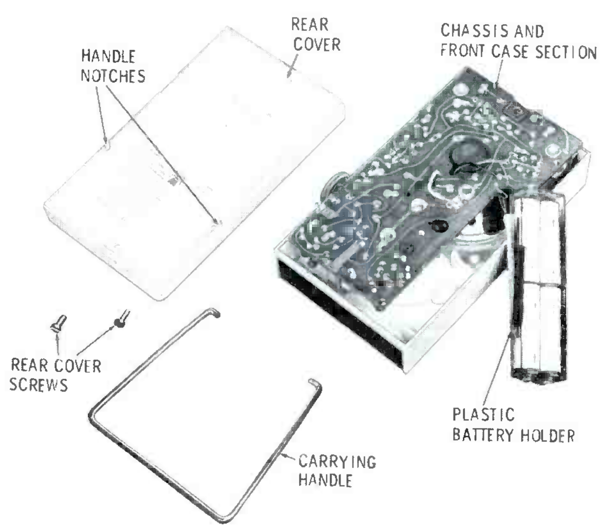


Fig. 3. To get at the batteries of the Westinghouse H-655P5, the handle, two screws, and the rear cover must be removed.

SIZED PORTABLES

driver, because the metal of the coin is relatively soft and is less likely to mar the decorative head of the screw. In addition, the blade of a screwdriver will usually be narrower than the slot and will have a tendency to bite into the brass where the corners of the blade make contact.

To give a more vivid picture of what you might run into when replacing or testing batteries, let's take a look at some typical transistor portables. The new General Electric Model shown in Fig. 1 features rechargeable batteries, but will also operate on conventional "AA" cells. To get to the batteries in this outfit, you merely loosen the coin-slotted screw in the end plate near the speaker grille and lift off the plate. The batteries are positioned in a cylindrical holder that runs almost the entire length of the case. The two small cells will fall out when the radio is tilted slightly toward the open end. A "C" clip, shown in Fig. 1, permanently secures the brass screw to the end plate and thus eliminates the chance of mislaying the screw. We will see later how the chassis of this receiver is removed.

In the Philco design pictured in Fig. 2, the batteries are made accessible by prying outward on a small metal clip located on one side of the plastic case and then pulling the back cover up and off. After this operation, the four "AA" cells may be replaced or tested and almost all of the major components on the printed wiring board can be seen.

Some other transistor portables have a slightly different latch style or a hinged rear panel. This hinged back is sometimes spring-loaded and merely snaps open or closed. Leather-type cases often have snap fasteners like those commonly found on clothing.

As can be seen in Fig. 3, disassembly of a late model Westinghouse for battery replacement is a little more complex. In this particular model, the wire carrying handle is removed first by gripping it on both sides and separating the arms until they are free from the notches in the side of the plastic case. The two brass screws on the back of the set are then removed and the rear cover is lifted off.

After these steps, the battery holder can then be slipped from the front section of the case as shown. One must be careful, however, not to place too much strain on the leads between the chassis and the battery terminals. Note that only the printed wiring side of the chassis is exposed by removal of the rear cover. To do much troubleshooting, the chassis board must be removed from the front section of the case. We will see presently how this is accomplished.

Some units with snap-in type battery holders have special pull-out tabs for removing old batteries. An example of this can be seen in Fig. 4, where two short pieces of plastic tape are attached to the battery compartment. When the cells are installed, the tape is mashed down into the four grooved sections, leaving only the ends sticking up as tabs.

The two most popular supply voltages used in transistor portables today are 6 and 9 volts. The 6-volt supply is usually made up of four 1½-volt "AA" cells connected in series, while the 9-volt source is generally derived from a single unit. In a few cases, however, the 9-volt system is also composed of 1½-volt cells in series. Other sets employ 4-, 13½-, or 22½-volt supplies, although these are not as common as the 6- or 9-volt design.

If you plan on servicing these "personalized" receivers, it's a good idea to stock at least a few of the most popular battery types. In the 1½-volt line, you may find three different sizes in use—but the one most often encountered will be the small "AA" size (commonly known as *penlite*) which are approximately 2" in length and about ½" in diameter. When several 1½-volt cells are used in a series or parallel arrangement, always remember to change the

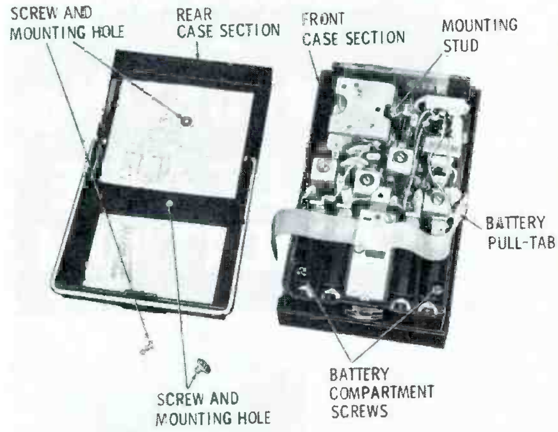


Fig. 4. Zenith portable incorporates a pull-out tape for quick removal of the battery cells.

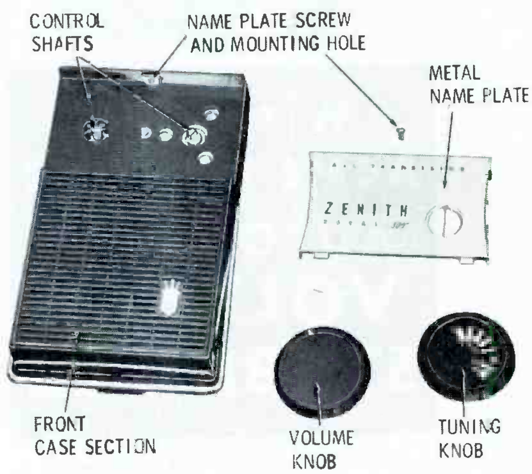


Fig. 5. To remove the chassis of the Royal "300," disassemble the name plate and control knobs.

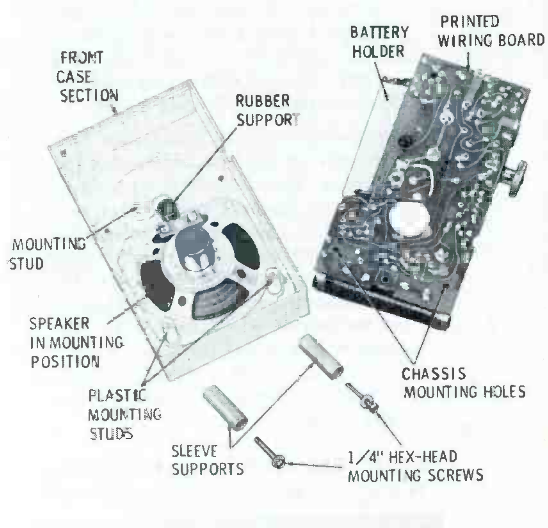


Fig. 6. Westinghouse H-655P5 chassis removed from the front section of its plastic case.

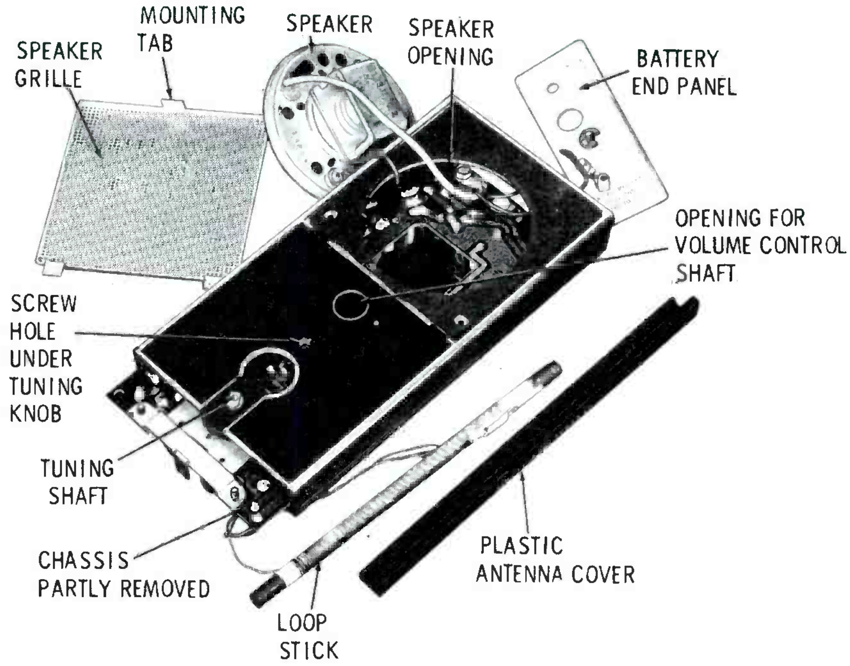


Fig. 7. In this G.E. model, the chassis board slides out one end of the metal case. Be sure to use caution when handling its delicate loop stick and speaker leads.

complete set of cells at one time.

For 9-volt systems, you will find at least six different styles of batteries in wide use. Their sizes and terminal contacts differ, and the units are therefore not interchangeable. It may pay you to contact your local distributor to see exactly what he has to offer in the way of a complete battery replacement line for transistor radios.

Pulling the Chassis

Battery replacement is one thing, but troubleshooting a transistor portable is another. In order to check transistors, measure voltages and resistances, or even for signal tracing, one must remove the chassis—which is usually a small printed-wiring board of very compact design.

Besides nimble fingers and a good deal of patience, you should be equipped with a few tools such as a pair of needle-nose pliers, a set of spin wrenches, a small- and a medium-size screwdriver, a small Phillips screwdriver, and a pair of tweezers. A soldering aid and low-voltage iron will also come in handy.

Suppose you were called upon to service a Zenith Royal "300" like the one pictured in Figs. 4 and 5. You would find that the rear cover and carrying handle can be disassembled by removing two brass screws from the back of the set (see Fig. 4). To pull the chassis, you would proceed to remove the two fairly large Phillips-head screws from inside the battery compartment.

Near the middle of the assembly, next to the tuning capacitor, you'd find a red-colored stud about ¼″ in diameter and almost 1″ long. The stud has a screwdriver slot in the exposed end and can be removed by turning it counterclockwise.

Next, turn the set over and remove the small Phillips-head screw at the top of the front section. This screw holds the front nameplate which covers both control knobs. After removing the plate, pull the tuning and volume control knobs off and lift the chassis out of the case.

It might be well to pause here for a moment and mention the fact that not all transistor portables have knobs of the familiar push-on type. Many of the tuning dials in particular are equipped with a decorative thumb screw which must be completely removed before the knob can be taken off. If you fail to notice this feature before pulling on the knob, you may find yourself holding only part of a knob in your hand.

When servicing the Westinghouse receiver presented in Fig. 3, you must first remove the wire handle and rear cover as previously mentioned. The push-on type tuning knob should then be removed. Since it is recessed slightly, it may be necessary to insert a loop of string under the knob and pull it up carefully. Proceed by taking out the ¼" hex-head screw located under the knob; next, turn the entire set over.

As pointed out in Fig. 6, you can then remove the two long hex-head screws from the speaker end of the unit and lift the printed board, sleeve supports, and speaker from the front section of the case. Be sure to note the placement of the rubber support shown in Fig. 6, and all washers and spacers removed during disassembly.

As another example, let's see what's required to remove the chassis of the G. E. Model 766A. In this procedure, we first take off the end panel and unsolder the chassis-to-case lead. (See Fig. 1.) Leave the connection to the panel terminal intact. Referring now to Fig. 7, we next straighten the mounting tab holding the speaker grille to the case and remove the grille by swinging it upward and back toward the end opposite from the tab. By lifting the speaker out of the case, the two speaker leads can then be unsoldered.

After removing the push-on type volume control knob, remove the thumb screw from the center of the tuning shaft and lift off the tuning knob. Under the knob you'll find a small hex-head screw which fastens the case to the chassis. Using a 3/16" spin wrench, remove it. Its mounting hole is pointed out in Fig. 7.

Next, remove the Phillips-head screw that secures the top end-

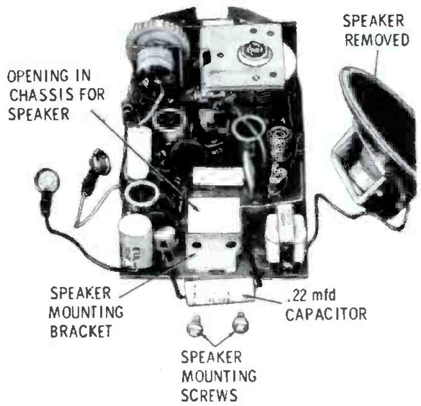


Fig. 8. Speaker of Silvertone 9202 must be removed to make parts accessible.

plate to the case. With this plate removed, snap out the plastic antenna cover and slide the chassis assembly out the tuning-dial end of the case. The battery end-panel will still be attached to the chassis, but this can be turned and pulled through the case along with the chassis. As the chassis is removed, handle the loop stick with care so as not to break its delicate leads.

Room to Work

The disassembly of these extremely compact receivers will not always end with removal of the chassis. Naturally, most of the parts and printed wiring will be accessible; but in some radios, a portion of the circuitry may still be jammed beneath a speaker, tuning gang, shield, or speaker-mounting plate. Take, for example, the Silvertone unit pictured in Fig. 8. By removing this chassis, we have exposed the soldered contact side of the board and perhaps some of the components on top, but it's still difficult to trace wiring or apply test instruments because of the speaker's position.

The speaker of the Silvertone may be removed by bending the .22 mfd capacitor (Fig. 8) downward and outward so that you can reach the two Phillips-head screws that hold the speaker frame to the mounting bracket on the chassis. When loosening these two screws, watch how you

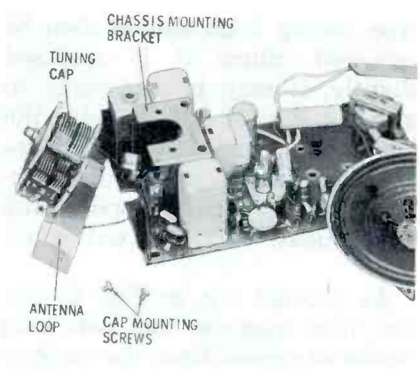


Fig. 9. Servicing Emerson Model 888 may require removal of tuning capacitor.

grasp the delicate chassis, for in most cases the screws will be so tight that it may require considerable force at first to break them free. Actually, if you contemplate troubleshooting the chassis, it might not be a bad idea to loosen the speaker-mounting screws while the assembly is still in its case. You might keep this point in mind when servicing any transistor portable. Remember, too, that if one side of the speaker voice coil connects to ground through the mounting frame, a short clip lead must be used from the proper speaker terminal to chassis.

As a second example of additional disassembly that may be required, let's investigate the Emerson model shown in Fig. 9. To service this unit properly, it's necessary to remove not only the speaker but also the tuning capac-

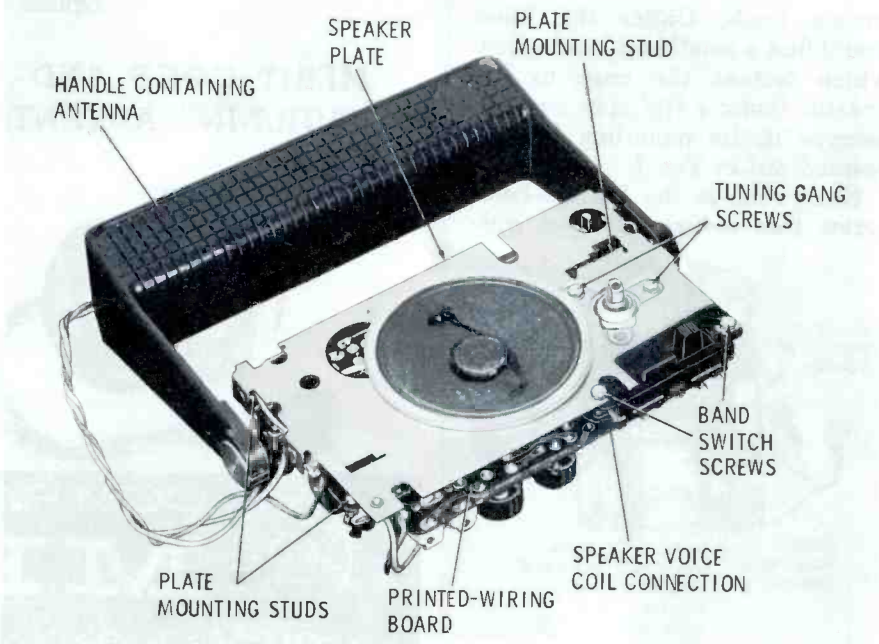


Fig. 10. To give yourself enough room to work on the Motorola Model 6X39A-2, the large speaker-mounting plate should be separated from the main chassis.

itor. Since about a dozen parts are located underneath the tuning gang, this unit should be separated from the main chassis by removing two small Phillips-head screws from atop the mounting bracket. The tuning capacitor and loop can then be moved out to one side as shown in Fig. 9. To operate the receiver, however, you must install a ground lead between the capacitor and chassis.

Turning now to another disassembly problem often encountered in transistor portables, note the speaker-mounting plate positioned over the entire printed-wiring side of the Motorola chassis in Fig. 10. When troubleshooting or replacing chassis components in this set, you may have to remove this panel completely. This is done by using a $\frac{3}{16}$" hex wrench to remove the bandswitch screws and tuning-gang screws identified in Fig. 10. Next, unsolder the speaker voice-coil contact on the opposite side of the board. This is not a lead but a stud-like terminal connected directly between speaker and printed wiring. After the three plate-mounting studs have been unsoldered, the chassis board and tuning gang can be separated from the speaker assembly and moved as far away as the length of the antenna leads will permit.

To operate the receiver in this disassembled condition, you must use clip leads from the chassis to one side of the voice coil and to the tuning-gang frame. Take care in handling the apparatus so as not to break the antenna or tuning-gang leads still connected to the printed wiring.

In conclusion, remember that transistor portables are much more fragile than ordinary radio or TV receivers and should therefore be serviced accordingly. Never work with the chassis on a metal bench top or subject the transistors to excessive heat or abnormal voltages. Be extremely cautious when probing, and keep in mind that certain p-n-p type transistors have one of their elements connected to the outer shell—so don't short it out. In general, save yourself trouble by never going any further than absolutely necessary with the unit's disassembly. ▲

the troubleshooter

answers your service problems

Vertical Frequency Drift

A General Electric Model 21C113 has a stubborn case of vertical rolling. When the set is first turned on, it operates normally for several minutes; then the picture starts to roll. Moving the vertical hold control clockwise to a new setting will lock in the picture for a few more minutes, but the rolling soon starts again. The oscillator eventually gets so far off frequency that the rolling cannot be stopped with the hold control.

I have checked the integrator and replaced the blocking transformer T2, but to no avail. On a previous occasion, I tried several different 6BL7's in the circuit and succeeded in finding one that would lock in the picture permanently. Now I have to replace this tube again, and I feel that it must be possible to remedy this complaint by a production change or some other method more satisfactory than simply trying several different tubes.

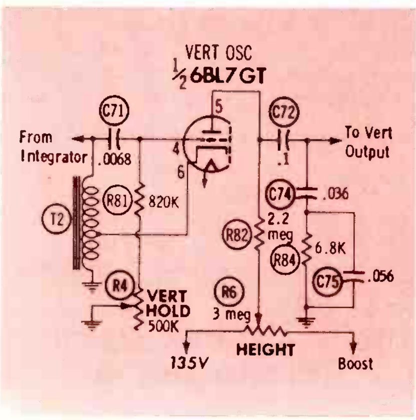
LOUIS J. MARKOVIC

Pittsburgh, Pa.

The only production change we can find listed for this vertical sweep circuit is the addition or removal of a 120K resistor between R81 and R4. This would affect the range of the hold control, but it wouldn't have much influence on your symptom of frequency drift in the oscillator.

I have one standard recommendation to make in any case of trouble encountered in the "S" line chassis used in this receiver: Check all ground connections in the circuit. The riveted ground lugs employed in this chassis are noted for their tendency to make poor contact. It's a good practice to solder all these lugs securely to the chassis whenever one of these sets comes into your shop.

Some measure of success in curing vertical drift may be obtained by replacing C74 with a .033- or .039-mfd paper capacitor rated at 300 volts or better. The original is a ceramic type which may tend to change value during the warm-up period. Instead of a paper capacitor, various ceramic units with different temperature coefficients could be tried as an experiment. You could also investigate the possibility that C71, C72 or C75 is changing value with heat.



Horizontal Pulling

A Zenith Chassis 17Z30Q has very bad horizontal pulling. Tube substitution hasn't helped. The set receives signals from both a cable system and a UHF translator, and the pulling is much worse in the former case. Our theory is that the horizontal sync pulses are clipped quite badly on a cable system, and that these Zenith sets are extremely sensitive to defects in the sync signal. Are there any changes I can make in the horizontal circuits to remedy this situation?

Incidentally, the vertical sync pulse looks OK when you view it on the CRT by adjusting the vertical hold control.

WESLEY SHREEVE

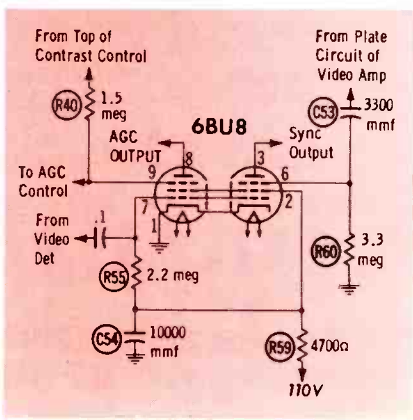
St. Johns, Ariz.

Since you say that the vertical pulse looks normal, I have an idea that the signal delivered by the cable is satisfactory. However, it is probably stronger than the translator signal, and this could account for the fact that it causes worse pulling.

You can make a more accurate check of signal quality by setting up a known good receiver and viewing the waveform at the cathode of the picture tube with a scope. If the signal is normal, the sync pulses will make up about 25% of the total amplitude of the signal at this point.

Also check the corresponding signal in the Zenith set. If the sync pulses are much "stubbier" than in the other set, one or more RF, IF, or video stages are being overloaded. In this event, the first thing to check is the AGC control.

This brings up an interesting point: A 6BU8 is employed as a sync and AGC tube, as described in "AGC Circuits for '58" in our April issue. This recently-introduced circuit might need some adjustment for better performance in your area—so check the 6BU8 stage thoroughly, using a scope if possible. Be especially on the lookout for excessive bias or signal amplitude at pin 7—either condition could cause the tube to be cut off by each sync pulse, thus causing a loss of sync. You might relieve this situation by slightly reducing the value of R55.



Fuse Resistor Blows

I have an RCA Model 17D8185 (Chassis KCS109C) in which the 5.6-ohm fusible resistor overheats and opens. I have checked and substituted selenium rectifiers and filter capacitors. The B+ voltage reads 240 volts. Picture and sound are both OK until the resistor burns out. I have tried disconnecting various B+ feed lines, but cannot isolate the trouble.

FRANK SZWANEK

Mullen, Nebr.

Since B+ is down only 20 volts from the normal value of 260 volts, you are apparently not drawing much more current than normal—just enough to cause the fusible resistor to burn out. Therefore, it's understandable that the results of disconnecting different branches of the B+ line are inconclusive.

If you have not done so already, be sure to check the 150-mfd capacitor wired between the fuse resistor and the junction of the two selenium rectifiers.

Check the cathode currents of the sweep output tubes. If either reading is greater than the value given on the schematic (110 ma for the horizontal and 28 ma for the vertical), the increase might be sufficient to cause the resistor to burn out.

Observe the damper circuit carefully for arcing, which could produce an intermittent low-resistance path between B+ and ground.

Check plate and screen voltages of all tubes. If any of these are markedly lower than normal, look in the associated circuit for such troubles as leaky bypass capacitors.

Just in case you can find nothing wrong with the set, measure B+ current at the output of the filter. If it is well within the rating of the selenium rectifiers, you may be safe in replacing the original fuse resistor with a 5- or 4.7-ohm unit.

Damper Fuse Goes

Recently, I was called on to repair an RCA Victor Model 21D8588, a nearly new receiver using Chassis KCS108. The fuse in the damper plate circuit was blown, and the 6AU4 damper tube turned out to be shorted. Replacement of the fuse and tube restored normal operation, or so I thought. Trouble is, the fuse keeps on blowing every week or so. I pulled this set into the shop on the second callback and made voltage and waveform checks, but these were all normal according to service information. Before returning the chassis, I put new capacitors in the damper circuit just to be on the safe side, but the fuse went out again.

E. J. Carolan

San Antonio, Texas

Insert an ammeter in series with the 3/10-amp fuse to determine whether the excessive current is continuous or intermittent. A steady current that exceeds the rating of the fuse might indicate a partial short somewhere in the horizontal output circuit, or excessive conduction of the 6DQ6A output tube. The latter condition could be remedied by adjusting the drive control. You may also need to check the vertical oscillator and the accelerator-grid circuit of the picture tube to be sure they are not causing an abnormally high current drain on the B+ boost line.

If the average current through the fuse is well below 3/10 amp, you're stuck with an intermittent, in which case you can't do much except to replace suspected parts one by one and go through "wait-it-out" tests to see if the fuse stops blowing.

"Seesaw" Rolling

Oh, what a headache this problem caused me—and how simple the final solution was! On an Emerson Chassis 120169-B, the picture would roll one way for six seconds, lock in for six seconds, and then roll in the other direction for six seconds. I finally discovered that this baffling effect was being produced by the fringe-compensator circuit. The switch had mistakenly been left in the "fringe" position after a previous service call.

Elmer B. Cook

North Highlands, Calif.

The fringe compensator removes noise interference from the signal at the plate of the sync preamplifier. When the control is properly adjusted, the noise-suppressor diode is driven into conduction by all noise pulses which exceed sync-pulse level. In strong-signal areas, the fringe-compensator circuit must be disabled to prevent clipping of the sync pulses.

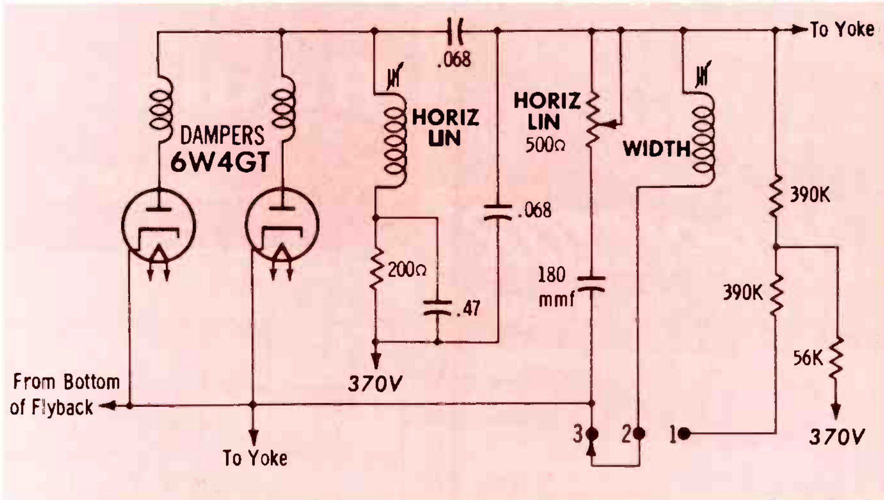
This strange case of back-and-forth rolling was evidently caused by a sort of "hunting" effect in the fringe compensator. Probably, there was a periodic variation in the height of the vertical sync pulses.

Lack of Width

An RCA Victor Chassis KCS68CB has insufficient width. I have tried replacing the yoke, horizontal output transformer, linearity coil, and every capacitor between the horizontal oscillator and output stages. By the way, B+ voltage is normal.

Leo Martinez

Oakland, Calif.



Width problems in this chassis have caused many headaches for technicians. Here are a few hints pertinent to this circuit:

1. Check the position of the jumper at one end of the width coil. If lug 2 is connected to lug 1 (lower position), more width should be obtained than if lug 2 is connected to lug 3 (upper position). Remove jumper for maximum width.

2. Try several different 6CD6's in the horizontal output circuit and use the one which yields the most width.

3. For positive results in making substitution checks of the two 6W4GT damper tubes, it is necessary to replace both tubes at the same time.

4. The linearity slug and control adjustments will affect width considerably, so it would be worth experimenting to see if you can find settings which will give acceptable linearity, together with sufficient width.

Overloading

I have a Motorola Model 17T22 with an intermittent condition. Symptoms are a loud buzz in the audio and a loss of both vertical and horizontal sync. I can't get much information from voltage readings, because the set begins to function properly whenever I touch the components with a test probe. Waveforms are distorted everywhere except in the horizontal sweep stages.

