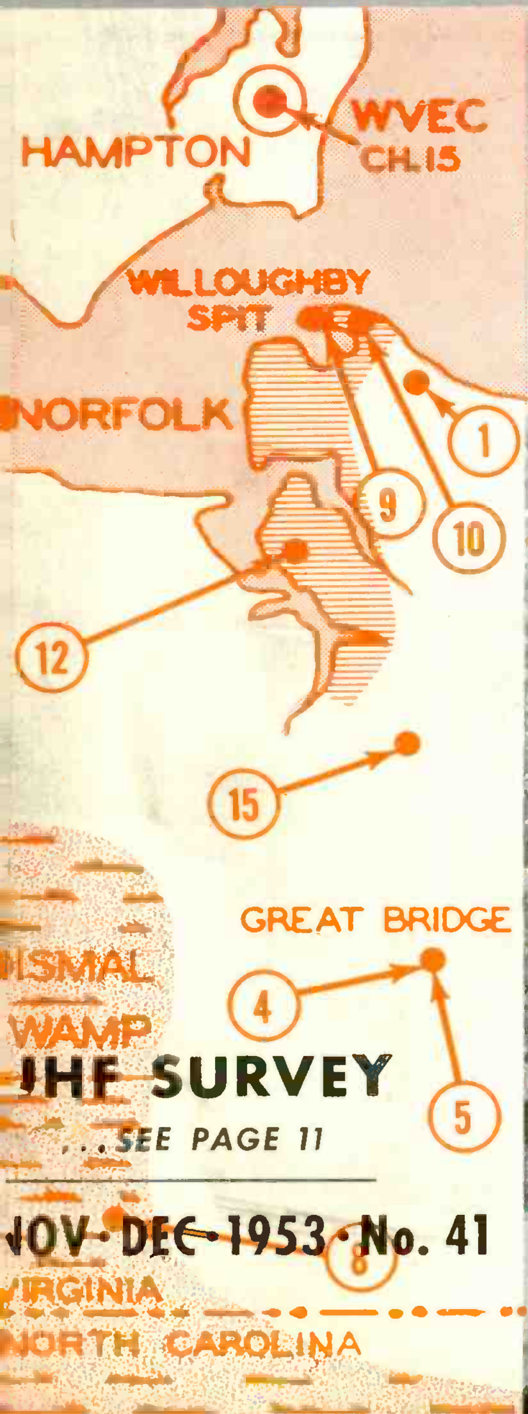
PF PHOTOFACT

# INDEX

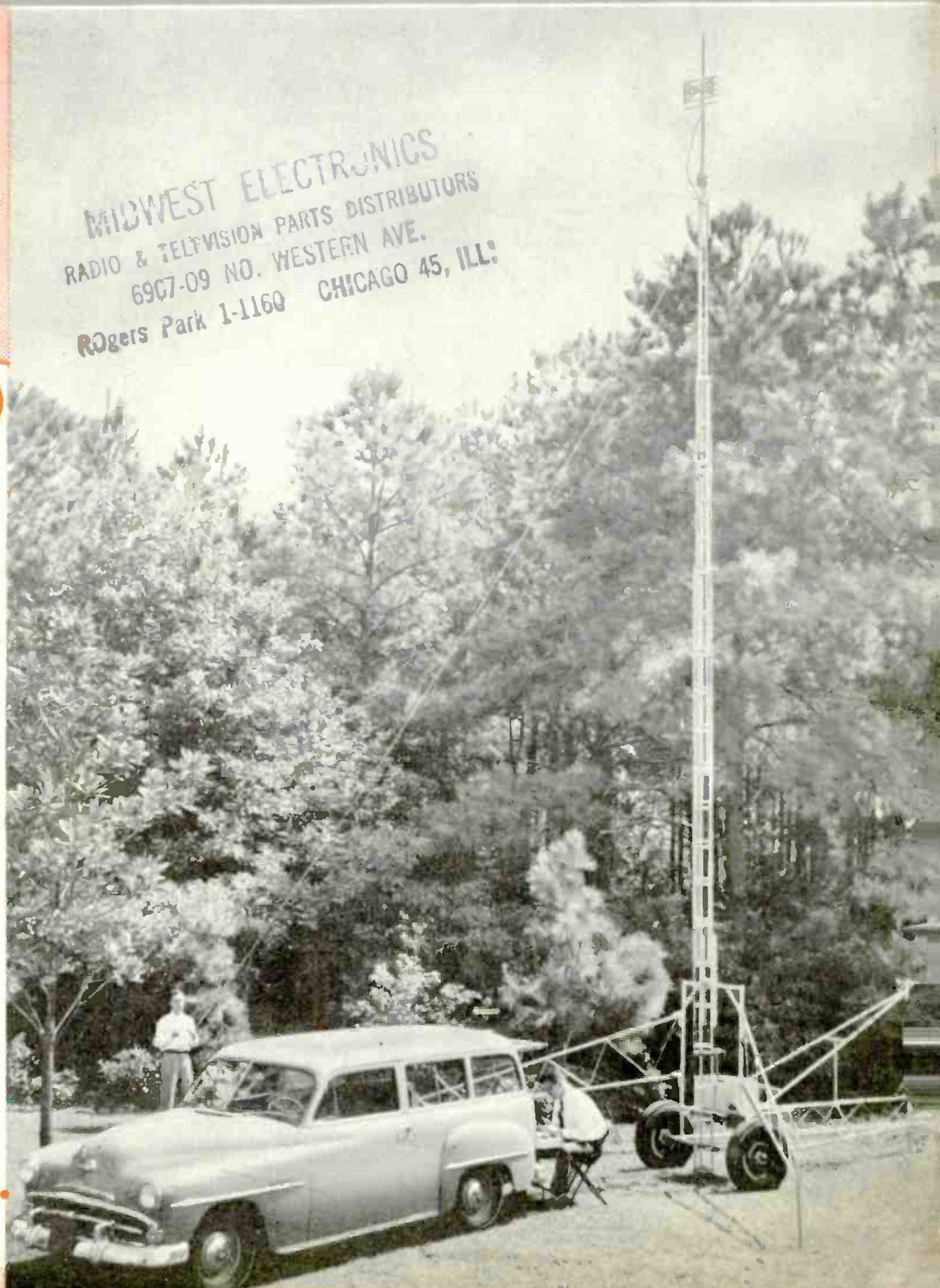
## AND TECHNICAL DIGEST




UHF SURVEY

... SEE PAGE 11

NOV-DEC-1953 · No. 41

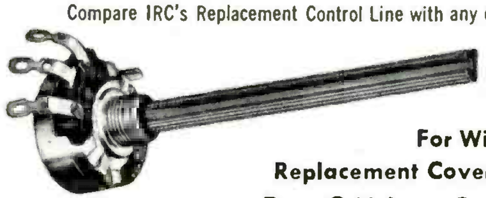


# FOR ALL OF TODAY'S REPLACEMENT CONTROL NEEDS

*IRC Volume Control Plant, Asheville, North Carolina.*

Name your requirement; it's in full production *now* at IRC's new volume control manufacturing plant. From no other single source can you get such wide replacement coverage. And no other replacement control gives you the IRC combination of easy installation and trouble-free performance.

Compare IRC's Replacement Control Line with any other:



**For Widest Replacement Coverage**

**Type Q Volume Control**

82 values—7 tapers—give greatest TV, AM, FM coverage with least stock. Flatted, knurled and slotted Knobmaster Fixed Shaft fits most knobs without alteration. 13 Interchangeable Fixed Shafts give fast conversion to "specials" with fixed shaft security. Small ¼" long bushing and compact 15/16" design ideal for small sets—yet handle large set needs as well. Cushioned-turn rotation. Quiet element. Handsome appearance.

**For Fast Assembly of Ganged Controls**

***IRC MULTISECTIONS***

In just a few minutes you can assemble standard duals, triples, even quadruples—with IRC Multisections and Q Controls. Simply remove control cover and attach Multisection. Over 15,000,000 combinations. 20 resistance values. Switches can be added. Use to provide low-cost L Pads and T Pads.

**Factory-Assembled**

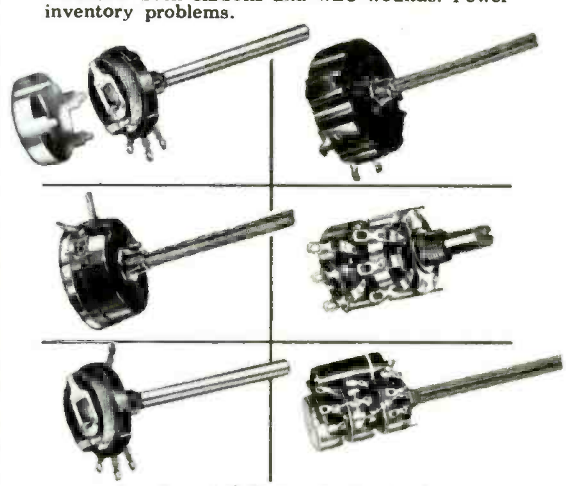
***IRC EXACT DUPLICATES***

IRC's complete line includes 492 Factory-Assembled Exact Duplicate Concentric Duals. Mechanical fit and electrical operation double-money-back guaranteed—specifications are based on set manufacturers' procurement prints. Resistance values are matched; tapers are closely followed; shaft lengths are never less than manufacturers' nominal—never more than ⅛" longer. Cover more than 5,000 TV sets. Carbon and wire wound.

**For Concentric Duals in Less Than A Minute**

***IRC CONCENTRIKITS***

Here's coverage of more than 5,000 TV models. Revolutionary 4-piece Universal Concentrikits assemble with shafts and elements in less than a minute to give you the exact duplicate replacement control you want. Mechanical fit and electrical operation double-money-back guaranteed. Assemble both carbons and wire wounds. Fewer inventory problems.



**For Special Purpose Controls**

**IRC's Complete Line**

*2-Watt Wire Wounds*—2 styles, full rounded shaft and Knobmaster shaft. *High Voltage Controls*—2-watt carbon-element control with Knobmaster shaft. *4-Watt Wire Wounds*—2 styles, short, knurled and slotted shaft or Knobmaster shaft. *TV Attenuators*—Carbon-element control for adjustment of signal input. *TV Centering Controls*—2-Watt Wire Wound Control with centering tap. *Loudness Controls*—Continuously variable, bring higher fidelity to ordinary audio.

No other brand of replacement controls offers you wider variety — greater efficiency. Send for New IRC Control Catalog DC1D.

For one-source-service on all your control requirements, order from your IRC Distributor.

IRC

**INTERNATIONAL RESISTANCE COMPANY**

**425 N. Broad Street, Philadelphia 8, Pa.**

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

*Wherever the Circuit Says*

# COMING IN JANUARY:

## the New Better-Than-Ever Monthly PF INDEX!

This is the last of the bi-monthly issues of the PF INDEX and Technical Digest. Beginning in January 1954, our new magazine will make its appearance regularly EACH MONTH.

The new publication will be truly the monthly Magazine of the Electronic Service Industry. The monthly schedule will now make possible the widest editorial coverage of new developments and latest servicing knowledge you've asked for.

We mean to make the new monthly PF INDEX more valuable to you than ever. For example, the January issue will feature the first comprehensive story on COLOR TV from the special viewpoint of its potential significance to you. This feature will be in addition to dozens of other invaluable articles on vital aspects of everyday servicing, and orientation on new circuit developments, equipment and techniques. Regular features, such as "Shop Talk," "In the Interest of Quicker Servicing," "Dollar and Sense Servicing," "UHF" and "Examining Design Features," will be retained.

**IMPORTANT:** The new monthly PF INDEX will be available early in January 1954, from your local Parts Distributor, at 25¢ per issue. Each Distributor will be allotted only a limited number of copies. To make certain that you will receive your issues, and to help your Distributor determine how many copies he will require each month, we suggest that you fill out the reservation card included as a part of this issue and leave it with, or mail it to, your Distributor. This will guarantee your receipt of each monthly issue of the new PF INDEX and avoid disappointment.*

Look for the new monthly PF INDEX starting in January 1954 and out each month thereafter—the Magazine of the Electronic Service Industry—the only publication that brings you the intimate, practical coverage and understanding of the developments, products, applications and techniques you require for success in your daily work.

Howard W. Sams

## SPECIAL NOTICE!

***to those who have standing orders for PHOTOFACT Folders***

You will continue to receive the Cumulative Listing Section (by manufacturers) to PHOTOFACT Folders as a part of your service. Free copies of this Cumulative Listing may also be obtained from your Distributor.

** The response to our announcement of the new monthly PF INDEX in our Sept.-Oct. issue, indicates a "sell-out" for the new magazine. Act early and make your reservation for the new monthly INDEX now.*


# PHOTOFACT PF INDEX

## AND TECHNICAL DIGEST

VOL. 3 · NO. 6 NOV.-DEC., 1953

JAMES R. RONK, *Editor*

*Editorial Staff:* Phyllis J. Aukerman, William E. Burke, Henry A. Carter, Robert B. Dunham, Don R. Howe, Fred McKinney, Glenna M. McRoan, Margaret Neff, Evelyn S. Mouser, L. H. Nelson, C. P. Oliphant, Glen E. Slutz, Paul C. Smith

*Technical Director:* W. William Hensler

*Art Directors:* Anthony M. Andreone, Pierre L. Crease

*Photography:* Robert W. Reed

*Production:* Archie E. Cutshall, Douglas Bolt


## CONTENTS




HOWARD W. SAMS, *Publisher*

BUSINESS DEPARTMENT

Donald B. Shaw, V. P. Treasurer; F. T. Dobbs, Secretary; Joe H. Morin, Sales Mgr.; Ann W. Jones, Advertising; Shirley A. Owens, Literature Service Mgr.; J. C. Keith, Circulation Mgr. Printed by The Waldemar Press, Joseph C. Collins, Mgr.





*Starting in January the PF INDEX will be published monthly by Howard W. Sams & Co., Inc., 2201 East 46th Street, Indianapolis 5, Indiana. The PF INDEX is on sale at 25 cents a copy at 1056 jobbers of Electronic Parts throughout the United States and Canada. (In Canada 30 cents.) When available, back numbers may be obtained by sending 25 cents for each copy desired.* WE ARE SORRY WE CANNOT ACCEPT SUBSCRIPTIONS. *Acceptance under Section 34.64 P. L. & R. authorized at Indianapolis, Indiana.*

# Shop Talk

MILTON S. KIVER
*President, Television Communications Institute*

The reception of television signals is particularly difficult in hilly or mountainous country. Often entire communities are deprived of normal television reception, because they are located in valleys surrounded on all sides by steep hills that isolate them from any television signals broadcast from nearby stations. When the interest and the financing are available, community TV distribution systems have been employed with a considerable degree of success.

Consider, however, the plight of the lone householder or even that of a small group of homes situated off by themselves in a similar submarginal signal area in which recourse to a community-type reception system is generally too costly. In such a locality television must either be forsaken or at best is very unsatisfactory, even with the assistance of elaborate towers and antennas. Furthermore, with the introduction of UHF, the obstructing hills become even more impenetrable; and where there may be even a modicum of reception at VHF, there is absolutely nothing at UHF.

An interesting solution to a problem similar to the one just described has recently come to the attention of this writer; and since it seems plausible and comes with good recommendations from obviously reliable sources, it is being passed along to the readers of the PF INDEX and Technical Digest. Colonel V. C. Huffsmith, assistant director of the Denver Research Institute, lives in a house which is situated in a valley on one side of a mountain. The nearest television transmitter is 55 miles away; the mountain stands between the house and the station and shields the latter so effectively that very little signal can be picked up at Colonel Huffsmith's house by ordinary means.

On top of the mountain, reception is excellent because considerable signal is present. The problem then is to bring the signal into the valley without resort to any expensive distribution system. This was the difficulty that Dr. Richard C. Webb of the Denver Research Institute set out to solve.

The logical place to start was at the top of the nearby mountain, since the signal level there was high. As a first step, Dr. Webb took a high-gain antenna and set it up to capture as much of the available signal as possible. This signal was then led through a low-loss transmission line to another high-gain antenna situated not far from the first antenna but so mounted that the main lobe of its directional pattern was directed toward the house in the valley. Whatever signal the second antenna received from the first was thus reradiated into the valley where it was picked up by a third antenna generally of similar design, and brought to the receiver in the house. See Fig. 1. In short, Dr. Webb developed a relay system similar in principle if not in scope to that employed by intercity microwave relays.

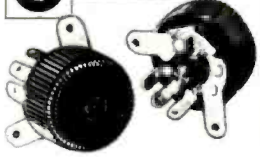
The operation of the system is based on a principle that has been known ever since antennas were first developed, namely, that an antenna used for reception will exhibit the same characteristics when employed for transmission. The first antenna mounted high on the neighboring mountain served to receive the signal from the transmitter. The signal thus garnered was then carefully led to a second antenna which functioned as a transmitter, reradiating the signal forward according to its directive characteristics. By properly positioning this latter antenna, the reradiated signal was directed down into the valley where it was received by a third array and brought to the receiver.

Does this combination work? According to Dr. Webb it works well. He was able to design the system so that a signal of 600 microvolts was made available to the receiver. The signal is steady and is present whenever the transmitter is on the air. Furthermore, none of the elements in this system require any external source of power or any more supervision than the average antenna installation.

There are a number of high-gain antennas that may be used in the manner just indicated, but the one chosen was the rhombic. This is capable of good gain, can readily be made unidirectional (which is extremely important in this application), and will operate over a fairly broad band of frequencies. The receiving and transmitting rhombics are mounted back to back (Fig. 2) and interconnected by a low-loss, open-wire line constructed as shown. A third rhombic is erected at the receiver, although there is no compelling reason for having this array similar to the first two.

Rhombic antennas have been known for some time and fall into the long-wire class of antennas. It is generally characteristic of these that the longer their length, the higher their gain and the sharper their directivity. A well-designed rhombic can have a gain of 16 db over the standard dipole and a beam width as narrow as 5 degrees. This means that the array has to be carefully mounted so that it is facing in exactly the right direction. A slight misalignment can mean a considerable loss of signal. That the rhombic has not been employed more extensively is because of the space it requires. Gain depends upon leg length (Fig. 3), and the minimum useful leg length is at least 2 wavelengths approxi-

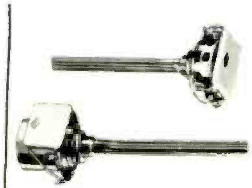
## 1 CONTROLS


Model B16 Radiohm® Miniature

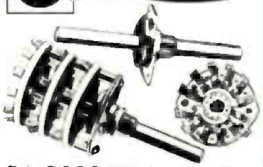

Twin and dual concentric Radiohms


Model B Blue Shaft† Radiohms

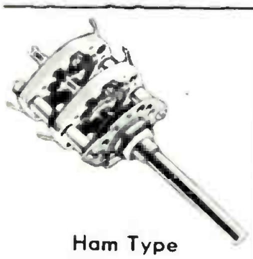

Type AB Adashaft® Radiohms

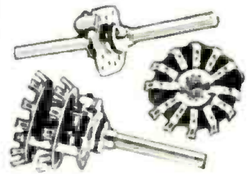

Compentrol† Infinitely variable loudness control

## 2 SWITCHES


PA-2000 Miniature Rotary, Steatite Insulation


2500 Series Standard Rotary, Steatite Insulation


Ham Type


1400 Series, Standard Rotary, Phenolic Insulation


Small General Purpose and tone


Complete Switch Kits

# FOR SALE!

**These and 100,001 other Centralab quality electronic components**

HERE'S a perfect check list to determine your electronic needs. And there are hundreds of variations available to you. Whether you need a few items or dozens — no other single manufacturer can offer you such a wide choice of standard fastest-for-servicing parts. That's why Centralab is the industry's No. 1 electronic component source . . . and keeps your distributor supplied with the latest developments in the fast-changing electronics field.

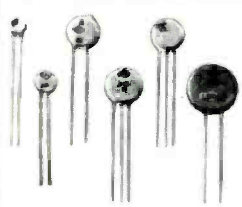
You know CRL parts are your best value because each is backed by a written guarantee. That means they're safest for servicing. And you'll agree that's mighty important for building consistent customer satisfaction.

So when you need parts, look for the familiar blue and white CRL package — the product inside is the result of more than 30 years of electronic experience. This experience has pioneered many profit-building "firsts" for you! For complete performance data and engineering specifications mail coupon.

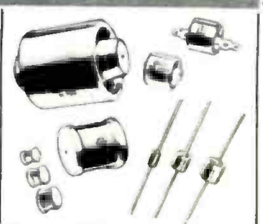
† Trademark
P.E.C.—Printed Electronic Circuits

## 3 CAPACITORS


BC Tubular TC Tubular

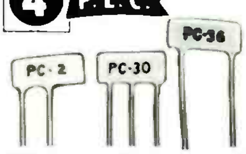

BC Discs


TV HI-VO-KAPS®

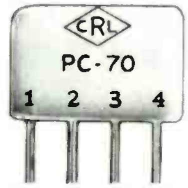

Transmitting Capacitors


Ceramic Trimmers

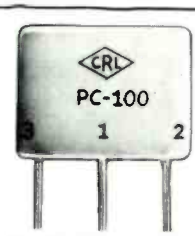
## 4 P.E.C.