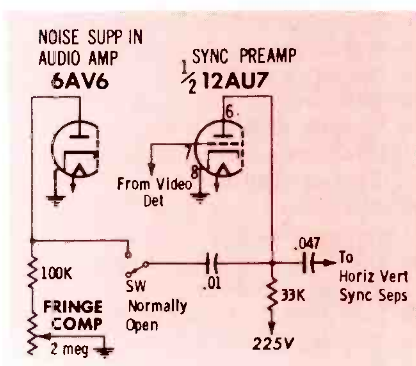
Ray's Electronics

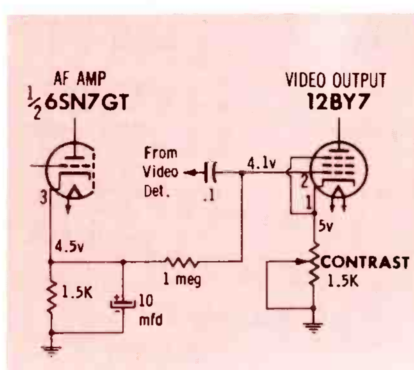
Austin, Texas

Your trouble sounds like a first-class case of overloading in the IF or video stages. Try substituting (not just checking) tubes in these circuits; if this doesn't work, then use a source of variable negative bias voltage to clamp the AGC line. Success in clamping may mean that you have AGC trouble. Unfortunately, though, it isn't sure-fire proof as long as you have an intermittent condition.

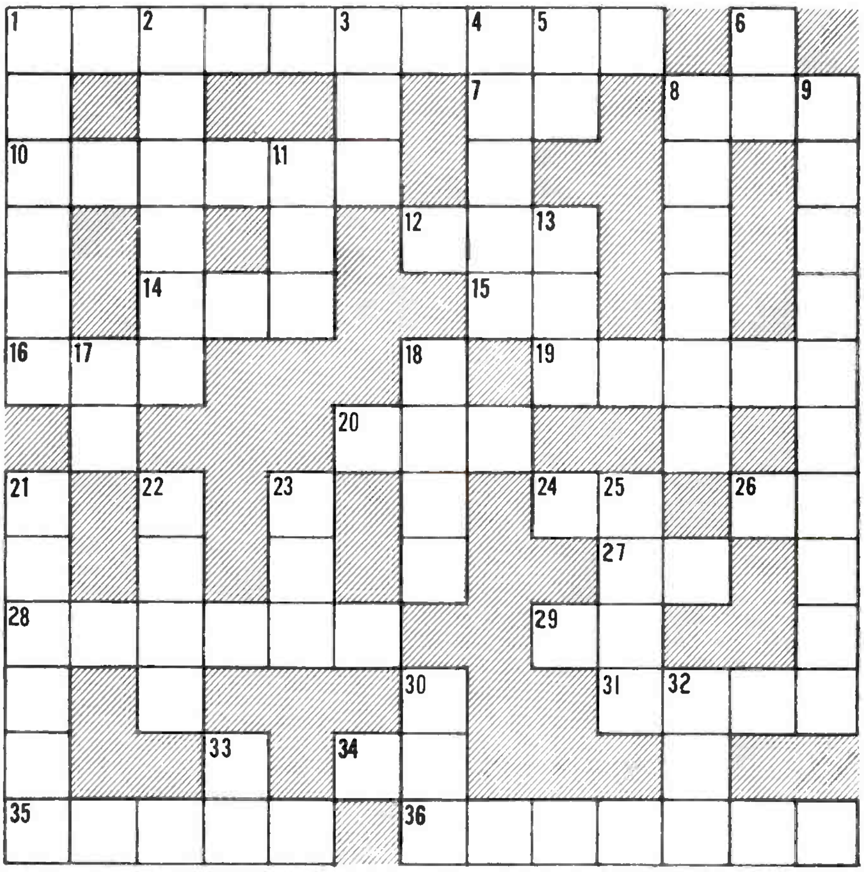
Your set may be one of those having a three-position area-selector switch; if so, check its setting and state of repair. It must be set in the "Local" position for satisfactory reception of strong signals.

This Motorola receiver has an unusual arrangement in which the cathode circuit of the audio amplifier supplies a DC bias voltage for the grid of the 12BY7 video amplifier. A malfunction of this circuit could produce trouble such as you describe. For example, gas or grid emission in the 12BY7 could induce a flow of negative grid current through the high-resistance grid circuit. This current would tend to reduce the difference between grid and cathode voltages, thus making the 12BY7 more sensitive to overloading. Another possibility is an open 10-mfd capacitor in the audio amplifier circuit. In this case, the cathode would be left unbypassed and spurious signals could be fed to the grid of the video output tube.





Radio-TV Service Puzzle



ACROSS

1. A color pix tube may need this.
7. One-million cycles. (abbr.)
8. Electrical discharge.
10. Video mixing circuit in color receiver.
12. TV receiver regulator circuit. (abbr.)
14. Transistor classification.
15. Symbol for voltage drop across resistance.
16. Regulator. (abbr.)
19. TV's "front-end."
20. Variable resistor. (abbr.)
24. One-thousandth of a volt. (abbr.)
26. Tube amplification factor.
27. Television. (abbr.)
28. Picture tube illumination.
29. One-thousand volts. (abbr.)
31. Antenna mounting pole.
34. Internally shielded. (abbr.)
35. To bring circuits into tune.
36. Service cord for TV set.

DOWN

1. TV circuit that prevents oscillations.
2. Signal-separating process.
3. Width of TV channel in megacycles.
4. Scene on a TV screen.
5. Blank terminal. (abbr.)
6. Regulating tube. (abbr.)
8. Gap-bridging current.
9. Signal of 3.58 mc. (two words)
11. Electronic particle.
13. Picture tube. (abbr.)
17. Grid voltage. (symbol)
18. Beam-deflection device.
21. Amplifier in a color set.
22. Circuit protecting component.
23. Property of color.
25. Test instrument. (abbr.)
30. Type of circuit. (abbr.)
32. Signal-pickup device. (abbr.)
33. Grid resistor. (abbr.)

ANSWER ON PAGE 53.

QUICKER SERVICING

by Calvin C. Young, Jr.

Antenna System for the Shop

A suitable antenna system is a must for the professional service shop. Sets must be tested on all channels received in a particular locale before they can be considered repaired. If your antenna system doesn't provide a near-perfect signal on every channel in your area, you should seriously consider bringing it up to "snuff." A study of the two systems outlined in this column should provide you with the data necessary for such upgrading.

The location of your shop with respect to the transmitting towers of the TV stations received is the first consideration. Whether your shop location is subject to electrical interferences such as ignition, appliance, diathermy, ghosts and co-channel is another factor. In fact, these two points will determine whether you need a complex system complete with booster amplifier, or a simple system using only a multiset coupler.

If your shop is located in a class-A signal area, and isn't subject to interference problems, the simple system (Fig. 1.) should be satisfactory. The antenna you select should be one that you know gives good results in your area. If there are several stations to be received, a rotator should be employed in conjunction with a high-gain, directional, all-channel antenna. Another alternative is to use a separate antenna for each channel with suitable antenna couplers. In any case, be sure that adequate lightning protection is provided.

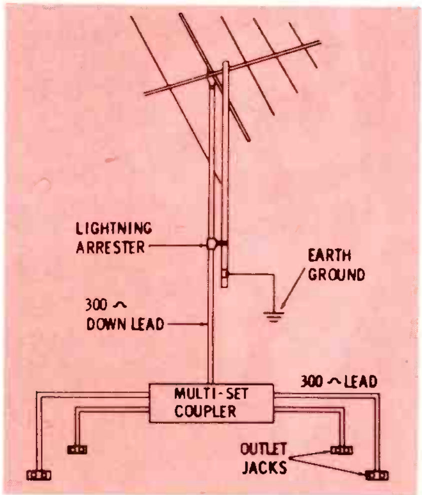


Fig. 1. Shop antenna system for strong signal areas where noise level is low.

The down lead should be kept as short as possible—not to exceed 75′. This will prevent excessive line losses and pickup of interfering signals. The individual feeders from the multiset coupler should be approximately equal in length, and should not be over 25′ long. These feeders should be supported with stand-off insulators and terminated with outlet plugs.

If your shop is located in an area where the signal strength is poor or where the interference pickup is excessive, you need something on the order of the more complex system shown in Fig. 2. Again, the antenna you select should be one you know gives good performance in your area. This is an even more important consideration than in a good signal area because the signal level at the antenna terminals is going to be a big factor in determining the signal-to-noise ratio of the entire system.

Mount the booster amplifier on the mast as close to the antenna as possible so that signal loss in the line ahead of the booster will be minimized. The down lead from the booster should be 72-ohm coaxial line to prevent noise pickup, and to simplify the job of providing multiple outlets in the shop. Suitable booster amplifiers, tap-off units and 72- to 300-ohm matching units that can be used to assemble the system shown in Fig. 2 are readily available through most electronic parts distributors.

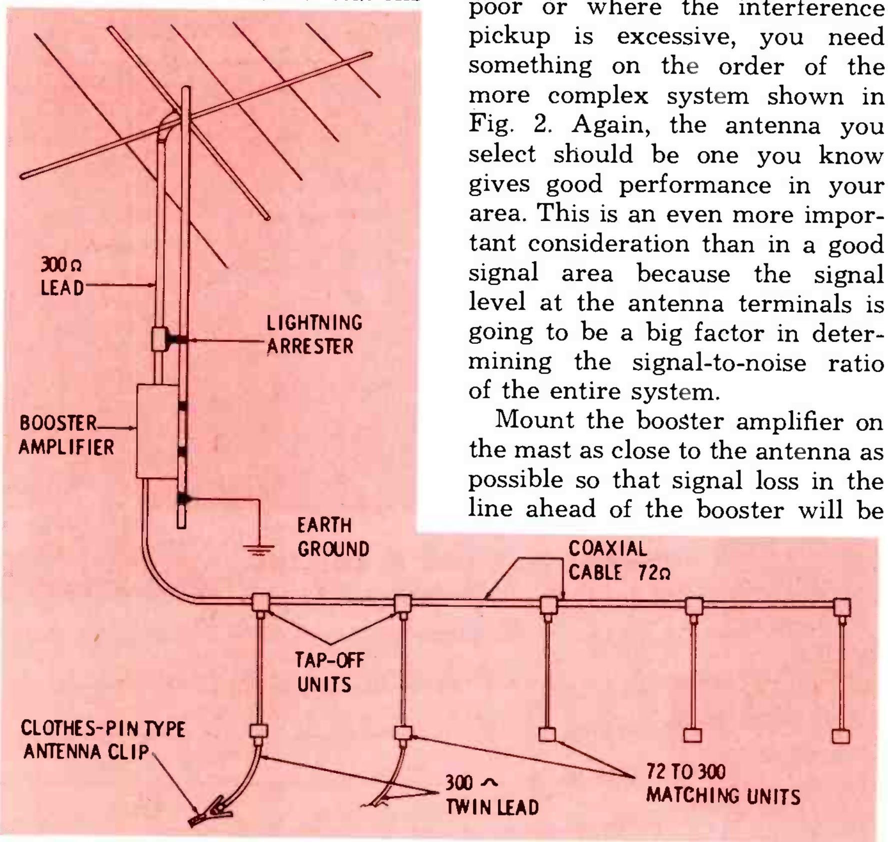


Fig. 2. Shop antenna system for weak signal areas where noise level is high.

If your shop engages in selling TV receivers, as well as servicing them, don't forget to include a number of well-placed outlets in the sales area. Nothing discourages a sale quicker than a poor picture on a set.

A single all-channel antenna, booster amplifier, 150′ of coaxial cable, five tap-off units and five 72- to 300-ohm matching units should cost about $100. This cost can be listed as a business expense for income tax purposes. In addition, you will find a reduction in the service and testing time needed on many repair jobs.

Re-Flock Old Turntables

Remember that "dog-eared" turntable on the changer you serviced last week? From now on,

BUSS FUSES *can help protect your reputation for sales and service*

When you sell or install BUSS fuses — you help avoid 'kicks' or complaints from customers that the fuses you furnish fail to protect when trouble occurs — or that the fuses blow needlessly.

BUSS fuses provide dependable electrical protection under all service conditions because . . . every BUSS fuse is tested in a sensitive electronic device that automatically rejects any fuse not correctly calibrated, properly constructed and right in all physical dimensions.

Why take a chance with your good name by furnishing fuses that might be faulty? Standardize on genuine BUSS fuses. They protect your profits and reputation.

To meet service needs . . . there's a complete line of BUSS fuses, — plus a companion line of fuse clips, blocks and holders.

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this condition presents you with a first-class opportunity to make a profitable service sale. "New Flock," a plastic-backed turntable mat made by Colman Tool & Machine Co., can be installed in a few minutes, and presents a like-new professional appearance. "New Flock" (Fig. 3) is available in 8", 9", 9½", 10", 12" and 16" diameters, and is supplied with a suitable adhesive to secure the new mat to the turntable. The old flocking must first be removed, a job easily done with a sharp putty knife. Do not remove the flocking from the perimeter edge of the turntable, since the new mat covers only the top—unless, of course, you want to paint the side of the turntable. This will take a little longer, but makes a better-appearing job.

Fig. 3. "New Flock" plastic-backed turntable mat is easily and quickly applied.

Checking Capacitors for Leakage

The easiest way to check a paper tubular capacitor for leakage is to disconnect one end from the circuit (the one closest to ground potential) and insert a VTVM across the broken connection as shown in Fig. 4. A DC voltage reading is an indication of leakage current through the capacitor and is sufficient reason for replacement of the component.

Electrolytic capacitors require a different type of test because they normally pass a certain amount of leakage current. If abnormally high leakage is suspected, it is advisable to measure the actual current by inserting a milliammeter in series with one lead of the unit. Generally, a new electrolytic should not pass more than a few milliamperes unless it is a high-capacitance, high-voltage type; in that case, current up to about 10 ma may be acceptable. To determine whether the leakage current of a new DC dry electrolytic capacitor is within safe limits, you can apply the following formula recommended by EIA:

$$I_{max} \text{ (in ma)} = kC + 0.3,$$

where C = capacitance in mfd and K = constant given in table.

DC working voltage	k
3 to 100	.01
101-250	.02
251-350	.025
351-450	.04

Sample problem: What is I_{max} for a capacitor rated at 100 mfd and 150 WVDC?

$$\begin{aligned} I_{max} &= .02 \times 100 + 0.3 \\ &= 2 + 0.3 \\ &= 2.3 \text{ ma.} \end{aligned}$$

Before making the current measurement, be sure to apply rated voltage across the capacitor for about 5 minutes to allow it to "form." If this is not done, a high, misleading reading will be obtained.

Noisy Operation in Portable TV

Recently a customer called to have a 14" portable TV repaired so it could be taken to an aged relative out of the state. The customer carefully explained that she wanted to make sure the set was in good shape because it was difficult to obtain service in the small town where the relative lived.

It was thus felt that the necessary tests could not be made in the home, so the receiver was taken into the shop. All tubes were tested in a high-quality tester and four were replaced. Next, the operation of each control was checked. The only discrepancy was that the vertical hold control would not roll the picture in both directions. Replacement of an .002 disc capacitor in the vertical oscillator circuit, and cleaning the hold control

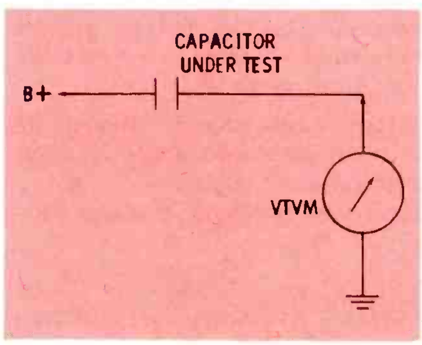


Fig. 4. Setup for testing paper capacitors for leakage uses VTVM and B+ source.

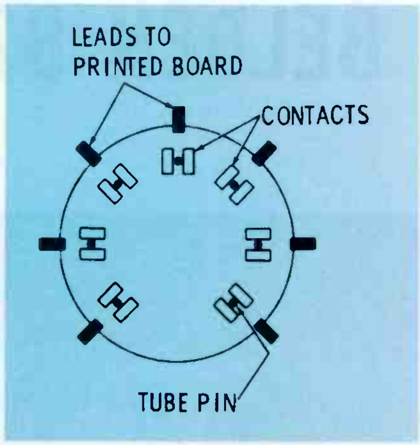


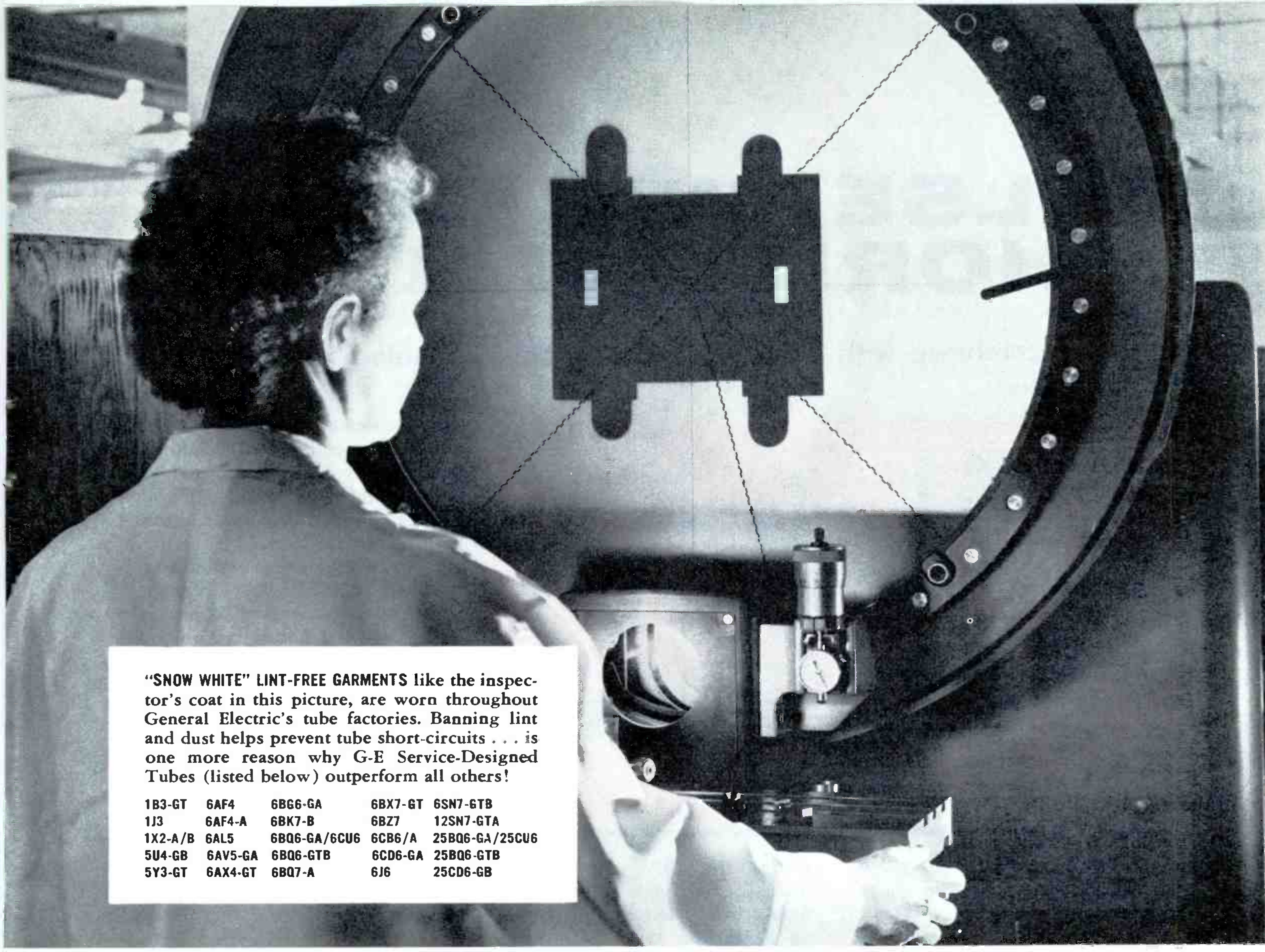
Fig. 5. Details of printed-board type tube socket that caused noisy operation.

restored this circuit to normal operation.

During these tests, the technician noticed that there was quite a bit of flashing in the picture, and instability of horizontal sync. Cleaning the tuner contacts helped but didn't cure the tendency of the picture to "shimmy" when the chassis was tapped. Substitution of the horizontal oscillator tube likewise failed to help. Since the chassis was out of the cabinet, the technician began a visual check of the printed wiring board. Almost at once he noticed that the tube sockets were a little out of the ordinary (Fig. 5). Close examination of these revealed that the metal pin contacts had become sprung and weren't making good contact. All of the 7- and 9-pin miniature tubes were removed and the contacts tightened by pressing them together with a small screwdriver. A final operation test proved that the flashing and instability was gone.

If you encounter any intermittent or noisy-operating condition on receivers that employ this type of tube socket, be sure the contacts are gripping the tube pins tightly before spending a lot of time substituting tubes in all the circuits. ▲

"I've got news for you--his hair is green."



"SNOW WHITE" LINT-FREE GARMENTS like the inspector's coat in this picture, are worn throughout General Electric's tube factories. Banning lint and dust helps prevent tube short-circuits . . . is one more reason why G-E Service-Designed Tubes (listed below) outperform all others!

1B3-GT	6AF4	6BG6-GA	6BX7-GT	6SN7-GTB
1J3	6AF4-A	6BK7-B	6BZ7	12SN7-GTA
1X2-A/B	6AL5	6BQ6-GA/6CU6	6CB6/A	25BQ6-GA/25CU6
5U4-GB	6AV5-GA	6BQ6-GTB	6CD6-GA	25BQ6-GTB
5Y3-GT	6AX4-GT	6BQ7-A	6J6	25CD6-GB

Easy to see, in G-E Service-Designed Tubes ...high-precision workmanship!

What you're looking at is a comparator—or industrial "magic lantern"—which shows the plate of a General Electric Service-Designed 6BQ7-A magnified in area 1,600 times.

The G-E inspector is checking close-to-perfect workmanship. Remember, the plate itself is less than ½ inch wide and long! Yet symmetry of structure is apparent; so are the plate's clean, precise outlines. Tolerances of this part are held to a few thousandths of an inch.

General Electric Service-Designed Tubes do a superior job in television sets because they're far better designed and built. High-precision manufacture such as you see above—of plates, cathodes, heaters, grids—pays off for you in fewer customer complaints and callbacks.

Best news of all: Service-Designed Tubes cost you no more! Your G-E tube distributor has them. Phone him today! *Distributor Sales, Electronic Components Division, General Electric Company, Owensboro, Kentucky.*

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PULSE-WIDTH HORIZONTAL AFC

Theory combined with Servicing Hints to Save Troubleshooting Time

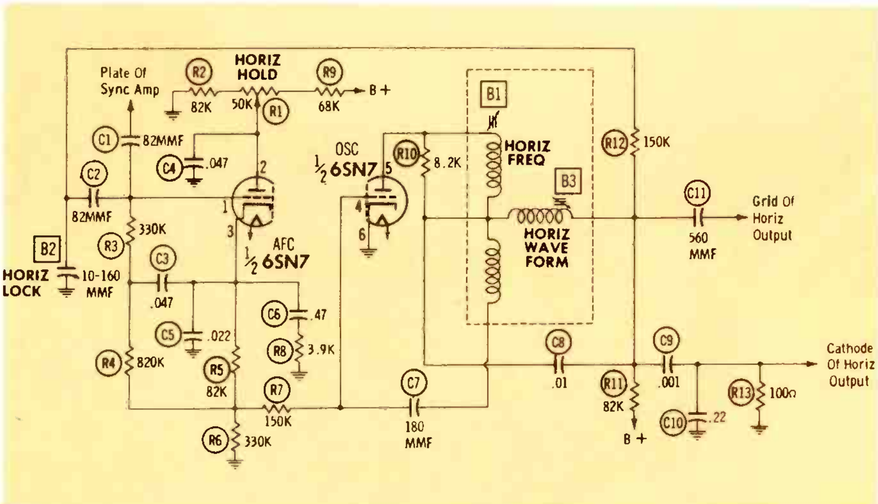


Fig. 1. Schematic of popular pulse-width AFC and oscillator circuit.

What can cause *squealing, squegging, pie crusting,* and *Christmas treeing?*

Answer: One often-overlooked stage—horizontal AFC!

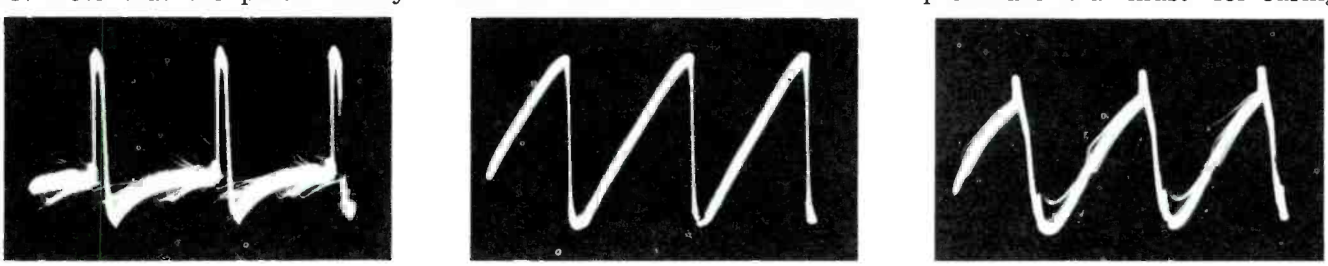
Fig. 1 is a schematic of a pulse-width system typical of many now found in the field. Some other circuits of this type (especially the newer versions) are simpler in design, but operate on the same principle. In normal operation, two different signals meet at the grid of the AFC tube—the horizontal sync pulses (Fig. 2A) and a sawtooth wave fed back from the horizontal oscillator or sweep circuit (Fig. 2B). When the oscillator is running at the correct frequency, the signals combine as shown in Fig. 2C. Note that the pulses neatly straddle the positive peaks of the sawtooth, with the leading edge resting firmly on the positive-going slope and the trailing edge sliding down the steep negative slope.

When the horizontal oscillator slows down, the sawtooth lags behind the pulse signal so that the pulse occurs slightly before the sawtooth reaches its peak. The pulse therefore gets a firmer footing on the positive slope of the sawtooth; that is, only a relatively small proportion of the total width of the pulse drops down the negative slope. The broader-than-normal pulse that remains on the peak of the sawtooth serves to reduce the bias on the AFC tube, and the tube conducts more heavily, thus causing the voltage across R6 in the cathode circuit to' shift in a positive direction. This voltage change is passed along through R7 to the oscillator grid, forcing the oscillator to speed up.

Now suppose the oscillator tries to run at too high a frequency. The sawtooth begins to lead the pulse signal, and has already reached its peak and is starting the steep downward slope by the time the pulse arrives. Then the pulse "loses its footing" and most of it falls down the negative slope; only a relatively narrow pulse stays up on top of the peak. This increases the grid bias on the AFC tube and slows down the oscillator.

A seemingly slight defect in this circuit can cause a loss of sync that cannot be corrected by adjusting the horizontal hold control. Result—a service call. Mild cases of trouble usually produce twitching and tearing of the picture, while more severe defects are associated with the familiar pattern of slanting black bars. A less common symptom of sync loss (Fig. 3) is an out-of-phase condition in which the horizontal blanking bar appears in the middle of the screen and shifts back and forth.

There are so many possible reasons for loss of horizontal sync that a methodical troubleshooting procedure is a "must" for curing



(A) Sync pulses. (B) Feedback sawtooth. (C) Combination of A and B.

Fig. 2. Waveforms in AFC grid circuit.

it. If changing tubes doesn't help the situation, the hold control should be turned slowly through its range and the effect observed; in addition, alignment adjustments B1 through B3 should be performed according to the instructions in the associated service data. These adjustments may be sufficient to restore the oscillator to such a condition that the AFC circuit can keep it on the right frequency. But check to see if any adjustments have to be set outside the middle third of their range to lock in the picture, or if frequency drift occurs. If so, the circuit is still not operating properly.

Disconnect the AFC circuit from the oscillator and see if the latter can be momentarily synchronized by adjustment of B1 over the middle portion of its range. If not, check for a trouble such as a change in value of C7 or C8 which would throw the oscillator off frequency—or for any defects which could cause unstable operation. Watch for intermittent troubles! If the oscillator seems OK, check the AFC circuit.

Using Test Equipment

What will a scope tell you about AFC operation? Quite a lot, if you're careful when checking the waveform at the grid. The scope will load this circuit even if a low-capacitance probe is used, but you can temporarily readjust the horizontal frequency slug to sync the picture while you are watching the signal. The grid waveform should look like Fig. 2C and should have an amplitude of about 35 volts peak-to-peak. Adjustment of trimmer B2 will have some effect on waveform height. If the sync pulses are missing, perhaps coupling capacitor C1 is open; if they are distorted, the sync section of the receiver may be at fault. Similarly, a loss of the sawtooth wave might indicate that C2 is open, and distortion of the sawtooth might mean trouble in the oscillator or output stages.

As for the plate and cathode waveforms, the presence of any signal more than a few volts in amplitude means trouble. A small amount of B+ ripple and vertical-pulse signal is normally present, but all other signals are supposed to be removed by bypass capacitors C4 and C5. When C4 opens, horizontal pulses as high as 80 volts peak-to-peak will appear in the plate circuit; and when C5 opens, degeneration takes place and a signal resembling Fig. 2C appears at the cathode. An open condition in either capacitor will usually unbalance the AFC circuit enough to cause loss of sync.

The *word* of the scope isn't always final in this circuit. Some defects upset the DC voltages in the circuit without greatly distorting the signal waveforms, requiring the use of a VTVM to find the trouble. For instance, a slight leak in coupling capacitor C1 or C2 will let the input signals pass through normally, but it will also provide a leakage path to the plate circuit of the sync amplifier or horizontal oscillator and from there to B+. AFC grid voltage then becomes less negative than the normal −20 to −30 volts. This causes the tube to develop too much control voltage, throwing the oscillator off frequency.

Two voltages of opposite polarity are developed across R6 — a positive one produced by the cathode current of the AFC tube, and a negative one furnished by the grid-leak bias circuit of the oscillator tube (C7, R7 and R6). These combined voltages determine the bias levels of both the AFC and oscillator stages. If the resultant voltage across R6 is more positive than normal, this is either an indication of insufficient grid-leak bias on the oscillator, or of excessive AFC cathode current. A more negative voltage than normal indicates too much grid-leak bias or not enough conduction of the AFC tube.

Although the voltage present at the top of R6 is not usually given in service data, a normal reading at the cathode of the AFC tube usually indicates that the voltage across R6 is also normal—barring certain conditions such as an incorrect value of R6 or R5. AFC cathode voltage is in the order of −5 volts when an input signal is present.

The plate voltage normally varies from about 110 to 210 volts according to the hold control setting, so it is not too reliable as a trouble indicator. On the other hand, grid and cathode voltages in a defective AFC stage will often be different enough from the normal values to

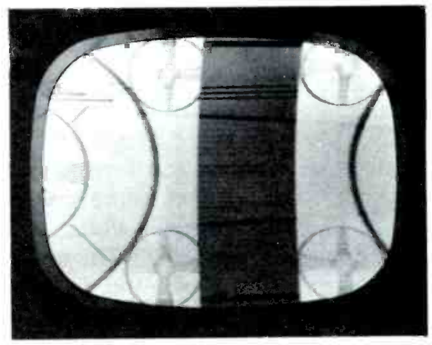
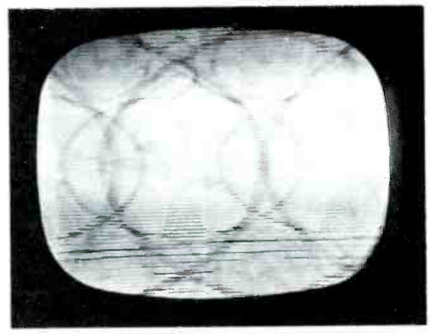
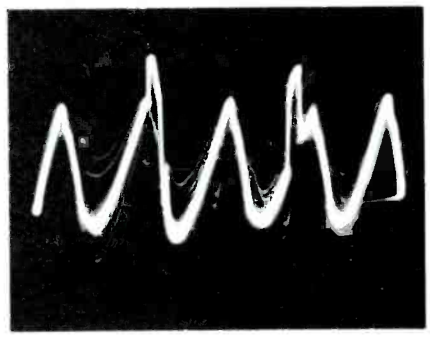


Fig. 3. This out-of-phase condition is due to improper horizontal AFC control.

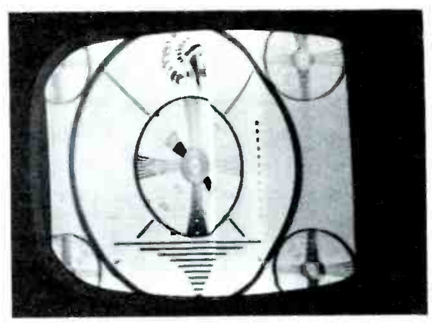


(A) Appearance of picture.

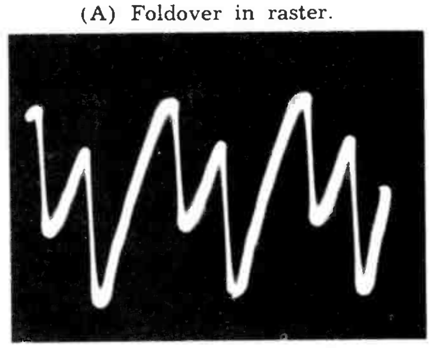


(B) AFC grid waveform.

Fig. 4. Horizontal oscillator operating at about 25 kc produces these symptoms.



(A) Foldover in raster.



(B) Oscillator plate waveform.

Fig. 5. Severe foldover such as this can be caused by improper AFC operation.

give valuable clues which may lead you to the source of trouble. For example, an open condition in C5 will cause degeneration which reduces the cathode current of the AFC tube. This action lowers the cathode voltage — in some cases, down to as low as −20 volts.

If out-of-tolerance VTVM readings cannot be corrected by replacement of tubes and suspected capacitors, you should consider the possibility of a change in value of some resistor in the circuit. Ohmmeter checks of individual resistors should be made in the part of the circuit where voltages seem most abnormal. Note that some AFC resistors are special types; replacements for these should have the correct tolerance and wattage ratings.

Special Troubles

Oscillator Far Off Frequency

Fig. 4A illustrates what happens to the picture when the horizontal oscillator gets out of control and runs at nearly double the correct frequency. The AFC grid waveform (Fig. 4B) contains almost two full cycles of sawtooth for each sync pulse. The basic cause of this trouble is that the oscillator grid voltage is too positive and the oscillator is being triggered too rapidly.

The most probable defect in this case is leakage in one of two capacitors. If C7 is leaky, electrons escape into the plate circuit of the oscillator and the grid-leak bias on the oscillator grid is reduced. Leakage in C3 reduces the grid-to-cathode voltage of the AFC tube by placing a shunt across R4, and then the AFC tube conducts too hard and produces too much positive control voltage across R6. Fairly severe leakage in C1 or C2 could produce a similar symptom.

Related to the trouble shown in Fig. 4A is *squegging* or *Christmas tree* effect, which is a pulsing of the oscillator at a random frequency, accompanied by coarse irregular horizontal lines on the screen and bursts of squealing from the flyback.

One difficulty connected with AFC servicing is that the same defect doesn't always produce the same symptom. For example, leakage in C2 once produced the unusual effect shown in Fig. 5A. Severe foldover in the center of the raster corresponded to a deep notch in the positive slope of the sawtooth wave (Fig. 5B). When circuit alignment was attempted, the symptoms in Fig. 4 appeared. AFC grid voltage turned out to be +33 volts.

Hunting

C6 and R8 are an anti-hunt network which prevents the AFC circuit from reacting too quickly to changes in its input signal. Without this network, the AFC *overcontrols* the oscillator—like a nervous driver who is constantly making small steering corrections. As a result, oscillator frequency never stabilizes, and the horizontal lines in the picture are not all the same length.

A very characteristic rippled effect called *pie crust* then appears. Usually it's most noticeable near the top of the picture, but it may affect the whole image. Here, at last, is one horizontal AFC defect that doesn't require much troubleshooting. Replace C6 and R8, and chances are that the wrinkles in the picture (and those on your brow, too) will be ironed out. ▲

servicing NEW DESIGNS

by Thomas A. Lesh

TV On the Half Shell

Some of the styling features in the newest TV sets, while admittedly designed for attractiveness, also succeed in making the sets easier to service. A case in point is the new General Electric "Designer" series introduced this spring, which have cabinets less than 8″ in depth to create an illusion of extreme shallowness. The neck of the 110° picture tube and a good part of the chassis naturally extend beyond the back edge of the cabinet, but these are neatly encased by a deeply-contoured metal cover. Because of the "closely-tailored" shape of this cover, the full depth of the receiver is not noticeable from the front. At first glance, the receiver has the startling appearance of being about the same size and shape as a small suitcase.

As seen in Fig. 1, the receiver typifies an interesting trend in chassis layout. These days, it's getting more and more difficult to classify TV chassis into clear-cut "horizontal" and "vertical" types. The M4 chassis in the new GE set has both horizontally- and vertically-mounted printed wiring boards. These are mounted on a frame which is basically horizontal in layout, but which has a large section at one side that juts upward and forward in a sort of L shape to support the tuner and operating controls. Since a power transformer is mounted near the bottom, the chassis has a low center of gravity and is not likely to tip over during bench servicing.

Shallow-cabinet construction is to the technician's advantage because most of the chassis parts are accessible after removal of the back. For tuner servicing or extensive repairs, the cabinet can be removed from the chassis by taking out 4 or 5 screws (depending on model) underneath the receiver and one at the left of the tuner. The picture tube remains attached to the cabinet.

Caution: Before removing the back, pull up the built-in antenna rods until they can be swiveled. Also, when disassembling this receiver, unsolder the speaker leads. This is easily accomplished at the terminal board adjacent to the audio-output transformer.

New FM Sound Detector

Another new General Electric chassis, the Q3 used in 14″ portables, is equipped with an ingenious "Delta" sound detector circuit using a 3AV6 dual-diode/triode. The FM sound signal is demodulated in this circuit by a simple, well-known process called slope detection. Although this system has seldom been applied to commercial circuits in the past because of its poor ability to reject AM noise interference, the "Delta" design has made the slope detector practical by coupling it with an efficient noise-suppression circuit.

Fig. 2 is a schematic of the detector stage. Let's study the operation of the slope detector and then turn our attention to the noise-rejecting circuitry.

A frequency-modulated 4.5-mc signal, fed into the secondary of T1 from the sound IF stage, is developed across C2 and then coupled through C3 to the grid circuit of the 3AV6 triode section. The tuned circuit at this point (L1, C4 and R4) develops the actual driving signal for the grid. This circuit is not tuned exactly to 4.5 mc as in most sound detectors, but to 4.563

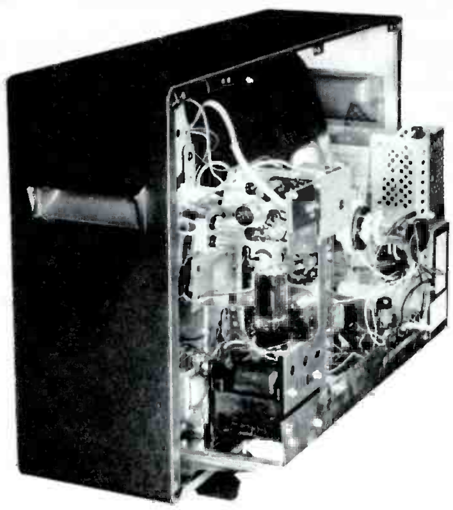


Fig. 1. In new General Electric "Designer" series, most of chassis is exposed when curved back cover is removed.

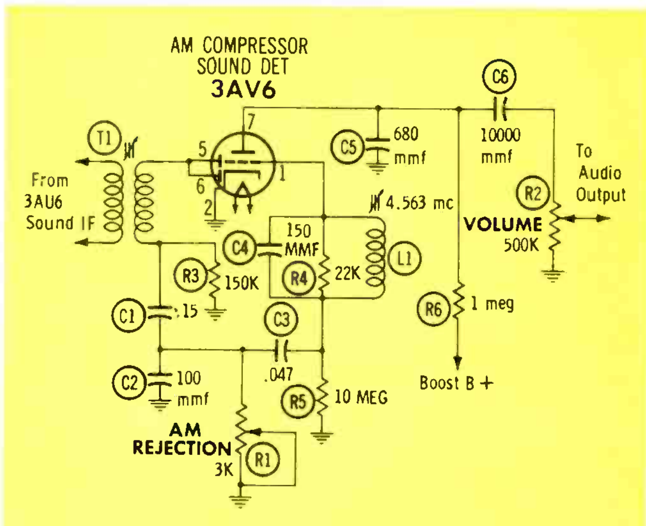


Fig. 2. "Delta" sound detector circuit of latest GE 14″ portable TV sets works on the slope-detection principle.

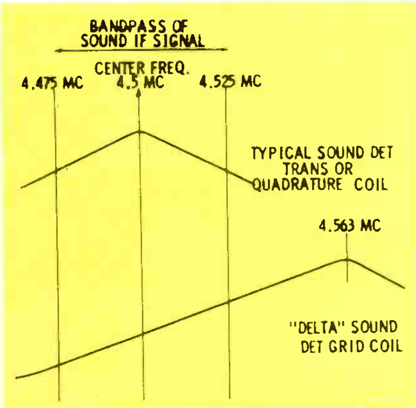


Fig. 3. Frequency response curves of tuned circuits used in sound detectors.

mc. The result is shown in Fig. 3. Although tuned-circuit response in other sound detectors falls off symmetrically on each side of 4.5 mc, the entire bandpass of the sound IF signal will fall on one slope of the "Delta" tuned circuit's response curve — hence the name "slope detector." Amplitude of the signal developed at the grid changes linearly in accordance with variations of the incoming signal frequency; thus, any frequency modulation present in the input signal will develop a corresponding amplitude modulation in the signal that is finally applied to the grid of the 3AV6.

The latter signal is superimposed on a grid-leak bias voltage developed across C3 and R5. The value of bias is such that the triode operates as a plate detector, both rectifying and amplifying the signal. The audio recovered in the plate circuit is coupled to the audio output stage without going through an intermediate amplifier.

No amplitude modulation, except that due to slope detection, should be present in the signal at the 3AV6 output. It is the job of the diode circuit and AM rejection control to prevent the presence of AM interference signals in the plate circuit of the detector.

Either positive- or negative-going AM interference signals can enter the detector circuit, but positive AM at the grid of the 3AV6 is most troublesome because it remains in the audio output after rectification. Therefore, the noise-rejection circuit must concentrate on flattening out the positive peaks of the incoming signal.

Both diodes of the 3AV6 are wired into the input circuit in such a way that the positive-going part of the signal will cause diode conduction. This loads down the output circuit of the sound IF tube and tends to swamp out or "compress" amplitude modulation, especially on the positive side of the signal envelope.

For vertical sync pulses and other interference which may be too strong to be removed by this process of AM compression, a noise-cancellation feature comes into play. Any extremely positive swing of the input signal causes heavy conduction of the diodes, thereby developing a negative pulse across the diode-load circuit composed of R3 and the series combination C1-R1. The portion developed across R1 is fed to the plate detector, where it cancels out the undesired AM pulse. This cancellation takes place in the plate circuit of the detector.

R1 should be adjusted for maximum cancellation. To do so, tune in the noisiest signal available and adjust the fine tuning control for maximum sound amplitude, where sound interference appears in the picture. This will emphasize buzz and noise in the sound, making

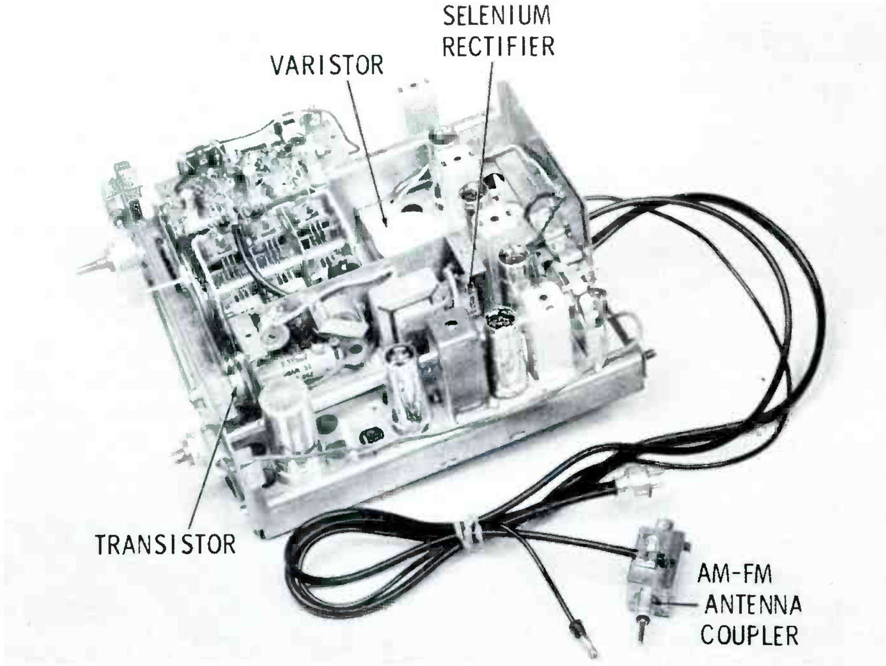


Fig. 4. The Model 88BH FM tuner is an accessory for the 1958 Lincoln.

the adjustment more sensitive. R1 is not especially critical, and its adjustment will have little effect on the audio output in some areas. If there is any doubt as to the correct setting, it is best to place R1 at the midpoint of its range. It must never be set at the maximum clockwise position, since the signal would then be shorted to ground.

The "Delta" circuit, like the −BN6 and −DT6 quadrature-grid detectors, can be aligned adequately by using an ordinary TV broadcast as a signal source—provided that you can obtain a weak enough input. For accuracy's sake, signal strength should be held down to the point where the sound is barely audible above the background noise level. It is often necessary to disconnect the antenna entirely from the receiver.

First, tune L1 for the loudest and clearest audio output. If you are performing more than just a touch-up alignment, you will notice that several peaks occur as the slug is turned. To locate the correct one, turn the slug all the way in (toward the chassis) and then start backing it out. Tune to the first *strong* peak that you encounter.

Tune the take-off coil in the grid circuit of the sound IF stage, and then adjust T1—both for maximum audio. None of the adjustments are critical, but L1 should be tuned as carefully as possible so that the response curve of the detector will be linear over the entire passband of the sound IF signal.

In case one of these receivers should develop insufficient audio output and excessive buzz, and quick remedies such as tube replacement and touch-up alignment do not help, try replacing C3—it could be leaky. Loss of output could result from a short in C3 or an open condition in either C1, C2 or C3.

FM Auto Radio

The object in Fig. 4 is an FM radio tuner for use in automobiles—the first of its type to be produced in this country. The unit is designed as an accessory for the Model 85BH radio in the 1958 Lincoln. Output of the tuner is fed to the main radio chassis, where it undergoes two stages of audio amplification before being applied to a push-pull audio output stage employing two 2N399 transistors.

Although the main chassis is powered entirely by the 12-volt "A" supply, the FM tuner obtains a B+ potential of 75 volts from a self-contained power supply consisting of a 400-cps transistor oscillator, power transformer, and selenium rectifier. A schematic of this circuit appears in Fig. 5. The B+ bleeder resistor is a "varistor" which regulates the output voltage to within ±10% of the nominal value.

The bias on the transistor can be

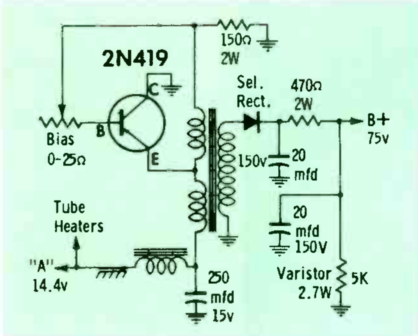


Fig. 5. Power supply of FM tuner uses 2N419 transistor as 400-cps oscillator.

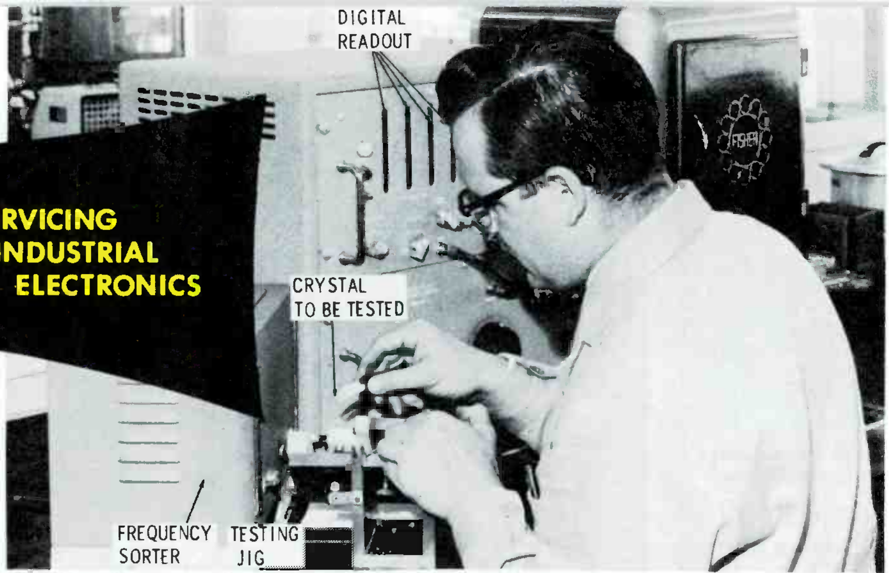
adjusted to allow maximum oscillator efficiency while keeping transistor current within safe limits. The adjustment procedure is as follows: Turn the control all the way counterclockwise, thus reducing transistor current to a minimum. Then apply 14.4 volts to the "A" power supply lead, and advance the bias control while monitoring the voltage at the top of the varistor with a VTVM. The correct bias setting is that which produces a B+ voltage of 75 volts.

Circuitwise, the Lincoln FM tuner is similar to conventional AC-powered hi-fi tuners. The tube lineup includes a 12AT7 cascode RF stage, a 12AT7 mixer-oscillator, two 12AU6 IF's, two 12AU6 limiters, a 12AL5 discriminator, and a 12AT7 used as an AFC tube and audio amplifier. Continuous tuning is provided, and an AM-FM switch disables the tuner when it is not in use. The AM and FM chassis are connected to a common antenna by means of a coupler unit.

The audio signal is fed from the tuner to the main chassis through a 3-prong plug. In case the AM radio is to be used while the FM unit is disconnected, a jumper must be placed across the two end prongs of the plug in order to provide a signal path from the AM detector to the first audio stage.

The 2N419 transistor in the FM power-supply circuit is fastened to a small subchassis that contains most of the power-supply components. To make the transistor accessible for removal, it is necessary to unscrew the subchassis from the tuner chassis and unsolder two interconnecting leads. It is not advisable to remove the front panel of the tuner in an attempt to get at the transistor, since this operation would involve unstringing the dial cord. ▲

part 10 — SERVICING INDUSTRIAL ELECTRONICS



COMPUTERS from BINARY to DECADE

by Melvin Whitmer

A binary stage counts by two's; that is, two negative input pulses produce one negative output pulse, the conducting tube section being the same as for a zero count (before the pulses were applied).

The circuit of Fig. 1 is slightly different from those described in the previous article. For instance, the cathode is connected directly to ground and grid bias is obtained from a B− supply, while cathode bias due to tube conduction was used in earlier descriptions. In addition, dual diodes used for input-pulse coupling have been replaced by capacitor-resistor coupling network R1-C1.

Input pulses are momentary negative voltages composed predominantly of high frequencies. C1 offers a low impedance to the applied pulse which reaches the triode plates and then the grids through C2 and C3. A negative pulse applied to a cut-off tube will not affect it; however, a conducting tube will be driven into cutoff. Thus, assuming that V1 is conducting, the first pulse cuts it off. Its plate load then generates a positive pulse which overrides the small negative input pulse at the grid of V2 and drives this tube into conduction. A second pulse will cause V2 to go into cutoff, and the resultant positive plate-voltage pulse will drive V1 into conduction, returning the stage to its original state.

Lamp NE1 in Fig. 1 is a gas-filled tube which requires a potential difference of about 70 volts between its plates before it will ionize. This feature allows selective lighting of the lamp by V1. Current through R3 develops enough voltage to cause ionization only when V1 conducts. The lamp goes out when S1 is momentarily opened and will not light again until the first negative input pulse cuts off V2 and causes V1 conduction. R2 limits the current through NE1 to a few microamps.

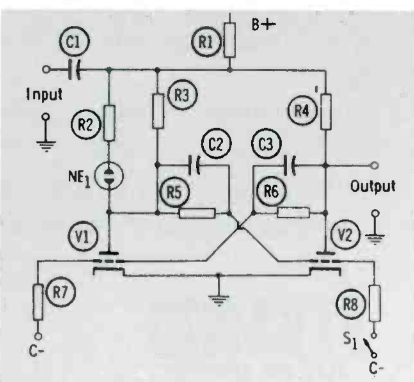


Fig. 1. Eccles-Jordan will change conduction status with each negative pulse.

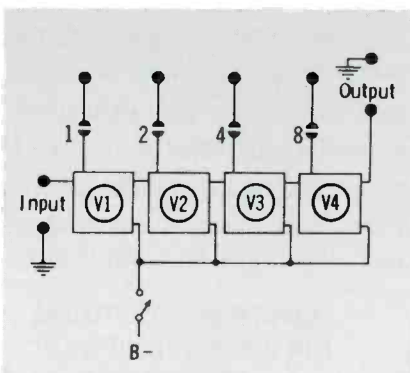


Fig. 2. Four Eccles-Jordan stages in series provide a reduction factor of 16.

Cascading Eccles-Jordans

From the previous installment, you may recall that a greater division of input repetition rate is made possible with the use of additional stages in series. A block diagram of four stages connected in this manner is shown in Fig. 2. Switch S1 is used to reset all stages (lamps out). Each stage divides the repetition rate by two, and the total division is the product of all dividing factors; thus, sixteen negative input pulses are required before one negative output pulse is formed.

The neon lights are identified according to the number of input pulses required to turn them on. The first light is No. 1, while the second is No. 2. The third input pulse will cause both to light; thus, more than one light may be on at a time; and the number of applied pulses is the sum of all the lamp numbers that are on. A fourth input pulse causes the third lamp to light and the first two to go out; therefore, it is No. 4. Up to 7 input pulses can be indicated with the first three lamps—but on the eighth input pulse, the fourth lamp will light and the others will go out; therefore, it is No. 8. All numbers up to 15 can be indicated by some combination of these four lamp numbers. Finally, the sixteenth input pulse produces a negative output pulse and turns off all lamps.

Changing Binary to Decade

A scale of 16 is very useful, but it does make *readout* rather difficult. For instance, if this unit provides low repetition-rate pulses for a mechanical counter, determining the actual number of input pulses requires multiplying the number indicated on the mechanical counter by 16 and adding to this the number indicated by the lights.

Readout would be simplified if the scale factor were changed from 16 to 10. Fig. 3 shows one type of scale-factor adjustment commonly used in decade units. Feedback coupling is provided from the plate of V2B through R17 and C7 to the grid of V1A. The second stage (V2) receives a negative pulse from V1B after two input pulses have been applied, causing V2B to go into cutoff. This generates a positive pulse which will be coupled through R17 and C7 back to V1A grid. A positive pulse applied directly to the grid will cause V1A to come back into conduction and drive V1B into cutoff, forming a scale factor of three.

Two consecutive feedback loops connected in the same manner will provide a scale factor of 5 rather than 8, and is the basic feedback arrangement used to provide a scale of 10 (see Fig. 4). The first feedback loop returns a positive pulse after application of the second negative input pulse, while the second feedback loop couples back a positive pulse on the third negative input pulse, driving V2A into conduction and V2B into cutoff. Integration and differentiation of the feedback pulses is such that the positive pulse generated at

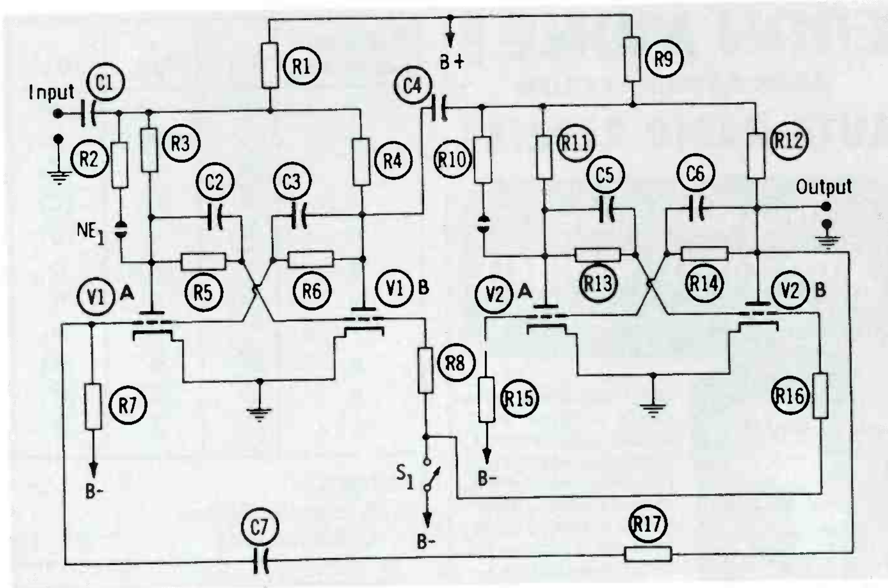


Fig. 3. Positive feedback from 2nd Eccles-Jordan reduces scale from 4 to 3.

V2B plate at this time will not change the state of V1. After 5 input pulses, all "B" sections will be conducting, which is the condition for zero count; therefore, counting will start over.

The feedback-connected scale of 5 can be increased to 10 by placing just one more Eccles-Jordan circuit before or after it. In series-connected stages, individual scale factors are multiplied to obtain the over-all divisor. It does not matter whether you say five times two, or two times five—the answer is still ten. Fig. 5 shows a block diagram of a decade counter with the scale of two preceding the scale of five. A positive pulse for the first feedback loop is generated by V3B on the fourth negative input pulse, and a positive pulse for the second feedback loop is formed by V4B on the sixth negative input pulse.