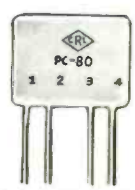
Miniature Resistor and Resistor-Capacitor Units



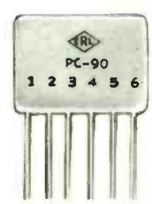
Standard Triode Couplate®



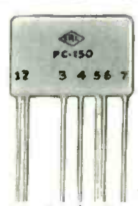
Vertical Integrator



Midget Triode Couplate®



Pentode Couplates®



Audet® Audio-detector plate


Ampec® standard and miniature 3-stage amplifiers


P. E. C. Kits

**Centralab** ®

A Division of Globe-Union Inc.
942K E. Keefe Ave., Milwaukee 1, Wis.
804 Mt. Pleasant Road, Toronto 12, Ontario

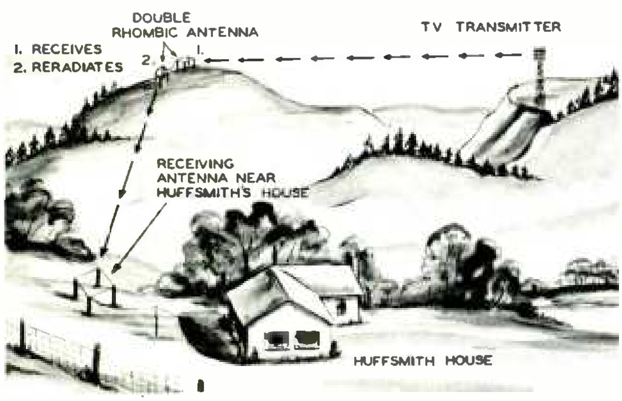



**Fig. 1. A Sketch of the Relay System Devised by Dr. Webb to Bring a Signal to Colonel Huffsmith's House.**

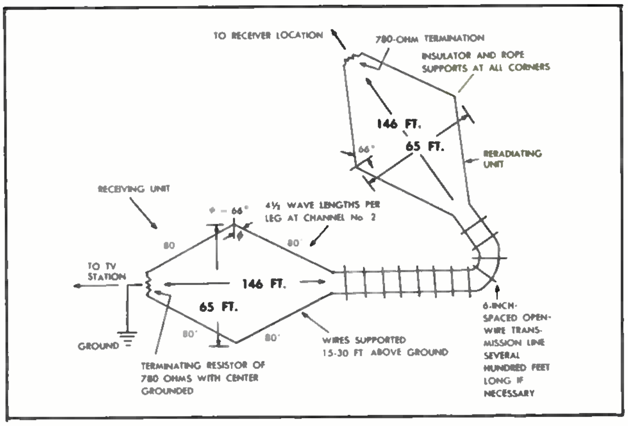



**Fig. 2. Diagram Showing How the Receiving and Reradiating Rhombics Are Mounted and Interconnected.**

mately. This means that if we wish to design a rhombic for use on channel 2 (54-60 mc), for example, then each leg should be at least 32 feet long. Actually longer lengths are desirable, and Dr. Webb makes each leg approximately 4 1/2 wavelengths long in his rhombic. Not many city dwellers have the space available for an array this large. Out in the country under the conditions just described, space is no particular problem.

The leg length of the rhombic also determines the angle where the sides join. For legs 2 wavelengths long, an angle of 110° is recommended; for 3, the angle is 120°; for 4, the angle is 130°.

Fig. 2 indicates that a terminating resistor is placed at the end of the rhombic opposite the corner to which the transmission line is attached. The purpose of this resistor is to absorb reflections which would otherwise tend to permit signals to be received from two directions. As it is, with the resistor in place the array response is unidirectional. The resistor value should be about 600 to 800 ohms, and the resistor should be of carbon or some other noninductive composition. The input impedance at the other end of the rhombic is approximately equal to the value of this resistor. In the Huffsmith installations, a 6-inch-spaced open-wire transmission line was used as the connecting link between the two rhombics mounted on the mountain top.

Complete specifications of these two rhombics atop the mountain are given in Fig. 2. The dimensions are for the reception of channel 2 signals, although all VHF channels will be well received. Increasing the angle from 66 degrees to 70 degrees by stretching out the antenna along its major axis to 150 feet tends to favor the higher group of VHF channels 7 to 13.

As a precautionary measure, the system should have a low DC resistance to ground to provide a leakage path for currents induced by electrostatic charges in the atmosphere. This is achieved by using two 390-ohm series-connected carbon resistors in place of a single 780-ohm resistor. Since the rhombic is a balanced array, connecting a wire from the junction of the two 390-ohm resistors to a grounded copper-plated steel rod will not upset the balance yet will still provide the necessary protection.

To mount the array physically, such natural supports as wooden poles or even trees were used. Antenna height should be from about 10 to 30 feet above the ground. Insulators should be used at each of the supporting corners to insulate the wires from the support and reduce loss due to signal leakage. (Wet or moist wood can offer a surprisingly high-leakage path.) For the rhombic itself, solid copper or copper-clad steel wire in sizes from about No. 14 to No. 18 gauge are recommended.

Orientation of the several rhombics is indicated in Fig. 2. For the initial receiving array, the end containing the terminating resistor is pointed directly toward the incoming signal. The optimum position is best determined by using a signal-strength meter. Next, the line to the second rhombic is installed, and then this latter array is

* * Please turn to page 79 * *

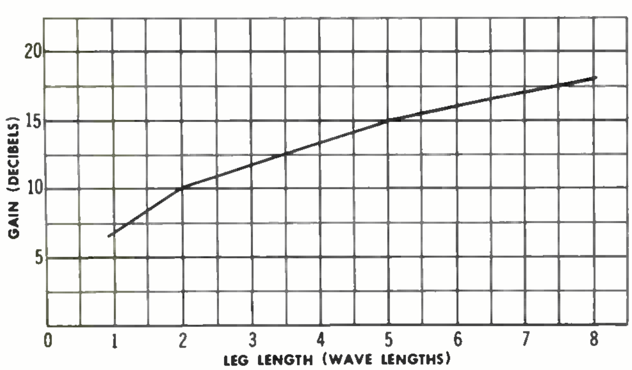



**Fig. 3. The Gain of a Rhombic Antenna Increases With Leg Length.**

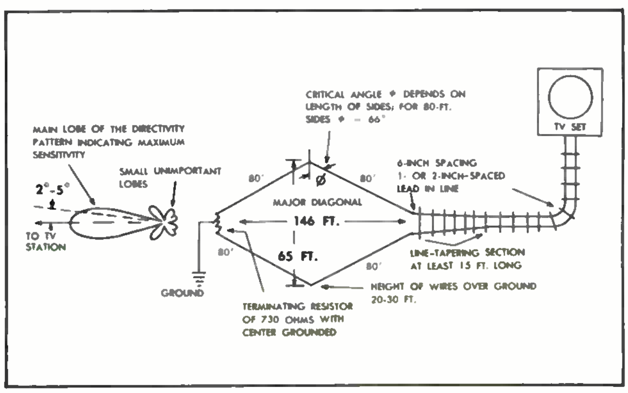



**Fig. 4. Plan View of Final Rhombic at Receiver.**

# SERVICE SHOP ON WHEELS

by

HENRY A. CARTER


## A Study of a Mobile Radio-TV Service Shop

A much-debated question among service technicians is, "Are mobile service shops practical?" The question is not a simple one, and we will not attempt to answer it within the scope of this report. However, we will endeavor to give the facts about the advantages and disadvantages of a mobile shop as they were presented to us. We sincerely hope that this article will help those who are contemplating such a shop to arrive at some conclusion.

One of the distinct advantages of a mobile shop is that the cost of operating the complete business is substantially reduced because a much smaller stationary shop is required merely to supplement the mobile one. In fact, the only reasons for a stationary shop are: (1) to store excess stock, (2) to store sets waiting for hard-to-get components, and (3) to enable the service technician to work on the more prolonged service troubles such as intermittent receivers, conversions, and overhauling jobs. Even a fairly large service organization can operate efficiently by employing mobile units together with one small stationary shop.

Another important factor to consider is the time element. The time required to transport a chassis from the home to the shop and back is often more than the actual time required to locate the trouble and correct it. It is true that the customer is usually billed for pickup and delivery, but is any of that amount actually a profit to you? Chances are that it is not as much as you would be earning on the next call which is being delayed. By repairing the set at the home, the customer is much happier for the fast service and for no pickup and delivery charge. All this adds up to better relations between the customer and service technician.

The small-town service technician may find the mobile service shop advantageous in many ways. For instance, it is much better to repair the set on the farm than to have to take it all the way back to the shop which may be several miles away and then take it back out again. The farmer will not appreciate having to pay double-mileage costs. Another possibility for the service technician, whose home town is too small to support a shop, is to include neighboring towns. A good way to do this is to advertise in each of the surrounding towns that he will be there on a certain day of each week. If the technician is good, he will soon get a reputation that will induce the customers in these towns to wait for him to service their sets. Without a mobile shop this would be rather difficult, especially if the towns are well separated.

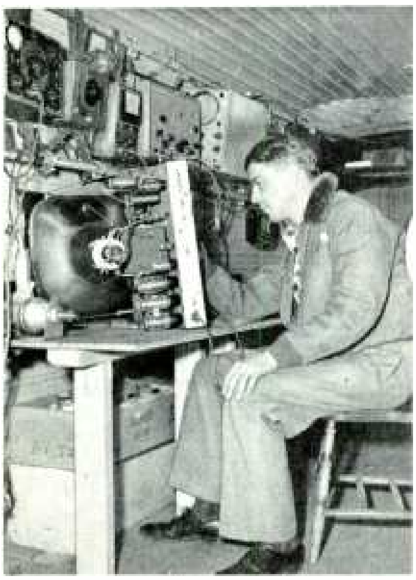


**Fig. 1 Owner and Operator at Work in "Ray's Mobile Service Shop"**

The type of truck chosen for a mobile shop is important and should satisfy the following requirements. It should have ample room inside for the technician to move about between the bench and the bins containing the parts. It should also have enough headroom that he will not have to work humped over. The unit shown and discussed in this article is an 18-foot Vanette or delivery van. A photograph is shown in the heading. Note the headroom above the service technician in Fig. 1.

The 7-foot workbench shown in Figs. 1 and 2 is a temporary bench that the owner hopes to replace in the near future with a metal one welded to the floor and wall. Shown on the bench is an electric drill, something that is important in every shop whether mobile or stationary. There is also a vise mounted on the bench.

The test equipment used in a mobile service shop may vary according to what the technician prefers. There are some things,

* * Please turn to page 97 * *

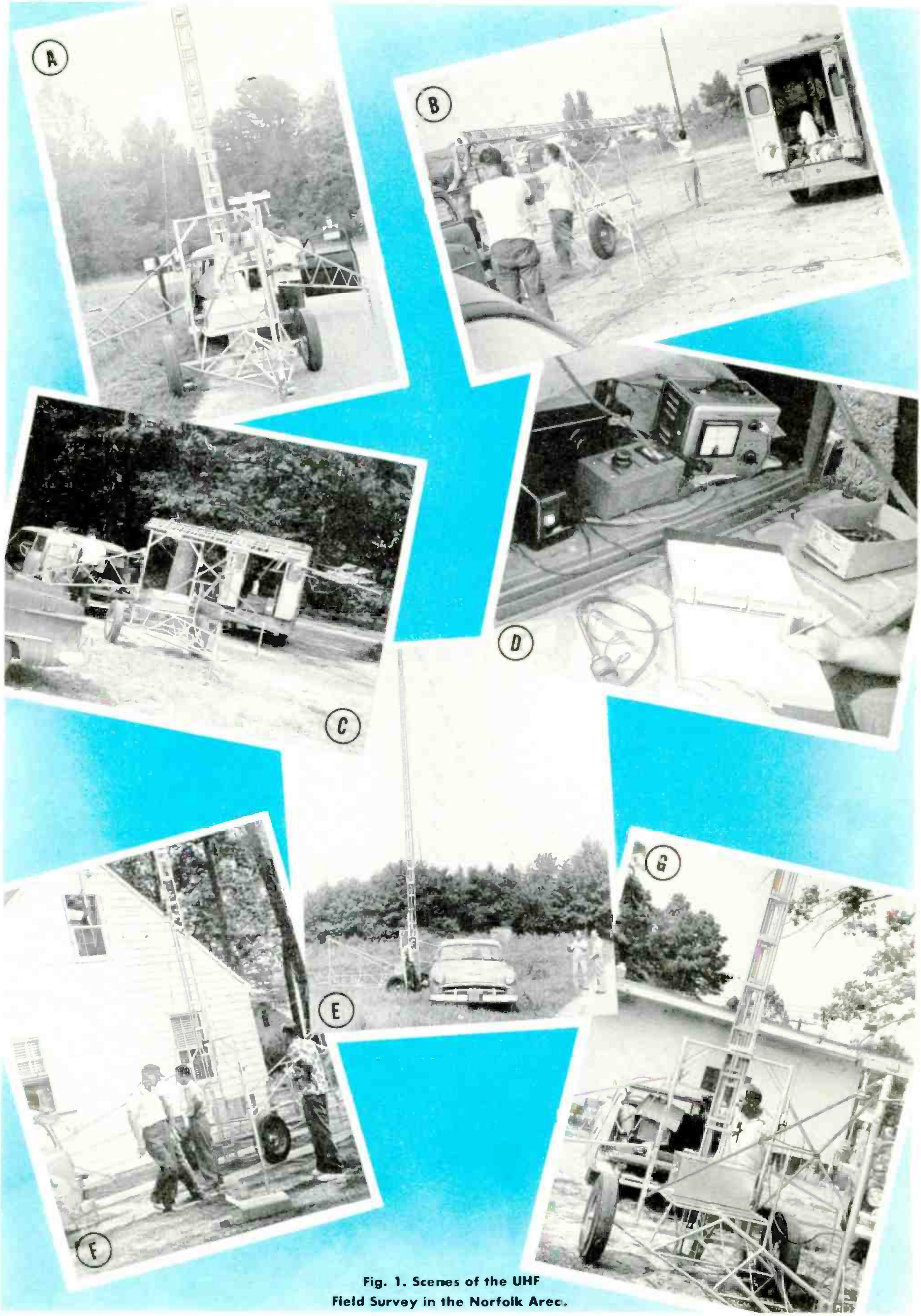
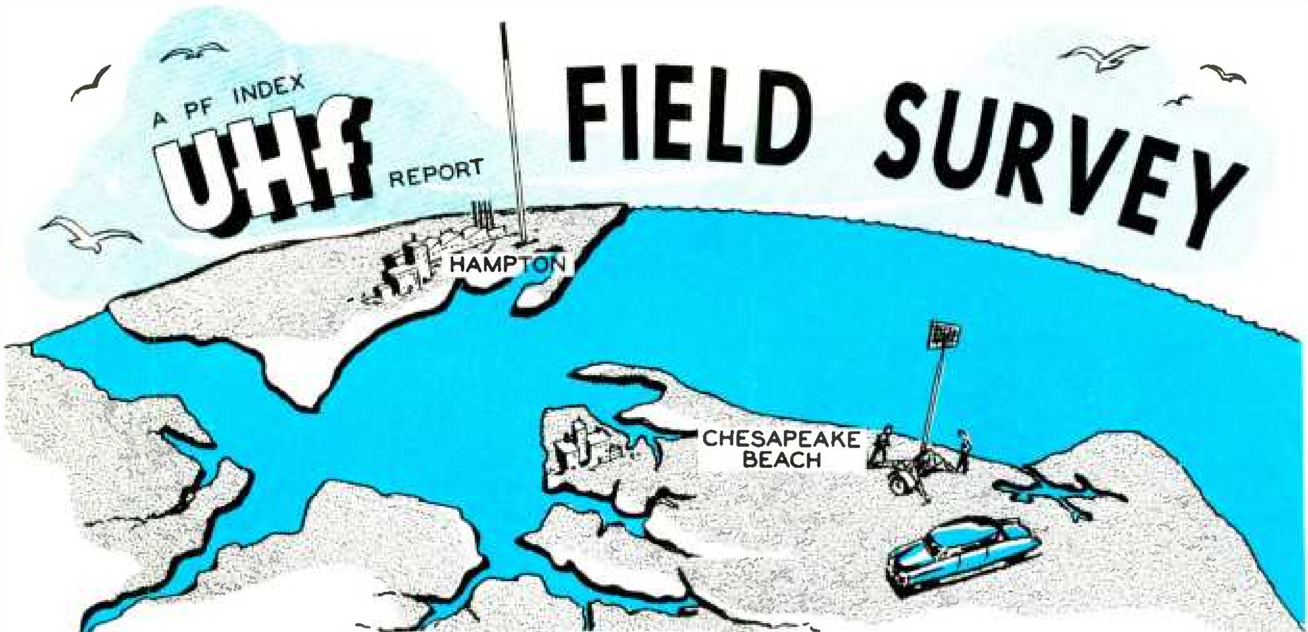



**Fig. 1. Scenes of the UHF Field Survey in the Norfolk Area.**

A PF INDEX UHF REPORT

# FIELD SURVEY




**by Glen E. Slutz and W. William Hensler**

*A Field Crew's Report on UHF Reception in the Norfolk, Va., Area*

One of the most frequently encountered expressions in connection with UHF installations is that there is no signal present. With this fact in mind, we felt that another field survey was necessary to supplement the one conducted in South Bend, Indiana.[1,2] Our first survey was particularly concerned with the solving of antenna problems rather than actual installation problems. Realizing that the two go hand in hand, we directed our activity in this second survey to the solution of installation problems chiefly.

On August 15, 1953, Station WVEC-TV, operating on channel 15. commenced operation in Hampton, Virginia. Hampton is located on Chesapeake Bay across from Norfolk, Virginia, which is the major service area. The transmitter is a 12-kilowatt General Electric unit and provides an effective radiated power of 200,000 watts. Another pertinent fact is that the area around Norfolk is a tidewater section and is essentially flat. This land feature should be kept in mind when reviewing the results of our tests, since it is known that reception conditions are quite different in hilly terrain.

The equipment used in the Norfolk field survey consisted of (1) a trailer with a telescoping, three-section tower; (2) a station wagon for drawing the trailer and carrying equipment; (3) a closed truck for transporting additional equipment; and (4) the various antennas, receivers, and test instruments used in the tests. For the most part, we depended on the cooperation of local residents to furnish us the power for operating our equipment. However, we did carry a vibrator supply so that we were able to make use of the car battery at one or two remote positions. We took with us many types of antennas, but used one as a standard to determine relative signal strength at the different test positions.

In conducting a typical test we first drew the trailer into position, making sure that it was safely away from overhead power lines. Then we uncoupled it from the trailer hitch and swung it around approximately 180 degrees so that the tower base was near the rear of the station wagon. This arrangement is visible in photographs A, B, C, F, and G in Fig. 1. In photograph E of Fig. 1 the trailer can be seen positioned at an angle with the station wagon but still close to the rear of the car.

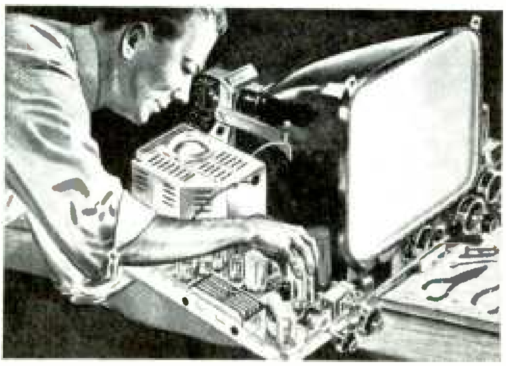
Next the side gates on the trailer were swung out into position and the trailer was leveled with a carpenter's level. The rotator was secured to the top of the tower and the preassembled antenna mounted. The lead-in which we employed in all our tests was a 300-ohm ribbon twin lead. Our reason for using this type was not because we believed it to be the best for all UHF installations, but rather because its flexibility and size were well suited to the particular needs of our operation. The lead-in was threaded through two 7-inch standoff insulators before it was fastened to the antenna. One of these standoffs was situated at the top of the innermost section of the mast; the other was located between the antenna and the rotator. Since the point of maximum stress on the lead-in during the tests was at the lower standoff, a hole was punched through the twin lead just above this point and a small polystyrene dowel pin was inserted as an anchoring device.

The next step in a typical test was to raise the tower to a vertical position and secure it at the base. The rotator cable was connected to the rotator control box, and the lead-in was connected to the field-strength meter. These devices were located in the station wagon together with a television receiver for monitoring the signal and a variac for adjusting the line voltage. When lowered into place, the tail gate of the station wagon formed a handy writing table for taking down data. A photograph showing this arrangement is presented in photograph D of Fig. 1. Notice the sunshade made by cutting out a cardboard carton and placing it over the television receiver to shut out some of the light. We found this a big help when working in direct sunlight. Another device which proved very worth-while was the clothespin connector which we used on the end of the lead-in. We fastened a similar connector to a small length of twin lead the other end of which went to the antenna

[1]W. William Hensler, "Operation UHF," PF INDEX and Technical Digest, March-April, 1953.

[2]C.P. Oliphant and Glen E. Slutz, "Which Antenna for UHF," PF INDEX and Technical Digest, March-April, 1953.

*Depend on Mallory for Approved Precision Quality*



# "There'll Be No Call-Back On This Job!"

THAT'S *one of your customers talking.* And the Mallory Capacitor in his hand is the reason he is so sure of himself.

Whenever you stock and recommend Mallory Capacitors, you . . . and the service men you serve . . . can be sure there will be no time-wasting call-backs to cut down profits for both of you.


Mallory Capacitors are engineered to meet the electrical requirements of any TV or radio set. Beyond that, they give long lasting performance that's equal to . . . and often better than the original equipment unit.

Rating for rating, Mallory FP Capacitors give longer life at higher temperatures and greater ripple currents. They give trouble-free performance even at 185° F. (85° C.). What's more, they are the only fabricated plate capacitors available to the replacement market.


It's good business to carry Mallory FP's. They cost no more . . . your customers will be sure that every job is right the first time.

*For Plastic tubular replacements,* recommend Mallory Plascaps®. They will put an end to premature shorts . . . leakage . . . off center cartridges . . . and unsoldered leads.