Digital Readout Lamps

Mechanical counters can be read very easily using the decade scaler of Fig. 5, but the lamps still present a problem since lamp-lighting sequence is changed with feedback. A method which would use ten lamps with only one lamp *on* at a time would simplify the task of determining the total number of pulses. Fig. 6 partially illustrates an arrangement which allows each lamp to light only under certain circumstances. Stages V1 and V2 provide a voltage change for every input pulse, and the same section will always be cut off by all the even or all the odd pulses; plate-load resistors are split to provide the voltage change desired.

Conditions of the circuit are V1 cut off while V4 and V8 are conducting (stages in between not shown). *Zero* lamp has 250V applied to the left side, since V1 is cut off at this time. The voltage value at the common connection of the lamps will depend on the conduction states of both V4 and V8. R1 and R2 form a voltage divider; thus, the voltage at the right side of the lamps is controlled by the conduction of V4 and V8 collectively. When both are conducting, there is no voltage drop across R1 and R2. The result-

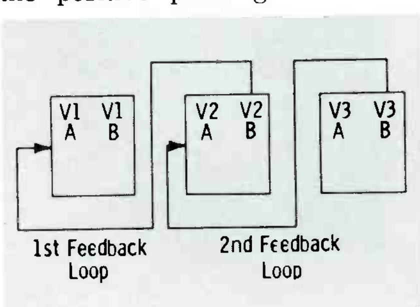


Fig. 4. Two consecutive feedback loops change reduction factor from 8 to 5.

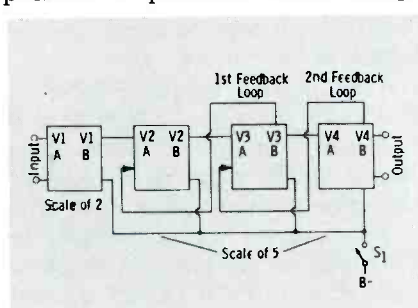


Fig. 5. Scale of 5 coupled to scale of 2 makes circuit into a decade counter.

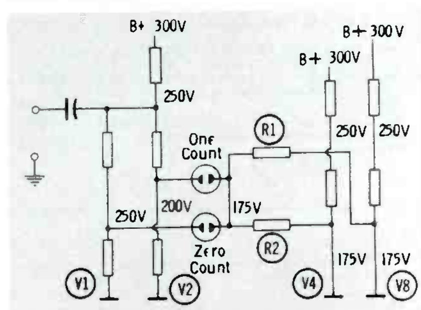


Fig. 6. Method of connecting lamps so they light for only one set of conditions.

Pulse and Lamp No.	V1	V2	V3	V4	V5	V6	V7	V8
0	N	C	N	C	N	C	N	C
1	C	N	N	C	N	C	N	C
2	N	C	C	N	N	C	N	C
3	C	N	C	N	N	C	N	C
4	N	C	(C)*	(N)*	C	N	N	C
5	C	N	C	N	C	N	N	C
6	N	C	N	C	(C)†	(N)†	C	N
7	C	N	N	C	C	N	C	N
8	N	C	C	N	C	N	C	N
9	C	N	C	N	C	N	C	N
0	N	C	N	C	N	C	N	C

LEGEND:
N = nonconducting
C = conducting

* state changed by feedback from V6
† state changed by feedback from V8
Circles indicate stages to which lamp connects

Fig. 7. Chart showing lamp connections and conditions under which each lights.

ant voltage across the *zero* lamp is therefore 75V, and across the *one* lamp, only 25V. Lamp *zero* lights since more than ionizing voltage is applied, while the *one* lamp cannot light. Lamp *one* will light when one pulse is applied, changing the state of V2 from conduction to cutoff. V1 goes into conduction, and the *zero* lamp goes out.

All even-numbered lamps from 0 to 8 are connected to V1 split-plate load, while odd numbers 1 to 9 are connected to V2 plate load. Resistors similar to R1 and R2 are connected to sections throughout the chain in a manner which will allow each lamp to come on for only one set of conditions (see Fig. 7); i.e., the split plate-load stage to which it connects must be cut off, while the other two stages (at the other end of the lamp-coupling resistors) must be conducting. Every selection of cutoff tube and two conducting tubes is a unique situation; that particular sequence never appears except for a specific two input-pulse time. Thus, V4 and V8 conduct on zero and one input pulse, but on all other counts from two to nine, one or both will be cut off.

A commercial decade counter is illustrated in Fig. 8. Numbers 0 to 9 are transparent parts of a plastic shield painted black. Behind the number plate is a row of neon lamps which connect to the tubes at the back. A ruggedized version of the 12AU7 is used and carries the designation 5964, designed with counter operation in mind. Grid current will not damage the tube and cathode emitting elements are thicker than those for standard 12AU7's.

An application of feedback decade units is shown in the head photo. The natural frequency of a crystal is determined in this crystal-sorting operation by placing it between two electrodes connected to the oscillator by a special jig. Oscillator output is a sine wave, and the frequency meter counts either the positive or negative half-cycle. The exact frequency is read on the lights. Seven decades connected in series allow a maximum count of 9,999,999! ▲

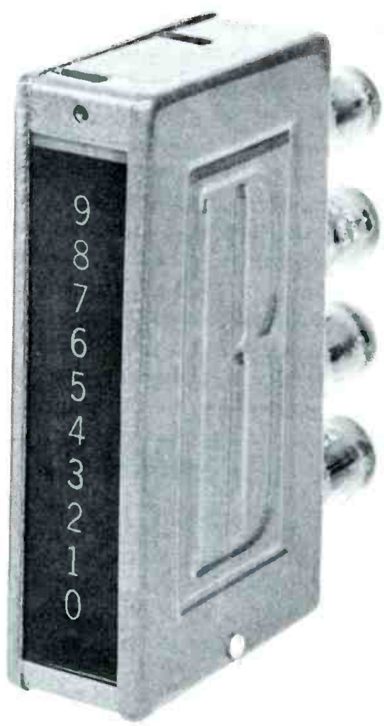


Fig. 8. Lamps are placed behind a plastic shield to illuminate numerals 0 to 9.

The FM Signal

(Continued from page 18)

frequency is of some importance, however. This "deviation ratio" or "modulation index" for FM radio is

$$\frac{75{,}000}{15{,}000} = 5,$$

but for TV sound it is only

$$\frac{25{,}000}{15{,}000} = 1.67.$$

In general, the higher this ratio, the greater the ability of the FM system to reject certain kinds of interference which tend to shift the carrier frequency of the desired signal. This interference is of two types—direct FM produced by radio and TV stations, and indirect FM or spurious phase modulation of the desired signals by miscellaneous types of interfering signals. As the deviation ratio of an FM signal is increased, modulation of the carrier produces wider frequency swings which do a progressively better job of swamping out the small frequency shifts produced by interference. An FM radio signal can suppress an interfering signal when the ratio of desired to undesired signal strength is as low as 2:1, except in the case of co-channel interference which requires a 10:1 ratio. By comparison, an AM signal must be approximately 100 times as strong as an interfering signal in order to override it.

The lower deviation ratio of the TV sound signal makes it less immune to interference than the FM radio signal, but this presents no practical problem because higher transmitter power is normally used in TV than in FM radio.

We have not yet considered the most annoying of all types of interference—amplitude modulation of the carrier by atmospheric static, auto ignition, and other noise sources. Perhaps the most valuable feature of FM is its ability to eliminate this noise interference almost completely. Since amplitude variations of the carrier provide no useful information in FM, they can be stripped off and discarded by passing the signal through some kind of limiter stage in the receiver. Some types of FM detectors, such as the ratio detector, accomplish limiting as a by-product of demodulation. In most commercial FM receivers, noise elimination is highly effective except when the input signal is extremely weak.

This noise-rejecting ability of FM allows a station to deliver a clean signal to practically all of its service area. Thus, an FM station in the VHF band, although theoretically restricted to line-of-sight transmissions, can dependably serve an area as large as that covered by a low- or medium-powered AM station on the long-wave broadcast band. Even though the AM signal may travel for a longer distance, reception in fringe areas is often marred by interference from other stations in the crowded broadcast band as well as by fading and static.

Just how far will the FM signal reach? Several factors such as transmitter power, antenna height, terrain, and receiver sensitivity enter into any exact computation of range, but a moderately low-powered FM radio station (about 5 kw) should generally be able to maintain a signal strength as high as 50 microvolts in all but a few "problem" locations at distances up to 30-50 miles from the transmitter. This signal intensity is adequate for most receivers, and deluxe hi-fi FM tuners can produce a clear output from much weaker signals than this. With a sensitive tuner and a high-gain antenna, consistent reception at distances of well over 100 miles has often been reported.

The sensitivity of a high-quality tuner is often expressed as a certain number of microvolts "for 20 (or 30) db quieting." An RF input of this specified value (usually less than 5 uv) is the weakest signal which is capable of holding internal receiver noise down to an unobjectionable level during pauses in modulation. "20 db quieting" means that the tuner output level measured during reception of an unmodulated carrier is 20 db lower than the output measured during 400-cps, 30% modulation of the same carrier. At RF signal levels lower than the specified minimum, the carrier becomes too weak to suppress internal receiver noise to a satisfactory degree.

Why Fi Is Hi

FM's wide audio-frequency range of 30-15,000 cps is certainly an important reason for the hi-fi quality of FM sound, but it should be emphasized that wide-band response is neither an exclusive feature of FM nor the sole requirement for high fidelity. Standard AM broadcasting could provide a frequency range equal to that of FM if a wider channel were allocated for each station, but such a move is impractical for two good reasons:

1. The long-wave AM broadcast band is already overcrowded, and the only way to widen channels would be to force numerous stations off the air.
2. AM already has the drawback of being highly susceptible to interference, and an increase in bandwidth would tend to aggravate this problem.

"Moving upstairs" to VHF and changing to FM transmission proved to be the best way to satisfy both major requirements for hi-fi broadcasting—wide frequency range and freedom from noise.

Allocations

FM radio fits into the VHF band between 88 and 108 mc, and this slice of the spectrum is split up into 100 channels of 200-kc width each. Channel numbers are assigned according to the following system:

Center freq. (mc)	Channel #
88.1	201
88.3	202
88.5	203
and up to:	
107.7	299
107.9	300

Like TV channels, the FM radio frequencies are assigned to different areas according to a fixed allocation table. Co- and adjacent-channel stations are well separated geographically to minimize any possibility of interference.

Note that each channel covers 200 kc. Even though a bandwidth of only 150 kc would be sufficient to accommodate the normal ±75 kc maximum swing of carrier frequency, an additional 25 kc is provided on each side of the channel as a guard band. To explain why these "margins" are needed, we must take into account a characteristic of FM which has not yet been mentioned; namely, that frequency modulation of a carrier produces not only a deviation of the carrier but also a complex system of sidebands. While a full explanation of their nature is beyond the scope of this article, we can simply state that appreciable sideband energy will sometimes appear more than ±75 kc from the center frequency of the channel, even under normal conditions. The guard bands accommodate this energy and prevent adjacent-channel interference.

Multiplex Broadcasting

Some FM stations have a profitable sideline of furnishing background music for a fee to stores and other business establishments. Until recently, "storecasting" consisted of feeding the station's regular broadcast signal to a special receiver which automatically cut out all spoken announcements. This receiver was keyed off and on by a supersonic "beep" before and after each break in the music.

The "beep" system had the disadvantage that there was no legal means for the broadcaster to prevent anyone from devising a home-made "storecaster" receiver and using the service without paying for it. To correct this and other problems, the FCC this year outlawed "beep" broadcasting. Adopted in its place is multiplex transmission, in which a regular broadcast and one or more separate "storecasts" are simultaneously carried on one FM channel. All except the broadcast signal

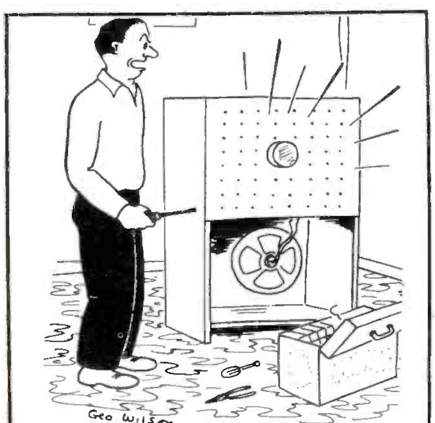
"and right before the big game yet....."

are considered private communications, and it is illegal for unauthorized listeners to receive these.

Another promising use for multiplexing has been successfully tried out—dual-track stereophonic sound broadcasting by a single FM station. Various other multiplex applications are feasible, including facsimile transmission of still pictures.

How can two or more separate signals be used to modulate the same carrier at the same time? It's easy to do, if each signal is placed within a different portion of the frequency range (with no overlapping of frequencies) so that the signals can be separated by filters in the receiver. At first thought, it might seem to be impossible to find room for more than one audio signal, since the main broadcast signal already occupies the audible range up to 15 kc. However, it is feasible to make room for the "storecasts" by converting them to supersonic frequencies, which can be considered equivalent to audio for modulating purposes. A supersonic subcarrier is generated for each "storecast," and is frequency modulated by the desired audio information.

The audible broadcast signal is added to the supersonic "storecast" signals to produce a wide-range composite signal, which is then fed to the modulator in the transmitter. Modulation of the RF carrier by this signal is basically no different from modulation produced by an ordinary 0-15 kc audio signal; the main difference being that a greater number of frequency swings per second are produced by the supersonic com-



" When you get that picture fixed — and not before ! "

ponents of the multiplex signal. All the information can be contained within a standard 200-kc FM channel, but because the sideband harmonics of the supersonic portions of the signal have a greater displacement from the carrier than the audio frequencies, the percentage of carrier modulation induced by these higher frequencies must be kept fairly low.

Let's study an example of a multiplex signal to see what frequency components it might contain. The audio signal from the main broadcast would provide frequencies from 30 cps to 15 kc. To this could be added a 42-kc subcarrier, frequency-modulated with audio from 30 cps to 15 kc to produce a band of frequencies from 27 to 57 kc. Finally, a 67-kc subcarrier could be modulated with a signal from 30 cps to 8 kc (adequate for background music) to cover the band from 59 to 75 kc. The frequencies named are among those actually being employed in commercial multiplex equipment.

In the receiver used in a multiplex "storecasting" installation, a detector separates the entire composite signal from the IF signal, and the output is filtered to remove all frequencies except those in the desired supersonic range. Finally, an additional detector separates the "storecast" audio information from the supersonic subcarrier.

Since multiplexing is a new service, the FCC rules governing its operation have purposely been kept flexible; however, one firm rule with especially important consequences has been adopted. A station which transmits multiplex programs must maintain a schedule of regular broadcasts for 36 hours each week. This indicates that multiplexing will be a source of financial support to keep FM stations operating, and that the growth of FM radio will be encouraged. ▲

"My set's in there ......"

Converting to Stereo

(Continued from page 11)

tially straight, while the other varies in width because of the equal vertical and lateral motions of the stylus. Variations in the vertical cut are indicated by the differences in shading on the photograph, which was made with overhead illumination.

Playback Cartridge Design

Because of the vertical component in the stereo record groove, the cartridge and needle used for playback must have both excellent vertical and horizontal compliance. The greater the compliance in a given direction, the less resistance there is to movement in that direction. Stereo cartridges have fairly high vertical compliance figures, averaging about 2 $\times$ 10^{-6} cm/dyne. The less expensive monaural playback cartridges have relatively little vertical compliance and will smooth out the vertical component of the stereo groove, even if used with the correct size needle. Anyone who desires to play both stereo and monaural records with a single cartridge can do so by merely changing to a stereo cartridge, which can be used on monaural records without adverse effects. In fact, reproduction of monaural records is often better with a stereo cartridge than with the original cartridge. To give you an idea of what is available, photos and specifications of several stereo cartridges accompany this article.

Both stereo and monaural records can be played on a stereo system with excellent results. While a stereo record can be played on a monaural system if the cartridge has sufficient vertical compliance (the professional grade dynamic cartridges do), there is little reason for so doing because there is no stereo effect and, after all, this is the reason for buying a stereo record.

Additional Equipment Requirements

The actual conversion to a stereo setup consists of expanding the single channel monaural phonograph system into a dual channel system. This is illustrated in Fig. 4, a block-diagram com-

Table I—Specifications for monaural equipment to be duplicated.

PREAMPLIFIER	
Gain (Input-to-output on phono channel)	*60 db*
Inputs available	*Phono, Tuner, Aux, Mag Phono, Tape*
Bass boost and droop in db	*15* and *14*
Treble boost and droop in db	*15* and *15*
Equalization positions	*RIAA, NAB, EUR, Col.*
Cathode follower	*Yes*
Maximum output signal voltage	*1.5V*
AMPLIFIER	
Power output (watts)	*12*
Input voltage (signal) needed to obtain full power output	*1.5*
Output impedances	*4, 8, and 16*
Frequency response	*20 cps to 50kc + 2db.*
Distortion figures (IM%)	*5% at 12 watts*
SPEAKER SYSTEM	
Number and sizes of speakers	*1-12", 1-5"*
Type of crossover network	*LC at 4kc*
Type of enclosure	*total*
Size of speaker magnets	*12"-6.9 oz; 5"-1.79 oz*

parison of monaural and stereo systems. The preamplifier, even though represented by a single block, actually has separate circuits for each channel. The controls of one channel are ganged to the equivalent controls of the other channel for convenience of operation.

Several manufacturers have just announced the introduction of stereo preamplifiers which can be substituted for the existing single channel preamplifier in most hi-fi sets. A usable stereo system can be provided, however, by the addition of a single channel preamplifier, power amplifier, and speaker system (Fig. 5) to the existing monaural system. Obviously, then, you must first know the capabilities and operating characteristics of the original system. For comparison purposes, list the preamplifier, power amplifier, and speaker specifications as outlined in Table I. If the system is of the so-called package type, the owner's manual should give most of the data. If any of the components such as speaker or power amplifier are of the conventional hi-fi

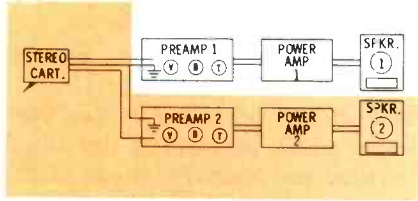


Fig. 5. Block diagram of changes necessary to convert monaural system to stereo.

type, then simply obtain duplicate units.

Another important consideration is the existing monaural cartridge. Make it a point to choose the crystal, ceramic, or magnetic stereo cartridge that most nearly duplicates the output voltage of the original monaural cartridge. This will insure that the output voltage from the preamplifier will be sufficient to drive the power amplifier to full output.

In the event that exact duplicates of the preamplifier and power amplifier cannot be obtained, use equipment which will give nearly the same performance and balance the outputs of the two channels as follows: Apply a sine wave signal of 1,000 cps to the input of one preamplifier, adjust the volume control to mid-range, terminate the amplifier with a dummy load resistor (usually 8 or 16 ohms), and measure the voltage drop across the dummy load. Repeat this procedure with the second preamplifier and power amplifier combination, making sure the attenuator on the signal generator is left in the original position. Adjust the input control of the second amplifier until the voltage across the dummy load is equal to the voltage obtained with the first combination. In this balanced condition, true stereophonic reproduction can be obtained.

"Poor devil! It was the last intermittent that did it."

Once you have the equipment necessary for the duplicate channel, the next step is to install the recommended cartridge load resistors in the input circuit of each preamplifier. The existing load resistor should be removed. Fig. 6 illustrates the location of this component in both original and stereo circuits. The value of these load resistors is specified for each stereo cartridge.

The lead wires from the stereo cartridge to the two preamplifiers should be equal in length and of the type specified for use with each cartridge. The length of this wire should be 3′ or less, the shorter the better—the reason being that the capacity offered by the wire, if excessive, can cause a loss of high frequencies and a reduction of the signal output from the cartridge. Be especially careful to obtain a good ground connection at both preamplifier inputs; in fact, the entire system should be very carefully bonded together. This can best be accomplished by connecting the preamplifiers to the power amplifiers through shielded cables.

Incidentally, if the existing monaural system or the second amplifier or preamplifier doesn't employ an isolation transformer, be sure the stereo cartridge selected has four terminals (separate grounds for each channel) and that the ground in each cable is insulated from the other. This precaution will eliminate introduction of hum and prevent possible damage to some of the equipment.

At this point we are still faced with the problem of where to locate the additional amplifiers. Naturally, the preamplifier unit or units will be near the record turntable. The power amplifier, however, can be remotely located and mounted inside or on the rear of the second enclosure.

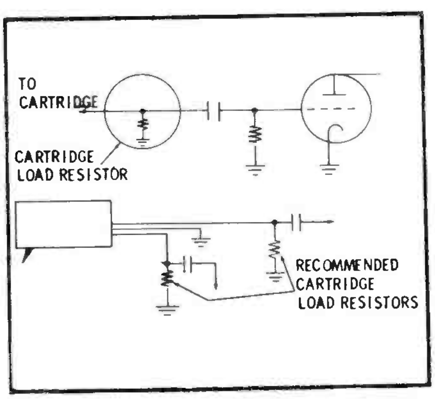


Fig. 6. Schematics indicating load resistors for monaural and stereo cartridges.

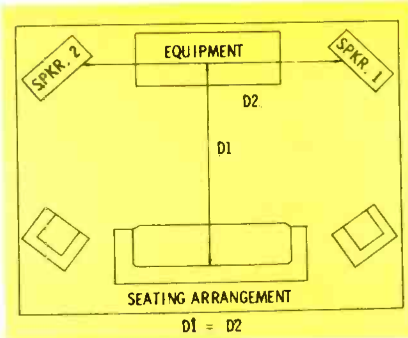


Fig. 7. Example of speaker placement with respect to listening area for stereo.

Complete the job by making sure the customer understands how to operate the system and has the speakers properly spaced and placed for best stereo operation. A good sample placement for speakers (Fig. 7) is where the distance between them is the same as to the listening seats. This is not a hard and fast rule, so experiment a little and place them where the stereo effect is best.

Conclusion

That the electronics industry is solidly behind the swing to stereo is emphasized by the rush to introduce stereo conversion kits as well as components for separate stereo units. Several set manufacturers have already introduced kits to convert their respective monaural outfits to stereo. In addition, stereo conversion kits for application with any existing monaural system are now available through many parts jobbers. Thus, it is easy to see that the opportunity for profitable conversions of even the table model or mass-market type of hi-fi phonographs is present and growing—so get on the band wagon and reap your rewards. ▲

D	E	G	A	U	S	S	I	N	G		V	
A		A			I		M	C		A	R	C
M	A	T	R	I	X		A			R		O
P		I		O		A	G	C		C		L
E		N	P	N			E	R		I		O
R	E	G				Y		T	U	N	E	R
	G				P	O	T			G		B
C		F		H		K		M	V		M	U
H		U		U		E			T	V		R
R	A	S	T	E	R			K	V			S
O		E				O			M	A	S	T
M			R		I	S				N		
A	L	I	G	N		C	H	E	A	T	E	R

Answer to puzzle on page 26

Shop Talk

(Continued from page 9)

tion of the wing dipole.

The center wing dipole is cut to resonate between channels 4 and 5 on the low band, while the third wing dipole is tuned to channel 2. All three are interconnected with an open-wire transmission line having 2" spacing between conductors. This line is purposely made longer than the actual distance between dipoles in order that the units may be properly interconnected for the response pattern desired. This is characteristic of an end-fire array, which is basically what this arrangement forms.

Now let us consider the other elements in the array. A long reflector is mounted at the rear of the cross-arm to make the front-to-back ratio as high as possible. This is followed, as we move forward, by the three wing dipoles. However, in front of the center wing dipole, there is a three section director. This element aids the high-end response of the second dipole; three insulated sections are employed because the wing dipole acts as if it were comprised of three half-wave, high-band dipoles. Another high-end director, this time a single half-wave unit, is positioned in front of the foremost wing dipole.

Still remaining is the folded dipole which is mounted at the front end of the structure. This is veered forward, in common with the other dipoles, its purpose being to serve as a director for the low-band elements. At the same time, the central section of its forward rod is insulated from the two ends of the rod, so it performs as a high-channel reflector, also.

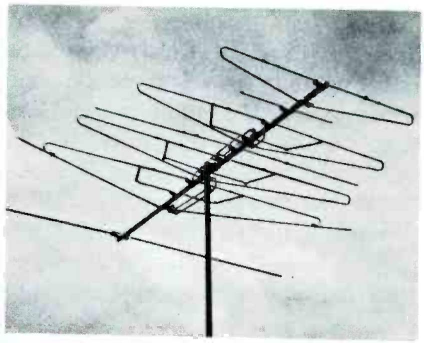


Fig. 7. "Zephyr Royal" employs three wing dipoles in an end-fire array design.

The *Color Royal,* Fig. 8, is closely similar to the *Zephyr Royal,* the chief difference being the more extensive reflector system, which provides for flatter response over the VHF range. Low-band gain for both arrays varies between 6 and 8 db; over the high band, the gain averages about 10 db. Directional patterns are quite sharp.

Use of Parasitic Elements

Another approach to broad-band operation and high gain is employed by the Finney Co. Their basic approach to the construction of the antenna in Fig. 9 was to take a conventional dipole or folded dipole and position a short rod near the center section. The spacing between the small parasitic element and the long driven element is of the order of 1% to 5% of the half wavelength to which the driven dipole is resonant. At the low-band frequencies, where the driven element is functioning as a half-wave antenna, the effect of the small parasitic rod may be ignored. However, over the upper band, when the driven element is being oper-

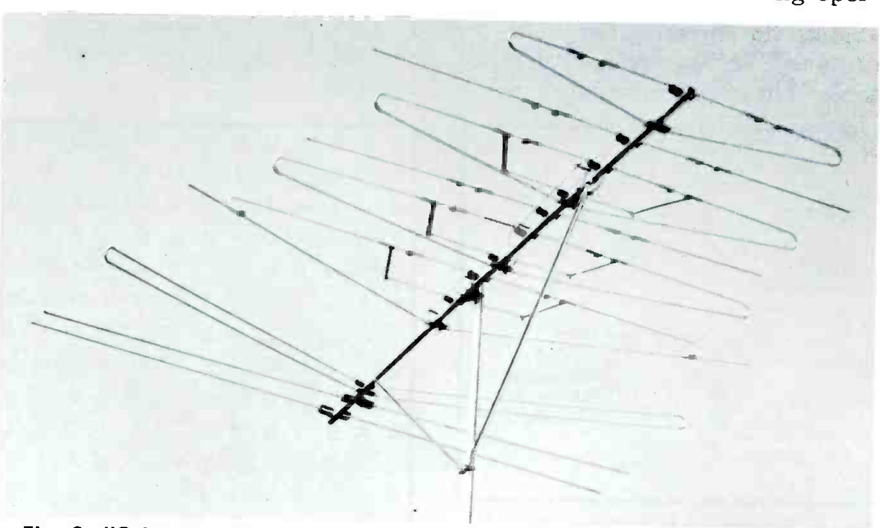


Fig. 8. "Color Royal" uses more extensive reflector system for flatter response.

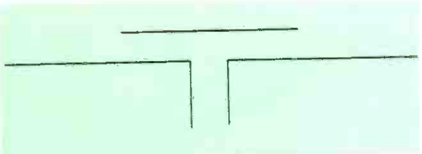


Fig. 9. Parasitic element is placed close to driven element in Finney arrays.

ated essentially on its third harmonic, the parasitic element eliminates the effect of the central current loop and leaves only the two end-current loops in operation (see Fig. 10). As we have seen previously, a half-wave dipole, operated at its third harmonic, will produce three current loops. Two of the loops (those on each end) will be in phase, while the center loop will be 180° out-of-phase. If the center loop is permitted to remain, it will break up the response pattern into a series of side lobes. By adding the small rod, equal in length to one-half wave at the upper frequency, we can remove the effect of the center section of the driven dipole.

Thus, the Finney antenna may be said to function at the higher frequencies so as to produce the effect of two center-fed, half-wave dipoles spaced a half-wave apart in a collinear (i.e., in-line) array and driven in phase. As far as operation is concerned, this combination provides substantially the same over-all radiation pattern as an array that has three half-wave elements connected together for inphase operation.

During development of this antenna it was found more desirable to convert the small parasitic rod to a unit having two elongated loops in order to increase its effectiveness over a broader frequency range (see Fig. 11). Note that while this element now looks like a folded dipole, it still functions as a simple dipole. The two loops come together at the center.

A Finney antenna that employs this particular combination is shown in Fig. 12. Essentially,

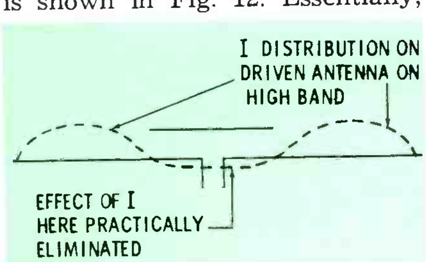


Fig. 10. On high band, parasitic element minimizes effect of reverse current.

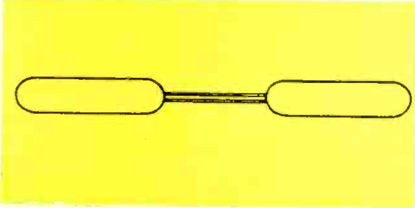


Fig. 11. In actual Finney arrays, parasitic element takes the form of "bowtie."

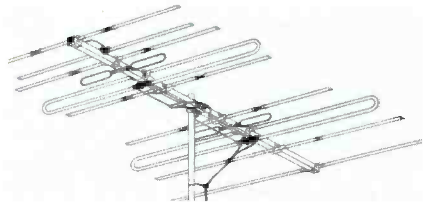


Fig. 12. This Finney antenna is essentially two arrays joined with open line.

it consists of two arrays joined together by an open-wire transmission line. The front section covers the high end of the low band and the upper end of the high band (by means of its third harmonic operation). The rear section covers the low end of the low band and the corresponding low end of the high band. In this latter section we find, at the very rear, a reflector designed for the low band. In front of this is a three-section, high-frequency reflector. Then comes a folded dipole with a small parasitic element in front of it. The length of this folded dipole is designed for best response somewhere in the neighborhood of channel 2. Finally, a three-section, high-frequency director is placed at the head of this rear section.

The front section has a somewhat altered sequence of elements. Just behind the folded dipole (cut to about channel 5) is a three-section, high-frequency director. Then comes the folded dipole and another small parasitic element. Next, there is a three-section, high-frequency director, then a low-frequency director and, at the head of the section, still another high-frequency director. The net result is a highly-directional, high-gain array suitable for use over all 12 VHF channels. For even more gain, two-bay stacking can be used.

It is interesting to note that the two folded dipoles are separated by a quarter wavelength on the low VHF band and, further, that they are fed 90° out-of-phase. This arrangement produces a cardioid (or heart-shaped) response pattern with the null point facing the rear of the array. On the high band, the dipoles are three-quarter wavelength apart and are fed three-quarter wavelengths (270°) out-of-phase. The result is the same cardioid pattern.

A second Finney antenna array of interest is the Model TCR-1 shown in Fig. 13, a unit which possesses the ability to receive certain stations (say channels 4 and 6) from one direction and other stations (say channels 7 and 10) from the reverse direction. The array is so designed that neither set of signals interferes with the other. Furthermore, the array will *not* respond to channel 4 or 6 signals coming from the same direction as channel 7 or 10 signals, *nor* will it respond to channel 7 or 10 signals coming from the direction of the channel 4 or 6 signals. While these particular channels were selected for illustration, the possibilities are unlimited and the company has already marketed over 100 different combinations.

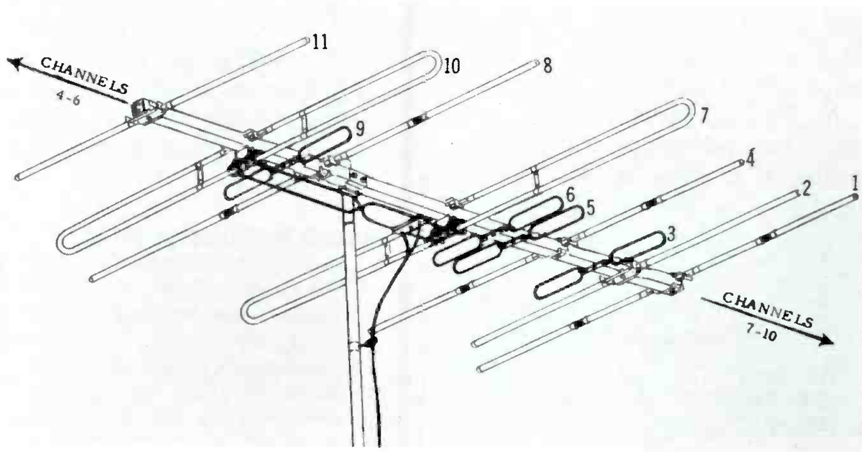


Fig. 13. Finney TCR-1 array receives selected signals from opposite directions.

The line-up of elements of Model TCR-1 is shown in Fig. 13. Element No. 1 is a three-section director cut for channel 10. Element No. 2 is a channel 4 reflector by itself, but with the phasing element in front of it (item No. 3), it also functions as a director on channel 10. The next element, No. 4, is still another three-section channel 10 director. Element No. 7, by itself, is cut for channel 4, but because of elements 5 and 6 near it, the dipole also functions on channels 7 and 10.

All of this dual operation, of course, follows directly from the effect which the small parasitic dipole (or phasing element) has on any larger element positioned close by.

Element No. 8 is a three-section channel 7 reflector. The forward folded dipole, element No. 10, is cut for operation on channel 6. Because of the presence of element No. 9, however, it will also function on channels 7 and 10. Finally, the foremost element, No. 11, is a channel 6 director.

"T" Matching

The Winegard antennas shown in Figs. 14 and 15 both use, as their basic elements, the dipole arrangement shown in Fig. 16. The long back rod CD is continuous and connects to the shorter front element only through rods A and B. These two rods are each about 4″ long and are made of metal. Connection to this antenna is made at the center of the shorter front element, points FG.

To understand how the combination operates, let us consider it first over the low band and then over the high band. Over the low band, we can disregard those portions of the front element that extend to the left of rod A and to the right of rod B. What is left of this front element then serves as a "T" matching section between the transmission line and the long back rod CD. This becomes clearer if we redraw the arrangement to the form shown in Fig. 17. From this illustration, we see where the "T" designation arose.

The purpose of the "T" section is to provide a match between the 300-ohm transmission line and the low-band antenna CD. The positions of rods A and B are adjusted

ABOUT THE COVER

One of the "hottest" things in the industry today is stereo—and what better way to represent this theme photographically than by use of twins.

For those with their minds on other things, we suggest you ignore the subtlety of all this and simply soothe your tired old eyeballs by concentrating on the two lovely bits of femininity. If you have a jealous wife or girlfriend, however, perhaps you'd better do your staring with the issue hidden behind a schematic—pretending to be laboring on a problem with a tough-dog set.

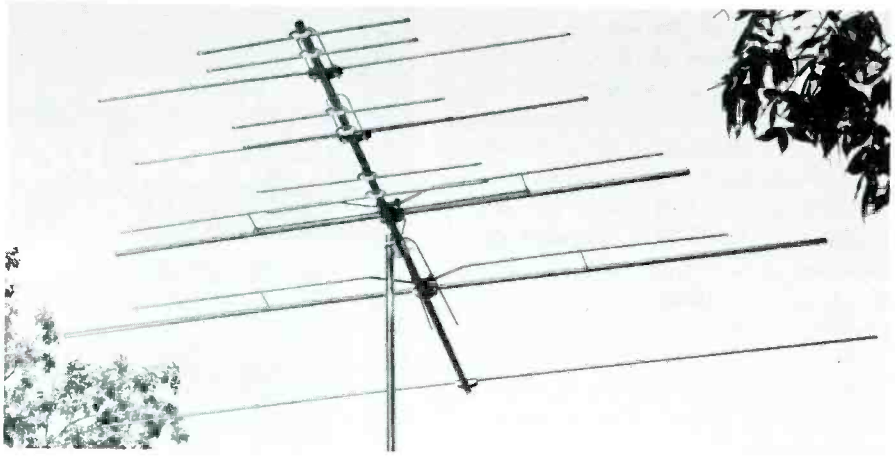


Fig. 14. Basis of Winegard "Color 'Ceptor" is T-matching sections toward rear.

at the factory so that this match is achieved.

For operation on the high VHF band, the full front element becomes active (including those sections to the left of rod A and the right of rod B). Furthermore, the length of the front elements is such that each half is able to accommodate a full half wave. Thus, the full front element has developed across it one complete wave at the operating frequency. It is because of this behavior that we have not referred to the front element as a half-wave dipole.

A and B are each positioned halfway along their respective front element rods. At these points, the voltage is very low and therefore very little current flows from the front element to the rear rod CD. In effect, this decouples CD from EH for high-band operation.

In the arrays shown in Figs. 14 and 15, two such combinations are employed. The front unit has a back rod of 70″ and a front element that is designed to operate at the center of the high VHF band. The rear unit has a back rod of about 100″ and a front section which is cut to operate at a frequency somewhat lower than the bottom end of the high band.

The two "T" matched antennas are interconnected as shown in Fig. 18. The over-all length of the connecting line is approximately one-half wavelength at the center of the high VHF band. (Note that the

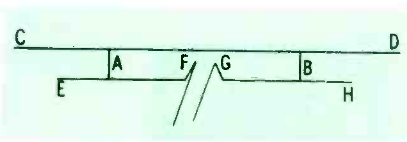


Fig. 16. Drawing of T-matched element in Winegard high-gain, wide-band models.

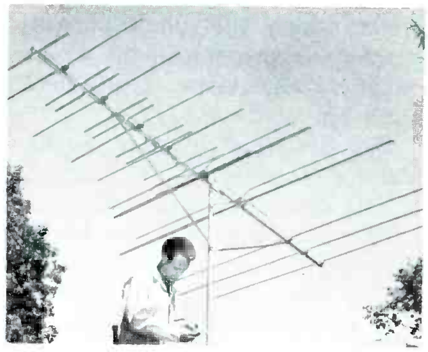


Fig. 15. Winegard Model CL-4X uses extra parasitic elements for added gain.

right-hand ends of the two rods of this line extend beyond the antenna connection at the right. This is done purposely to provide the necessary length to achieve one-half wavelength.) The 300-ohm transmission line leading to the receiver then connects to points X and Y on this line.

Here is the reason for this particular arrangement. Since EF and GH of Fig. 16 are each one-half wavelength long, the impedance at points F-G will be quite high — on the order of several thousand ohms. The conventional transmission line, on the other hand, has an impedance of 300 ohms. To produce a match between the two, we proceed as follows: The open-wire line connecting the two antennas is one-half wave long and open at one end (see Fig. 18), producing a high impedance at the other end of the line, where it connects to the forward antenna. Now, as we move in from either end of this line, the impedance decreases; at points X-Y, it is 300 ohms. It is here that the transmission line leading to the receiver is attached.

So much for the basic section of the Winegard antennas. Now let us examine the other elements of the

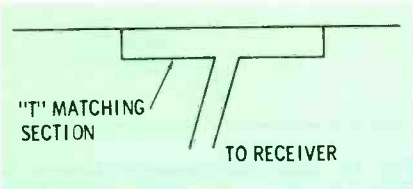


Fig. 17. T-matching section formed between the transmission line and dipole.

two arrays in Figs. 14 and 15. In the first array, there is a long reflector at the rear of the structure. This serves to reduce reception from the rear. Then come the two driven elements. Directly in front of the front driven dipole there are three sets of short directors, each with two rods.* Two rods are employed to produce the same electrical effect as a large diameter single rod. When the rods used are small in diameter, they tend to resonate quite sharply at one frequency, which makes them effective only at this frequency (as directors). At all other frequencies, their effectiveness is reduced sharply. This operating range can be broadened by increasing the rod diameter; however, for the desired coverage over the upper VHF band, a fairly large diameter would be required. Electrically, the same effect can be achieved by using two smaller diameter rods positioned close together, and that is the procedure followed here. Thus, the three sets of two small rods are equivalent to three large diameter directors.

For the low band, two directors are used. However, at the center of each of these directors, there is a small loop as shown in Fig. 19. Each rod is cut in half and the loop connects the two halves together. The inductance of these

* In Fig. 14, the first set of two short director bars can be seen clearly. However, due to the angle from which the photo was taken, the rear rod of each of the other two sets tends to be obscured.

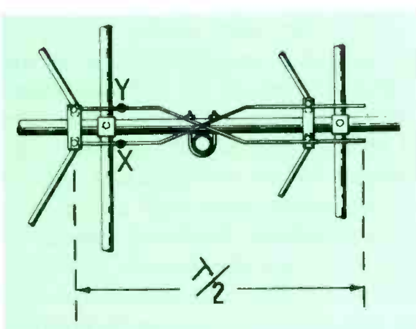
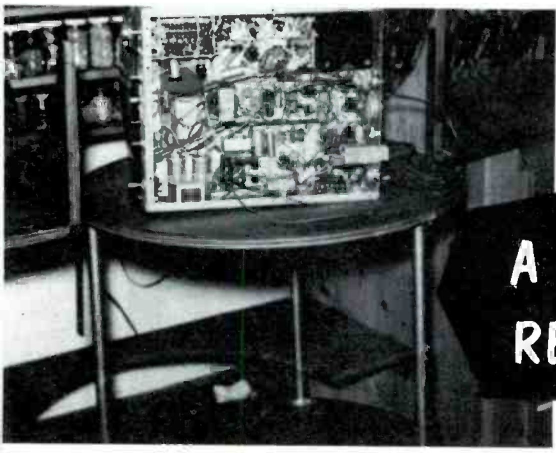


Fig. 18. Two-conductor coupling between T-matched sections. Lead-in goes to X-Y.



A WHILE-YOU-WAIT REPAIR BENCH

Fig. 1. Bench with movable round table.

by Herb Sulkin

Several months ago we made a radical change in our shop procedure, with the twin objectives of increasing our service business and cutting down our overhead. Realizing that our locality was rich in industrial electronics plants spewing forth their nightly army of "engineers" and "do-it-yourselfers," we were determined to convert this negative aspect of the service business into profit for ourselves. Our idea was to encourage these people to bring sets in to us, and then to streamline our shop operation and run the sets through on a "While-U-Wait" basis.

Our first step was to construct six double-decked mobile tables to hold the chassis, and also a labor-saving bench with bays to accommodate the tables. (See Fig. 1.) We chose round tables instead of the usual rectangular shape so that the technician would be able to revolve them a full 360°, thus bringing his chassis to an optimum working position without undue exertion or disturbance of the components attached to the set.

To lend mobility to these "turntables," we made a special arrangement for the power and antenna receptacles. The required outlets were installed dead-center over each of the two working positions in the bench (as shown in Fig. 2) by running a cable outward from the wall and suspending it from the ceiling on a spring. In this way, we achieved unhampered table motion — even with power, antenna and speaker leads all connected to the chassis.

We next copied a design idea from modern, step-saving kitchens and con-

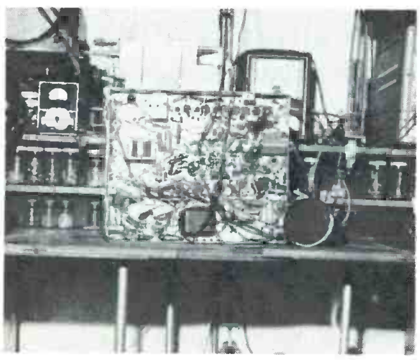


Fig. 2. Receptacles suspended overhead.

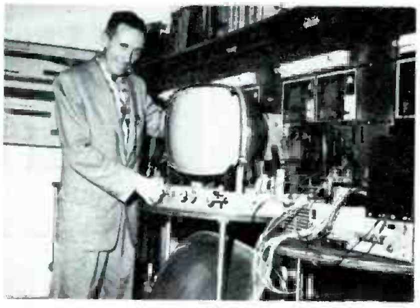


Fig. 3. Test area for "cooking" chassis.

structed a "test area" behind the technicians and running parallel to the bench. (Fig. 3.) A finished chassis can be swung quickly out from the bench and over to the test area, where it can immediately be re-connected to fittings similar to those in the bench receptacles.

While working at our bench, we find it easy to notice any trouble symptoms that develop in the sets in the test area and to make necessary adjustments. An added feature of the test panel is a cycling switch that turns some or all of the chassis on and off at set intervals.

The bench cost about $300, each table cost $75, and the panel and receptacles amounted to about $200—a total of roughly $1,000 for the whole setup. Considering the cost and trouble involved in construction of all this equipment, the reader may be wondering if it is practical; but it has "paid off" for us from the very first day of use.

We found that the ease of handling TV chassis, with almost complete freedom from lifting sets, was a factor in enabling us to employ older and more experienced men as technicians. Our production figures for the first six months we used this equipment, as compared to the six months previous to the change, revealed a gain of six extra bench jobs per week over our former average of 40 per week. At this rate, we anticipate our initial investment will be written off after ten months of operation.

Our minimum labor charge for "While-U-Wait" service is $5.00 for 30 minutes or less. Seven out of every 10 sets now brought to us can be put into working order within 20 minutes, although a full half hour is still required just to obtain an estimate on a lengthy bench job. ▲

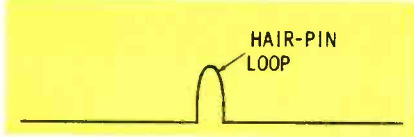


Fig. 19. Each low-frequency director in Figs. 14 and 15 has small center loop.

coils, with the capacity between the two sections of the rods they connect, and the stray capacity of the mounting hardware, form parallel tuned circuits that resonate in the central part of the high VHF band. The high impedance of this circuit at resonance effectively isolates the two halves of each rod electrically on channels 7 to 13.

This is done to prevent these long rods from acting as reflectors and shielding the high frequency directors from the oncoming signals, thereby counteracting the effectiveness of the directors. By inserting the loading coils, we effectively break each long rod into two smaller ones, and each then functions independently as a high-band director. These aid the other high-band directors, and the gain and directivity are enhanced.

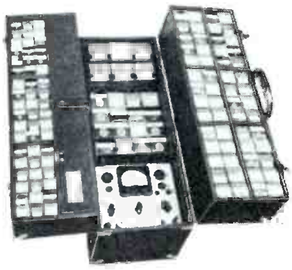
On the lower channels, 2 to 6, the inductance of the loading coils is negligible and each long director rod performs its normal function. The coils act simply to connect each half of the rod together.

In the antenna array of Fig. 15, the same sequence of directors are employed, only here there are more of them. At the rear of the array are three reflectors. The two extra reflector elements, in conjunction with the regular reflector, create a flat tuned screen designed to more effectively block signals arriving from the rear. In addition, these elements increase the gain uniformly across the low band. Over-all gain is said not to vary more than ±1.2 db over any channel.

This five-part series has been presented to acquaint you with the various types of TV antennas now on the market with the hope that it will aid you in serving your customers. While we were not able to cover every make and model, the theory behind the basic design of the most popular brands has been discussed and you should be able to use this information to analyze and understand variations in the designs heretofore presented. ▲

PRODUCT report

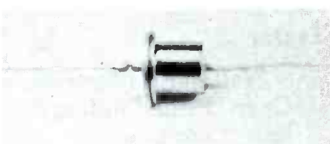
Caddy With Tube Tester



A caddy with built-in tube tester is being marketed by Vis-U-All Products Co., Grand Rapids, Mich. The tester provides checks for quality, grid-cathode or heater-cathode shorts, interelectrode leakage, grid emission, and gas. Sensitivity of the leakage test can be regulated to suit the owner. An adapter is furnished for checking picture tubes. An adapter is also available for checking selenium rectifiers. Dealer net price of the Model V100 Caddy Tube Tester is $99.50.

For further information, check 39T on Literature Card.

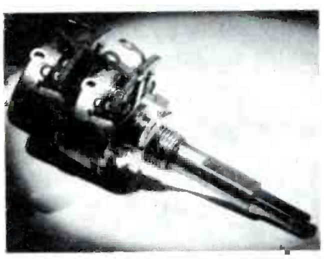
Silicon Rectifier



A silicon rectifier with pigtail leads is now being offered to the radio-TV replacement market by the General Instrument Distributor Div., Brooklyn, N. Y. This new unit, the PT5, is intended for B+ rectifier applications and has an output rating of 500 ma DC. The AC input voltage rating is 130 volts. The case is shaped like a top hat measuring 5/16″ in height, .270″ in diameter at the top, and .375″ across the "brim." No mounting hardware or heat sink is required.

For further information, check 44T on Literature Card.

Controls for Stereo Amplifiers



It takes more than just a session of random knob-twiddling to establish the correct settings for the pairs of identical controls used in dual-channel stereo sound amplifiers. First of all, each pair must be properly balanced—that is, both controls must be adjusted individually until identical levels have been established in both sound channels for the volume, bass boost, or other characteristic being controlled. Once a balance has been established, further adjustments should be made simultaneously to both controls of a pair, in order to maintain an equal effect on both channels.

These stereo requirements are met in a new series of dual concentric controls just introduced by Clarostat Mfg. Co., Dover, N. H. The units are similar to regular TV controls, except for the addition of a clutch arrangement. Pulling outward ⅛" on the rear shaft causes the clutch to be disengaged so that the controls can be individually adjusted for balance. After this operation has been completed, the controls can be locked together again by pushing in on the shaft.

Two lines of controls are available in the new style—Stereo D47's having a 1 5/16" diameter, and Stereo D37's with a 1⅛" diameter. A wide range of multiple-tap combinations (with a maximum of three taps per control) are available in the latter series.

For further information, check 41T on Literature Card.

Phono Cartridges

Jensen Industries, Inc., Forest Park, Ill., has announced a new line of 32 phono cartridges designed as replacements for 80% of all cartridges now on the market. Both turnover and single-needle types are available in a wide variety of output-voltage ratings and mounting styles. Some of the units are equipped with Jensen's new hairpin-shaped needle that is held in the cartridge by friction. A catalog of the new line gives an actual-size silhouette of each cartridge for ease in identification. List prices range from $4.95 to $8.50, including replaceable needles.

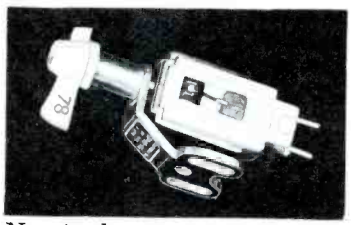
For further information, check 38T on Literature Card.

CRT Tester

Hallmark Electronics Corp., Philadelphia, Pa., has announced the Model PC-100 "Pix-Chex," a compact picture-tube checker. Tests can be made for grid-cathode and heater-cathode shorts (or leakage up to 100K ohms), cathode emission, heater continuity, and open cathode or grid. The instrument is operated from the AC line by means of a transformer-type power supply. Dimensions of the metal case are 4" long by 1½" wide by 2" deep, and net price is $4.95.

For further information, check 48T on Literature Card.

Ceramic Cartridge

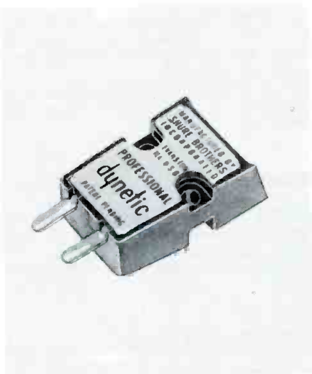


A medium-output ceramic phono cartridge of the turnover type, the ACOS Type GP65-1, is being imported from Great Britain by Duotone Co., Inc., Keyport, N. J. Nominal output is 0.16 volts, and frequency response is substantially flat from 50 to 12,000 cps. Also being supplied is the Type GP65-3 cartridge with higher output (1.0 volt, nominal value) and somewhat less high-frequency response. Both units have a needle pressure of 10 grams and a recommended load resistance of 2 megohms.

For further information, check 45T on Literature Card.

MERCHANDISING AIDS

Cartridge Exchange Offer



Shure Bros., Inc., Evanston, Ill., has announced a plan whereby any purchaser of their newly-introduced monaural "Professional Dynetic" cartridge can trade it in later for a stereo version of the same unit and receive an allowance of 75% of the original purchase price. Offer expires at the end of 1959.

For further information, check 40T on Literature Card.

Tube Caddy

Electron Tube Div., Westinghouse Electric Corp., Elmira, N. Y., is offering through its distributors a new Model 55 tube caddy with four separate sections and a cover. Any desired combination of sections can be assembled together with snap catches. A mirror is mounted in the cover. The caddy has a total capacity of more than 350 tubes plus tools and equipment.

For further information, check 42T on Literature Card.

Rectifier Pocket Pack

Sarkes Tarzian, Inc., Bloomington, Ind., is packaging pigtail-type "K" Series silicon rectifiers in pocket-size "5-Paks." Cartons of five pocket packs are also available.

For further information, check 43T on Literature Card.

Cartridge Merchandiser

Electro-Voice, Inc., Buchanan, Mich., has designed a counter display stand holding 12 Power-Point phono cartridge-needle combinations. The cartridges are mounted in transparent plastic boxes that snap into place in the display. Color-coded specification cards are inserted into the boxes.

For further information, check 46T on Literature Card.

Microscope Display

Recoton Corp., Long Island City, N. Y., is furnishing a No. 1400 counter display, consisting of a birchwood cabinet for needle storage and a 100-power microscope for inspection of stylus wear, free to dealers who buy a selection of diamond needles.

For further information, check 47T on Literature Card.

INDEX TO ADVERTISERS

July, 1958

CATALOG AND LITERATURE SERVICE

ACCESSORIES

1T. *E-Z-HOOK* — A convenient reference sheet titled, "How to Build the Five Most Useful Scope Probes," with schematic, mechanical component layout, etc. *See ad page 56.*

ANTENNAS

2T. *WINEGARD*—Two illustrated catalog sheets describing features of Scotchman TV antenna and Scotchman stamp premium offer. *See ad page 19.*

ANTENNA DISTRIBUTION

3T. *BLONDER-TONGUE* — Catalog sheet B-23 describes important profit features of the Blonder-Tongue two-set booster. *See ad page 47.*

AUDIO EQUIPMENT

4T. *AMERICAN MICROPHONE*—16-page, two-color catalog on microphones for tape recording, broadcast, public address, and general purposes, as well as handsets, phono cartridges and arms, mobile equipment, and accessories.

5T. *CENTRALAB* — 20-page booklet on a quickly-installed hi-fi compensated volume control that improves the response of radios and phonographs by automatically increasing the volume of frequencies normally lost by ordinary volume controls. *See ad page 25.*

6T. *SWITCHCRAFT*—Catalog S-58 contains illustrations, prices, schematics, dimensional drawings on hundreds of electronic components including jacks, plugs, switches, etc.

CAPACITORS

7T. *SPRAGUE*—"ABC's of Ceramic Capacitors," comprehensive brochure on theory and applications. *See ad page 2.*

CARTRIDGES & NEEDLES

8T. *JENSEN*—New Jensen Needle Handbook DL-101, a complete guide to needle reference in handy pocket-size book. Also cartridge catalog DL-118. *See ad page 54.*

CONTROLS

9T. *CLAROSTAT*—Precision potentiometers for prototype work. Series 42-900—5K to 100K, 3 watts. *See ad page 5.*

FUSES

10T. *BUSSMANN* — Quick reference catalog to all types of fuses used in the electronic industry. Buss Bulletin SFUS. *See ad page 31.*

11T. *LITTELFUSE* — Illustrated price sheet on fuses, fuse-holders, etc. *See ad 4th cover.*

POWER SUPPLIES

12T. *ACME*—Variable Voltage Adjustor Catalog VA-312. *See ad page 22.*

RESISTORS

13T. *IRC*—Bulletin DC3C on close-tolerance resistors. *See ad 2nd cover.*

14T. *WORKMAN TV*—No. CS 40 replacement guide on CANDOHM resistors. *See ad page 54.*

SALES PROMOTION

15T. *VIS-U-ALL* — Auto-radio service merchandising manual. *See ads pages 28, 52.*

SERVICE AIDS

16T. *CBS-HYTRON*—Bulletin E-292 describes new 8JP4, an aluminized 110° TV test picture tube. *See ad page 17.*

17T. *GENERAL CEMENT* — General catalog No. 158 on complete line of products. *See ads pages 28, 53.*

18T. *HALLMARK*—Catalog sheet and price list on CRT tester. *See ad page 56.*

19T. *PERMA-POWER*—Descriptive literature on the new "Magneformer" used to magnetize and demagnetize metallic hand tools. *See ad page 59.*

20T. *SERVICE INSTRUMENTS*—New complete catalog of all Sencore units. *See ads pages 32, 53, 58.*

SHOP EQUIPMENT

21T. *EQUIPTO* — 48-page reference manual completely describing all types of steel shelving, cabinets, work benches and tables, and other shop and office equipment.

TECHNICAL PUBLICATIONS

22T. *GERNSBACK*—Descriptive literature on Gernsback Library books. *See ad page 55.*

23T. *WESTINGHOUSE*—"Tech-Lit" Service covering schematics and technical service data for all Westinghouse radio, TV and hi-fi sets. *See ad page 39.*

TEST EQUIPMENT

24T. *B & K*—Bulletin AP12 gives helpful information on new point-to-point signal-injection techniques with Model 1075 TV "Analyst"; other bulletins describe "Dyna-Quick" Models 500B, 650, and automatic 675 portable dynamic mutual conductance tube and transistor testers plus Model 400 CRT cathode rejuvenator tester. *See ad page 41.*

25T. *DOSS*—Instruction manuals containing details on the new D-600 "Electrolytic Substitute," D-700 "Sync Master," and D-400 "Hi Leak" Analyzer. Also on D-200 "Video Master," D-100 "Sweep Analyzer," and D-500 "Slave Oscillator." *See ad page 38.*

26T. *EICO*—New 1958 16-page catalog shows you how to save 50% on test instruments and hi-fi equipment in both kit and factory-wired form. *See ad page 24.*

27T. *ELECTRO-PRODUCTS* — Illustrated folders on new DC power supply that powers transistor portable or "hybrid" auto radios, available in kit or factory-wired form. Also deluxe, ruggedized kit for transistor or heavy-duty work. *See ad page 57.*

28T. *JACKSON*—Folder covering entire line of "Service Engineered" test equipment. *See ad page 64.*

29T. *RCA* — Form 3F767, flyer on Model WV-84B ultra-sensitive DC microammeter. Form 3F764, RCA test-equipment line flyer. *See ad 3rd cover.*

30T. *SIMPSON*—New test equipment bulletin 2060. *See ads pages 50, 51.*

31T. *TRIPLETT*—Circular on universal VOM-VTVM.