P. R. MALLORY & CO. Inc.
**MALLORY**

CAPACITORS • CONTROLS • VIBRATORS • SWITCHES • RESISTORS
RECTIFIERS • POWER SUPPLIES • FILTERS • MERCURY BATTERIES

**APPROVED PRECISION PRODUCTS**

**P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA**


Fig. 2. Map of Norfolk Area Served by WVEC-TV. (See Text for Information About the Indicated Test Positions.)

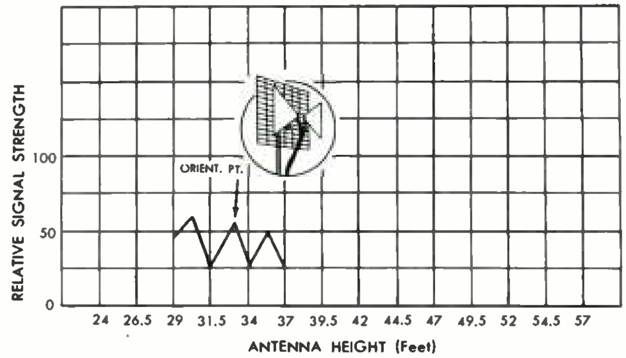



**Fig. 3. Changes in Signal Strength at Lower Antenna Elevations. Location is Position 1 (Pinewell).**

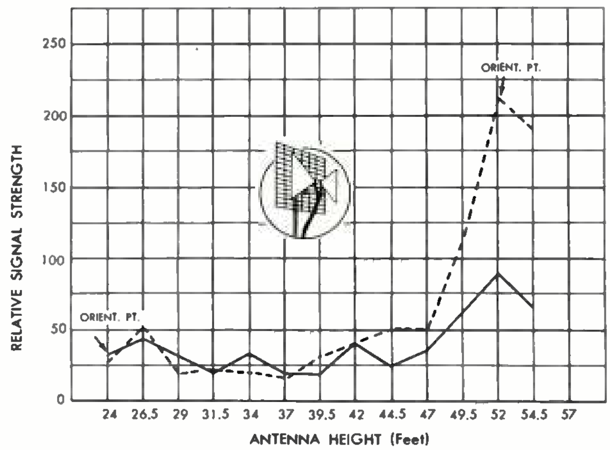



**Fig. 4. Vertical Field-Strength Patterns at Position 1 (Pinewell).**

terminals on the back of the television receiver. This made it possible for us to switch the antenna from the field-strength meter to the television receiver in a matter of seconds when we so desired.

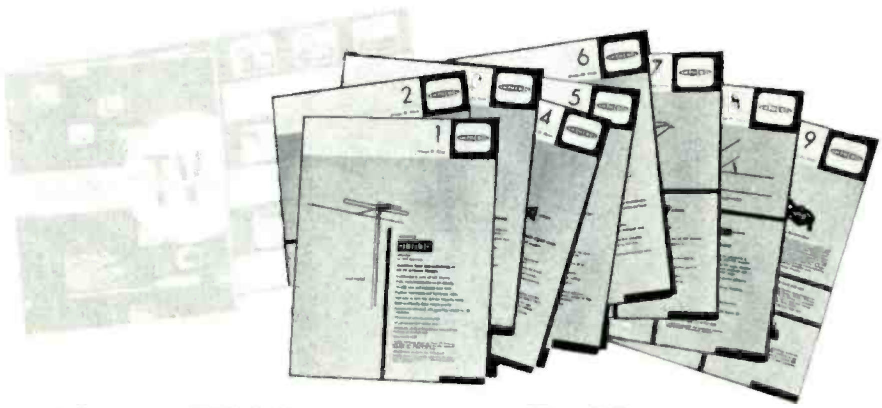
All of our tests with one or two exceptions were conducted with the same length of transmission line. At lower tower heights we had the problem of slack in this line. To prevent it from lying on the ground one of the crew members stood out away from the tower and held the line taut by means of a loop of dry twine, as shown in Fig. 1E. Then as the tower was raised and the slack was taken up, he moved in with the line, keeping it away from the tower and the ground. In this way transmission-line losses were maintained nearly constant during all tests.

At most of the test positions signal-strength readings were taken at equal steps in antenna height from 24 feet up to 57 feet. As the tower was raised, the steps were gauged by using the evenly spaced supporting ribs in the outside tower section as guideposts. Ordinarily, an antenna was rotated to the maximum signal point while it was at the 24-foot level and left in this position during elevation. Then at the 57-foot level, the orientation of the antenna was rechecked by rotation. If the maximum signal point was found to have changed appreciably, we usually left the antenna in its new position and recorded a second set of readings while lowering the tower. A comparison of the two sets of data gave us clues at times to the manner in which the signal was reaching the test position.

Before beginning operations on this field survey, we obtained a list of locations in and around Norfolk where difficulty in UHF reception had been experienced. The complaints in these areas ranged from slightly snowy pictures to no pictures at all. Our first test site was located in the Pinewell section of Norfolk. This area has a great number of pine trees, most of them being 60 feet or more in height. Thus, it was impractical in most instances to install an antenna above the tree tops. The Pinewell location is identified as position 1 on the map of Fig. 2. It is approximately eight miles from the station transmitter.

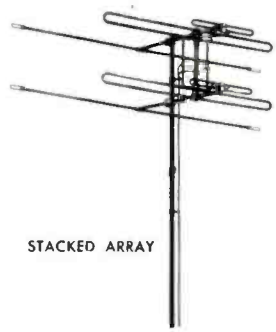
We conducted the test at position 1 in the driveway of a residence there. See photograph F in Fig. 1. The permanent installation on the house was made up of a single bow tie with reflector which was placed on the existing VHF antenna mast. The antenna was approximately four feet above the peak of the roof, resulting in a 30-foot elevation above the ground. Tubular lead-in was used, but only 5-inch standoff insulators were incorporated. The UHF lead-in was also installed quite close to the VHF line, a situation which probably resulted in some loss of the signal. Both lead-ins entered the house through the same hole of an iron grating in the foundation. A hole had been drilled in the floor of the living room, and the lead-in was brought up through this opening. After pulling on the lead-in from within the house, it was found that four or five feet of slack line had been left under the floor. This was long enough to allow the lead-in to lie on the ground beneath the house—a condition which further contributed to the losses. We checked the picture on the receiver in the home and found that it was very snowy; it was so much so, in fact, that it was termed unsatisfactory.

# TECHNICIANS will read with profit...



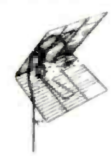
# the "TVAntenna Folio"

INLINE
REISSUE PATENT 23,273



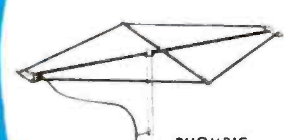
STACKED ARRAY

CORNER REFLECTOR



BO-TY

YAGI



RHOMBIC

STACKED-V

Designed primarily to give installer-technicians a handy reference work on television, the new AMPHENOL "TVAntenna Folio" is a six page folder that gives the complete story of television from the transmitting antenna to the home. Along with its very informative and readable text, the "TVAntenna Folio" has beautiful Kodachrome illustrations that picture everything from television wave transmission to antenna types.

The "TVAntenna Folio" illustrates and discusses the differences between VHF and UHF. It shows how the factors of attenuation, refraction, diffraction, reflection and interference influence UHF and VHF television waves. It points out what the installer can do, where possible, to overcome these factors and emphasizes the importance of the proper installation in UHF. Particularly helpful to the technician is the discussion in the "TVAntenna Folio" of how antenna gain and radiation measurements are made—it will help him in interpreting published antenna data.

Along with each copy of the "TVAntenna Folio" are enclosed the new AMPHENOL antenna and accessories catalog sheets. These contain complete gain charts and radiation patterns (measured in accordance with current RETMA standards) on each antenna.

The "TVAntenna Folio" is a digest of the fuller information contained in the new AMPHENOL film "The UHF-VHF Television Antenna Story." Now being shown across the nation, this color slide-film is something you will not want to miss. Be sure and contact your AMPHENOL distributor and make arrangements to see "The UHF-VHF Television Antenna Story."

**AMERICAN PHENOLIC CORPORATION**
*chicago 50, illinois*

AMPHENOL

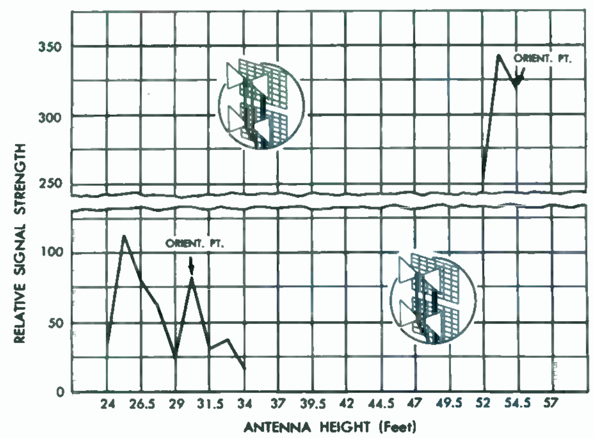



**Fig. 5. Comparison of Signal Strengths at Lower and Higher Antenna Elevations. Location is Position 1 (Pinewell).**

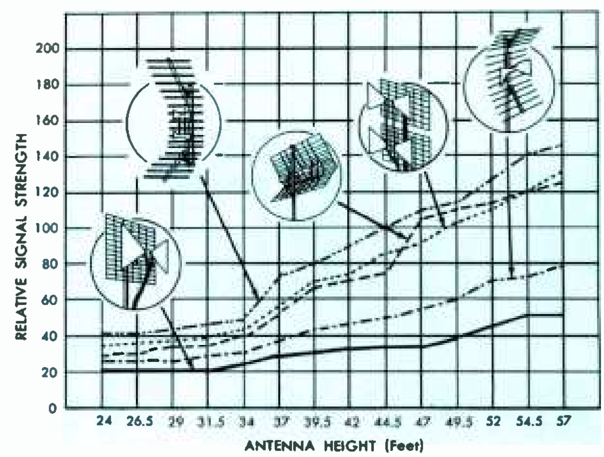



**Fig. 6. Vertical Field-Strength Patterns of Several Antennas Tested at Position 2 (Virginia Beach).**

The problem of our field crew was to determine whether the signal in that vicinity was too weak or whether the placement of the antenna was incorrect. We set up our tower as close to the house as possible in order to survey the situation at approximately the same location. The permanent-antenna mast can be seen in Fig. 1F near the peak of the house. One of the members of the field crew was in the process of rotating the antenna at the time the photograph was taken.

The first measurement with the portable tower was made using a single bow-tie antenna at the same elevation as the antenna on the house. After properly orienting the antenna at this height, it was found that the antenna on the house had been improperly aimed. It was pointed approximately 80 degrees away from the direction of maximum signal. We rotated our antenna to match the position of the house antenna and found that there was a weak signal being picked up from that point. We assumed that the signal received by the permanent antenna was being reflected from some object. The pickup from this minor lobe might have caused the error in the original orientation of the permanent antenna. We rotated our test antenna back to the maximum-signal point and found that a relative reading of 53 could be obtained. We then raised and lowered the tower and found that the vertical positioning of the antenna was quite critical. A graph showing the readings obtained during this particular test is shown in Fig. 3. Note the signal-strength variation which was obtained by a slight movement of the antenna.

In order to determine the vertical pattern, we lowered the antenna to the 24-foot level and rotated it for maximum pickup. We then raised the tower to the 54-1/2-foot level, taking readings at various steps. The readings obtained are shown in Fig. 4. The maximum reading obtained was 90 at the 53-foot level. When the antenna was rotated at this height, a maximum reading of 210 was noted. This indicated that the signal at the upper level was arriving at a slightly different angle than at the lower level. It was then decided to check the readings while bringing the antenna down, and the results are also shown in Fig. 4. It is interesting to note that the readings obtained below the 47-foot level were essentially the same for the two tests. It was found that a relative reading of 80 or more was required to produce a snow-free picture. Again referring to the graphs in Fig. 4, it can be seen that an antenna height of 48 feet or higher was required to obtain a snow-free picture using this particular antenna.

Our next approach was that of using a higher-gain antenna to determine whether it would give satisfactory operation at a lower level. A stacked bow tie with reflector was installed on the tower, and it was again set at the same height as the antenna on the house. A relative reading of 80 was recorded after it was properly oriented. This setup provided us with a signal which was barely passable, as far as obtaining a snow-free picture was concerned. The antenna was raised and lowered; the results are shown in Fig. 5. This test revealed that the maximum signal was received at about the 25-foot level. At this point a reading of 115 was recorded. In order to test the operation of the antenna at the upper level, it was raised to the 54 1/2 foot point where it was properly oriented. This produced a reading of 320. In lowering the antenna a half step, a reading of 342 was recorded. Lowering the antenna another half step reduced the reading to 252. The results of this test are also shown in Fig. 5. Again the vertical placement of the antenna was quite critical.

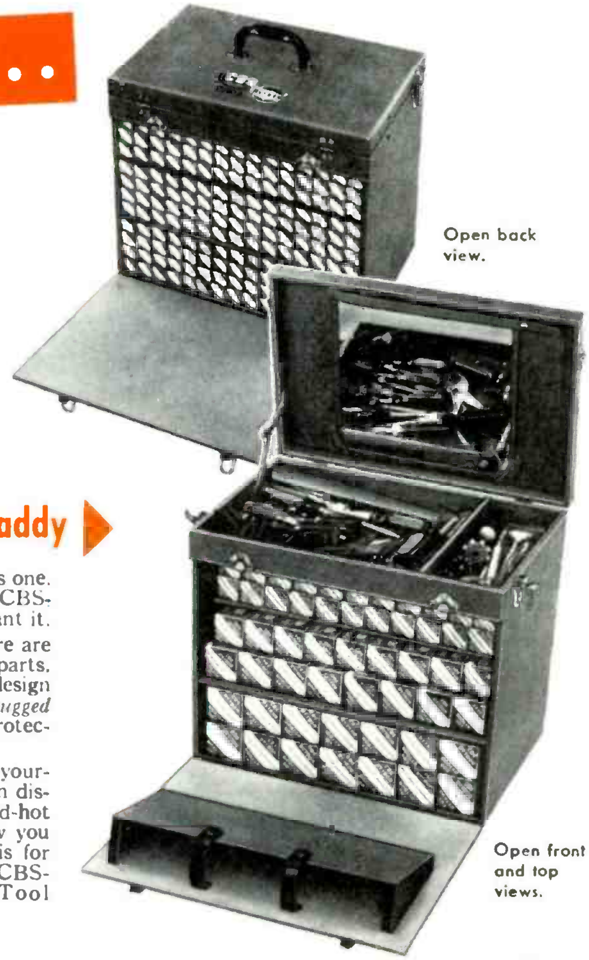
The results obtained at this test position were so different from those which we had previously experienced that we felt an explanation was imperative. Checking the surrounding terrain, we concluded that there was nothing which could have contributed to the critical vertical pattern with the exception of the pine trees themselves. We had not encountered this type of tree in any abundance on any previous field test. Therefore, it was decided that a test should be made at a site having a similar terrain but without the pine trees. Such a test was made and will be described later.

Our next problem at position 1 was to take whatever steps we felt necessary to improve the installation on the house. First, the antenna was properly oriented to provide maximum signal pickup. Second, the lead-in was pulled up through the opening in the floor so that it did not lie directly on the ground. These two steps made a marked improvement in the test pattern produced by the receiver. The installation in its original condition produced a very snowy picture; but after the changes, a very satisfactory picture was obtained.

Even though we were able to obtain a satisfactory picture after taking the steps mentioned, additional improvement could still have been gained by the following measures:

# 2 NEW SERVICE AIDS . . .

# DESIGNED BY AND FOR YOU!



Open back view.

Open front and top views.

## New CBS-HYTRON Tube-and-Tool Caddy

Another Tube Caddy? Yes, but *you* service-dealers helped us design this one. Helped us throw out a dozen almost-right designs. Stayed with us until the CBS-Hytron Tube-and-Tool Caddy became *your* Caddy. Built the way *you* want it.

Your new Caddy has literally dozens of features . . . many unique. Here are only a few: *Roomy* . . . holds 218 tubes! Also all your necessary tools, small parts, volt-ohmmeter, flashlight, and reference data. *Compact* . . . functional design wastes not one inch of space. *Accessible* . . . everything in sight and reach. *Rugged* . . . strong, tip-proof — used safely as seat. *Test Mirror* . . . reversible for protection — mounted in cover supported by adjustable friction hinge.

Sorry, there's just not enough space to tell all. But *see* your new Caddy yourself at your CBS-Hytron distributor's. He has a red-hot deal for you. He'll show you how *amazingly easy* it is for you to own this unique CBS-Hytron Tube-and-Tool Caddy. See him today.

## New CBS-HYTRON Twin Pin Straightener

Ever wished you had a combination 7-Pin and 9-Pin Straightener? One that was handy, compact, light? But also a precision job, just like CBS-Hytron's original 7-Pin and 9-Pin Straighteners?

Here it is: The new CBS-Hytron Twin Pin Straightener, SH79. Same life-time, wear-and-corrosion-resistant steel dies. Same individually drilled, precision pin-circle holes. Same absence of guide-posts, permitting that final touch of sidewise straightening. The "Twin" is also roll-proof.

And the Twin is only 98¢ net. Get at least two . . . for pocket, tool kit, bench. Call your CBS-Hytron distributor today. Yes, he still has the famous individual CBS-Hytron 7-Pin and 9-Pin Straighteners at only 65¢ each net. Get them, too.

### CUTTING YOUR CALL-BACKS WITH CBS-HYTRON CTS-RATED* 5AW4 and 6CU6?

They're the most talked-about tubes in TV today. CBS-Hytron CTS-Rated 5AW4 and 6CU6 are both rated for dependable Continuous Television Service. Heavy-duty work horses, they replace the 5U4G and 6BQ6GT respectively.

Brand new designs, not just improved tubes, the 5AW4 and 6CU6 have big safety factors. Give you long . . . long trouble-free life. Loaf in those hard-working, heavily loaded rectifier and horizontal amplifier sockets . . . even in 21-inch jobs.

Start slashing your call-backs with these tubes right now. 5AW4 and 6CU6 are available only from your CBS-Hytron distributor. See him today. Ask for complete 5AW4 and 6CU6 data. Or write direct. Above all, don't let another day slip by without trying these wonderful, new CBS-Hytron CTS-Rated tubes.


*P.S.* Yes, more CBS-Hytron CTS-Rated tubes are coming. Watch for them.

*Rated for Continuous Television Service

CBS HYTRON

Manufacturers of Receiving Tubes Since 1921

**CBS-HYTRON** Main Office: Danvers, Massachusetts

*A Division of Columbia Broadcasting System, Inc.*

**A MEMBER OF THE CBS FAMILY:** CBS Radio • CBS Television • Columbia Records, Inc. CBS Laboratories • CBS-Columbia, Inc. • and CBS-Hytron

RECEIVING . . . TRANSMITTING . . . SPECIAL-PURPOSE AND TV PICTURE TUBES • GERMANIUM DIODES AND TRANSISTORS

(1) spacing the UHF lead-in farther from the mast and the house (seven-inch insulators should have been used throughout), (2) separating the UHF and VHF transmission lines by at least seven inches, and (3) installing individual feed-through insulators for each line in order to reduce the shunting effect at the entrance point in the iron grating. These measures would have provided additional signal at the receiver terminals and might have made the difference between a good or poor picture during adverse weather conditions.

In summarizing our field test at this position, it can be said that the signal strength was low. This had resulted in a general feeling among installers that a satisfactory picture could not be obtained in the vicinity. Our tests showed, however, that proper selection and positioning provided a usable signal and that even though the site was only eight miles from the transmitter, a higher gain antenna should have been used. The figures presented in the graphs show conclusively that a more satisfactory antenna would have been a stacked bow tie rather than the single unit. This brings up a very important point: that the distance from the transmitter to the installation point does not necessarily dictate the type of antenna which should be used. If additional pickup is required because of low signal strength, do not hesitate to use a higher-gain antenna.

The next test position which was selected is located just north of Virginia Beach and is identified on the map of Fig. 2 as position 2. Several installers had reported difficulty in making satisfactory installations in this vicinity. In checking a map, it was found that there is a state park located between the test location and the transmitter tower. This park has an abundance of tall trees, a great many of them being pine trees. Position 2 is approximately 20 miles from the transmitter tower.

Our first test was made using a single bow-tie antenna. We selected this particular antenna because it was to be used as a standard in many of our tests, even though we did not feel it would provide satisfactory operation at this position. The readings obtained during this test are shown in the graph of Fig. 6. The maximum relative reading obtained was 50, which was far below the minimum requirements for a snow-free picture.

We then installed parabolic reflectors on the single bow-tie antenna and recorded the readings shown in the graph of Fig. 6. Here again all readings obtained were below the minimum signal requirements. This proved conclusively that a higher-gain antenna would be required to overcome the weak signal condition.

The next test was made with a stacked bow tie. The results obtained were much more satisfactory. By referring to the graph of Fig. 6, it can be seen that a reading of 80 at approximately the 43-foot level was recorded. Further increase in antenna height produced a rise in signal strength in almost a linear fashion. We might point out here that at this test position the trailer was located on the cement driveway in front of a house the peak of which was approximately 50 feet high. With the elevation afforded by the roof top, it would not have been difficult to position a permanent antenna at a point where sufficient signal pickup could be achieved using a stacked bow-tie antenna.

Feeling that an even higher-gain antenna might be more satisfactory, we installed parabolic reflectors on the stacked bow-tie unit. With this unit we received an even greater signal pickup, and the results are shown graphically in Fig. 6. At the 43-foot level where the stacked bow-tie unit without reflectors had produced a reading of 80, we obtained a reading of 96, or an increase of 20 per cent. On the assumption that an antenna was to be permanently placed at this level, it would have been advisable to use the higher-gain antenna to overcome losses experienced during adverse weather conditions.

In order to check the performance of a side-by-side type of antenna, we conducted a test using a double-corner reflector. The results of this test, shown in the graph of Fig. 6, closely paralleled the performance of the stacked bow tie. Note, however, that between the 45- and 54 1/2-foot level the pickup exceeded that of the stacked bow-tie unit. This might be caused by the difference in vertical directivity between the two units. Except in this region of elevation, the pickup of the two units was essentially the same. This brings to mind the importance of considering the vertical directivity when selecting an antenna. In some cases a unit having sharp vertical directivity may be advantageous, while in other cases a unit having broad vertical directivity will be more desirable. There is no set rule, however, which can be used to determine which type will be better. Such a decision can be made only after actual tests are made.

The signal strength at this location was well suited for testing the merits of a specific type of antenna. With this in mind, we set about testing some all-channel antennas in order to determine their adaptability to this particular location. Two UHF units, one a corner reflector and the other a four-bay antenna with reflector, were tested. The results of these tests are shown in the graph of Fig. 7. The maximum readings were obtained at the 57-foot level; and since they were increasing rather consistently up to that point, it was very probable that a further increase in height would have produced a corresponding increase in signal pickup.

The next unit tested was an Amphenol Model 114-059 which is a stacked V-type antenna. This unit is designed for operation throughout the entire VHF and UHF bands. The graph in Fig. 7 shows the results of this test.

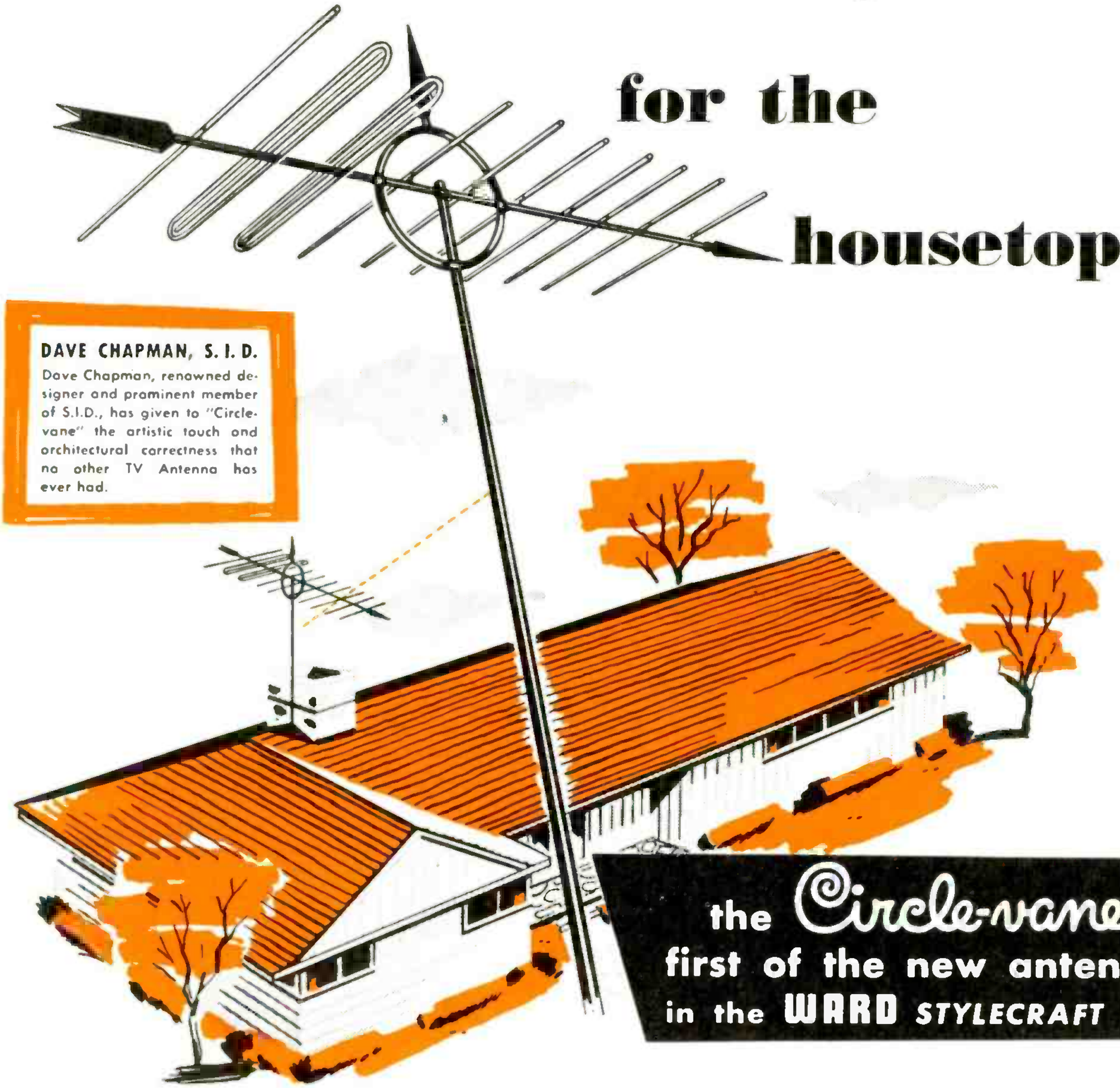
Shown graphically in Fig. 7 are the results of a test made using a Telrex Model 440 antenna. This unit is also designed for operation in the VHF and UHF bands.

In reviewing the last two tests it would appear that a combination VHF-UHF antenna would be desirable in any installation, but there are certain disadvantages in the use of the combination antenna. For instance, take the case where there is an existing VHF antenna. The small size of a UHF antenna causes it to be easily adapted to use on an existing VHF mast. If it can be so mounted, UHF reception can be provided with a minimum of cost to the owner. Also, in many cases it will be found that the most satisfactory location for the UHF antenna might not be practical for the VHF antenna on account of its large size. If the VHF antenna is to be used in connection with a rotator, it might be impossible to mount such a large unit at the point where the best UHF reception is obtained and still be able to rotate the unit. As an example, suppose the best UHF reception point were only a few inches above the peak of the roof. It would be impractical to mount a VHF-UHF antenna at this point. Under such conditions, it would be better to use two separate antennas.

Many receivers use built-in antennas for VHF reception, some-

* * Please turn to page 85 * *

# now . . . new beauty for the housetops



**DAVE CHAPMAN, S. I. D.**

Dave Chapman, renowned designer and prominent member of S.I.D., has given to "Circle-vane" the artistic touch and architectural correctness that no other TV Antenna has ever had.

## the Circle-vane first of the new antennas in the WARD STYLECRAFT LINE

Antennas, styled to the modern tempo . . . cleverly patterned to enrich the appearance of any house . . . expertly engineered to give finer pictures . . . skillfully designed by the famous Dave Chapman, (S.I.D.) . . . these new Ward Circle-vane Antennas complement the home and add dignified charm and beauty. Everybody, dealers and owners alike, have been waiting for "something new" in antennas — The new, finer Ward Circle-vane supplies the answer. The Ward Circle-vane is constructed of aluminum elements with a cross-arm of durable Permatube . . . Comes completely pre-assembled.

***Be first with this Ward FIRST in your territory. Order today.***

**THE WARD PRODUCTS CORP.**

*DIVISION OF THE GABRIEL COMPANY*

A GABRIEL PRODUCT

**1148 Euclid Avenue, Cleveland 15, Ohio • In Canada: Atlas Radio Co., Ltd., Toronto, Ont.**

Causes and Cures for

# the NARROW PICTURE

by Glen E. Slutz

"My picture has dark strips down each side."

"My picture is drawn in on each side."

"People look so tall and skinny, and the picture doesn't cover the whole width of the screen."

These are some common complaints voiced by set owners when narrow-picture troubles develop in their television receivers. Servicing one of these receivers may require only a slight readjustment of a rear chassis control or it may entail a more intricate servicing procedure depending on the origin of the trouble.

### *Misadjusted Service Controls*

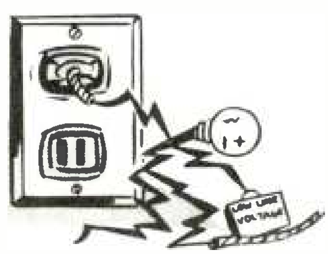
Probing, but tactful, questions by the service technician may draw from the customer certain helpful clues to the cause of the narrow-picture difficulty. It may be that a set owner is a "knob-fiddler" and finds himself unable to return the controls of his receiver to their proper settings. The service procedure in such a case would be to adjust the service controls to settings which produce a satisfactory picture and then to advise the set owner about those controls which he himself may vary without mishap and about those whose complexity of adjustment requires the attention of an experienced technician.

The controls which most often require resetting when the picture is too narrow are the width control, the horizontal-linearity control, and the horizontal-drive control. There is also the chance that the ion trap may be slightly out of place, thereby creating an off-centering effect on the picture. In addition, the centering control should be checked for proper adjustment.


Even though a satisfactory picture width can be attained simply by control adjustment, it is advisable to determine if possible how the picture narrowness developed. If it did not come about from "knob-fiddling" by the set owner, it may be a sign of weakening tubes or of some other defect making its appearance in the receiver. In case of weakening tubes or of a defect, merely readjusting the controls would provide only a temporary cure; and a "call-back" would be a probable consequence.

### *Low Line Voltage*

A set owner may volunteer information which will help the service technician in his diagnosis. For example, if the owner says that the narrowness in the television picture usually occurs at certain times of the day or night, the indication is that the voltage in the AC power lines may be varying and causing the trouble in the set. This condition is prevalent in rural districts where lines are long and where distribution transformers are far apart. Such a situation leads to poorer line-voltage regulation than in urban areas. The condition may also show up in congested business or industrial sections where heavy loads are placed on the power systems which supply such areas. At certain locations in these areas the line voltage may be above normal during portions of a 24-hour period, while at other locations the line voltage may be too low at times. Either situation interferes with the normal operation of a television receiver.



If it is established that a narrow picture is being caused by periodically low line voltage, a possible solution may be found through the use of a voltage-booster device such as the unit pictured in Fig. 1. This particular unit is the Regency VB-1 voltage booster. It consists of an autotransformer fitted with a tap switch for adjusting the output-voltage level. Two neon indicating lamps are incorporated in the unit to provide a quick visual method for properly setting the switch. In practice the switch is advanced until one of the neon lamps lights. At this setting, the output voltage is very nearly 117 volts. Then if the line voltage rises, both lamps light and the switch should be turned back until only one is lit. On the other hand, if the line voltage drops, both indicating lamps go out and the switch should be advanced until one of the lamps goes on.

The voltage booster which has been described is particularly useful in areas which are affected by abnormal line voltages for lengthy periods. In locations where line-voltage fluctuations occur at frequent intervals, constant adjustment would be required to maintain proper line voltage with this unit. In the latter locations a slightly more expensive voltage regulator can be employed. One such unit is the TeleVolt constant-voltage transformer made by the Sola Electric Company of Chicago, Ill. This transformer automatically maintains the voltage available to the receiver at a nearly constant level despite rapid fluctuations in the input voltage.

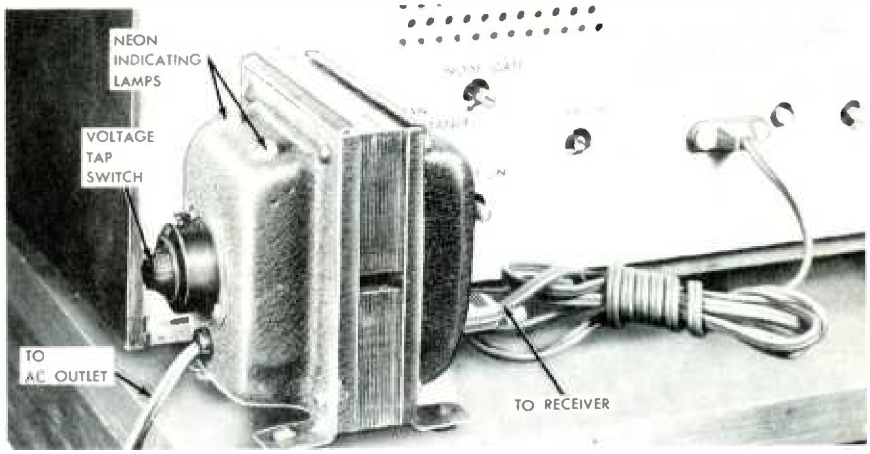



**Fig. 1. A Voltage Booster for Use in Areas Affected with Abnormal Line Voltages (Regency Model VB-1. Sample Courtesy of I.D.E.A., Inc.)**

### *Defective or Weak Tubes*

The next logical check is to substitute tubes in the circuits responsible for horizontal deflection. The horizontal-output amplifier is a common offender. The weakening of this tube is very often a direct cause of picture narrowing. If a weak output tube is found, good practice prescribes that a leakage check ought to be run on the input coupling capacitor to insure that the replacement tube will not be driven abnormally hard and thereby have its life shortened appreciably. Other tubes which should be checked are the horizontal oscillator, the damper, and the horizontal-discharge tube if used.

One other consideration about horizontal-output amplifiers before leaving this subject: in some receiver models (relatively few), the circuit used with the horizontal-output tube is critical to the point where one tube (out of several tried) may produce a wider picture than the others even though all the tubes are new and of the same type. When confronted with a critical circuit of this kind, use the replacement which gives optimum circuit performance.

### *Low B+ Supply Voltage*

If for some reason the low-voltage supply fails to furnish the horizontal-deflection system of a television receiver with enough B+ voltage, a narrow picture may result. Service literature usually sets forth normal values for the B+


supply voltages in a receiver. A quick check with a voltmeter will show whether the voltages in a particular receiver come up to normal. If below-normal voltages are detected, look for the following defects in the low-voltage supply:

a. The rectifier tube may be found to have low emission. This can be determined by means of a tube tester or by actual substitution of a new rectifier tube.

b. An electrolytic filter capacitor may have developed excessive leakage which will lower the voltage output of the supply. If this is suspected, disconnect the original capacitor and then connect a new unit in its place.

c. Should the set employ selenium rectifiers, their condition may be determined by using one of the commercially available selenium-rectifier testers or by actual substitution if replacement units are at hand.

### *Defective Components Other Than Tubes*

There is always the possibility that a defect or value change in some component other than a tube is contributing to a narrow picture. The width coil should be checked for a broken slug or for a slug which has been screwed completely out of position in the coil form. Shorted turns in a width coil will sometimes produce a narrow picture. If the width coil is suspected, substantiate this through substitution of a new coil.

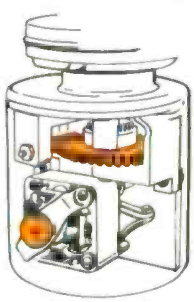
The screen grid of the horizontal-output tube is another point which warrants investigation. Insufficient screen voltage on this tube will decrease the amplification of the tube and may give rise to a narrowing effect on the picture. The components in the screen cir-

cuit should be checked if such is the case. The screen resistor may have increased in value from overheating or other causes, or there may be leakage through a bad screen by-pass capacitor. Another voltage check may be made at the plate of the horizontal-oscillator tube. Low voltage at this point could indicate either a defective resistor or a faulty capacitor in the plate circuit of this tube.

Bear in mind when making these voltage checks that they may not be conclusive if the voltage source for the check points is the boosted B+ supply; frequently a by-product of narrow-picture troubles is a below-normal boosted B+ voltage.

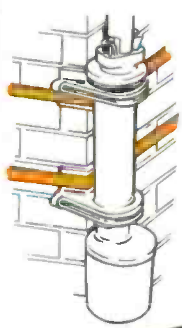
* * Please turn to page 95 * *


"TERRIFIC!" say TV servicemen — and you'll echo their words when you see the amazing new **Superotor**. Imagine — a drive unit as easy to replace as a light bulb! Strictly a one-man job! No fussin', no cussin', — no need to dismount the antenna — no need to interrupt TV viewing while the drive unit is being serviced. Great? Yes! — and this is just one of FIVE major advances that put **Superotor** years ahead of anything on the market. No wonder the big switch is to **Superotor**!



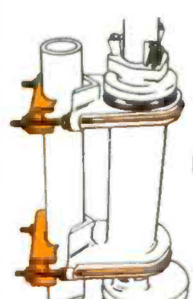
- **Double Lock Stop Prevents Drift & Coast**

A Leader FIRST



- **Built-in Chimney Mount Design**

A Leader FIRST



- **Steel Reinforced Construction**

A Leader FIRST

**VP* Tuning**

*Vernier Precision

A Leader FIRST

Patent Applied for

Copyright

**Leader ELECTRONICS INC.**

2925 EAST 55th ST., CLEVELAND 27, OHIO

... LEADING THE WAY TO BETTER PRODUCTS

# COMPATIBLE COLOR TV

## A Description of the Color-Picture Signal, Its Formation at the Transmitter, and Its Utilization by the Color Receiver

by C. P. Oliphant

### Part II

Sometime in the near future, the service technician will be faced with the task of servicing color-television receivers. This will be true if the NTSC (National Television System Committee) compatible-television standards, which are now before the FCC (Federal Communications Commission), are approved. To install and service color receivers designed for reception of the NTSC color signal, the service technician will have to become familiar with the operation of many new circuits. The proposed color receiver contains a larger number of stages than the receiver now used for black-and-white reception. Therefore, servicing of the color receiver will be more difficult.

To help familiarize the service technician with the way in which the NTSC color signal is utilized in the color receivers, the following discussion has been prepared. The response of the receiver to the color signal can be more fully understood with a knowledge of what the transmitted signal consists and how it is generated. Therefore, this subject will be covered before entering the discussion of the color receiver.

### *Color-Picture Signal*

The picture information in the NTSC color system is transmitted by combining two simultaneous signals. First of these is the monochrome (luminance) signal which carries the over-all brightness of the picture. This signal is very much the same as the monochrome signal being used for the transmission of the conventional black-and-white picture. Therefore, the monochrome portion of the color signal is capable of producing a black-and-white picture on the monochrome receivers. The other signal is the chrominance signal which supplies all the coloring information. Both the monochrome and chrominance signals are derived by proportionately mixing three voltages obtained from the red-, green-, and blue-signal outputs of the color camera. These three voltages are designated as $E_R$, $E_G$, and $E_B$, respectively.

The monochrome signal voltage, which is designated by $E_Y$, contains the three camera-output voltages in definite proportions according to the visual luminance of each color. The expression for this signal is:

$$E_Y = 0.30E_R + 0.59E_G + 0.11E_B \qquad (1)$$

The proportionality value of each color voltage in the monochrome signal was determined through extensive experimenting by the NTSC. Each color contributes 30, 59, and 11 per cent, respectively, of the total luminance of the monochrome signal. The addition of the three numerical factors is equal to unity. The system is so proportioned that whenever $E_R = E_G = E_B$ white (no color) is produced. Therefore, under the condition of white light, equation 1 becomes $E_Y = E_R = E_G = E_B$.

There are two important factors that are necessary in transmitting color. The first is that information must be transmitted with a minimum of redundancy. That is, only information that is absolutely necessary for the accurate reproduction of the color picture at the receiver need be transferred to the communication channel. The second factor is that the transmitted information can exclude that which the human eye does not register. The red, green, and blue components of the televised scene contain both luminance and color information. For the purpose of making the NTSC system compatible, the luminance is contained in the monochrome signal. When transmitting the chrominance signal, it would be redundant to transmit the luminance of each of the three colors along with the color information. Therefore, when forming the chrominance signal, the luminance of each individual color is removed. The process of removing the luminance is by actually subtracting it from each of the red, green, and blue color signals. This results in producing three signals which represent red minus luminance, green minus luminance, and blue minus luminance. These are denoted as $E_R - E_Y$, $E_G - E_Y$, and $E_B - E_Y$ with $E_Y$ being equal to the monochrome signal (equation 1).

The three foregoing signals plus the monochrome signal make up four pieces of information which would be necessary for transmission of the color-picture signal. However, it has been determined by the NTSC that it is not necessary to transmit four pieces of information. The signal $E_G - E_Y$ representing the green portion of the scene can be obtained at the receiver by a mixture of $-0.51(E_R - E_Y)$ and $-0.19(E_B - E_Y)$. Therefore, the complete color-picture signal consists of portions representing $E_R - E_Y$, $E_B - E_Y$, and the monochrome signal $E_Y$. The derivation for obtaining $E_G - E_Y$ is shown below. *

The chrominance information is contained in two separate signals called color-difference signals. These signals are designated as $E_Q$ and $E_I$ and are derived from the three voltage outputs of the camera.