32T. *WINSTON*—Complete data on full line of equipment, including the new 6-in-1 Hi-Fi Audio System Analyzer. *See ad page 4.*

TOOLS

33T. *XCELITE*—Illustrated catalog on full line of tools, plus literature on new products. *See ad page 55.*

TRANSFORMERS & COILS

34T. *MERIT* — Service Technician's Handbook lists part numbers and prices of products in company's line. *See ad page 23.*

TUBES

35T. *DUMONT*—Picture-tube data sheet. *See ad page 7.*

36T. *GENERAL ELECTRIC*—Receiving-tube interchangeability chart. Lists 122 television and radio types which can directly replace 180 others. (ETR-1749). *See ad page 35.*

37T. *RAYTHEON* — Revised 14-page Television Picture Tube Characteristics booklet includes data on aluminized black-and-white and color tubes, face-plate deflection angle, bulb dimension, ion-trap information, and basing diagrams. *See ads pages 1, 48.*

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Covers PHOTOFACT Set Numbers 390 through 407 Released

MARCH through JULY

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Set No.—Folder No.

ADMIRAL
(Also See Record Changer Listing)
Chassis 3J1 ... 392—5
Chassis 3K1 ... 398—6
Chassis 4R2 ... 406—1
Chassis 4S2A ... 404—1
Chassis 6B3 ... 404—12—S
Chassis 6R2B ... 356—1
● Chassis 8F1 (TV Remote Control Unit) ... 404—1
● Chassis 8G1 (TV Remote Control Unit) ... 394—1, 406—1
Chassis 8H1A ... 404—1
● Chassis 16AB1, 16AB1C ... 394—1
● Chassis 16AD1, 16AD1C, 16AE1, 16AE1C ... 394—1
● Chassis 16AF1 ... 395—1
● Chassis 16AG1, 16AG1C ... 394—1
● Chassis 16AH1 ... 405—1
● Chassis 16AL1, 16AL1C ... 394—1
● Chassis 16B1, 16B1C ... 394—1
● Chassis 16D1, 16D1C, 16E1, 16E1C ... 394—1
● Chassis 16F1 ... 395—1
● Chassis 16G1, 16G1C ... 394—1
● Chassis 16H1 ... 405—1
● Chassis 16J1, 16J1C, 16K1, 16K1C, 16L1, 16L1C ... 394—1
● Chassis 17AB1 ... 406—1
● Chassis 17AC1, 17AG1 ... 397—1
● Chassis 17AK1 ... 406—1
● Chassis 17AL1 ... 404—1
● Chassis 17B1, B ... 406—1
● Chassis 17C1, B ... 397—1
● Chassis 17D1 ... 404—1
● Chassis 17F1 ... 402—1
● Chassis 17G1, B ... 397—1
● Chassis 17J1 ... 406—1
● Chassis 17K1 ... 406—1
● Chassis 17L1, B ... 404—1
● Chassis 20AZ4EF (See Photofact Servicer) ... 399
● Chassis 20SZ4EF (See Photofact Servicer) ... 399
● B1A21F1 ... 397—1
● B121AF1 ... 397—1
● B121F1 ... 397—1
● C21E2, C21E3 ... 394—1
● C21E6, C21E7 ... 394—1
● C21E12, C21E13, C21E14, C21E16, C21E17 ... 394—1
● C21E22, C21E23, C21E24 ... 394—1
● C21F42, C21F43, C21F46, C21F48 ... 397—1
● CA21E2, CA21E3 ... 394—1
● CA21E12, CA21E13, CA21E14 ... 394—1
● CA21E22, CA21E23, CA21E24 ... 394—1
● CA21F42, CA21F43 ... 397—1
● CH21F52, B, CH21F53, B, CH21F54, B ... 406—1
● CHA21F52, CHA21F53, CHA21F54 ... 406—1
● CR21E12, CR21E13, CR21E14 ... 394—1
● HF21F22, HF21F23 ... 406—1
● HF21F32, HF21F33, HF21F34 ... 404—1
● HFA21F22, HFA21F23 ... 406—1
● HFA21F32, HFA21F33, HFA21F34 ... 404—1
● HFR21F42, HFR21F43, HFR21F44 ... 404—1
HT2236, HT2237 ... 398—6
● L21E22, L21E23 ... 394—1
● LA21E22, LA21E23 ... 394—1
● LH21F32, B, LH21F33, B, LH21F34, B ... 406—1
● LHA21F32, LHA21F33, LHA21F34 ... 406—1
● LHR21F32, LHR21F33, LHR21F34 ... 406—1
● P14D11, P14D12, P14D13, P14D14 ... 405—1
● P17D21, P17D22, P17D23, P17D24 ... 395—1
● PA14D11, PA14D12, PA14D13, PA14D14 ... 405—1
● PA17D21, PA17D22, PA17D23, PA17D24 ... 395—1
● T18A11, T18A12, T18A13 ... 402—1
● T21E1, T21E2, T21E3 ... 394—1
● T21E21, T21E22, T21E23 ... 394—1
● T21F32, T21F33 ... 397—1
● TA21E1, TA21E2, TA21E3 ... 394—1
● TA21E21, TA21E22, TA21E23 ... 394—1
● TA21F32, TA21F33 ... 397—1
● TR21E21, TR21E22, TR21E23 ... 394—1

ADMIRAL—Cont.
3J14, 3J16 ... 392—5
7M11 ... 369—1
303, 304 ... 404—12—S
382, 383, 384 ... 356—1

AIRKING
● Ch. 702-10, -50 (See Photofact Servicer) ... 401

AIRLINE (Also See Auto Radio and Recorder Listing)
GAA-1003A ... 404—4
GAA-1009A ... 404—4
GAA-2642B, GAA-2643B ... 384—6
GEN-1107A ... 349—2
GEN-1662A, GEN-1663A ... 358—1
● GRX-4019A ... (PCB 395-4) 345—2
● GRX-4020B ... (PCB 396-5) 347—1
● GRX-4023A, GRX-4025A ... (PCB 395-4) 345—2
● GSL-4019A, GSL-4023A ... (PCB 395-4) 345—2
GTM-1109A ... 392—6
GTM-4200A, GTM-4300A ... 401—1
● WG-4041A ... 394—2
● WG-4042A ... 396—1
● WG-4051A ... 394—2
● WG-4052A ... 396—1
● WG-4141A ... 394—2
● WG-4142A, WG-4143A ... 396—1
● WG-4151A ... 394—2
● WG-4152A, WG-4153A ... 396—1
● WG-4204A ... 403—12—S
● WG-5040A, WG-5041A ... 394—2
● WG-5042A ... 396—1
● WG-5047A ... 396—1
● WG-5051A ... 394—2
● WG-5052A ... 396—1
● WG-5140A, WG-5141A ... 394—2
● WG-5142A, WG-5143A ... 396—1
● WG-5147A ... 396—1
● WG-5151A ... 394—2
● WG-5152A, WG-5153A ... 396—1

ALTEC LANSING
440C ... 305—3

AMC (AIMCEE)
● A17P1T (Similar to Chassis) ... 379—3
● 21-K-102 (Similar to Chassis) ... 380—5
● 21-100 (Similar to Chassis) 380—5
● 717-MT-500 (Similar to Chassis) ... (PCB 394-5) 371—13
● 721-K-611 (Similar to Chassis) ... (PCB 394-5) 371—13
● 721-LP-651 (Similar to Chassis) ... (PCB 394-5) 371—13
● 721-MT-601 (Similar to Chassis) ... (PCB 394-5) 371—13
● 4017 (Similar to Chassis) ... (PCB 394-5) 371—13
● 4117 (Similar to Chassis) ... (PCB 394-5) 371—13
● 4217 (Similar to Chassis) ... (PCB 394-5) 371—13

AMC (AIMCEE)—Cont.
● 4517 (Similar to Chassis) ... (PCB 394-5) 371—13
● 5023, 5024, 5025, 5027 (Similar to Chassis) ... (PCB 394-5) 371—13

AMERICAN MOTORS
(See Auto Radio Listing)

ARTONE
● 10TS90T, 10TS90TA, 10TS91T ... 403—1
● 14TS78T, 14TS78TA ... 400—1
● 17TT61MA ... 399—1
● 21CT64MA ... 399—1
● 21TT61MA ... 399—1
● 721-K-765 (Similar to Chassis) ... 380—5
● 721-K-771, 721-K-774 (Similar to Chassis) ... (PCB 394-5) 371—13
● 721-LP-775, 721-LP-777 (Similar to Chassis) ... (PCB 394-5) 371—13
● 721-MT-770 (Similar to Chassis) ... (PCB 394-5) 371—13
● 721-T-760 (Similar to Chassis) ... 380—5
● 724-K-772 (Similar to Chassis) ... (PCB 394-5) 371—13
● 1710 (Similar to Chassis) ... (PCB 394-5) 371—13
● 1720 (Similar to Chassis) ... (PCB 394-5) 371—13
● 1735, 1736, 1740, 1741 (Similar to Chassis) ... (PCB 394-5) 371—13

ARVIN
956T1 (Ch. 1.42400) ... 391—5
5578 (Ch. 1.43500) ... 393—6
8565 (Ch. 1.41200) ... 300—2
8571, 8572, 8573 (Ch. 1.41100, 1.41300) ... 394—7
8576 (Ch. 1.41400) ... 395—5
Ch. 1.41100 ... 394—7
Ch. 1.41200 ... 300—2
Ch. 1.41300 ... 394—7
Ch. 1.41400 ... 395—5
Ch. 1.42400 ... 391—5
Ch. 1.43500 ... 393—6

AUDIO INDUSTRIES
(See Ultratone)

AUTOMATIC
(Also See Auto Radio Listing)

AYRES
(L. S. Ayres & Co. Dept. Stores)
● SV721 (Similar to Chassis) ... 375—3
● SV725R (Similar to Chassis) ... 375—3

BECKER
(See Auto Radio Listing

BELL SOUND SYSTEMS
3DT(G) ... 401—4
2315 ... 397—6
2325 ... 395—6
5615 ... 399—5
5630 ... 402—5

BLAUPUNKT
(See Auto Radio Listing)

BUICK
(See Auto Radio Listing)

CADILLAC
(See Auto Radio Listing)

CHALLENGER
CHA20, Y ... 394—9
CHA33, Y ... 391—6
CHA75 ... 395—7

CHEVROLET
(See Auto Radio Listing)

COLUMBIA RECORDS
TR-1000 ... 405—5
360 ... 402—6
513 ... 287—4
517R, 518R ... 401—5
523 ... 406—6
534 ... 407—5
542 ... 402—7
582 ... 402—7
705 ... 407—5

CORONADO
PH7-4095A ... 395—8
RA48-8158A ... 394—10
RA48-8159A ... 400—6
● TV2-9465A, TV2-9466A, TV2-9470A, TV2-9471A, TV2-9475A, TV2-9476A, TV2-9480A, TV2-9481A ... 407—1
● TV2-9485A, TV2-9486A ... 404—2
● TV3-9402A ... 385—13—S
● TV3-9450A ... 396—2
● TV3-9455A, TV3-9456A ... 396—2
● TV3-9460A, TV3-9461A ... 396—2
● TV3-9402A ... 398—1

CRESCENT
A-640A, B ... 391—7

CROSLEY
● F-24PDBH, PDBU, PDMH, PDMU (TV Ch. 414, 414-1 and Radio Ch. 362-3) (See Photofact Servicer) ... 390
F-25BE, BK, GN, MN (Ch. 25F) (See Photofact Servicer) ... 397
G-200BD, EY, MY, WT (Ch. 200GA, GT) (See Photofact Servicer) ... 392
● H-21LPKBF, H-21LPKBU (Ch. 468, 469) (See Photofact Servicer) ... 391
● H-21LPKMF, H-21PKMU (Ch. 468, 469) (See Photofact Servicer) ... 391
Ch. 25F (See Photofact Servicer) ... 397
Ch. 200GA, 200GT (See Photofact Servicer) ... 392
Ch. 362-3 (See Photofact Servicer) ... 390
Ch. 414, 414-1 (See Photofact Servicer) ... 390
Ch. 468, 469 (See Photofact Servicer) ... 391

DAVID BOGEN
L60 ... 391—8
LX60 ... 397—7
L330 ... 392—8

DUMONT
● RA-133 ... (PCB188-1) 110—7
RA-346-A1, -A2 ... 340—6
● RA-400, RA-401 ... 405—2
● RA402, RA403 ... 388—14—S
● RA-406, RA-407 ... 406—14—S
Beaumont "21" ... 405—2
Beverly "21" ... 405—2
Biscayne "21" ... 405—2
Chatham "21" ... 405—2
Essex "21" ... 405—2
Flanders "24" ... 405—2
Newport "24" ... 405—2
Palm Beach "21" ... 405—2
Park Lane "21" ... 405—2
Revere "21" ... 405—2
Ridgewood "24" ... 405—2
Riviera "21" ... 405—2
Sherwood "24" ... 405—2
Sportsman "17" ... 406—14—S
Versailles "21" ... 405—2
Westminster "21" ... 405—2

EDSEL
(See Auto Radio Listing)

EMERSON
856 (Ch. 120274) ... 311—4
867B (Ch. 120366B) ... 407—6
● 1000D (Ch. 120206D) ... (PCB 249-1, 269-1) 235—5
● 1001F (Ch. 120208D) ... (PCB 249-1, 269-1) 235—5
● 1004D (Ch. 120206D) ... (PCB 249-1, 269-1) 235—5
● 1006D (Ch. 120206D) ... (PCB 249-1, 269-1) 235—5
● 1007F (Ch. 120208D) ... (PCB 249-1, 269-1) 235—5
● 1007J (Ch. 120236D) ... 304—7
● 1008D (Ch. 120206D) ... (PCB 249-1, 269-1) 235—5
● 1009F (Ch. 120208D) ... (PCB 249-1, 269-1) 235—5
● 1010D, F (Ch. 120206D) ... (PCB 249-1, 269-1) 235—5
● 1011F (Ch. 120208D) ... (PCB 249-1, 269-1) 235—5
● 1012J (Ch. 120233F) ... 304—7
● 1014F (Ch. 120223D) ... (PCB 249-1, 269-1) 235—5
● 1016D (Ch. 120210D) ... 243—4
● 1019F (Ch. 120210D) ... (PCB 249-1, 269-1) 235—5
● 1020C (Ch. 120206D) ... (PCB 249-1, 269-1) 235—5
● 1021E (Ch. 120208D) ... (PCB 249-1, 269-1) 235—5
● 1022G (Ch. 120210D) ... 243—4
● 1026E (Ch. 120225D) ... (PCB 249-1, 269-1) 235—5
● 1034D (Ch. 120220D) ... (PCB 291-1) 275—7
● 1036D (Ch. 120206D) ... (PCB 249-1, 269-1) 235—5
● 1037D (Ch. 120208D) ... (PCB 249-1, 269-1) 235—5
● 1037H (Ch. 120238D) ... 304—7
● 1038F (Ch. 120225D) ... (PCB 249-1, 269-1) 235—5
● 1041J (Ch. 120238H) ... 304—7
● 1042F (Ch. 120206D) ... (PCB 249-1, 269-1) 235—5
● 1044H, 1046F, 1048F (Ch. 120225D) ... (PCB 249-1, 269-1) 235—5
● 1054F (Ch. 120225D) ... (PCB 249-1, 269-1) 235—5
● 1060H, 1062J (Ch. 120245D) ... (PCB 318-1) 299—4
● 1064F (Ch. 120239F) ... (PCB 291-1) 275—7
● 1066F, 1070F, 1072F (Ch. 120223D) ... (PCB 249-1, 269-1) 235—5
● 1073F (Ch. 120237D) ... 304—7
● 1074H (Ch. 120225D) ... (PCB 249-1, 269-1) 235—5
● 1084F (Ch. 120225F) ... (PCB 249-1, 269-1) 235—5
● 1084H (Ch. 120235D) ... 304—7
● 1086F, 1088F (Ch. 120225D) ... (PCB 249-1, 269-1) 235—5
● 1090F, H, 1092F (Ch. 120225D, F) ... (PCB 249-1, 269-1) 235—5
● 1094D (Ch. 120253) ... (PCB 291-1) 275—7
● 1096A (Ch. 120257D) ... (PCB 308-1, 319-1) 296—6

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

Set No. — Folder No.

EMERSON—Cont.
- ●1096D (Ch. 120247D) .... 304—7
- ●1097A (Ch. 120258D) .... (PCB 308-1, 319-1) 296—6
- ●1110F, 1112F, 1116F, 1120F (Ch. 120257P) .... (PCB 308-1, 319-1) 296—6
- ●1122 (Ch. 120286P) .... (PCB 319-1) 296—6
- ●1139 (Ch. 120285T) .... (PCB 319-1) 296—6
- ●1148H (Ch. 120259H) .... (PCB 318-1) 299—4
- ●1160 (Ch. 120286P) .... (PCB 319-1) 296—6
- ●1236 (Ch. 120245Z) .... (PCB 322-1) 299—4
- ●1237 (Ch. 120289R) .... (PCB 322-1) 299—4
- ●1240 (Ch. 120331H) .... 354—7
- ●1270 (Ch. 120331H) .... 354—7
- ●1276, 1277 (Ch. 120382H, HC, 120383M, MC) .... 406—2
- ●1282 (Ch. 120380H) ... 386-15-S
- ●1283 (Ch. 120381M) ... 386-15-S
- ●1284 (Ch. 120380H) ... 386-15-S
- ●1285 (Ch. 120381M) ... 386-15-S
- ●1286 (Ch. 120388H) ... 386-15-S
- ●1287 (Ch. 120389M) ... 386-15-S
- ●1288, 1289 (Ch. 120390H, HC, 120391M, MC) .... 406—2
- ●1290, 1291 (Ch. 120386H, HC, 120387M, MC) .... 406—2
- ●1404 (Ch. 120400S) .... 400—2
- ●1405 (Ch. 120401U) .... 400—2
- ●1418 (Ch. 120403S) .... 400—2
- ●1419 (Ch. 120404U) .... 400—2
- ●1420 (Ch. 120377C) .... 400—2
- ●1421 (Ch. 120370G) .... 400—2
- ●1424 (Ch. 120377C) .... 400—2
- ●1425 (Ch. 120370G) .... 400—2
- ●1426 (Ch. 120369C) .... 400—2
- ●1428 (Ch. 120369C) .... 400—2
- ●2007E (Ch. 120225D) .... (PCB 249-1, 269-1) 235—5
- Ch. 120206D, 120208D .... (PCB 249-1, 269-1) 235—5
- Ch. 120210D .... 243—4
- Ch. 120220D .. (PCB 291-1) 275—7
- Ch. 120223D, 120225D, F .... (PCB 249-1, 269-1) 235—5
- Ch. 120331H .... 354—7
- Ch. 120233F, 120235D, 120236D, 120237D, 120238D, H ... 304—7
- Ch. 120239F .. (PCB 291-1) 275—7
- Ch. 120245D .. (PCB 318-1) 299—4
- Ch. 120247D .... 304—7
- Ch. 120253 .... (PCB 291-1) 275—7
- Ch. 120257D, 120258D .... (PCB 308-1, 319-1) 296—6
- Ch. 120259H .. (PCB 318-1) 299—4
- Ch. 120285T, 120286P .... (PCB 319-1) 296—6
- Ch. 120289R .. (PCB 322-1) 299—4
- Ch. 120366B .... 407—6
- Ch. 120369C, 120370G .... 400—2
- Ch. 120377C .... 400—2
- Ch. 120380H, 120381M . 386-15-S
- Ch. 120382H, HC, 120383M, MC .... 406—2
- Ch. 120386H, HC, 120387M, MC .... 406—2
- Ch. 120388H, 120389M 386-15-S
- Ch. 120390H, HC, 120391M, MC .... 406—2
- Ch. 120397B .... 400—2
- Ch. 120400S, 120401U, 120403S, 120404U .... 400—2

FIRESTONE
- 4-A-166 (Code 1-7-5T10) .. 407—7
- 4-A-167 (Code 382-7-41900) 394-11
- 4-A-168 (Code 1-7-5C81) .. 407—7
- 4-A-173 (Code 364-7-165) . 401—6
- 4-A-174 .... 393—8
- 4-C-33 (Code 120-7-PTR15B) .... 402—9
- ●13-G-49, 13-G-50 (Code 105-0-70090) (See Photofact Servicer) 404
- ●13-G-58, 13-G-59, 13-G-79 (Code 105-1-70096) (See Photofact Servicer) 406
- ●13-G-135 (Code 334-3-MS39B/5A6A) (See Photofact Servicer) 405

FISHER
- CA-40 .... 405—6
- FM-90X .... 407—8
- PR-6 .... 398—8
- TR-1 .... 391—9
- 80-R, 80-T .... 401—7
- 500 .... 400—7

FONOVOX
- 7060 402-10

FORD
(See Auto Radio Listing)

GENERAL ELECTRIC
- C420A, C421 .... 407—9
- P725A, P726A .... 378—7
- ●14P1208 ("Q3" Line) .. 397-19-S
- ●14P1209 ("Q2" Line) .... 381—2
- ●14P1215, 14P1216 ("Q3" Line) 397-19-S
- ●17P1326, 17P1327 ("M3" Line) .... 383—3
- ●17P1333, 17P1334, 17P1335 ("M3" Line) .... 383—3
- ●21C1536, -UHF, 21C1537, -UHF ("U2" Line) .... 391—1

GENERAL ELECTRIC—Cont.
- ●21C1545, -UHF, 21C1547, -UHF, 21C1548, -UHF, 21C1549, -UHF, 21C1550, -UHF, 21C1551, -UHF, 21C1552, -UHF, 21C1553, -UHF, 21C1554, -UHF, 21C1555, -UHF, 21C1556, -UHF, 21C1557, -UHF, 21C1558, -UHF, 21C1559, -UHF, 21C1560, -UHF, 21C1562, -UHF, 21C1563, -UHF, 21C1564, -UHF, 21C1566, -UHF, 21C1567, -UHF, 21C1570, -UHF, 21C1572, -UHF, 21C1573, -UHF, 21C1574, -UHF ("U2" Line) .... 391—1
- ●21T1539, -UHF, 21T1540, -UHF, 21T1541, -UHF, 21T1542, -UHF, 21T1543, -UHF, 21T1544, -UHF ("U2" Line) .... 391—1
- ●21H2425, 21T2426 ("M4" Line) 402-16-S
- ●24C1660, -UHF, 24C1661, -UHF ("U2" Line) .... 391—1
- ●24C1670, -UHF, 24C1671, -UHF ("U2" Line) .... 391—1

GRUNDIG MAJESTIC
- "Concert Boy" 57 .... 404—6
- 97 .... 405—7
- 3028 .... 406—7
- 7068 .... 403—8
- 8058, 8068, 8095, 8098 ... 407-11
- 9078 .... 401—9

HARMAN-KARDON
- A-120 .... 404—7

HOFFMAN
- ●B1227, U (Ch. 327, U) ... 398—2
- ●B1231, U (Ch. 332, U) ... 393—1
- ●B1241, U (Ch. 332, U) ... 393—1
- ●B1251, U (Ch. 332U, 333) . 393—1
- ●B1261, U (Ch. 334, U) ... 400—3
- ●B3081 (Ch. 419) 321-15-S
- ●B3311, U (Ch. 332, U) ... 393—1
- ●B3321, U (Ch. 332U, 333) . 393—1
- ●B3331, U (Ch. 334, U) ... 400—3
- ●B3341, U (Ch. 334, U) ... 400—3
- ●B3351, U (Ch. 422, U) .... (PCB 398-5) 378—3
- ●B3364, U (Ch. 332, U) ... 393—1
- ●B3374, U (Ch. 334, U) ... 400—3
- ●K1231, U (Ch. 332, U) ... 393—1
- ●K1241, U (Ch. 332, U) ... 393—1
- ●K3341, U (Ch. 334, U) ... 400—3
- ●M1227, U (Ch. 327, U) ... 398—2
- ●M1231, U (Ch. 332, U) ... 393—1
- ●M1241, U (Ch. 332, U) ... 393—1
- ●M1251, U (Ch. 332U, 333) . 393—1
- ●M1261, U (Ch. 334, U) ... 400—3
- ●M3081 (Ch. 419) 321-15-S
- ●M3311, U (Ch. 332, U) ... 393—1
- ●M3321, U (Ch. 332U, 333) . 393—1
- ●M3331, U (Ch. 334, U) .. 400—3
- ●M3341, U (Ch. 334, U) ... 400—3
- ●M3351, U (Ch. 422, U) .... (PCB 398-5) 378—3
- ●M3364, U (Ch. 332, U) ... 393—1
- ●P1227, U (Ch. 327, U) ... 398—2
- ●P1231, U (Ch. 332, U) ... 393—1
- ●P1251, U (Ch. 332U, 333) . 393—1
- ●P1261, U (Ch. 334, U) ... 400—3
- ●P3081 (Ch. 419) 321-15-S
- ●P3311, U (Ch. 332, U) ... 393—1
- ●P3321, U (Ch. 332U, 333) . 393—1
- ●P3364, U (Ch. 332, U) ... 393—1
- ●P3374, U (Ch. 334, U) ... 400—3
- ●RP-409 (TV Remote Control) 400—3
- ●SP3331, U (Ch. 334 U) .. 400—3
- ●SP3341, U (Ch. 334, U) .. 400—3
- ●SP3351, U (Ch. 422, U) .... (PCB 398-5) 378—3
- ●W1227, U (Ch. 327, U) .. 398—2
- ●W1251, U (Ch. 332U, 333) . 393—1
- ●W3081 (Ch. 419) 321-15-S
- ●W3311, U (Ch. 332, U) ... 393—1
- ●W3321, U (Ch. 332U, 333) 393—1
- ●X3341, U (Ch. 334, U) .. 400—3
- Ch. 327, U .... 398—2
- Ch. 332, U, 333 .... 393—1
- Ch. 334, U .... 400—3
- Ch. 419 .... 321-15-S
- Ch. 422, U .. (PCB 398-5) 378—3

HOTPOINT
- ●17S305, 17S306 ("M3" Line) .... 390—1
- ●21S400 ("M3" Line) .... 390—1
- ●21S405 ("M3" Line) .... 390—1
- ●21S505, 21S506 ("M3" Line) .... 390—1

HYDE PARK
- ●721-K-765 (Similar to Chassis) .... 380—5
- ●721-K-771, 721-K-774 (Similar to Chassis) .... (PCB 394-5) 371-13
- ●721-LP-775, 721-LP-777 (Similar to Chassis) .... (PCB 394-5) 371-13
- ●721-MT-770 (Similar to Chassis) .... (PCB 394-5) 371-13
- ●721-T-760 (Similar to Chassis) .... 380—5
- ●724-K-772 (Similar to Chassis) .... (PCB 394-5) 371-13
- ●1710 (Similar to Chassis) .... (PCB 394-5) 371-13
- ●1720 (Similar to Chassis) .... (PCB 394-5) 371-13
- ●1735, 1736, 1740, 1741 (Similar to Chassis) .... (PCB 394-5) 371-13

KNIGHT
(Also See Recorder Listing)
- KN-515 (92SX400) 407-12
- KN-530 (92SZ402) .... 406—8
- 92SX400 407-12
- 92SZ402 .... 406—8

LAFAYETTE
- LA-69 .... 397—8

LINCOLN
(See Auto Radio Listing)

MADISON FIELDING
- A15 .... 395—9
- FM-15 .... 393—9

MAGNAVOX
- ●24 Series .... 392—1
- ●25 Series .... 402—4
- ●26 Series .... 404—3
- Chassis AMP-148BB, CB .... (PCB 398-5) 340-10
- Chassis AMP-151BB, CB .... (PCB 398-5) 343—6
- Chassis AMP-164AA, BA ... 395-10
- Chassis AMP-166AA .... 399—8
- Chassis AMP-169AA, AMP-170AA .... 404—8
- Chassis CR-745AA, BB .... 404—9
- ●Chassis U24-01AA, U24-02AA, U24-03AA, U24-04AA, U24-06AA .... 392—1
- ●Chassis U25-01AA, U25-02AA, U25-03AA, U25-04AA, U25-05AA, U25-06AA, U25-07AA, U25-08AA, U25-09AA, U25-10AA, U25-11AA .... 402—4
- ●Chassis U26-01AA, U26-02AA, U26-03AA, U26-04AA .... 404—3
- ●Chassis V24-01AA, V24-02AA, V24-03AA, V24-04AA, V24-06AA .... 392—1
- ●Chassis V25-01AA, V25-02AA, V25-03AA, V25-04AA, V25-05AA, V25-06AA, V25-07AA, V25-08AA, V25-09AA, V25-10AA, V25-11AA .... 402—4
- ●Chassis V26-01AA, V26-02AA, V26-03AA, V26-04AA .... 404—3