*The mixture is $-0.51(E_R - E_Y) - 0.19(E_B - E_Y)$. Substituting the value of $E_Y$ as given by Equation 1, we obtain:

$$-0.51(-0.59E_G + 0.70E_R - 0.11E_B) - 0.19(-0.59E_G - 0.30E_R + 0.89E_B)$$

$$= 0.41E_G - 0.30E_R - 0.11E_B$$

$$= E_G - (0.59E_G + 0.30E_R + 0.11E_B)$$

$$= E_G - E_Y.$$

"I want to read zero center"

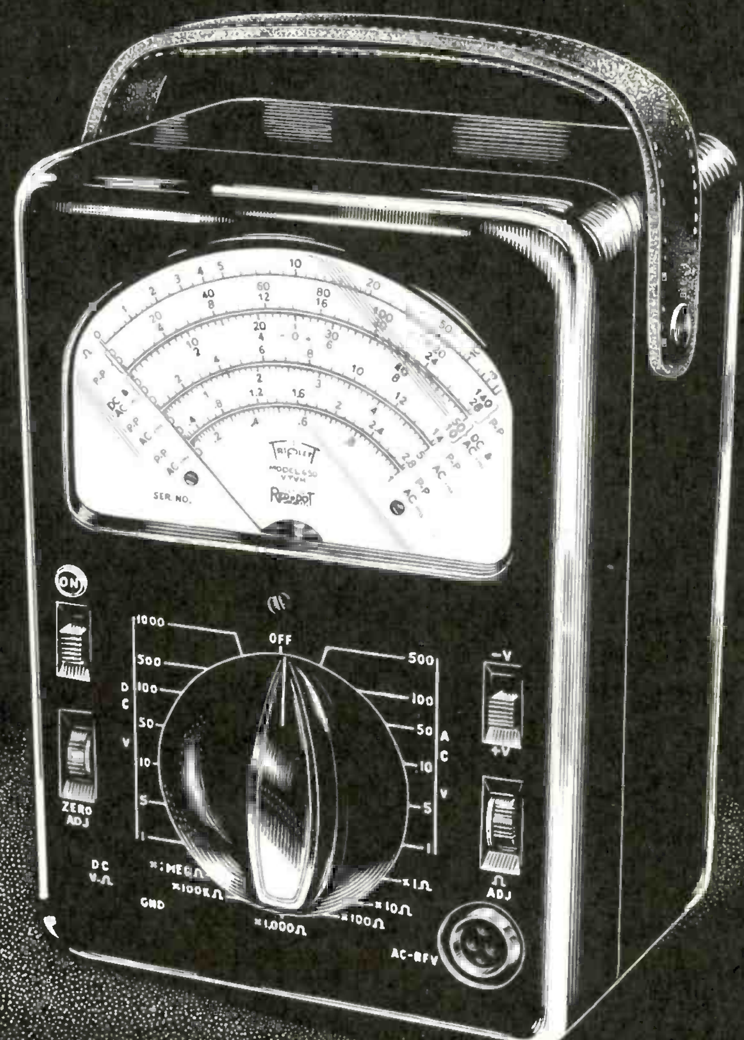
"How about reading up to 110 megacycles RF?"

"Can I read peak to peak direct?"

"Can I read 1 volt full scale, AC and DC?"

*You can with*

TRIPLETT 650 VTVM




## This combination of features explains why

- Complete frequency coverage with one probe, 20 cps to over 110-mc. Insulated and shielded RF tube probe, found usually only with laboratory instruments, is included.
- Peak to Peak ACV and RF with one probe.
- One volt full scale reading on AC & DC.
- One main selector switch, all ranges.
- ACrms—Peak to Peak
- 32 Ranges
- Zero center mark for FM discriminator alignment plus any other galvanometer measurements.
- High input impedance 11 megohms on DC.

**Suggested U.S.A. Dealer Net $69.50**

TRIPLETT

TRIPLETT ELECTRICAL INSTRUMENT CO., BLUFFTON, OHIO

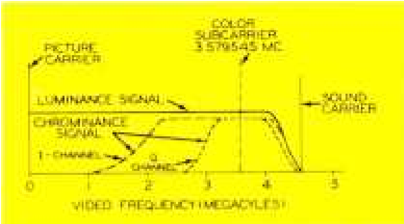



**Fig. 1. Color-Picture-Signal Passband.**

$E_Q$ and $E_I$ are used as separate modulations of the color subcarrier with a frequency of 3.579545 megacycles.

The expressions for the two color-difference signals as specified by the NTSC are:

$$E_Q = 0.41(E_B - E_Y) + 0.48(E_R - E_Y) \quad (2)$$

$$E_I = -0.27(E_B - E_Y) + 0.74(E_R - E_Y) \quad (3)$$

After substituting values for the monochrome signal $E_Y$ of equation 1, equations 2 and 3 become:

$$E_Q = -0.52E_G + 0.21E_R + 0.31E_B \quad (4)$$

$$E_I = -0.28E_G + 0.60E_R - 0.32E_B \quad (5)$$

Each of the three colors are contained in both color-difference signals as to definite magnitudes which are needed for proper reproduction of the televised scene. The coefficients of each color voltage have been derived by the NTSC through extensive experimenting. Both $E_Q$ and $E_I$ are expressed with absence of the luminance of each primary color.

The color-difference signals are combined with the monochrome signal to form the complete color picture signal $E_M$ whose equation is:

$$E_M = E_Y + \left[E_I\cos(\omega t + 33°) + E_Q\sin(\omega t + 33°)\right] \quad (6)$$

The color subcarrier is modulated in amplitude and phase by the color-difference signals in such a way that the instantaneous amplitude of the subcarrier is proportional to the product of the luminance and purity for a picture element, while the phase of the subcarrier is proportional to the dominant wavelength of the picture element. Rather than get involved in definitions of such terms as luminance and purity, let us say that the product of the luminance and purity for a picture element determines the degree of color saturation. The dominant wavelength of the picture element determines the hue — whether it is blue, red, green, or the like.

Vestigial sideband transmission of the color-picture signal is employed in the NTSC system. Color receivers will attenuate signals which lie more than 4.2 megacycles above the carrier frequency; therefore, the sidebands of the subcarrier will remain double only for modulating frequencies below 0.6 megacycle. Modulating frequencies above 0.6 megacycle will be available in single-sideband or vestigial-sideband components. Modulating frequencies up to 0.6 megacycle are contained in the $E_Q$ signal, while frequencies above 0.6 megacycle are contained in the $E_I$ signal. The equivalent bandwidths assigned to the color-difference signals prior to modulation are given by the following table:

Q-Channel Bandwidth

At 400 kc less than 2 db down
At 500 kc less than 6 db down
At 600 kc at least 6 db down

I-Channel Bandwidth

At 1.3 mc less than 2 db down
At 3.6 mc at least 20 db down

The color-picture signal passband that is applied to the radio-frequency transmitter is shown in Fig. 1. It shows the relationship of the sidebands of the color signal to the color subcarrier.

## *Formation of the Color-Picture Signal*

A block diagram of the video section of a color-television transmitter is shown in Fig. 2. It shows the stages that are necessary to form the three voltages $E_Y$, $E_Q$, and $E_I$ which make up the color-picture signal $E_M$.

The color camera picks up the three primary colors of the televised scene and forms in its output three voltages representative of the colors. The camera voltages $E_R$, $E_G$, and $E_B$ are then fed to the matrix unit. Here they are porportionately mixed to form the monochrome and color-difference signals. The expressions for these signals are shown at the output of the matrix unit. These expressions have been discussed previously.

After being formed in the matrix unit, each signal is passed through a bandpass filter to limit the bandwidth to the values recommended by the NTSC. The filter for the monochrome signal $E_Y$ is designed to provide a bandpass of 0 to 4.2 megacycles. The $E_Q$ signal is limited to a bandwidth of 0 to 0.6 megacycle and the $E_I$ signal, to a bandwidth of 0 to 2 megacycles.

The monochrome signal passes directly to the output and the color-difference signals are applied to individual balanced modulators. Here the color-difference signals modulate independent carriers. Balanced modulators are employed for each signal so that only the sidebands resulting from the modulation processes are transmitted. $E_I$ modulates a carrier $\cos(\omega t + 33°)$ while $E_Q$ modulates a carrier $\sin(\omega t + 33°)$. The carrier is generated by the color subcarrier oscillator at a frequency of 3.579545 mc. The carrier, $\sin(\omega t + 33°)$, is fed directly to the balanced modulator for the $E_Q$ signal where it is modu-

* * Please turn to page 105 * *

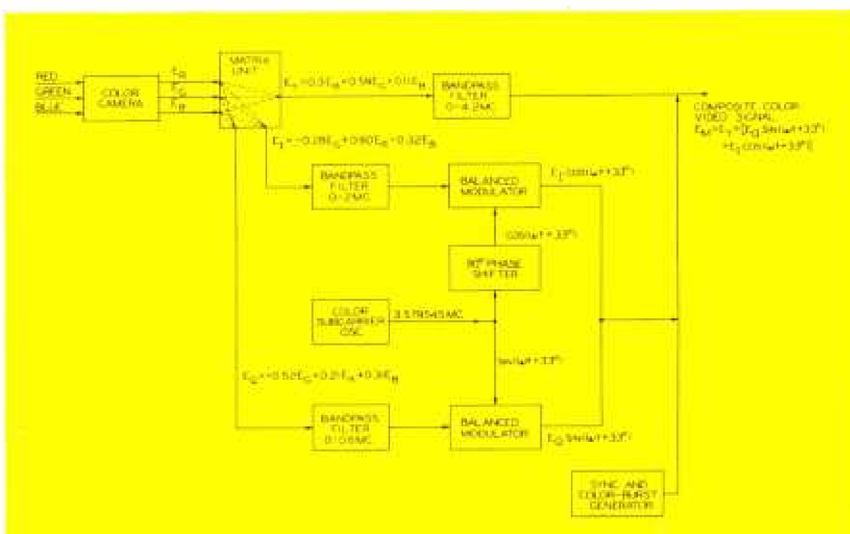
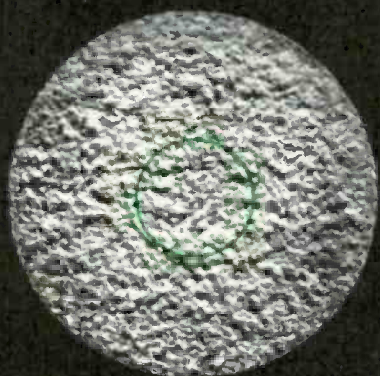



**Fig. 2. Block Diagram of Video Section of a Color-TV Transmitter.**

# Decide on DuMont

## on the basis of...

## *Product Superiority*



Microscopic look at the cathode surface reveals soft, even texture, necessary for efficient tube performance

*not too wet, not too dry—*
*not too light or heavy...*


THE CATHODE plays an important role as source of electron energy in the picture tube. Moisture content and texture of the cathode coating must meet rigid standards to insure maximum picture tube life.

At Du Mont, exclusive processes are used for applying the cathode substance. The soft even texture achieved (see illustration) packs the effective emitting area (in circle) with extra electron power.

The resulting brighter performance over maximum tube life tells you why Du Mont is the right replacement for any set.

*Trade-mark

REPLACEMENT SALES, CATHODE-RAY TUBE DIVISION • ALLEN B. DU MONT LABORATORIES, INC., CLIFTON, N.J.

A PF INDEX UHF COVERAGE

# A description of circuits and equipment for Ultra High Frequency reception.

by GLEN E. SLUTZ

## UHF Converter and VHF Booster Astatic Model CB-1

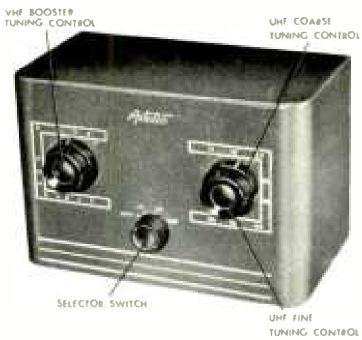



Figure 1. The Astatic Model CB-1 Converter-Booster

Serving both as a booster and as a UHF converter, the Astatic Model CB-1, shown in Fig. 1, combines these functions in a single unit. The selector switch on the front panel has positions labeled OFF, LO, HI, and UHF. These indicate positions for off, low VHF-band, high VHF-band, and UHF operation. In the two VHF positions, the unit functions as a booster; while in the UHF switch position, it operates as a converter. Any television receiver tuned to channels 4, 5, or 6 will accept the converter output satisfactorily.

Three front-panel controls are incorporated in the Astatic CB-1. The one on the left tunes channels 2 through 6 in the LO-VHF band and channels 7 through 13 in the HI-VHF band. The control on the right continuously tunes channels 14 through 83 during UHF-converter operation. The center of this knob operates a vernier with approximately a 5-1/2-to-1 reduction for fine tuning of the UHF channels. The control in the center of the front panel is the function-selector switch.

The various types of operation available in the Astatic CB-1 are portrayed by the block diagram of Fig. 2. A complete schematic of the unit is shown in Fig. 5. In the OFF position of the selector switch, all power is removed from the unit; and the VHF antenna terminals, lettered E and F on the chassis, are connected through the switch directly to the output terminals A and B which supply the signal to the television receiver. In the LO- and HI-VHF positions of the switch, power is applied to all the tube heaters and to the plates of those tubes associated with booster operation. The 6T4, UHF oscillator does not receive plate voltage in these switch positions; therefore it remains inoperative. The switch also connects the VHF antenna to the input of the booster section, and the output terminals are tied to the output of the booster. In going from LO-VHF to HI-VHF, the switch selects the appropriate taps on the tuning coils in the booster section to provide the necessary band change.

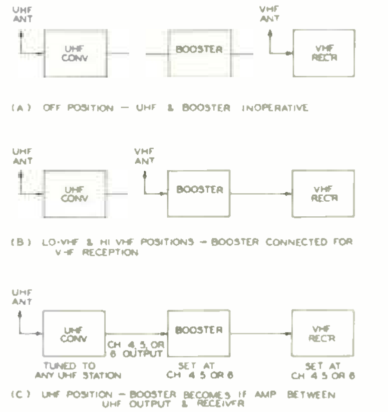



Figure 2. Block Diagram Illustrating Function of Selector Switch in Astatic Model CB-1.

In the UHF position, power is applied to the complete unit and the switch acts to connect the UHF section to the booster section so that the booster, in effect, acts as a two-stage IF amplifier for the converter output. The switch also selects the proper coil taps for IF-amplifier performance in the range of channels 4, 5, and 6.

VHF input to the Astatic CB-1 may be through 300-ohm balanced line or through 75-ohm coaxial line. An input of 300 ohms is provided for connection to the UHF antenna. The output impedance of the converter-booster may be either 300 ohms or 75 ohms.

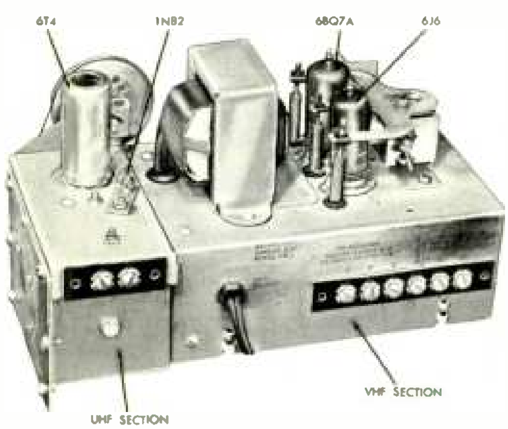



Figure 3. Top and Rear View of Astatic Model CB-1 Chassis.

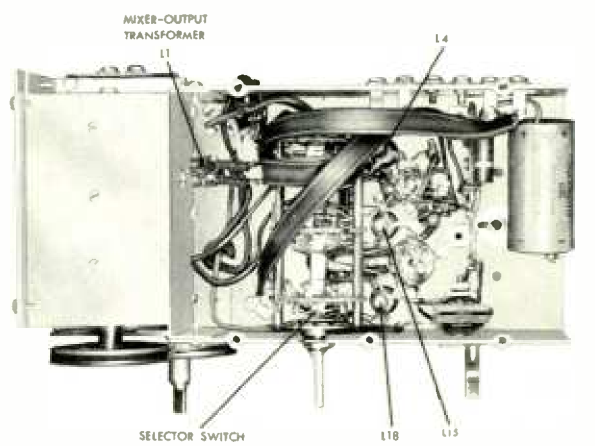



Figure 4. Bottom Chassis Layout of Astatic Model CB-1.

# FREE—your Choice of
## NEW PHONO-CARTRIDGE CARRY-KIT or DISPLAY-DISPENSER


Handy All-Metal Carry-Kit Holds 6 E-V Cartridges

Complete E-V Interchangeability Chart on both sides makes servicing positive and easy

**PLUS**
WINDOW or DOOR DECAL


**PLUS**
REVISED SET-MODEL REPLACEMENT GUIDE


6-Cartridge Metal Display Dispenser for Wall or Shelf

Each E-V Cartridge in Two-Tone Jewel-like Golden Yellow Plastic Box

# 10,000,000
## PHONOGRAPHS ARE WAITING TO BE SERVICED

*Get your share with these E-V aids to sales!*

*Again* E-V gives you a positive profit-maker—and helps make *you* the authority on Phono-Service in your community!

*Free* of extra cost, from your E-V Distributor, you can get your choice of new Cartridge Carry-Kit or Display Dispenser *plus* professional Decal and up-to-date set-model Replacement Guide, with *every* purchase of *any* 6 E-V Phono Cartridges.

Furthermore, the new E-V high output, high compliance, permanent Ceramic Cartridges revolutionize servicing. They are *not* affected by moisture or heat—can be carried in your service kit or kept on display without fear of deterioration. *And they are directly interchangeable with silent-needle type crystal cartridges that do not use a thumb screw*—yet cost no more than crystal. They are part of the famous E-V Basic 6 Preferred Types that make over 92% of all cartridge replacements.

Take advantage of this offer now! Make money selling cartridge replacements. Cash in on the $70,000,000 phono-cartridge modernization replacement market.

For a limited time only.

SEE YOUR E-V DISTRIBUTOR TODAY

**Electro-Voice**

BUCHANAN, MICHIGAN

*Export: 13 E. 40th St., New York 16, U.S.A., Cable: Arlab*

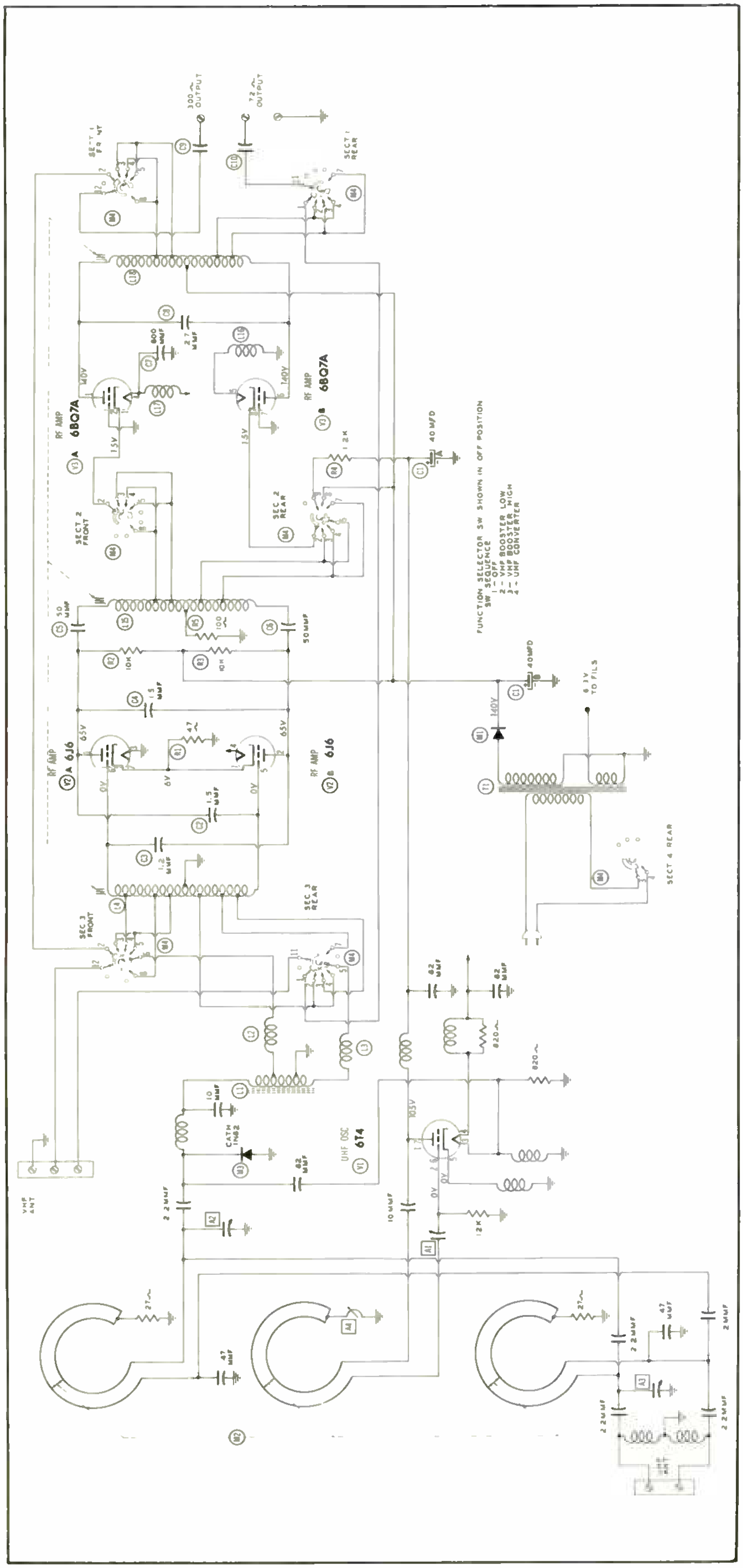


Figure 5. Schematic of Astatic Model CB-1.

By reference to the top view in Fig. 3 and to the bottom chassis photograph of Fig. 4, it may be seen that this unit is constructed in two sections. The section on the left contains the UHF preselectors and oscillator. The VHF booster portion and the power supply are found in the section to the right. The VHF section employs a 6J6 and a 6BQ7A as push-pull, wide-band amplifiers. It is interesting to note that the triodes of the 6BQ7A are operated as grounded grid amplifiers to improve the signal-to-noise ratio. Tuning of the booster stages is accomplished by the use of three-ganged tuning slugs operated by the VHF tuning control.

The UHF section uses three-ganged, concentric, resonant lines in conjunction with a 6T4 oscillator and a silicon diode mixer 1N82. Two of the resonant lines are utilized as preselector stages; the third is used to control the oscillator frequency. Output of the oscillator is taken from the filament of the 6T4 in order to reduce loading effects on this stage.