McINTOSH
- MC-30 .... (PCB403-5) 275—9
- MC-60 .... (PCB403-5) 344-10

MERCURY
(See Auto Radio Listing)

METEOR
- ●7144 (Ch. 528.50060, 62, 63, 64, 65, 66, 67) .... 389—3
- ●7145 (Ch. 528.50070, 71, 73, 74, 75) .... 389—3
- ●7146 (Ch. 528.50060, 62, 63, 64, 65, 66, 67) .... 389—3
- ●7147 (Ch. 528.50070, 71, 73, 74, 75) .... 389—3
- ●7180 (Ch. 528.50060, 62, 63, 64, 65, 66, 67) .... 389—3
- ●7181 (Ch. 528.50070, 71, 73, 74, 75) .... 389—3
- Ch. 528.50060, 528.50062, 528.50063, 528.50064, 528.50065, 528.50066, 528.50067, 528.50070, 528.50071, 528.50073, 528.50074, 528.50075 .. 389—3

MOPAR
(See Auto Radio Listing)

MOTOROLA
(Also See Auto Radio Listing)
- ●TR-89R, T (Remote Control Unit) .... 393—2
- ●Y14P3-1, -2, Y14P4-1, Y14P5-1, -2, -3, Y14P6-1, Y14P6A-1, Y14P7-1, -2, Y14P8-1, -2 (Ch. TS, TTS, VTS, WTS-423Y) .... (PCB 399-4) 366—7
- ●Y17P3-1, -2, -3 (Ch. TS-427Y) .... 401—2
- ●Y21C6BG, MG (Ch. TS-537Y) .... (PCB 397-4) 345—9
- ●Y21F8B, BA, W, WA (Ch. TS-544Y) .... 393—2
- ●Y21K53B, BA, M, MA, Y21K55B, BA, M, MA (Ch. TS-537Y, TTS-537Y) .. (PCB 397-4) .... 345—9
- ●Y21K64B, M, Y21K65B, M, Y21K66B, M, Y21K68B, M (Ch. QTS-537Y, TTS-537Y, WTS-537Y) .... (PCB 397-4) .. 345—9
- ●Y21K73B, BA, M, MA, Y21K75B, BA, CW, CWA, M, MA, Y21K76B, BA, CW, CWA, M, MA, Y21K77B, M, Y21K80, CW, CWA (Ch. TS-544Y) .... 393—2
- ●Y21K81B, M (Ch. WTS-544Y) .... 393—2
- ●Y21T32B, BA, CH, CHA, MGA, Y21T34B, BA, M, MA (Ch. TS-537Y, TTS-537Y) .... (PCB 397-4) .. 345—9
- ●Y21T40BG, BGA, MG, MGA, Y21T-42B, BA, M, MA (Ch. TS-544Y) .... 393—2
- ●Y21T47MO (Ch. MTS-537Y) .... (PCB 397-4) 345—9
- ●Y21V1W, WA (Ch. TS-544Y) .... 393—2
- ●Y24C1B, M (PTS-537Y) .... (PCB 397-4) 345—9
- ●Y24K13B, M, Y24K18B, M (Ch. PTS-537Y, WTS-537Y) .... (PCB 397-4) 345—9
- ●Y24T5BG, MG (Ch. WTS-537Y) .... PCB 397-4) 345—9
- 5C21W (Ch. HS-530) .... 353—8
- 5C21W-1 (Ch. HS-618) .... 353—8
- 5C27N, N-1, V, V-1, W, W-1 (Ch. HS-528, HS-567) .... 359—9
- 5K21B, 5K21M (Ch. HS-608) 406-10

MOTOROLA—Cont.
- 5K21B-A, 5K21M-A (Ch. HS-632) 406-10
- 5K23B-1, 5K23CW-1, 5K23M-1 (Ch. HS-608) 406-10
- 5K23B-1A, 5K23CW-1A, 5K23M-1A (Ch. HS-632) 406-10
- 5T21W, 5T22M, R, W, Y, (Ch. HS-571) .... 347—9
- 5T21W-1, 5T22M-1, 5T22R-1, 5T22W-1 (Ch. HS-625) .. 405-10
- 5T22Y-1, 5T23N-1, 5T23P-1, 5T23W-1, 5T23Y-1 (Ch. HS-627) 405-10
- 5T23N, P, W, Y, (Ch. HS-573) .... 347—9
- 5T24GW-1, 5T24WN-1 (Ch. HS-628) 407-14
- 5T25B-1, 5T25M-1, 5T25MC-1 (Ch. HS-629) 407-14
- 5T27N, N-1 ,V, V-1, W, W-1 (Ch. HS-523, HS-565) .. 358—8
- 6C26A, W (Ch. HS-581) .. 357—6
- 10T28B, M, MC (Ch. HS-589) 402-11
- ●14P3-1, -2, 14P4-1, 14P5-1, -2, -3, 14P6-1, 14P6A-1, 14P7-1, -2, 14P8-1, -2 (Ch. TS, TTS, VTS, WTS-423, A) (PCB 399-4) 366—7
- ●17P3-1, -2, -3 (Ch. TS-427) 401—2
- ●21C6BG, MG (Ch. TS-537) .... PCB 397-4) 345—9
- ●21F8B, BA, W, WA (Ch. TS-544) .... 393—2
- ●21K53B, BA, M, MA, 21K55B, BA, M, MA (Ch. TS-537, TTS-537) .... (PCB 397-4) 345—9
- ●21K64B, M, 21K65B, M, 21K66B, M, 21K68B, M, (Ch. QTS-537, TS-537, WTS-537) .... (PCB 397-4) 345—9
- ●21K73B, M, 21K75B, CW, M, 21K-76B, CW, M, 21K77B, M, 21K80-CW, CWA (Ch. TS-544) .. 393—2
- ●21K81B, M (Ch. WTS-544) . 393—2
- ●21T32B, BA, CH, CHA, MGA, 21T34B, BA, M, MA, (Ch. TS-537, TTS-537) .... (PCB 397-4) 345—9
- ●21T40BG, MG, 21T42B, M (Ch. TS-544) .... 393—2
- ●21T47MO (Ch. MTS-537) .... (PCB 397-4) 345—9
- ●21V1W, WA (Ch. TS-544) . 393—2
- ●24C1B, M (Ch. PTS-537) .... (PCB 397-4) 345—9
- ●24K13B, M, 24K18B, M (Ch. PTS-537, WTS-537) .... (PCB 397-4) 345—9
- ●24T5BG, MG (Ch. WTS-537) .... (PCB 397-4) 345—9
- 54L1A, 54L2A, 54L3A, 54L4A, 54L5A, 54L6A (Ch. HS-468) .... 266—9
- Ch. HS-468 .... 266—9
- Ch. HS-523 .... 358—8
- Ch. HS-528 .... 359—9
- Ch. HS-530 .... 353—8
- Ch. HS-565 .... 358—8
- Ch. HS-567 .... 359—9
- Ch. HS-571, HS-573 .... 347—9
- Ch. HS-581 .... 357—6
- Ch. HS-589 402-11
- Ch. HS-608 406-10
- Ch. HS-618 .... 353—8
- Ch. HS-625, HS-627 405-10
- Ch. HS-628, HS-629 407-14
- Ch. HS-632 406-10
- Ch. MTS-537, Y, PTS-537, Y, QTS-537, Y . (PCB 397-4) 345—9
- Ch. TS-423, A, Y, ... (PCB 399-4) 366—7
- Ch. TS-427, Y .... 401—2
- Ch. TS-537, Y .... (PCB 397-4) 345—9
- Ch. TS-544, Y .... 393—2
- Ch. TTS-423, Y .... (PCB 399-4) 366—7
- Ch. TTS-537, Y .... (PCB 397-4) 345—9
- Ch. VTS-423, Y .... (PCB 399-4) 366—7
- Ch. WTS-423, Y .... (PCB 399-4) 366—7
- Ch. WTS-537, Y .... (PCB 397-4) 345—9
- Ch. WTS-544, Y .... 393—2

MUNTZ
- ●724 Series 352-12
- ●727 Series 352-12

NEWCOMB
- E-50 394-12
- H-25 .... 390—7
- H-50 391-10
- KX-25 393-10

OLDSMOBILE
(See Auto Radio Listing)

OLYMPIC
- "Domino" 5806 T/W .... 398—9
- "Kobold" 5720W .... 390—8
- "Meteor" 5781W .... 392—9
- "Moderna" 5783W .... 392—9
- ●C21BC15, C21BC16 (Ch. BC) 306-11
- ●C24BJ22, C24BJ30 (Ch. BJ) 306-11
- ●CD108, U, CD109, U, CD110P, PU (Ch. GD, GDU) .... 397—2
- ●CH402, U (Ch. GH, GHU) .. 397—2
- ●K21BC12, K21BC13, K21BC14 (Ch. BC) 306-11
- ●K24BJ31, K24BJ32, K24BJ33 (Ch. BJ) 306-11

OLYMPIC—Cont.
- ●KD118, U, KD119, U, KD120, U (Ch. GD, GDU) .... 397—2
- ●KH406, U, KH407, U (Ch. GH, GHU) .... 397—2
- ●T21BC10 (Ch. BC) 306-11
- ●TD102, U (Ch. GD, GDU .. 397—2
- ●1C72 (Ch. TA) .... 126—8
- ●1T71 (Ch. TA) .... 126—8
- ●1TY95L (Ch. DY) .... 391—2
- ●14TT91, U, 14TT92, U (Ch. GT, GTU) .... 395—2
- ●14TU93, U, 14TU94, B, BU, M, MU, U (Ch. GU, GUU) .... 395—2
- ●17BE23 (Ch. BE) .... 290—5
- ●17KU98, U (Ch. GU, GUU) . 395—2
- ●17T (Ch. TA) .... 126—8
- ●17T34 (Ch. TG) .... 182—6
- ●17T76, 17T77 (Ch. TM) .. 216—7
- ●17TE67 (Ch. AE) .... 290—5
- ●17TX52 (Ch. CX) 337-13
- 407, 408 405-11
- ●784 (Ch. TA) .... 126—8
- Ch. BC 306-11
- Ch. BE .... 290—5
- Ch. BJ 306-11
- Ch. DY .... 391—2
- Ch. GD, GDU .... 397—2
- Ch. GH, GHU .... 397—2
- Ch. GT, GTU .... 395—2
- Ch. GU, GUU .... 395—2
- Ch. TA .... 126—8
- Ch. TG .... 182—6
- Ch. TM .... 216—7

PACEMAKER
- PM10, PM10S 394-13
- PM20 .... 397—9
- 2285 .... 399—9

PACKARD
(See Auto Radio Listing)

PACKARD-BELL
- ●RM-200 (TV Remote Control) 393—3
- 3T3 .... 392—2
- ●16RP1 (See Photofact Servicer) 407
- ●21DC5, 21DC6, 21DC7 (Ch. 98D3) .... 393—3
- ●21DK1, -U (Ch. 98D1) .... (PCB 400-5) 318—9
- ●21RP1 (See Photofact Servicer) 407
- ●21SC6, 21SC7, 21SC8 (Ch. 88S3) .... 392—2
- ●21SK3 (Ch. 88S3 and AM Tuner 3T3) .... 392—2
- ●21ST3 (Ch. 88S3) .... 392—2
- ●21VT2 (Ch. 88S3) .... 392—2
- ●24DC4 (Ch. 98D3) .... 393—3
- ●24DK1, -U (Ch. 98D1) .... (PCB 400-5) 318—9
- ●24SC2 (Ch. 88S3) .... 392—2
- ●24VT1 (Ch. 88S3) .... 392—2
- Ch. 88S3 .... 392—2
- Ch. 98D1 .... (PCB 400-5) 318—9
- Ch. 98D3 .... 374-17-S

PHILCO
- ●E2002C, E2004F, G, SP, E2006SA (Ch. 7E10, 7E11, 7E12) .... (PCB 407-4) 348-10
- F-760 .... 396—6
- F-963 .... 396—6
- F-1372, F-1372X, F-1374 .... (PCB 407-4) 384-13
- F-1402 .... (PCB 407-4) 384-13
- F-1404 .... (PCB 407-4) 376-15
- F-1406, F-1408 (Code 124) .... (PCB 405-4) 359-11
- F-1500 .... 362—5
- F-1900, F-1902 .... 404-12-S
- F20031, SS, F2005 (Ch. 8E11) .... (PCB 407-4) 348-10
- ●F3035B, F3035SA, F3035SS (Ch. 8H20) .... (PCB403-5) 376—3
- ●F3042F, G, F3044A (Ch. 8H25) 387-17-S
- ●F3202C, F3204B, L, M (Ch. 8H25) 387-17-S
- ●F4210, E, L (Ch. 8L41) .... 399—2
- ●F4210X (Ch. 8L41B) .... 399—2
- ●F4212, L (Ch. 8L41) .... 399—2
- .... 399—2
- ●F4214STM, STN (Ch. 8L42) .... 399—2
- ●F4216, L (Ch. 8L71) .... 403—2
- ●F4618, L, F4620SL, SM (Ch. 8L41) .... 399—2
- ●F4621S, SL, F4622, L (Ch. 8L43) .... 399—2
- ●F4623 (Ch. 8L71) .... 403—2
- ●F4624, F4625S, SL (Ch. 8L43) .... 399—2
- ●F4626, L, M, F4627, L (Ch. 8L73) .... 403—2
- ●F4628, L (Ch. 8L41) .... 399—2
- ●F4630, L, F4632, F4634, L, F4636, L (Ch. 8L43) .... 399—2
- ●F6206SL, SM (Ch. 8P51, A) .... 399—2
- ●F6620SL, SM (Ch. 8P51, A) 399—2
- ●F6624T, TL (Ch. 8L72) .... 403—2
- HFT-1 .... 404-12-S
- ●RC30 (TV Remote Control) . 403—2
- RT-200, RT-200-1, RT-201 .... 404-12-S
- T-9 .... 405-17-S
- T-700, T-800, (Code 124, 126) 401-10
- ●UC4618 (Ch. 8L41U) .... 399—2
- ●UE2002C, UE2004F, G, SP, UE2006SA (Ch. 7E10U, 7E11U, 7E12U) .... (PCB 407-4) 348-10
- ●UF20031, SS, UF2005 (Ch. 8E11U) .... (PCB 407-4) 348-10

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

	Set No.	Folder No.

PHILCO—Cont.

●UF3035B, UF3035SA, UF3035SS (Ch. 8H20U) (PCB 403-5) 376—3
●UF3042F, G, UF3044A (Ch. 8H25U) 387—17—S
●UF3202C, UF3204B, L, M (Ch. 8H25U) 387—17—S
●UF4210, E, L (Ch. 8L41U) 399—2
●UF4210X (Ch. 8L41BU) 399—2
●UF4212, L (Ch. 8L41U) 399—2
●UF4214STM, STN (Ch. 8L42U) 399—2
●UF4216, L (Ch. 8L71U) 403—2
●UF4618, L, UF4620, SL, SM (Ch. 8L41U) 399—2
●UF4621S, SL, UF4622, L (Ch. 8L43U) 399—2
●UF4623 (Ch. 8L71U) 403—2
●UF4624, UF4625S, SL (Ch. 8L43U) 399—2
●UF4626, L, M, UF4627, L (Ch. 8L73U) 403—2
●UF4628, L (Ch. 8L41U) 399—2
●UF4630, L, UF4632, UF4634, L, UF4636, L (Ch. 8L43U) 399—2
●UF6206SL, SM (Ch. 8P51U) 399—2
●UF6620SL, SM (Ch 8P51U) 399—2
●UF6624T, TL (Ch. 8L72U) 403—2
Ch. 7E10, U, 7E11, U, 7E12, U (PCB 407-4) 348—10
Ch. 8E11, U, 8E13 (PCB 407-4) 348—10
Ch. 8H20, U, 8H22 (PCB 403-5) 376—3
Ch. 8H25, U 387—17—S
Ch. 8L41, B, BU, U, 8L42, U, 8L43, U 399—2
Ch. 8L71, U, 8L72, U, 8L73, U 403—2
Ch. 8P51, A, U 399—2

PHONOLA

656 401—11
1057, 1057W 399—10

PILOT

PT-1030D 377—14

PONTIAC
(See Auto Radio Listing)

RCA VICTOR
(Also See Record Changer & Recorder Listing)

HFP (Ch. RS-164B) 395—11
HRD-2 (Ch. RS-158J) 346—10
SHF2 (Ch. RC-1180A, RS-147E) 405—12
SHF3, SHF3D (Ch. RC-1168B) 396—7
SHF4 (Ch. RC-1155A, RS-151B) 323-11, 387—13
SHF5 (Ch. RS-151B) 387—13
9JD1DE 391—11
SHF6, SHF7 (Ch. RS-164, A) 395—11
8EY31HE, KE (Ch. RS-165 (2nd Prod.) 383—11
8HFP1 (Ch. RS-158B) 346—10
8RF13 (Ch. RC-1168A) 390—9
9C7EE, FE, LE, 9C8FE, J, ME (Ch. RC-1166B) 394—14
9ED1HE, JF (Ch. RS-170C) 398—10
9ED2KF, LE (Ch. RS-170D) 400—9
9ED31K, L (Ch. RS-170A) 398—10
9ED32HJ, LJ (Ch. RS-170) 400—9
9ES5H, JE (Ch. RS-170B) 400—9
9INT1, 9INT2 (Ch. RC-1172) 399—11
9T1 (Ch. RC-1155A) 323—11
9US5H, KE (Ch. RC-1170A) 395—12
9X10FE, JE, ME (Ch. RC-1166A) 394—14
●14PD8053, U, 14PD8054, U, 14PD8055, U, 14PD8057, U (Ch. KCS111C, D) 396—3
●14PT8021, U, 14PT8022, U (Ch. KCS111A, B) 396—3
●14VT8155, U, 14VT8157, U (Ch. KCS111F, H) 396—3
●17D8185, U, 17D8186, U, 17D8187, U (Ch. KCS109C, D) 392—3
●17PD8093, U, 17PD8094, U, 17PD8096, U, 17PD8099, U (Ch. KCS109C, D) 392—3
●17PT8071, U, 17PT8072, U (Ch. KCS 109A, B) 392—3
●21CD8725, U, 21CD8727, U (Ch. CTC7A, B) 399—3
●21CD8775, U, 21CD8776, U, 21CD8777, U (Ch. CTC7A, B) 399—3
●21CD8865, U, 21CD8866, U, 21CD8867, U (Ch. CTC7C, D) 399—3
●21CD8885, U, 21CD8886, U, 21CD8888, U (CTC7C, D) 399—3
●21CD8906, U, 21CD8907, U (Ch. CTC7C, D) 399—3
●21CD8926, U, 21CD8927, U (Ch. CTC7E, F) 399—3
●21CD8949, U (Ch. CTC7E, F) 399—3
●21CS7815, U, 21CS7817, U (Ch. CTC5, A) (PCB 395-4) 353—11
●21CT7835, U, 21CT7837, U (Ch. CTC5B, C) (PCB 395-4) 353—11
●21CT7855, U, 21CT7857, U (Ch. CTC5D, E) (PCB 395-4) 353—11
●21CT7865, U, 21CT7866, U, 21CT-7867, U (Ch. CTC5D, E) (PCB 395-4) 353—11

RCA VICTOR—Cont.

●21CT8785, U, 21CT8787, U (Ch. CTC5F, H) (PCB 395-4) 353—11
●21D8281, U, 21D8282, U (Ch. KCS116A, B) 400—4
●21D8305, U, 21D8306, U, 21D-8307, U (Ch. KCS116A, B) 400—4
●21D8525, U, 21D8526, U, 21D-8527, U, 21D8528, U (Ch. KCS108C, D) 390—2
●21D8545, U, 21D8546, U, 21D-8547, U (Ch. KCS108C, D) 390—2
●21D8565, U, 21D8566, U, 21D8567, U (Ch. KCS108E, F) 390—2
●21D8588, U (Ch. KCS108C, D) 390—2
●21D8605, U, 21D8607, U, 21D-8608, U (Ch. KCS108C, D) 390—2
●21D8628, U (Ch. KCS116C, D) 400—4
●21DF8635, U, 21DF8636, U, 21DF8637, U (Ch. KCS108K, L, CTP5C 403—3
●21DF8646, U, 21DF8649, U (Ch. 108K, L, CTP5C 403—3
●21RD8525 (Ch. KCS108H) 390—2
●21RT8202 (Ch. KCS113H) 398—3
●21RT8425 (Ch. KCS113K) 398—3
●21T7112, U, 21T7113, U (Ch. KCS-98A, C) (PCB 393-5) 347—14
●21T7117, U (Ch. KCS98A, C) (PCB 393-5) 347—14
●21T7152, U, 21T7153, U (Ch. KCS98A, C) (PCB 393-5) 347—14
●21T7352, U, 21T7355, U, 21T7357, U (Ch. KCS98E, F) (PCB 393-5) 347—14
●21T7157, U (Ch. KCS98A, C) (PCB 393-5) 347—14
●21T7375, G, GU, U, 21T7377, G, GU, U (Ch. KCS98J, K, L, M) (PCB 393-5) 347—14
●21T8202, U, 21T8205, U, 21T8207, U (Ch. KCS 113A, B) 398—3
●21T8265, U, 21T8267, U (Ch. KCS113A, B) 398—3
●21T8375, U, 21T8376, U, 21T8377, U (Ch. KCS113P, R) 398—3
●21T8395, U, 21T8397, U (Ch. KCS113P, R) 398—3
●21T8405, U, 21T8407, U (Ch. KCS113P, R) 398—3
●21T8425, U, 21T8426, U, 21T8427, U, 21T8428, U (Ch. KCS113E, F) 398—3
●21T8445, U, 21T8447, U, 21T8448, U (Ch. KCS113E, F) 398—3
●21T8465, U, 21T8466, U, 21T8467, U, 21T8468, U (Ch. KCS113E, F) 398—3
●21T8485, U, 21T8486, U, 21T8487, U (Ch. KCS113E, F) 398—3
●21VF8695, U, 21VF8696, U, 21VF8697, U (Ch. KCS108K, L, CTP5B) 403—3
●24D8655, U, 24D8657, U, (Ch. KCS108C, D) 390—2
●24D8676, U, 24D8678, U, (Ch. KCS108C, D, E, F, H 390—2
●24T8325, U, 24T8327, U (Ch. KCS113M, N) 398—3
●24T8335, U, 24T8337, U (Ch. KCS113M, N) 398—3
Ch. KCS108C, D, E, F, H 390—2
Ch. CTC5, A, B, C, D, E, F, H (PCB 395-4) 353—11
Ch. CTC7A, B, C, D, E, F 399—3
Ch. CTP5B, C 403—3
Ch. KCS108C, D, E, F, H 390—2
Ch. KCS108K, L 403—3
Ch. KCS109A, B, C, D 392—3
Ch. KCS111A, B, C, D, F, H 396—3
Ch. KCS113A, B, E, F, H, K, M, N, P, R 398—3
Ch. KCS116A, B, C, D 400—4
Ch. KRS23A 396—3
Ch RC-1155A 323—11
Ch. RC-1166A, B 394—14
Ch. RC-1168A 390—9
Ch. RC-1168B 396—7
Ch. RC-1170A 395—12
Ch. RC-1172 399—11
Ch. RC-1180A 405—12
Ch. RS-147E 405—12
Ch. RS-151B 387—13
Ch. RS-158B 346—10
Ch. RS-158J 346—10
Ch. RS-164, A, B 395—11
Ch. RS-165 383—11
Ch. RS-170A, C 398—10
Ch. RS-170, B, D 400—9

RAULAND

1925, A 405—13

REGENCY

RC-103 397—11
TR-8 361—8

ROCKLAND

88-1-S, 88-1-SR 405—14

SENTINEL

Chassis AMP-154AA 396—8

SETCHELL-CARLSON

●P-63 (Ch. C-102) 402—3
●P64 (Ch. C102A) 407—15—S
●58, R (Ch. 158, 158RP) 396—4
●58C21 (Ch. 258-A) 406—14—S
●581, 582, 583 (Ch. 158, 158RP) 396—4

SETCHELL-CARLSON—Cont.

●5800, R, 5801, 5802, 5803 (Ch. 158, 158RP) 396—4
Ch. C-102 402—3
Ch. C102A 407—15—S
Ch. 158, 158RP 396—4
Ch. 258-A 406—14—S

SHERWOOD

S-1000 II 390—10
S-2000 396—9
S-3000 401—12

SILVERTONE

6062, 6063, 6064 (Ch. 528.39900) 378—12
6237 (Ch. 567.36006) 402—12
●7100A, AY, AZ (Ch. 528.50023, 24, 25, 26, 27, 28) (PCB 405-4) 339—13
●7101A (Ch. 528.50034, 35, 36, 37, 38, 39) (PCB 405-4) 339—13
●7102R, S, T (Ch. 528.50080, 82, 83, 84, 85, 86, 87) (PCB 405-4) 339—13
●7103R (Ch. 528.50033, 34, 35, 36, 37, 38, 39) (PCB 405-4) 339—13
●7110A (Ch. 528.50023, 24, 25, 26, 27, 28) (PCB 405-4) 339—13
●7111A (Ch. 528.50034, 35, 36, 37, 38, 39) (PCB 405-4) 339—13
●7112A (Ch. 528.50023, 24, 25, 26, 27, 28) (PCB 405-4) 339—13
●7113A (Ch. 528.50034, 35, 36, 37, 38, 39) (PCB 405-4) 339—13
●7114 (Ch. 528.51040) (See Photofact Servicer) 393
●7115 (Ch. 528.51050) (See Photofact Servicer) 394
●7116 (Ch. 528.51040) (See Photofact Servicer) 393
●7117 (Ch. 528.51050) (See Photofact Servicer) 394
●7120 (Ch. 528.51040) (See Photofact Servicer) 393
●7121 (Ch. 528.51050) (See Photofact Servicer) 394
●7122 (Ch. 528.51040) (See Photofact Servicer) 393
●7123 (Ch. 528.51050) (See Photofact Servicer) 394
●7124 (Ch. 528.51040) (See Photofact Servicer) 393
●7125 (Ch. 528.51050) (See Photofact Servicer) 394
●7126A (Ch. 528.50023, 24, 25, 26, 27, 28) (PCB 405-4) 339—13
●7127A (Ch. 528.50033, 34, 35, 36, 37, 38, 39) (PCB 405-4) 339—13
●7128 (Ch. 528.51040) (See Photofact Servicer) 393
●7129 (Ch. 528.51050) (See Photofact Servicer) 394
●7130 (Ch. 528.51040) (See Photofact Servicer) 393
●7131 (Ch. 528.51050) (See Photofact Servicer) 394
●7132 (Ch. 528.52040) (See Photofact Servicer) 396
●7133 (Ch. 528.52050) (See Photofact Servicer) 398
●7134 (Ch. 528.52040) (See Photofact Servicer) 396
●7135 (Ch. 528.52050) (See Photofact Servicer) 398
●7136 (Ch. 528.51040) (See Photofact Servicer) 393
●7137 (Ch. 528.51050) (See Photofact Servicer) 394
●7138, 7140, (Ch. 528.46300, 301) (PCB 400-5) 388—1
●7164 (Ch. 528.50084, 85, 86, 87) (PCB 405-4) 339—13
●7165 (Ch. 528.50036, 37, 38, 39) (PCB 405-4) 339—13
●7166 (Ch. 528.50084, 85, 86, 87) (PCB 405-4) 339—13
●7167 (Ch. 528.50036, 37, 38, 39) (PCB 405-4) 339—13
●7172 (Ch. 528.51040) (See Photofact Servicer) 393
●7173 (Ch. 528.51050) (See Photofact Servicer) 394
●7175 (Ch. 528.52050 (See Photofact Servicer) 398
●7190 (Ch. 528.51040) (See Photofact Servicer) 393
●7191 (Ch. 528.51050) (See Photofact Servicer) 394
●7192 (Ch. 528.51040) (See Photofact Servicer) 393
7244D, 7246B, D, 7247D (Ch. 567.39000) 357—7
7777 (Ch. 528.53190) 391—3
8005, 8006, 8007 (Ch. 132.42700) 395—14
8009, 8010, 8011, 8012 (Ch. 132.42800) 391—12
8013, 8014, 8015 (Ch. 132.42900) 396—10
8017A, 8018A (Ch. 528.53030) 397—12
8019, 8020 (Ch. 528.53200) 397—12
8021, 8022, 8023 (Ch. 528.53040) 392—10
8059, A, 8060, A, 8061, A, 8069, A (Ch. 528.53150) 394—15
●8100BE, GR (Ch. 456.50061, 65) 389—3
8102AQ, CL, YL (Ch. 528.50125) 389—3
8104CH, CO (Ch. 528.50125) 389—3
●8106 (Ch. 528.50125) 389—3
●8110 (Ch. 528.50144) 389—3

SILVERTONE—Cont.