One other interesting feature in the Astatic CB-1 is that the output appears to have a direct short circuit across it when the function switch is in the HI-VHF position. This is not actually the case, however, since the output impedance is furnished by the distributed inductance in the leads to the switch.

### *UHF Converter Silverline Model 63A*

The UHF all-channel converter, Silverline Model 63A shown in Fig. 6, is manufactured by the General Instrument Corporation of Elizabeth, New Jersey. This unit converts the UHF signal to a frequency which can be received on either a channel 5 or channel 6 setting of the television receiver. The choice of 5 or 6 depends upon which of these channels happens to be unoccupied in the particular operating location.

Two front-panel controls are employed in the Silverline Model 63A: a function selector switch with OFF, VHF, and UHF positions indicated and a tuning control. The unit features a straight-line frequency dial calibration which eliminates bunching of the higher channels and consequently eases the problem of tuning in this portion of the spectrum.

In using this converter, the television receiver may be connected so

* * Please turn to page 109 * *


TOWN
Simpson
MODEL 488 FIELD STRENGTH METER
Saves service time in TV antenna installation—makes service profits longer....Whether installation is fringe in the hills or in the bounce-filled canyons of the city, Model 488 gives you the best location quickly, accurately....Location of maximum signal areas, antenna orientation, comparison of antenna systems, adjustment of boosters and checking antenna and lead-in installations are only a few of the many functions of Model 488.
You're losing profits without one....Dealer's net price including operating instructions and shoulder strap, $115.00
See your jobber for full information or write Simpson Electric Company, 5200 West Kinzie Street, Chicago 44, Illinois. Phone EStebrook 9-1121.
In Canada: Bach-Simpson, Ltd., London, Ont.
Another reason why Simpson is the world's largest manufacturer of test equipment
Simpson
TV FIELD STRENGTH METER
CHANNEL SELECTOR
12 13 2 3 4 5 6 7 8 9 10 11
Country

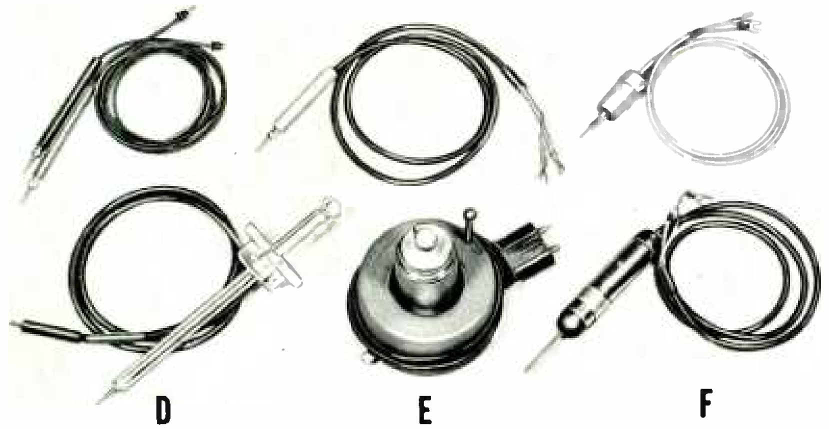



Fig. 1. Typical Test Probes (A) Test Leads (B) Isolation (C) Audio Tracer (D) High Voltage (E) Capacitive-Voltage Divider (F) High Impedance.

# TEST PROBES

*Descriptions and Applications of the Various Types of Probes Used in Service Work*

by DON R. HOWE

Every progressive service technician is interested in ways to improve his servicing techniques. One improvement which should not be overlooked is the correct use of test probes. These probes allow tests to be made which ordinarily could not be accomplished with the test instrument alone. These additional tests tend to provide for quicker and more efficient servicing. The following probes are representative of the types found in the service shop. The first group is shown in Fig. 1.

## Test Leads

Test leads are a form of probe used most often by the service technician. Their function is strictly a mechanical one, that of connecting the test instrument to the circuit under test. Although these leads may vary in appearance, their function is the same and need not be elaborated upon. However, the use of other forms of test probes is not so readily apparent, so we shall investigate these in detail.

## Isolation Probes

Isolation probes are used in conjunction with the DC-VTVM. Their function is both mechanical and electrical. The electrical function is performed by a 1-megohm resistor placed in series with the hot test lead. Construction details are shown in Fig. 2B. This resistor prevents interaction between the circuit under test and the voltmeter, hence the term "isolation." This isolation resistor also reduces the effect of capacitance from the test lead and the operator's hand. In sensitive circuits, erroneous readings may result because of the loading of the circuit by the DC-VTVM. The isolation probe tends to reduce this effect.

## Audio-Tracer Probes

The audio-tracer probe is illustrated in Fig. 1C and is shown schematically in Fig. 2C. This type of probe is used in conjunction with a pair of headphones or an audio amplifier. The audio-tracer probe allows the checking of audio circuits by aural means and consists of a capacitor placed in series with the test prod. This capacitor blocks any DC voltage present in the circuit but allows the passage of audio signals. This probe is often used for quick checks of points where sufficient signal is present to operate the headphones or amplifier.

## High-Voltage Probes

With the advent of television and its associated high voltages, it has become necessary for the service technician to possess equipment to measure these voltages. Very few voltmeters have the ability to do this; however, the use of a high-voltage probe extends the range of the voltmeter to a point sufficient for the measurement of voltages up to 30 kilovolts and more. This is a very good example of how test probes may contribute to the versatility of test equipment. The main parts of this probe are shown in Fig. 2D. They consist of a resistor located in an insulated handle. The resistor is in series with the voltage-divider network in the DC voltmeter, in order that the voltage input to the meter will be of low enough value to be easily accommodated. If this probe was designed to measure 30 kilovolts on a 300-volt scale, the resistor would have to drop 27,700 volts at maximum deflection of the meter.

These probes are constructed in such manner as to prevent arcing of the resistor and shocking of the user. Specially made resistors in conjunction with special insulating materials are required for this application. The safety flanges prevent possible burns from corona discharge in addition to protection from accidental contact with high-voltage circuits. The value of the dropping resistor is dependent upon the type of meter with which it is used.

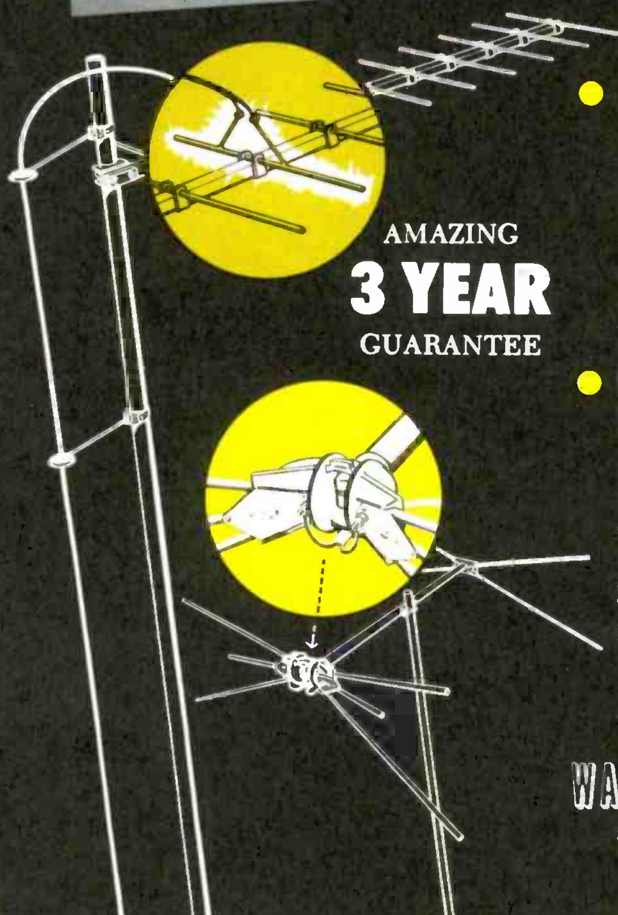
## Capacitive-Voltage-Divider Probes

A capacitive voltage-divider probe may be used with an oscilloscope to view waveforms of large amplitudes, or it may be used in conjunction with an AC meter for the measurement of high-voltage pulses. This probe could be used advantageously to make measurements at the plate of the horizontal-output tube. A probe of this type is exemplified by the one shown in Figs. 1E and 2E. This particular probe is designed to measure voltages up to 25 kilovolts rms. The probe illustrated is used primarily for laboratory applications but is indicative of the wide variety of probes available.

By examining Fig. 2E, we see that the voltage divider consists of a 15-mmf capacitor in series with three capacitors totalling 15,000 mmf. This gives a voltage division of 1,000:1.

It is interesting to note the mechanical construction of this probe. The 15-mmf capacitor is a vacuum capacitor with a very high voltage rating. One terminal of this capacitor furnishes the connection for the high voltage. A spark gap is provided to prevent damage to the divider from excessively high voltage.

# DISCOVER WHAT GOLD AND 2 INCHES OF AIR DO FOR 2 NEW WALSCO ANTENNAS




● **NEW WALSCO GOLD DIPOLE YAGI** *(UHF)*

No less than *24 kt. gold* plating on the receiving dipole of this great, new, 10 element Yagi. Why *gold?* Because *gold* resists corrosion better than any other metal... and *gold* is an excellent conductor. Like the most powerful *radar* antennas, the Walsco *Gold* Dipole Yagi guarantees *permanent* high gain in any location, under all weather conditions. It's custom-made for each location. The *only* Yagi that carries a *3 year* unconditional guarantee! And it costs no more than conventional Yagis.

● **NEW WALSCO IMPERIAL CONICAL** *(VHF)*

Here's the first radical improvement in Conicals. A new insulator which utilizes "barrier discs" and *2 inches of air space* between the terminals prevents "shorts." Soot deposits, dirt, moisture, salt, etc., *cannot* affect the insulator. This great, new Conical will therefore maintain high gain performance under any and all weather conditions. Front-end hardware is *stainless steel* to prevent corrosion losses permanently. Takes only 2 minutes to assemble because there's no loose hardware. Nothing compares to the Walsco Conical at any price ...and it's backed by the *only* 3 year unconditional guarantee!

*Write for complete information*

**WALSCO ELECTRONICS CORPORATION**

3602 Crenshaw Boulevard, Los Angeles 16, California

Such an elaborate probe is seldom required in the ordinary shop, but capacitive voltage-divider probes could be constructed for circuits containing much lower voltages. If such a project is contemplated, high quality components should be used. The presence of resistance in the probe could cause an integration or differentiation of the waveform.

### *High-Impedance Probes*

Oscilloscopes are often used to investigate the operation of high-impedance circuits. It then becomes necessary for the test instrument to offer a high resistance and low capacitance to these points in order that the circuit remain as normal in operation as possible. The high-impedance probe meets these requirements very nicely. The variable capacitor $C_1$ in Fig. 2F is adjusted to compensate for the input capacitance of the oscilloscope, which capacitance is usually 30 to 60 mmf. This adjustment is accomplished by injecting a square wave into the scope through the probe and adjusting the capacitor for minimum distortion of the waveform.

The high-impedance probe is practically a necessity in trouble shooting synchronizing circuits. A slight disturbance of these circuits may result in misleading information. It is therefore necessary to use a probe which will have a negligible loading effect. This characteristic is exhibited by the high-impedance probe. The output of the video amplifier is very susceptible to the effects of shunt capacity, and therefore the high-impedance probe is recommended for use with the oscilloscope in this application.

Attenuation of the input signal is one of the undesirable features of this probe. This means that the high-impedance probe can only be used in circuits having considerable signal strength. The use of the probe in the video amplifier and sweep circuits of a television receiver is possible because these stages provide a signal of adequate strength.

### *Detector or Demodulator Probes*

Detector probes used in conjunction with a VTVM allow the reading of RF voltages present in television and radio receivers. See Fig. 3. The voltage indicated will be the peak voltage and not the rms value. Signal tracing with the oscilloscope is also possible with the use of this probe.

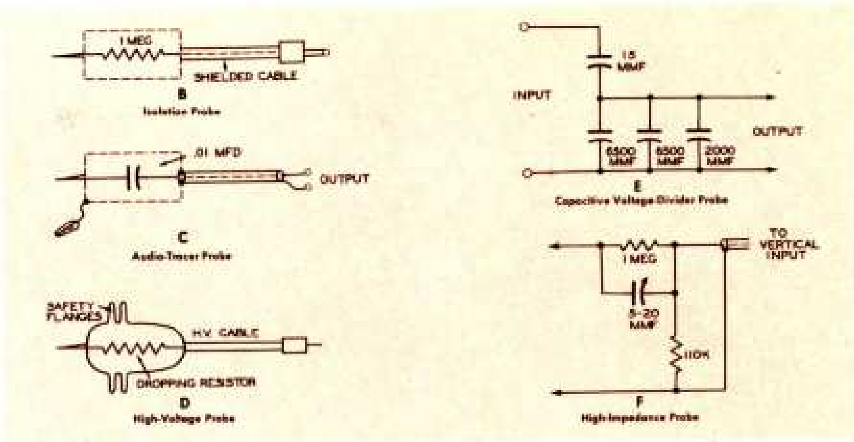



**Fig. 2. Schematic Diagrams of Several Test Probes.**

This type of probe may be divided into two general classifications: those employing germanium crystals and those using vacuum tubes. Although the principle of operation remains the same, each type has its advantages.

The crystal probe illustrated in Fig. 4A does not require heater voltage, is more compact, and is free from contact potential. Its limiting factor is indicated by the maximum RF voltage to which it may be subjected. For a 1N34 crystal, this voltage is approximately 29.97 peak volts.

The vacuum-tube probe is characterized by its large size, heater requirements, and its contact potential. Its advantage lies in its ability to handle higher voltages than those of the crystal.

The function of the circuit is one of rectifying the RF voltages in order to offer a DC voltage to the VTVM.

Detector probes utilizing vacuum tubes require some method of compensating for the no-signal current due to tube emission. One method utilizes a small 1.5 volt battery in conjunction with a potentiometer to accomplish this. Another method uses a diode section to provide the bucking voltage. By referring to Fig. 4B, it may be seen that the first section of the 6H6 is the rectifying diode. Emission current in the second diode flows through resistor $R_1$, setting up a voltage across it. This voltage is the bucking voltage and cancels the no-emission current of the first diode section.

Reading RF voltages is a definite advantage in the servicing of RF and IF sections of receivers. These probes are the type frequently used with signal tracers.

By applying a modulated RF signal to the input of a receiver, circuit tracing may be accomplished by the oscilloscope and the demod-

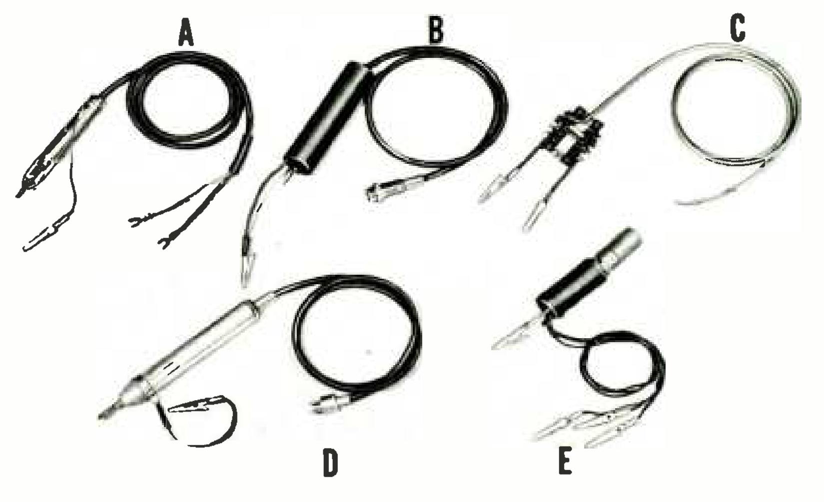
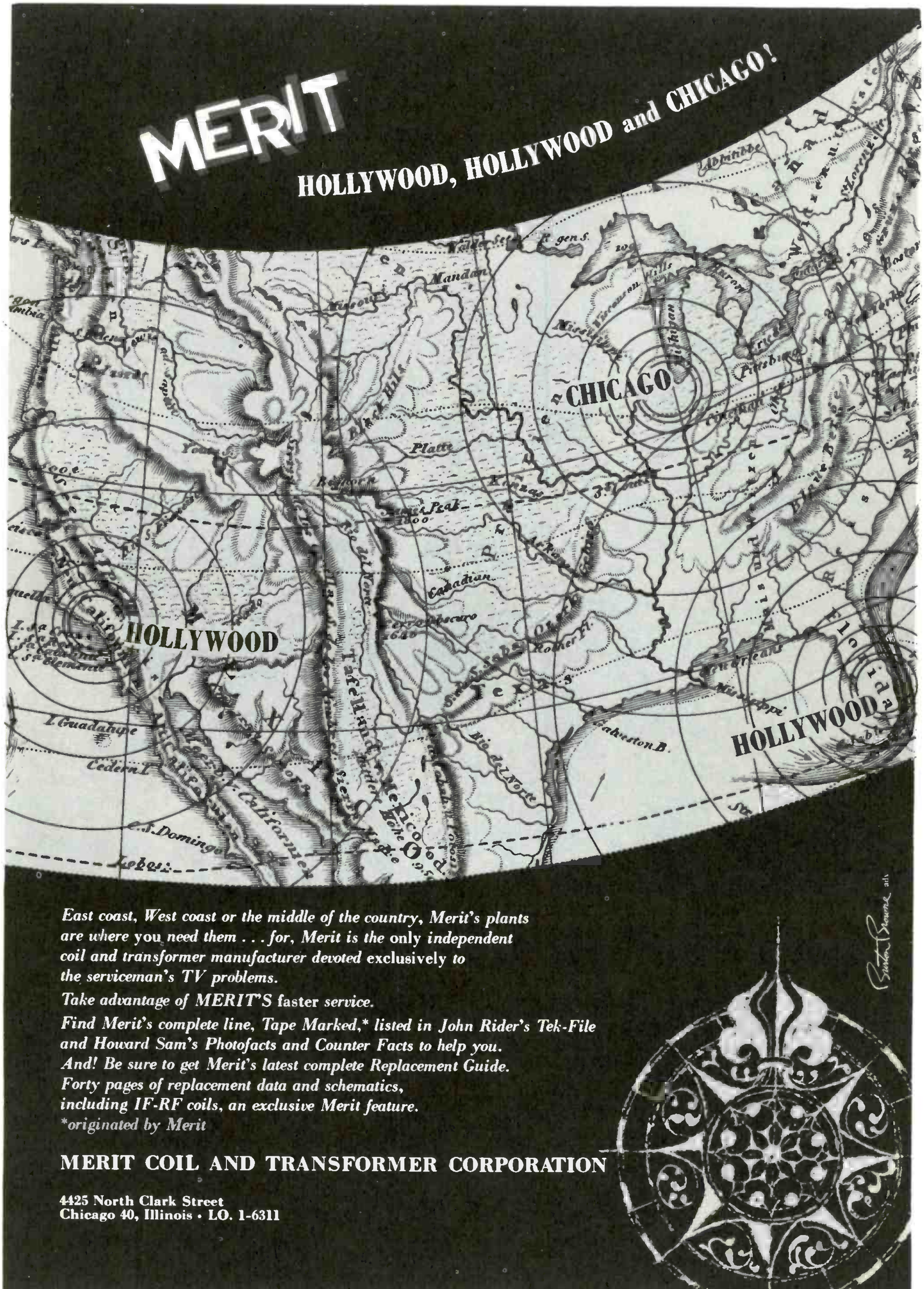



**Fig. 3. Typical Test Probes (A) Crystal Detector (B) Self-Bucking Detector (C) Balanced-Input Detector (D) Grid-Leak Detector (E) Cathode Follower.**



MERIT
HOLLYWOOD, HOLLYWOOD and CHICAGO!
CHICAGO
HOLLYWOOD
HOLLYWOOD
East coast, West coast or the middle of the country, Merit's plants are where you need them . . . for, Merit is the only independent coil and transformer manufacturer devoted exclusively to the serviceman's TV problems.
Take advantage of MERIT'S faster service.
Find Merit's complete line, Tape Marked,* listed in John Rider's Tek-File and Howard Sam's Photofacts and Counter Facts to help you.
And! Be sure to get Merit's latest complete Replacement Guide.
Forty pages of replacement data and schematics, including IF-RF coils, an exclusive Merit feature.
*originated by Merit
MERIT COIL AND TRANSFORMER CORPORATION
4425 North Clark Street
Chicago 40, Illinois • LO. 1-6311

CHART 1

A Guide for Using Test Probes

| TYPES OF PROBES | USED WITH | RADIO APPLICATIONS | TV APPLICATIONS | ADVANTAGES |
|---|---|---|---|---|
| Isolation Probe | DC-VTVM | Used for DC measurements | Used for DC measurements | Permits measurement of sensitive circuits by reducing loading by VTVM |
| Audio-Tracer Probe | Headphones or audio amplifier | Signal tracing of audio circuits | Signal tracing of audio circuits | Rapid check for defects in audio stage |
| High-Voltage Probe | DC voltmeter | | Measurement of picture-tube voltages | Permits standard voltmeter to be used for high-voltage measurements |
| Capacity Voltage Divider | Oscilloscope or AC voltmeter | | Useful in horizontal-output stage | Adapts standard test instrument to high-voltage AC measurements |
| High-Impedance Probe | Oscilloscope | High-impedance circuits | Sync circuits, video-amplifier circuits | Minimizes loading of circuit by oscilloscope |
| Crystal-Detector Probe | VTVM oscilloscope | Signal tracing and measurements in RF stages | Signal tracing and measurements in RF stages | Extends range of test equipment to incorporate RF applications by detecting RF signals |
| Self-Bucking Detector | VTVM oscilloscope | Signal tracing and RF measurements | Signal tracing and RF measurements | Permits higher-voltage readings than crystal detector but requires external source of voltage |
| Balanced-Input Detector | VTVM oscilloscope | | RF measurements in circuits having balanced output | Functions as detector and permits balanced input to unbalanced output; proper termination of output impedances |
| Grid-Leak Detector | VTVM oscilloscope | Signal tracing in low-signal RF stages | Signal tracing in low-signal RF stages | Provides detection; very sensitive; amplifies signal |
| Cathode-Follower Probe | Oscilloscope | | High-impedance circuits where frequency response is critical | Minimizes loading of high-impedance circuit; excellent high-frequency response |
| Peak-to-Peak Probe | DC-VTVM | | Gives direct readings of peak-to-peak values | Permits voltmeters to give peak-to-peak voltage readings |

ulator probe. Oscilloscopes do not have the ability to respond accurately to signals of RF frequencies found in FM and TV receivers, but they will respond to audio frequencies. When the demodulator probe is applied to a modulated RF signal, the signal is rectified and the RF removed. This presents at the oscilloscope an audio signal which is indicative of the RF signal. Again we have shown how the use of probes expands the uses of test equipment to meet conditions which would otherwise be impossible.