●8111 (Ch. 528.50150, 152, 153, 154, 155) (PCB 400-5) 389—3
●8112 (Ch. 528.50144) 389—3
●8113 (Ch. 528.50150, 152, 153, 154, 155) (PCB 400-5) 389—3
●8114 (Ch. 528.51100, 102, 104) 390—3
●8114, B (Ch. 28.51106, 107, 108, 160, 161, 163, 164, 165, 166, 167, 168) 397—3
●8115 (Ch. 528.51110, 112, 113) 390—3
●8115 (Ch. 528.51170, 171, 172, 173, 175) 397—3
●8116 (Ch. 528.51100, 102, 104) 390—3
●8116 (Ch. 528.51106, 107, 160, 161, 163, 164, 165, 166, 168) 397—3
●8117 (Ch. 528.51110, 112, 113) 390—3
●8117 (Ch. 528.51170, 171, 172, 173, 175 397—3
●8150 (Ch. 528.50144) 389—3
●8151 (Ch. 528.50150, 152, 153, 154, 155) (PCB 400-5) 389—3
●8152 (Ch. 528.50144) 389—3
●8153 (Ch. 528.50150, 152, 153, 154, 155) (PCB 400-5) 389—3
●8154 (Ch. 528.51100, 102, 104) 390—3
●8154 (Ch. 528.51106, 107, 160, 161, 163, 164, 165, 166, 168) 397—3
●8155 (Ch. 528.51110, 112, 113) 390—3
●8155 (Ch. 528.51170, 171, 172, 173, 175) 397—3
●8156 (Ch. 528.51100, 102, 104) 390—3
●8156 (Ch. 528.51106, 107, 160, 161, 163, 164, 165, 166, 168) 397—3
●8157 (Ch. 528.51110, 112, 113) 390—3
●8157 (Ch. 528.51170, 171, 172, 173, 175) 397—3
●8158 (Ch. 528.51100, 102, 104) 390—3
●8158 (Ch. 528.51106, 107, 160, 161, 163, 164, 165, 166, 168) 397—3
●8160 (Ch. 528.51140, 142, 143) 390—3
●8160 (Ch. 528.51180, 181, 182, 183, 184, 185, 187) 397—3
●8161 (Ch. 528.51150, 152, 153) 390—3
●8161 (Ch. 528.51190, 191, 193, 194) 397—3
●8162 (Ch. 528.51140, 142, 143) 390—3
●8162 (Ch. 528.51180, 181, 182, 183, 184, 185, 187) 397—3
●8163 (Ch. 528.51150, 152, 153) 390—3
●8163 (Ch. 528.51190, 191, 193, 194) 397—3
●8182 (Ch. 528.51100, 102, 104) 390—3
●8182 (Ch. 528.51106, 107, 160, 161, 163, 164, 165, 166, 168) 397—3
●8183 (Ch. 528.51110, 112, 113) 390—3
●8183 (Ch. 528.51170, 171, 172, 173, 175) 397—3
●8184 (Ch. 528.51104, 140, 142, 143) 390—3
●8184 (Ch. 528.51161, 162, 163, 180, 181, 182, 183, 184, 185, 187) 397—3
●8185 (Ch. 528.51150, 152, 153) 390—3
●8185 (Ch. 528.51190, 191, 193, 194) 397—3
●8186 (Ch. 528.51104, 140, 142, 143) 390—3
●8186 (Ch. 528.51161, 162, 163, 180, 181, 182, 183, 184, 185, 187) 397—3
●8187 (Ch. 528.51150, 152, 153) 390—3
●8187 (Ch. 528.51190, 191, 193, 194) 397—3
●8188 (Ch. 528.51140, 142, 143) 390—3
●8188 (Ch. 528.51180, 181, 182, 183, 184, 185, 187) 397—3
●8190, 8190A (TV Ch. 528.52100, 101, 102 and Radio Ch. 528.53190) 391—3
●8191, 8191A (TV Ch. 528.52110, 111, 112 and Radio Ch. 528.53190) 391—3
●8192, 8192A (TV Ch. 528.52100, 101, 102 and Radio Ch. 528.53190) 391—3
●8193, 8193A (TV Ch. 528.52110, 111, 112 and Radio Ch. 528.53190) 391—3
●8196 (Ch. 528.51240, 241, 242, 245) 397—3
●8197 (Ch. 528.51250, 251, 253) 397—3
●8198 (Ch. 528.51240, 241, 242, 245) 397—3
●8199 (Ch. 528.51250, 251, 253) 397—3
8200, 8202 (Ch. 132.43200, 201) 398—11
8236, 8238 (Ch. 528.59030, 567.59030) 398—12
8239, 8242 (Ch. 528.59020, 567.59020) 400—10

SILVERTONE—Cont.

8244, 8245, 8246, 8247, 8248 (Ch. 528.59010) 400—10
9017 (Ch. 528.53200) 397—12
9019, 9020 (Ch. 528.53310) 397—12
●9118, 9119 (Ch. 528.51220, 230) 400—14—S
9224 (Ch. 528.46400) 382—11
9242 (528.59020) 400—10
9244, 9245 (Ch. 528.59010) 400—10
Ch. 132.42700 395—14
Ch. 132.42800 391—12
Ch. 132.42900 396—10
Ch. 132.43200, 132.43201 398—11
Ch. 456.50061, 65 389—3
Ch. 528.46300, 528.46301 (PCB 400-5) 388—1
Ch. 528.46400 382—11
Ch. 528.50023, 528.50024, 528.-50025, 528.50026, 28.50027, 528.50028 (PCB 405-4) 339—13
Ch. 528.50033, 528.50034, 528.-50035, 528.50036, 528.50037, 528.50038, 528.50039 (PCB 405-4) 339—13
Ch. 528.50080, 528.50082, 528.-50083, 528.50084, 528.50085, 528.50086, 528.50087 (PCB 405-4) 339—13
Ch. 528.50125 389—3
Ch. 528.50144 389—3
Ch. 528.50150, 528.50152, 528.50153, 528,50154, 528.50155 (PCB 400-5) 389—3
Ch. 528.51040 (See Photofact Servicer) 393
Ch. 528.51050 (See Photofact Servicer) 394
Ch. 528.51100, 528.51102, 528.51104 390—3
Ch. 528.51106, 528.51107, 528.51108 397—3
Ch. 528.51110, 528.51112, 528.51113 390—3
Ch. 528.51140, 528.51142, 528.51143 390—3
Ch. 528.51150, 528.51152, 528.51153 390—3
Ch. 528.51160, 528.51161, 528.51163, 528.51164, 528.51165, 528.51166, 528.51167, 528.51168, 528.51170, 528.51171, 528.51172, 528.51173, 528.51175 397—3
Ch. 528.51180, 528.51181, 528.51182, 528.51183, 528.51184, 528.51185, 528.51187, 528.51190, 528.51191, 528.51193, 528.51194 397—3
Ch. 528.51220 400—14—S
Ch. 528.51230 400—14—S
Ch. 528.51240, 528.51241, 528.51242, 528.51245 397—3
Ch. 528.51250, 528.51251, 528.51253 397—3
Ch. 528.52040 (See Photofact Servicer) 396
Ch. 528.52050 (See Photofact Servicer) 398
Ch. 528.52100, 528.52101, 528.52102 391—3
Ch. 528.52110, 528.52111, 528.52112 391—3
Ch. 528.53030 397—12
Ch. 528.53040 392—10
Ch. 528.53150 394—15
Ch. 528.53190 391—3
Ch. 528.53200 397—12
Ch. 528.53310 397—12
Ch. 528.59010, 528.59020 400—10
Ch. 528.59030 398—12
Ch. 567.36006 402—12
Ch. 567.39000 357—7
Ch. 567.59020 400—10
Ch. 567.59030 398—12

SONIC

410 397—13
465 390—11

SPARTAN

●18 Series 401—3
●24 Series 398—4
●25 Series 407—2
Chassis AMP-158AA 390—12
Chassis CR-729AA, BA (PCB 407-4) 395—15
●Chassis U18-01AA, BB, U18-02AA, BB, U18-03AA, BB, U18-04AA, BB 401—3
●Chassis U24-01AA, U24-02AA, U24-03AA, U24-04AA, U24-06AA 398—4
●Chassis U25-01AA, U25-02AA, U25-03AA, U25-04AA, U25-05AA, U25-06AA, U25-07AA, U25-08AA, U25-09AA, U25-10AA, U25-11AA 407—2
●Chassis V18-01AA, BB, V18-02AA, BB, V18-03AA, BB, V18-04AA, BB 401—3
●Chassis V24-01AA, V24-02AA, V24-03AA, V24-04AA, V24-06AA 398—4
●Chassis V25-01AA, V25-02AA, V25-03AA, V25-04AA, V25-05AA, V25-06AA, V25-07AA, V25-08AA, V25-09AA, V25-10AA, V25-11AA 407—2

Set No. Folder No.

STEELMAN

1A19-2 398–13
3A14-3 400–11
3S8 397–14
4A21, 4A22 397–15
4A23 402–13
4D15, 4D17, 4D18 395–16

STROMBERG-CARLSON

AU-62 391–13
SR-402 395–17
SR-403B 400–12

STUDEBAKER
(See Auto Radio Listing)

SYLVANIA (Also See Record Changer and Recorder Listing)

●31C606 Series (Ch. 1-534-1, -2) .... 391—4
●31T304 Series (Ch. 1-534-1, -2 .... 391—4
4401 (Ch. 1-608-1) 396–11
Ch. 1-534-1, -2 .... 391—4
Ch. 1-608-1 396–11

TECH-MASTER

FM-18 398–14
TM-15A 402–14
16A 396–12
21 391–14
630-5, 630-5T ....(PCB 400-5) 388—2
●1930N .... 390—4
●2430N .... 390—4

TELEFUNKEN

"Gavotte 7" .... 399—12

TONFUNK

W706 .... 403—9
7046M 399–13

TRAV-LER

TR-250-A, TR-251-A 392–11
●17MT65 (Ch. 743-48) .. 402–16–S
●617-33U, 617-34U (Ch. 628A6) ....(PCB 399-4) 337–14
●621-30U, 621-31U, 621-32U, (Ch. 628A6) (PCB 399-4) 337–14
●621-74-8, 621-74-8A, 621-75-9 (Ch. 627-26) (PCB 403-5) 335–14
●621-74U, 621-75U (Ch. 628A6) ....(PCB 399-4) 337–14
●717-MT-500 (Ch. 775-37) ....(PCB 394-5) 371–13
●721-K-610 (Ch. 718-17, 775-17) ....(PCB 394-5) 371–13
●721-K-610 (Ch. 775-88) 402–16–S
●721-K-611, U, 721-K-612, 721-K-613 (Ch. 736-47, 737-47) ....(PCB 394-5) 371–13
●721-LP-650 (Ch. 718-17, 775-17) ....(PCB 394-5) 371–13
●721-LP-650 (Ch. 775-88) 402–16–S
●721-LP-651, U (Ch. 736-47, 737-47) ....(PCB 394-5) 371–13
●721-MT-600 (Ch. 718-17, 775-17) ....(PCB 394-5) 371–13
●721-MT-600 (Ch. 775-88) 402–16–S
●721-MT-601, U (Ch. 736-47, 737-47) ....(PCB 394-5) 371–13
●721-T-602 (Ch. 736-47) ....(PCB 394-5) 371–13
●724-K-772 (Ch. 776-17) ....(PCB 394-5) 371–13
●1710, A (Ch. 72917, A, 775-27) ....(PCB 394-5) 371–13
●1715, U (Ch. 72916, 72917, 73016) ....(PCB 394-5) 371–13
●1720, U (Ch. 72916, 72917, 73016) ....(PCB 394-5) 371–13
●1722, 1723, 1723U, 1724 (Ch. 740-78, 775-88) 402–16–S
●1722, 1723, 1725 (Ch. 740-17) ....(PCB 394-5) 371–13
●1730 (Ch. 729-26) 399–15–S
●1731 (Ch. 775-57) 399–15–S
●1760, 1760U (Ch. 743-18) 401–16–S
Ch. 627-26 ..(PCB403-5) 335–14
Ch. 628A6...(PCB 399-4) 337–14
Ch. 718-17...(PCB 394-5) 371–13
Ch. 729-26 .... 399–15–S
Ch. 736-47, 737-47 ....(PCB 394-5) 371–13
Ch. 740-17...(PCB 394-5) 371–13
Ch. 740-78 .... 402–16–S
Ch. 743-18 .... 401–16–S
Ch. 743-48 .... 402–16–S
Ch. 744-88 .... 402–16–S
Ch. 775-17, -27, -37, 776-17 ....(PCB 394-5) 371–13
Ch. 775-88 .... 402–16–S

Set No. Folder No.

TRAV-LER—Cont.

Ch. 775-57 .... 399–15–S
Ch. 72916, 72917, 72917A, 73016 ....(PCB 394-5) 371–13

TRUETONE (Also See Auto Radio Listing)

D2832B, D2834B 384–16
D2836A 406–11
D3614B, D3714A ....(PCB403-5) 343–14
D3715A 405–15
D5736A 386–12
D5770B, D5771B, D5772B 399–14
D5801A, D5802A, D5804A 403–10
D5842A, D5844A 397–16
D5892, A, D5894, A 397–17
DC3715B 405–15
DC5901A, DC5902A, DC5904A 403–10
●2D1824A, B, 2D1825A, B, 2D1826A, B, 2D1827A, B .... 394—3
●2D1830A, 2D1831A, 2D1832A, 2D1833A .... 403—4
●2D1834A, 2D1835A, 2D1836A, 2D1837A .... 402—4
●2D1840A, 2D1841A, 2D1842A, 2D1843A, 2D1844A, 2D1845A .... 395—3
●2D2720C....(PCB 398-5) 357–10
●2D2728A, B..(PCB 396-5) 375—5
●2D2830A, 2D2831A, 2D2832A, 2D2833A .... 403—4
●2D2840A, 2D2841A, 2D2842A, 2D2843A .... 395—3
●2D3820A, 2D3821A ..... 406—3
●2DC1840B, 2DC1841B, 2DC1842B, 2DC1843B, 2DC1844B, 2DC1845B .... 405—3
●2DC2840B, 2DC2841B, 2DC2842B, 2DC2843B .... 405—3
●2DC3840A 407–15–S

ULTRATONE

1210, 1211 404–11

V-M (Also See Record Changer and Recorder Listing)

155A 393–11
991 398–15
1276 391–15
1290 392–12

WEBCOR
(See Webster-Chicago)

WEBSTER-CHICAGO

1853 356–17

WELLS-GARDNER

●321AM54-A-436 (See Photofact Servicer) 400
●321AM54-A-470 (See Photofact Servicer) 400
●2321AM54-A-438 (See Photofact Servicer) 400
●2321AM54-A-494 (See Photofact Servicer) 400

WESTINGHOUSE

●H-17T241, H-17T242, H-17T243, H-17T244, H-17T245 (Ch. V-2373-1) .... 392—4
●H-17TU241, H-17TU242, H-17TU243, H-17TU244, H-17TU245 (Ch. V-2383-1) .... 392—4
●H-21K210, A, H-21K211, A (Ch. V-2364-1, -3)... 399–15–S
●H-21K226B (Ch. V-2372).. 388—3
●H-21K256, H-21K257 (Ch. 2371) .... 387—4
●H-21KU210, A, H-21KU211, A (Ch. V-2364-2, -4)... 399–15–S
●H-21KU256, H-21KU257 (Ch. V-2381) .... 387—4
●H-21T206, A, H-21T207, A (Ch. V-2364-1, -3)... 399–15–S
●H-21T219B, H-21T221B, H-21T222B (Ch. V-2372) .... 388—3
●H-21TU206, A, H-21TU207, A (Ch V-2364-2, -4).... 399–15–S
H-435T5A, H-437T5A, H-438T5A (Ch. V-2390-3) 405–16
H-580T5, H-581T5, H-583T5, (Ch. V-2259-3) 392–13
H-621P6, H-622P6 (Ch. V-2296-1) 396–14
H-636T6, H-637T6, H-638T6 (Ch. V-2391-1) 403–11
H-644T6, H-645T6 (Ch. V-2391-2) 403–11

Set No. Folder No.

WESTINGHOUSE—Cont.

HF-100BN, HF-101BN (Ch. V-2500-1) 401–14
Ch. V-2259-3 392–13
Ch. V-2296-1 396–14
Ch. V-2364-1, -2, -3, -4 399–15–S
Ch. V-2373-1 .... 392—4
Ch. V-2383-1 .... 392—4
Ch. V-2390-3 405–16
Ch. V-2391-1, 2 403–11
Ch. V-2500-1 401–14

ZENITH (Also See Record Changer Listing)

A512W, Y (Ch. 5A02).... 397–18
A723F, R, W, A724G, L, Y, A730E, R, (Ch. 7A02, 7A04, 7A05) 398–16
●A1410L, LU, A1411P, PU, A1412G, GU (Ch. 15A26, U)..... 407—3
●A1716L, LU, A1717G, GU, A1718G, GU, A1719J, JU (Ch. 15A26, U) .... 407—3
●A1815P, PU (Ch. 15Z31, U) .... 376—5
●A2001L (Ch. 15A26Q).... 407—3
●A2221J, JU, Y, YU, A2223E, EU, H, HU, R, RU, Y, YU, (Ch. 17A20, U) .... 393—4
●A2221L, R, A2223E, R, Y, (Ch. 17A30) 390–13–S
●A2245E, EU, R, RU (Ch. 17A20, U) .... 393—4
●A2245E, R, A2246E, R (Ch. 17A30) 390–13–S
●A2250M, MU, R, RU, A2251E, EU, R, RU, (Ch. 17A20, U) .... 393—4
●A2252R, A2253E, R (Ch. 17A30) 390–13–S
●A2282E, EU, R, RU, (Ch. 17A20, U) .... 393—4
●A2282E, R (Ch. 17A30) 390–13–S
●A2329J, JU, A2330E, EU, H, HU, R, RU (Ch. 19A20, U)... 394—4
●A2329R, RU, A2330E, EU, R, RU (Ch. 19A30, U)........ 406—4
●A2358E, EU, R, RU, A2359E, EU, H, HU, R, RU, A2362M, MU, R, RU (Ch. 19A20, U)...... 394—4
●A2360M, MU, R, RU (Ch. 19A30, U) .... 406—4
●A2673E, EU, R, RU, (Ch. 17A20, U) .... 393—4
●A2673E, R (Ch. 17A30) 390–13–S
●A3000E, R (Ch. 17A21Q) .. 393—4
●A3000E, R (Ch. 17A31Q) 390–13–S
●A3001E, H, R, (Ch. 17A20Q) .... 393—4
●A3001E, R (Ch. 17A30Q) 390–13–S
●A3004, E, R (Ch. 17A21Q) .... 393—4
●A3004, E, R (Ch. 17A31Q) 390–13–S
●A3006E, H, R (Ch. 17A20Q) .... 393—4
●A3006E, H, R (Ch. 17A30Q) 390–13–S
●A3007R (Ch. 17A30Q).. 390–13–S
●A3008E, R (Ch. 17A20Q) .393—4
●A3008E, R (Ch. 17A30Q) 390–13–S
●A3009E, H (Ch. 17A30Q) 390–13–S
●A3010E, H, R, A3011, E, Y, A3012H, R, A3013H, A3014H, R (Ch. 19A20Q) .... 394—4
●A3010E, R, A3011, E, Y, A3012H, R, A3013H, A, 3014H, R (Ch. 19A30Q) .... 406—4
●A4007E, R (Ch. 19A20Q).. 394—4
●A4007E, R (Ch. 19A30Q).. 406—4
●A4012H, R (Ch. 19A30Q).. 406—4
HF10G, L, Y, HF11F, L (Ch. 3A04, 3Z04) 401–15
HF16E, R (Ch. 3A03)...... 396–15
HF1290H, R, HF1292, E (Ch. 12Z21) 394–16
Royal 700L (Ch. 7AT43, 7AT43Z3) 406–13
Royal 1000 .... 405–17–S
●Y2636E, EU, R, RU (Ch. 17Y23, U) (See Photofact Servicer) 402
●Y2670E, EU, R, RU (Ch. 17Y23, U) (See Photofact Servicer) 402
●Z2675EZ, RZ (Ch. 17Z33) 357–14–S
●Z4000EZ, RZ (Ch. 17Z33Q) 357–14–S
Z4006EZ, RZ (Ch. 17Z33Q) 357–14–S
Ch. 3A03 396–15
Ch. 3A04 401–15
Ch. 3Z04 401–15

Set No. Folder No.

ZENITH—Cont.

Ch. 5A02 397–18
Ch. 7A02, 7A04, 7A05.... 398–16
Ch. 7AT43, 7AT43Z3...... 406–13
Ch. 12Z21 394–16
Ch. 15A26, Q............ 407—3
Ch. 17A20, Q, U, 17A21Q .... 393—4
Ch. 17A30, Q, 17A31Q 390–13–S
Ch. 17Y23, U (See Photofact Servicer) 402
Ch. 17Z33, Q 357–14–S
Ch. 19A20, Q, U........ 394—4
Ch. 19A30, Q, U........ 406—4
Ch. 20J23 (See Photofact Servicer) 403

AUTO RADIOS

AIRLINE

FJB-6571 (See Photofact Servicer) 401

AMERICAN MOTORS

84MA (8990494) .... 394—6
8990494 .... 394—6

AUTOMATIC

CRT-97 .... 403–12–S
CTR-77, CTR-77A 403–12–S
DET-27 .... 403–12–S
FTP-37A 403–12–S

BECKER

"Europa" MU, MUK..... 397—5

BLAUPUNKT

"Frankfurt" .... 393—7
"Hamburg" .... 394—8
"Koln" .... 392—7

BUICK

981902 .... 404—5
981903 .... 406—5

CADILLAC

7266565 (See Photofact Servicer) 396
7270405 .... 395–18–S
7270555 .... 395–18–S
7270625 (See Photofact Servicer) 397
7268065 (See Photofact Servicer) 397

CHEVROLET

987724, 987727, 987730 393–13–S
3748611 .... 393–13–S

EDSEL

85SE .... 402—8
87SE .... 403—7

FORD

B7A-18805-A1 .... 401—8
B8A-18805-B ...399—6, 401—8
FEG-18805 .... 399—6
74BF (FEG-18805) .... 399—6
74MF (B7A-18805-A1) ..... 401—8
84BF (B8A-18805-B)...... 399—6
84MF (B8A-18805-B) ..... 401—8

LINCOLN

85BH (FFC-18805-C, -D) 394–17–S
85BHP (FFC-18805-C, -D) (Above Serial No. 50,000).. 401–16–S
88BH (FFC-15491-B) ... 394–17–S
FFC-15491-B 394–17–S
FFC-18805-C, -D........ 394–17–S
FFC-18805-C, -D (Above Serial No. 50,000) 401–16–S

MERCURY

84BM (FEW-18805-U) .. 394–17–S
85BM (FEW-18805-T) .. 394–17–S
FEW-18805-T 394–17–S
FEW-18805-U 394–17–S
FFC-18805-C, -D (Above Serial No. 50,000) 401–16–S

MOPAR

700 (TAR-58) .... 405—9
845, 846 .... 390—6
848 (P-5801) .... 406—9
851 407–13
923 .... 398–17–S
924 (C-5809) 398–17–S
925 (P-5803) 398–17–S

MOTOROLA

8MX 401–16–S

Set No. Folder No.

OLDSMOBILE

989127 .... 395–18–S
989131 .... 396–16–S

PACKARD

AC-2906, AC-2907 ..... 396–16–S

PONTIAC

988822 .... 396–16–S
988823 .... 397–19–S
988837 .... 400—8

STUDEBAKER

AC-2905 .... 397–19–S
AC-2906, AC-2907 ..... 396–16–S

TRUETONE

DC4623B 350–16

RECORD CHANGERS

ADMIRAL

RC-550A, GA [See Model RC-500—Set 132-2 (CM-4) and Model RC-550—Set 185-2 (CM-5)]
RC607-1, -1A, -1B, -4, -4A, -6A, RC637-1, -1B, -1E, -2, -2A, -2B, RC647-2D, 3B, -3C, -3F.. 398—7

COLLARO

"Conquest" .... 390—5

GLASER-STEERS

GS-77, GE, GED........ 399—7

RCA VICTOR

RP-208-2, -3, -4, -5 391–11

SYLVANIA

1-318-1, -2, -3 401–13

V-M

959 396–13

ZENITH

S-14067 402–15
S-14078, S-14079, S-14082, S-14083, S-14084, S-14085 392–14
S-14086 402–15

RECORDERS

AIRLINE

WG-3740A, WG-3741A, B 349–13

BELL & HOWELL

730-G (Steretone).(CM-6) 256–13
770, 775G-1, 775G-10 ... 403—6

GRUNDIG MAJESTIC

TK5, TK8, TK8/3D, TK8E, TM8, TM8E, TM8U 407–10

KNIGHT

KN-4010 (91RZ750) ...... 405—8
KN-4020 (91RZ751) ...... 405—8
91RZ750, 91RZ751 .... 405—8

RCA VICTOR

TR-2A-1, -2 397–10
8TR2, 8TR3 (Ch. RS-156F, H) 397–10
Ch. RS-156F, H 397–10

REVERE

T-700D, TR-800D 395–13

SYLVANIA

4901 (Ch. 1-400-1, -2, 1-628-1) 404–10
Ch. 1-400-1, -2 404–10
Ch. 1-628-1 404–10

VIKING

PB60 ....(CM-9) 344–15
RP61 ....(CM-9) 344–15

WEBCOR

2812, 2816 393–12
2822 393–12
2892, 2896 393–12

WILCOX GAY

772 406–12

WOLLENSAK

T-1500 400–13

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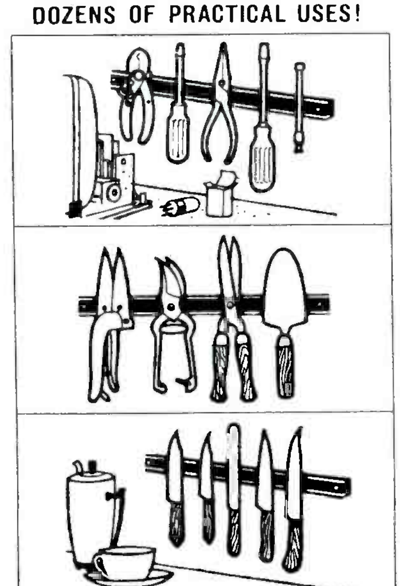

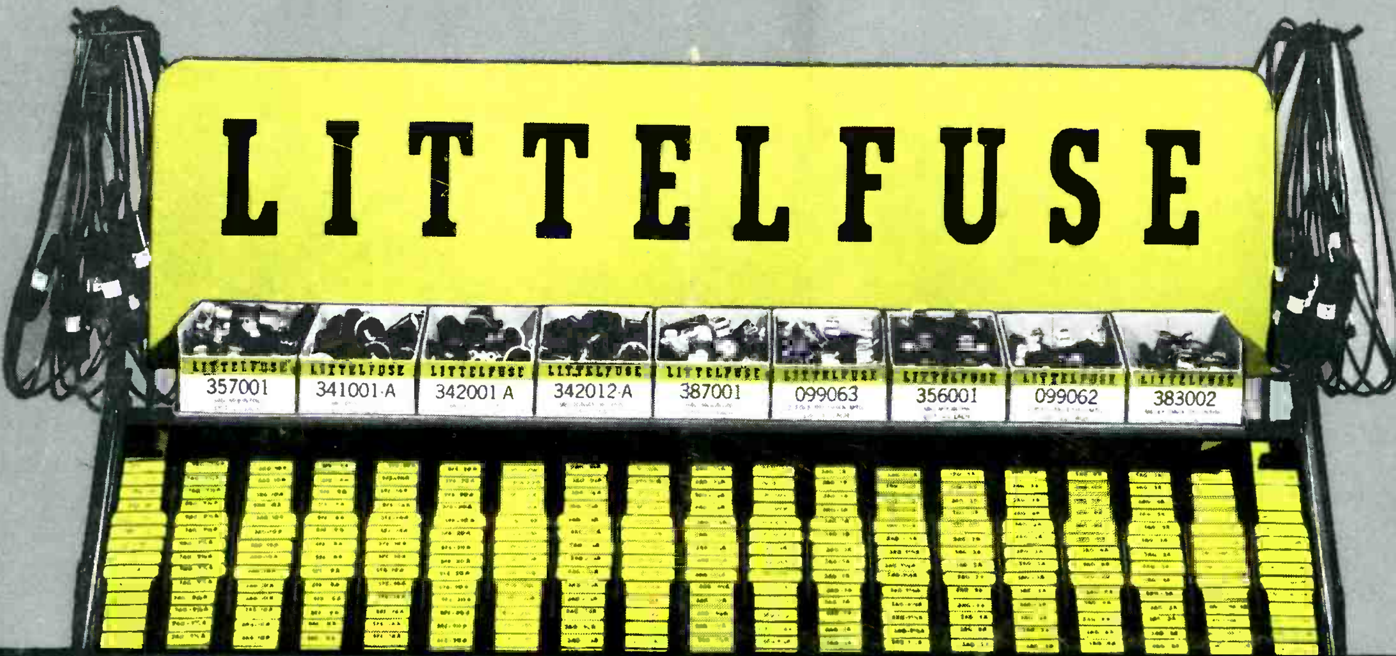

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