### *Balanced-Input Detector*

Balanced-input detector probes are designed for use with DC-VTVM's and oscilloscopes. This type of probe permits the measurement of RF and at the same time terminates the circuit under test with the proper impedance.

In the servicing of television equipment such as boosters and converters, it may be necessary for the probes to offer a balanced circuit to match the outputs of these devices properly. An example of this type probe is illustrated in Figs. 3C and 4C, which show a probe that may easily be constructed.

The input circuit of the probe offers a balanced input of 300 ohms, while the output is an unbalanced one to match the oscilloscope. This probe was constructed on two terminal strips and requires no shielding.

### *Grid-Leak-Detector Probes*

A more sensitive RF probe is illustrated in Fig. 3D. This is the grid-leak detector type. This probe has the advantage of amplifying the detected signal. By reference to Fig. 4D, it may be seen that resistor $R_1$ and capacitor $C_1$ form a grid-leak detector for the triode tube. This probe is used in circuits where there is a very low RF signal such as those found in radio and television front ends. This probe is frequently used with signal tracers and oscilloscopes.

### *Cathode-Follower Probes*

In the discussion of high-impedance probes, it was pointed out that the loading effect of high-impedance circuits is largely due to the capacity presented by the oscilloscope and its leads. Cathode-follower probes provide a means of offsetting this. The advantage of a cathode follower is high-impedance input and low-impedance output. Its excellent high-frequency response is also of prime importance. Square waves are composed of a combination of odd harmonics. The perfect-square wave theoretically contains an infinite number of these odd harmonics. It may be seen by this that poor frequency response will result in a distortion of this waveform. This probe is recom-

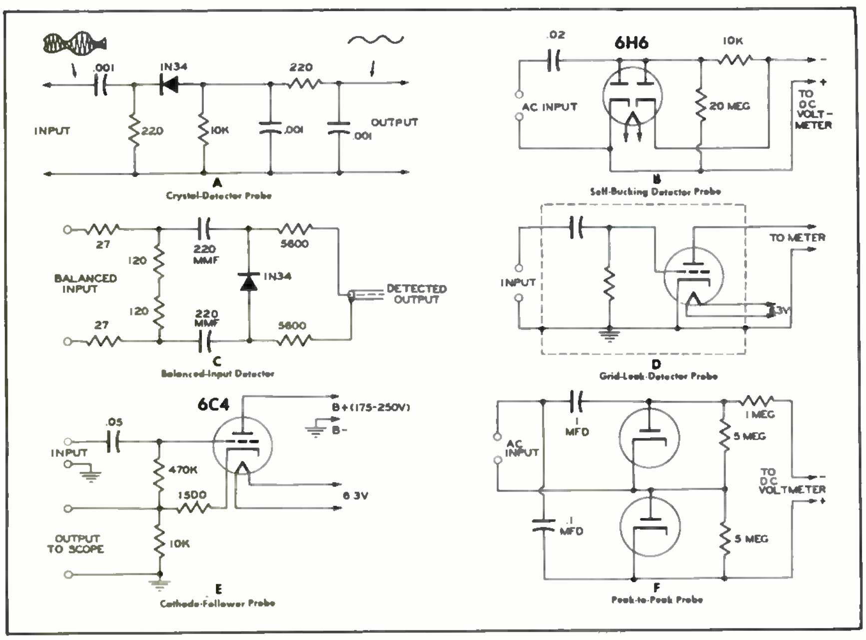
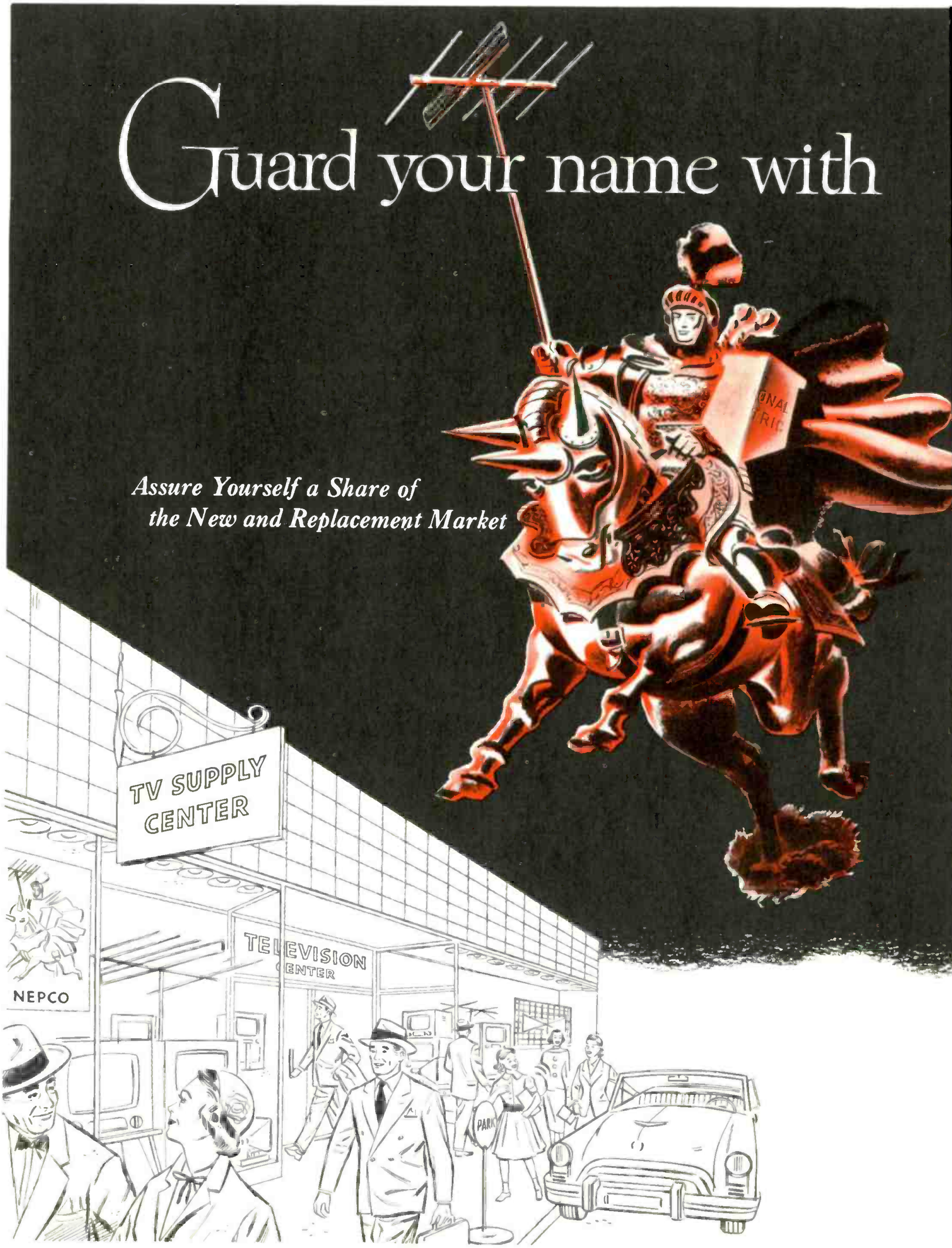



**Fig. 4. Schematic Diagrams of Several Test Probes.**

* * Please turn to page 94 * *


Guard your name with
Assure Yourself a Share of the New and Replacement Market
TV SUPPLY CENTER
TELEVISION CENTER
NEPCO
PARK

# the Nepco Line

Your name and reputation depends on your customers' satisfaction. That's why it pays you to take a tip from the growing list of dealer-installers who have turned to the NEPCO LINE to make sure of quality materials that won't let them down. They've learned this complete line of TV Antennas, Mountings and Accessories provides built-in ruggedness . . . meets the test of time and weather and assures them of a reputation for good work.

## *You Get EXTRA "Dividends" with the NEPCO Line!*

***Quality materials with the strength to stay on the job . . .***

- All parts heavily zinc-coated plus baked enamel finish.
- Rigid heavy gauge 1/8" steel used in all mounts.
- Two 15' *stainless steel* chimney bands (ample even for the larger chimneys), 5/16" eye bolts, and four heavy gauge banding clips with patented imbedding screws available with each chimney mount.
- All hardware corrosion-protected in the same complete manner as the mounts.
- Every item in the NEPCO Line is engineered, tested and field proved to assure long service on the job.

***Plus features for fast, easy installation and handling***

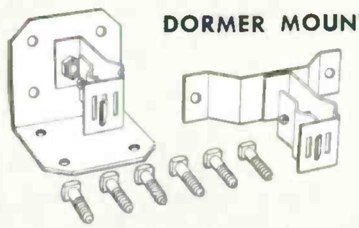
- Unique adjustable mast clamp with one bolt mounting.
- Exclusive antenna mast clamp with positive alignment in all planes.
- Slotted hex-head bolts for screw driver or wrench installation.
- Versatile mounts that accommodate all types of installations.
- A line designed with your handling problems in mind . . . strong compact boxes easy to move and stack.
- Large easy-to-read illustrated package labels.

### CHIMNEY MOUNTS

New "Y" Type Chimney Mount for extra rigidity using 5/16" eyebolts, extra heavy banding clips.

Complete with installation hardware and two 15' coils of stainless steel banding.

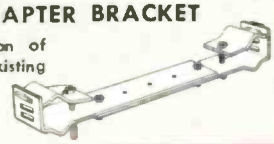
### DORMER MOUNT



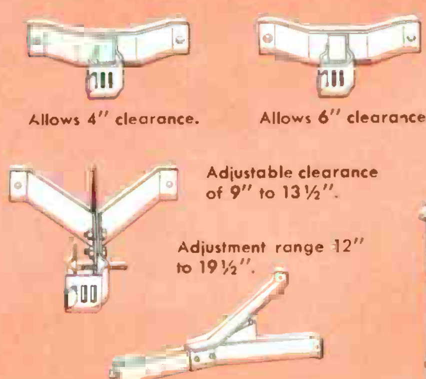
Used with 4" wall bracket for mounting masting to homes with dormer where other roof type installations would be hazardous. Furnished with 6 lag screws.

### MAST ADAPTER BRACKET

For quick installation of UHF antennas on existing mast. Two to a unit.



### WALL BRACKETS

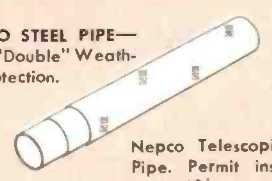


Allows 4" clearance. Allows 6" clearance.

Adjustable clearance of 9" to 13 1/2".

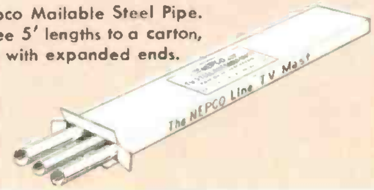
Adjustment range 12" to 19 1/2".

**NEPCO STEEL PIPE—** With "Double" Weather Protection.



Nepco Telescoping Steel Pipe. Permit installations up to 40'.

Nepco Mailable Steel Pipe. Three 5' lengths to a carton, two with expanded ends.




**DEMAND THE NEPCO LINE**

THE **COMPLETE** LINE FOR FAST, PERMANENT INSTALLATIONS

*Write for the Name of Your Nearest Jobber Today*
*Catalog on request.*

## National Electric Products

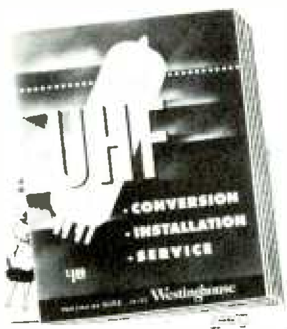
**RADIO & TELEVISION DEPARTMENT, PITTSBURGH, PA.**

# 30 DAYS LEFT

## TO GET THE WESTINGHOUSE UHF SERVICE KIT THAT BUILDS BIG EXTRA SERVICING PROFITS

**YOURS AT *NO COST*** with 100 WESTINGHOUSE RELIATRON RECEIVING TUBES or 4 WESTINGHOUSE RELIATRON PICTURE TUBES

### *You Get* THIS 32-PAGE UHF CONVERSION AND SERVICING HANDBOOK




It tells and shows you how to convert any model. Tells you *when* to use tuners, converters, UHF strip replacement, and *how!* Shows how to solve UHF antenna and lead-in problems. Easy to understand.

### *You Get* THIS TERRIFIC 3-FOOT, 6-COLOR HEAT-MOTOR DISPLAY

Familiar TV troubles appear in motion on the lighted screen — startle and stop sidewalk traffic. It's the best window display you ever used.


### *You Get* THIS UHF WINDOW STREAMER

*That Sells Your Conversion and Servicing Know-How*

17" x 34", printed in 4 brilliant colors, it will make you the busiest UHF man in town.

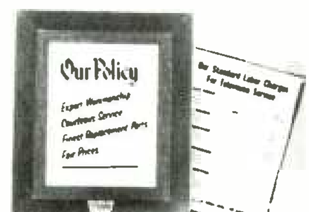


### *You Get* THIS EXCITING LUMINESCENT "NEW LIFE" WINDOW STREAMER

It puts the Westinghouse quality reputation squarely behind you!

### *You Get* THIS FRAMED PRICE-POLICY STATEMENT

Permanent frame with acetate window displays your standard service charges or store policy. Interchangeable inserts provided.




## *You pay Nothing!*

That's right. Just look up your nearest Westinghouse Tube Distributor and give him an order for 100 Westinghouse Receiving Tubes or 4 Picture Tubes. He has a Kit waiting for you. But hurry. This offer ends Nov. 30th. If you don't know who your Westinghouse Tube Distributor is, drop a postcard to Dept. K-211, and we'll send you his name.

ET-95031

**YOU CAN BE SURE... IF IT'S Westinghouse RELIATRON TUBES** TM

WESTINGHOUSE ELECTRIC CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, N. Y.

# *Examining* DESIGN FEATURES

**by HENRY A. CARTER**

### *ARVIN 746P*

A very unique chassis is employed in the Arvin 746P portable radio. The chassis is built in such a way that it seems to have been built around the speaker. (See Fig. 1.) By using this manner of construction, it was possible to use a larger speaker than could ordinarily be placed in a cabinet of this size.

The inside measurements of the cabinet are 2 1/4 by 6 1/4 by 8 inches. In addition to the 4-inch speaker, four miniature tubes, and standard 1-1/2-volt A battery and a 67-1/2-volt B battery.

Using a larger speaker than is ordinarily found in a portable of this size permits better sound reproduction.

The tubes may be removed from the front of the set for testing purposes.

### *DAVID BOGEN HOME COMMUNO-PHONE*

The David Bogen Deluxe Communo-Phone system is designed especially for the home. The basic system requires the use of three units. They are: PS-1 (the power supply), FC-1 (the control station), and FR-1 (the remote station). A view of these units may be seen in Fig. 2.

The power supply PS-1 contains the rectifier, filters, tubes, transformers, and relay. The relay is used for connecting B+ voltage to the tubes when the control station is in use. With the master switch in the ON position and the control station-selector switch OFF, the power supply is in stand-by condition. In this position, the unit draws very little current, allowing it to be left on continuously with very little resultant cost.

The control station FC-1 has provision for employing as many as five other control stations and four remote stations. It is designed for use in rooms where both privacy of conversation and selectivity of originating calls are desired. Such places may be the kitchen, nursery, bedrooms, living room, and maid's room.

The remote station FR-1 is a speaker which may be mounted any place where call origination and privacy are not desired, such as: the front or rear door, the garage, the laundry room, or the workshop.

The control station should be mounted to the wall studs so that the front edge of the box is flush with the wall. The cable is fed through the box and run through the walls to the power sup[illegible]d to the remote stations.

The power supply and the remote station may be either flush mounted or surface mounted; however, they will look better if they are flush mounted like the power supply shown in Fig. 2. The remote station is shown surface mounted for the purpose of illustration.

### *GENERAL ELECTRIC 21T7*
### *High-Voltage Stability*

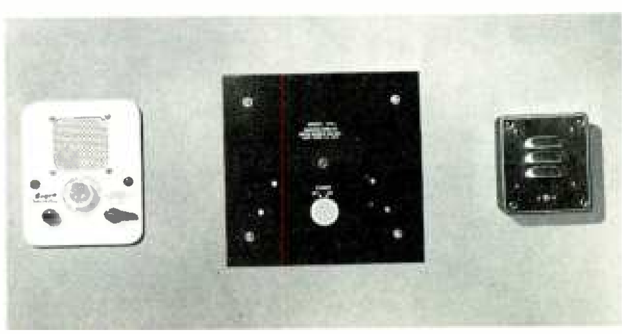
The General Electric 21T7 employs a couple of features which are quite interesting. One of these is a circuit for maintaining constant high voltage and horizontal sweep as the brightness control is varied. This is accomplished by the use of a 20,000-ohm potentiometer which is ganged to the contrast control and connected in the horizontal-output screen circuit. It may be seen by examining Fig. 3 that when the brightness control is advanced, the screen voltage of the horizontal-output tube is increased. This increase causes a larger current flow, thereby producing a greater high voltage. The opposite is true when the brightness is decreased. Since increasing brightness tends to decrease high voltage and increasing screen voltage of the 6CD6 tends to increase it, the result is a very stable high voltage. By holding the

*(Left)*

**Fig. 1. Chassis and Cabinet View of Arvin 746P.**

*(Below)*

**Fig. 2. Basic Units of David Bogen Home Communo-Phone, From Left to Right: FC-1 (Control Station), PS-1 (Power Supply), and FR-1 (Remote Station).**



HICKOK

*Complete*

# TUBE TESTER

AND

# SET ANALYZER

MODEL

605A

Large 5" Meter

## TECHNICAL DESCRIPTION

Enthusiastically accepted everywhere, this fine instrument is specifically designed to meet the technician's need for a smaller size, lower cost portable tube and set tester. The 605A is built with HICKOK *Dynamic Mutual Conductance* circuits with a 3-range micromho scale of 0-3000, 6000, 15,000. Tests all tubes normally encountered in all phases of communications and electronics. Provides the HICKOK Tube Gas Test. New bias fuse prevents accidental damage to bias potentiometer. Operating voltages, including DC grid bias, are applied to the control grid and large 5" meter shows AC component in plate current. This HICKOK test is the same test used by tube manufacturers in their own laboratories.

See your nearest parts jobber and ask for a demonstration of this lighter, smaller, handier Tube & Set Tester. (Also available as Model 600A without multimeter.)

INCLUDES:

High Sensitivity

## MULTIMETER

The Model 605A, in addition to being a complete and highly accurate tube tester, also contains a handy 20,000 ohm per volt DC multimeter to measure . . .

Volts: AC-DC; 0-10, 100, 500, 1000

Sensitivity: 20,000 ohms per volt DC; 1,000 ohms per volt AC

Resistance: 0.1 ohm to 100 megohms, (center scale 25, 2500, 500,000 ohms)

Inductance: to 70 henries through use of conversion chart furnished

Capacitance: Microfarads; 50, 5, as low as .0001

Current: DC; 10, 100, 500 M.A.

Built with minimum number of jacks. Ranges are selected with a rotary master switch.

**THE HICKOK ELECTRICAL INSTRUMENT CO.**

10566 DUPONT AVENUE • CLEVELAND 8, OHIO

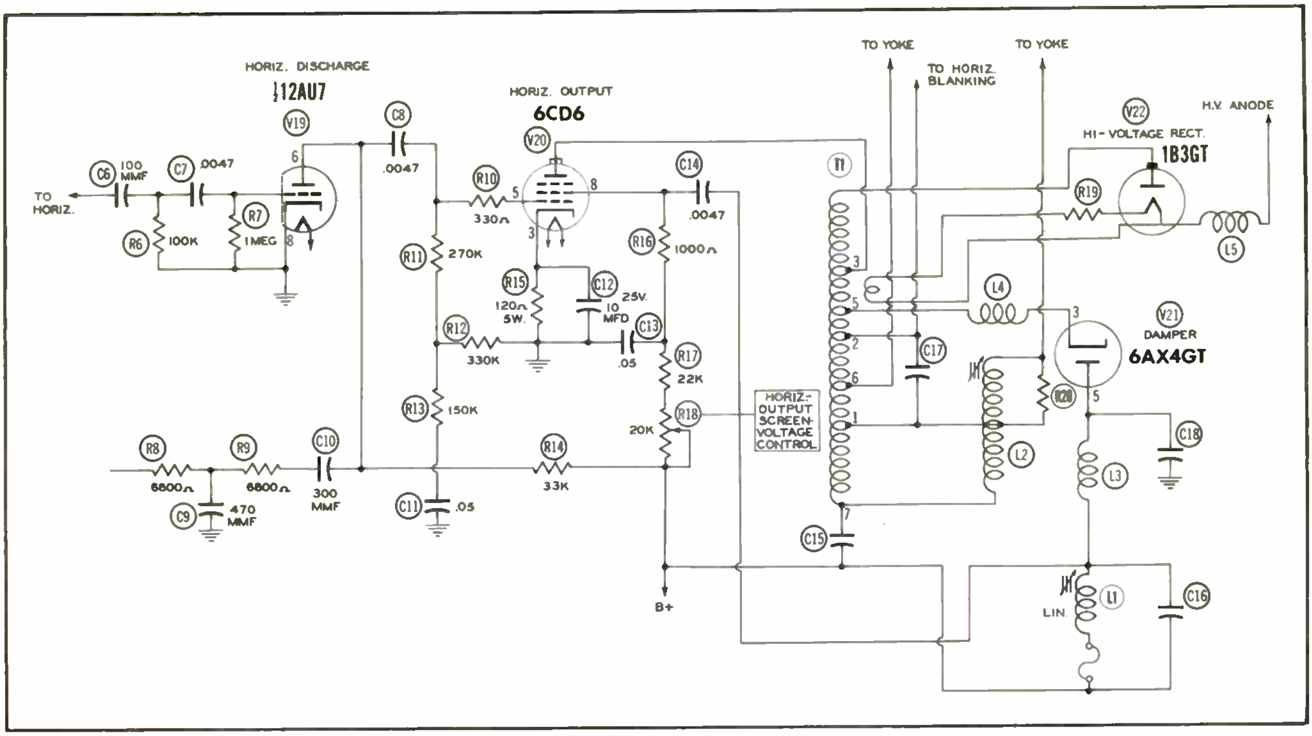



**Fig. 3. Partial Schematic of General Electric 21T7 Showing High-Voltage Stabilizing System.**

high voltage constant, there is no change in width when brightness is varied.

### *Horizontal Blanking*

Another interesting feature of the General Electric 21T7 is the horizontal-blanking circuit. A cathode follower (see Fig. 4) is used to reduce the loading effect usually placed on the horizontal-output circuit by the horizontal-blanking circuit. By employing a cathode follower, the stray capacity of the circuit is minimized. In addition, it also serves to isolate the horizontal-output stage from the picture-tube circuit.

It is unnecessary to employ a cathode follower for the vertical blanking, because loading is not so noticeable in the vertical output.

## *SENTINEL 1U-521T*

### *Hi-Lite Control*

This receiver includes in its circuit a system known as a Hi-Lite control. (See Fig. 5.) It consists of a three-position rotary switch and a number of capacitors connected across a portion of the contrast control in such a way as to control the high-frequency response of the video-output stage in which it is employed.

The Hi-Lite control acts much the same as a tone control in an audio circuit. That is, by switching more or less capacitance across the cathode resistor, which in this case is the contrast control, the high-

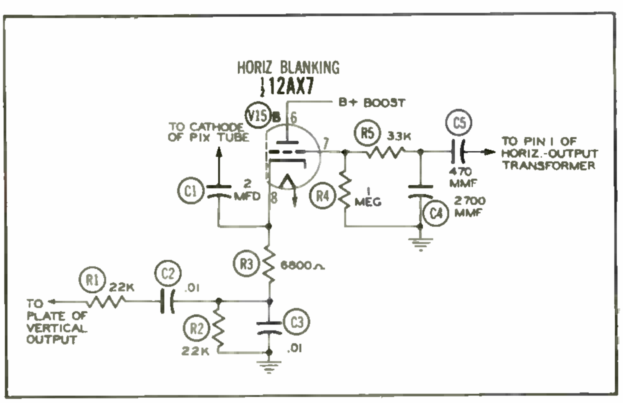
* * Please turn to page 120 * *

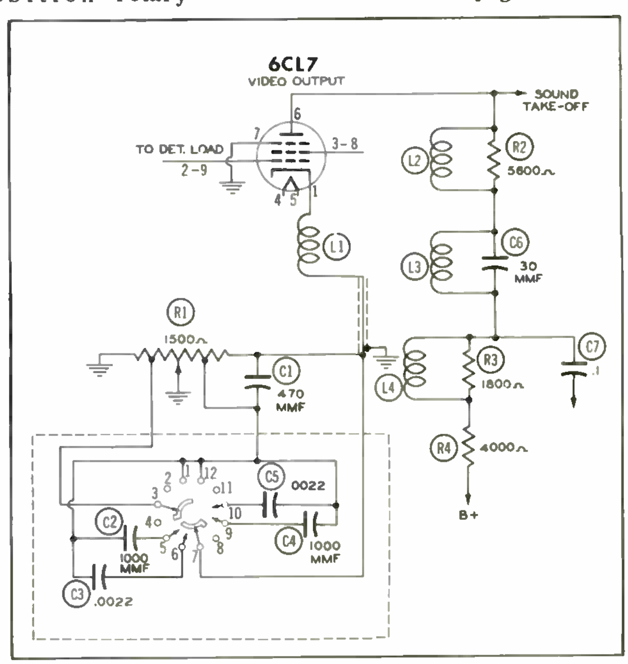
***(Below)***

**Fig. 4. Partial Schematic of General Electric 21T7 Showing Horizontal-Blanking Cathode Follower.**

***(Right)***

**Fig. 5. Partial Schematic of Sentinel 1U-521T Showing Hi-Lite Control.**



# JETOMIC AGE

For the era of all-channel reception—model JeT454, the JFD JeTOMIC.

TWO broadband antennas in ONE revolutionary pre-assembled UHF-VHF array for channels **2-83**.

The JFD JeTOMIC combines for greater gain the most highly directive UHF antenna design—the **rhombic**—and the JeTenna conical—acknowledged classic of VHF performance.

ONE LEAD-IN—NO LOSSY COUPLER
*BRILLIANT* UHF-VHF RECEPTION!

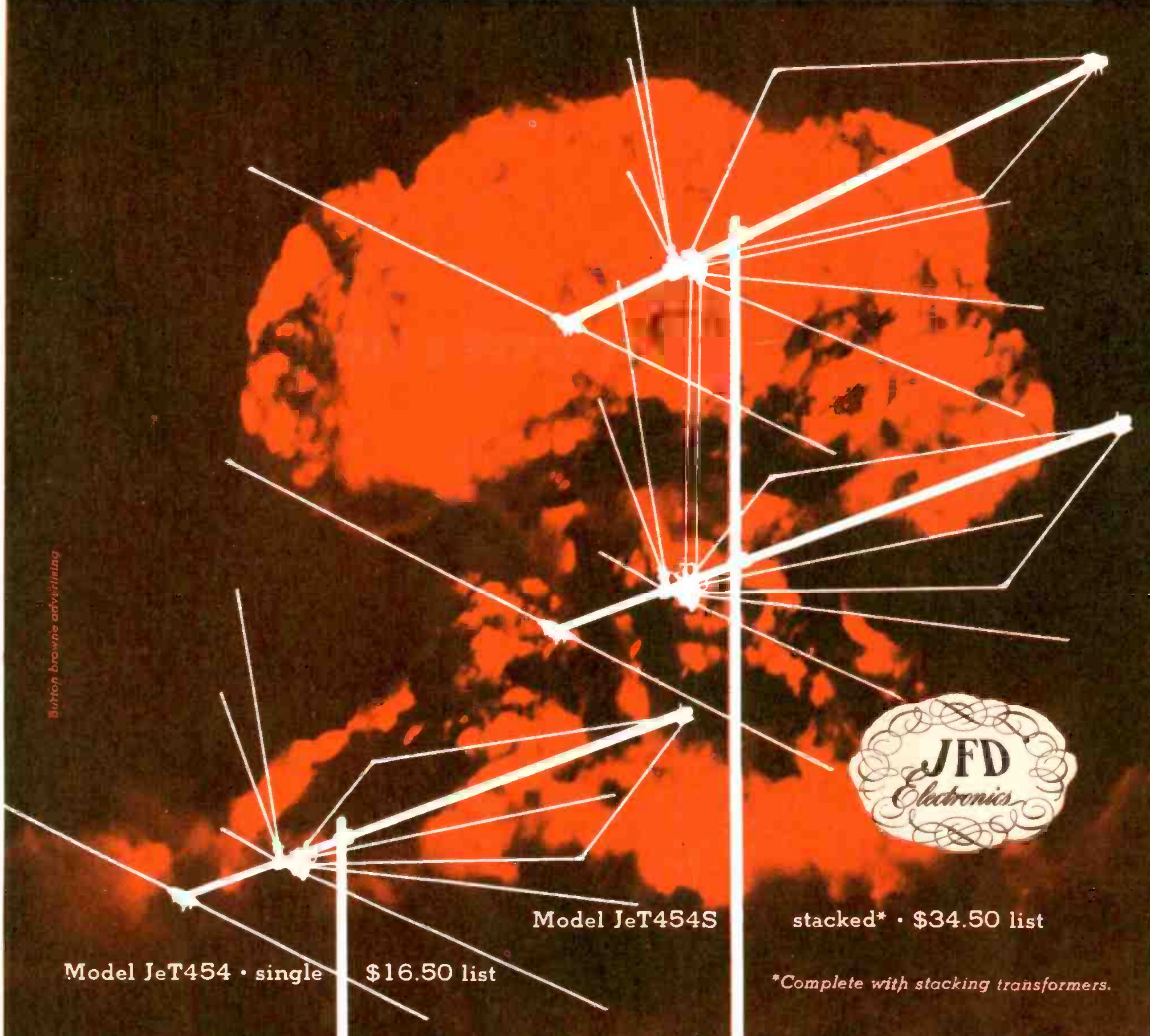
*Send for form No. 241*

**FACTS TALK! COMPARE FOR YOURSELF**

DB GAIN

| Channels | 14 | 21 | 28 | 35 | 42 | 49 | 56 | 63 | 70 | 77 | 83 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Competitor A Conical with Bowtie (2 stack) | 4.0 | 3.25 | 2.0 | 1.0 | 1.0 | 0.75 | 0.5 | 0.7 | 0.9 | 0.75 | 0.3 |
| Competitor B Bedspring with UHF | 0.75 | 0.75 | 0.9 | 1.0 | 0.8 | 1.0 | 1.5 | 1.6 | 1.5 | 1.25 | 1.0 |
| Competitor C Conical with V (2 stack) | 3.0 | 3.3 | 4.0 | 4.6 | 4.9 | 5.0 | 4.8 | 4.5 | 4.25 | 4.0 | 3.75 |
| Competitor D Filter type with attached "V" | 2.0 | 2.0 | 2.5 | 2.75 | 2.9 | 2.9 | 2.4 | 2.2 | 2.0 | 1.3 | 1.0 |
| JFD JeT 454S | 7.0 | 7.25 | 7.4 | 8.5 | 9.0 | 9.5 | 10.25 | 10.25 | 10.25 | 10.0 | 9.75 |

**JFD MFG. CO.** Brooklyn 4, N.Y. *World's largest manufacturer of TV antennas and accessories*



*In the Interest of . . .*

# Quicker Servicing

**by** DON R. HOWE

### *A DC Source for the Service Bench*

The servicing of automobile radios in the shop requires conditions as nearly as possible paralleling those found in the automobile. In order to determine what these conditions are, we shall examine briefly some of the major components found in a typical automobile electrical system.

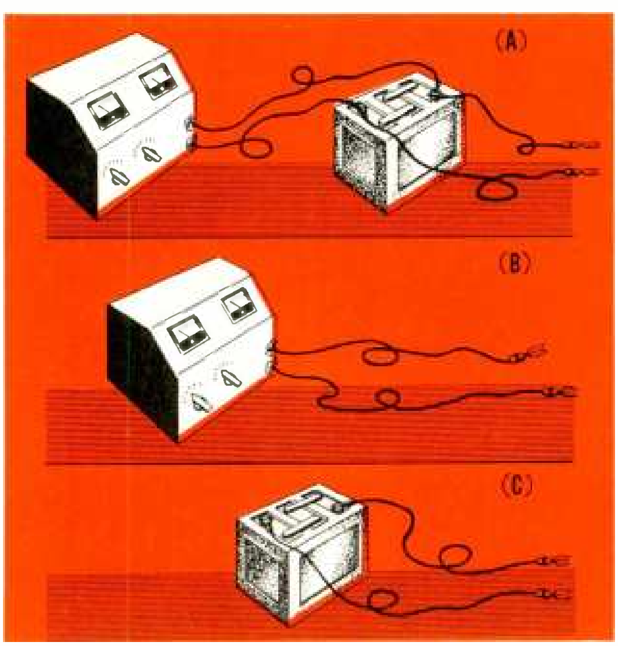
The items with which we shall primarily concern ourselves are the battery, generator, and regulator. The primary function of the battery is to provide an electrical source to meet the demands of the automobile, but the operation of the many electrical accessories puts a tremendous drain on the battery. Consequently, some method must be furnished to replenish the electrical current taken from the battery. This is the function of the generator. The generator must keep the battery charged and assist in furnishing current to the automobile accessories.

Conditions vary in the electrical system because of engine speed of the generator, condition of the battery, and the amount of accessories in use; therefore we must have a device to compensate for these variations automatically. This task is accomplished by the regulator which controls the generator to prevent overcharge or discharge of the battery. In addition, the regulator provides a form of voltage regulation.

When the engine is idling and generator voltage is below battery voltage, the regulator cuts out the generator to prevent current flow from the battery to the generator. When the battery is charged to a normal value and the generator is supplying more current than is required, the regulator prevents the voltage of the electrical system from exceeding a predetermined value, usually about 7.5 volts.

It may be seen that during periods of high current drain, the battery voltage may fall below the normal voltage of 6.6 volts. During periods of high-speed generator operation, the electrical-system voltage may rise to 7.5 volts. In order to duplicate this condition, we must have a source of DC voltage in the shop variable from 5.5 to 7.5 volts. Conditions of intermittent operation in an automobile radio may be very difficult to locate without this variation in supply voltage.

The best type of supply for the bench consists of a storage battery connected in parallel with a variable-voltage battery eliminator. This is illustrated in Fig. 1A. This system gives a source of variable DC to meet the demands outlined previously. The battery has the ability to furnish large surges of current required in the operation of solenoids encountered in some automatic tuning devices. The disadvantages are: the weight and size of the battery and also the danger of spilled acid. The variation of the voltage



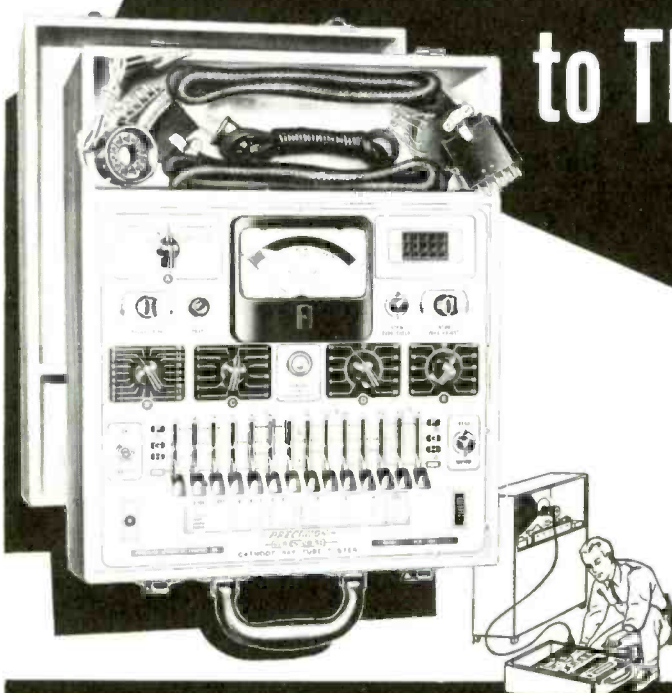

*(Left)*

**Fig. 1. Three Sources of DC Voltage for the Service Bench.**

*(Below)*

**Fig. 2. Front View of the Substitution Box.**

# It takes a CR TUBE TESTER to TEST a CR TUBE...



*...because CR tubes are electrically and physically different from all other types of electron tubes! Some of the more obvious differences include:*

PICTURE PRODUCING BEAM CURRENT
EXTREMELY LOW ANODE CURRENTS
DIFFERENT, MULTIPLE OPERATING VOLTAGES
HIGH LEAKAGE and SHORT CHECK LIMITS
MORE and DIFFERENT TUBE ELEMENTS
- ELECTROSTATIC FOCUS ELEMENT
- ELECTROSTATIC DEFLECTION PLATES
- ELECROMAGNETICALLY FOCUSED GUN
- ELECTROMAGNETICALLY DEFLECTED BEAM

ETC., ETC., ETC.

*YES, IT TAKES A CR TUBE TESTER TO TEST A CR TUBE...*

**AND THE *PRECISION CR-30***

**WAS SPECIALLY DEVELOPED FOR THIS VERY IMPORTANT PURPOSE!**

## TESTS ALL TV PICTURE TUBES

Magnetic & Electrostatic
Oscilloscope & Industrial Types

## ...FOR BEAM CURRENT INTENSITY (Proportionate Picture Brightness)

### *Stop Guess-Checking with CABLE ADAPTERS!*

- *Receiving tube checkers were made for testing receiving tubes and NO CABLE ADAPTER can adapt them to do the job of the CR-30.*
- CABLE ADAPTERS only check for filament continuity, a degree of inter-element short and a so-called emission test.
- *CABLE ADAPTERS do not test for the all-important, picture producing beam current.*

*You can't afford to guess when you test the most expensive component of a TV set.*
*Be sure with PRECISION Model CR-30!*

***IT IS THE ELECTRON BEAM* (and NOT total cathode emission) which traces the pictures on the face of the CR tube.**


Cathode emission can be high, and yet Beam Current (and picture brightness) unacceptably low. *The CR-30 will reject such tubes because it is a Beam Current tester.* Conversely, cathode emission can be low and yet Beam Current (and picture brightness) perfectly acceptable. *The CR-30 will pass such tubes because it is a Beam Current Tester.*

The CR-30 incorporates additional special test facilities necessary for overall performance evaluation of the CR tube as will permit positive answer to the question "Is it the Picture Tube or the TV Set?" And the CR-30 gives the answer in but a fraction of the time required to test the other 2 dozen or so tubes in the set.

**SERIES CR-30:** In hardwood, tapered, portable case, with hinged, removable cover. 17¼" x 13¾" x 6¾". Complete with standard picture tube cable, universal CR tube test cable and detailed instruction manual. Shipping weight: 22 lbs.

**NET PRICE $104.75**

PRECISION TEST EQUIPMENT — *Standard of Accuracy*

**PRECISION APPARATUS COMPANY, INC.**
**92-27 HORACE HARDING BLVD., ELMHURST 13, N. Y.**
Export Division: 458 Broadway, New York 13, U.S.A. • Cables—Morhanex
In Canada: Atlas Radio Corp., Ltd., 560 King Street, W., Toronto 2B

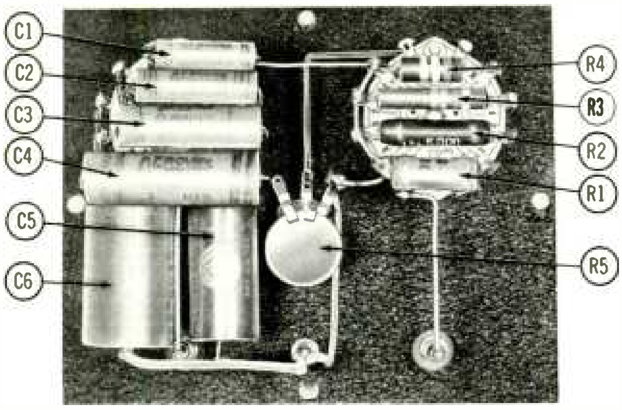



Fig. 3. Rear View of the Substitution Box With Cover Removed.

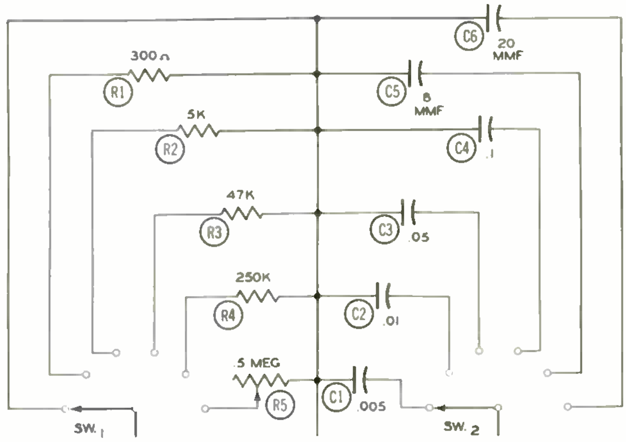



Fig. 4. A Schematic Diagram of the Substitution Box.

furnished by the eliminator is not instantaneous because of the presence of the battery.

However, a fluctuating voltage does not necessarily constitute a serious problem in the servicing of the automobile radio. The system shown in Fig. 1B employs a battery eliminator alone. The advantages are that instantaneous voltage variations can be obtained and that there is no storage battery to maintain. The disadvantage is the inability to furnish large surges of current.

PARTS LIST FOR SUBSTITUTION BOX

CAPACITORS

| Item No. | Rating Cap. | Volt. | Aerovox | Centralab | Cornell Dubilier | Mallory | Sprague |
|---|---|---|---|---|---|---|---|
| C1 | 0.005 | 600 | P688-005 | D6-502 | PTE6D5 | PT625 | 6TM-D5 |
| C2 | 0.01 | 600 | P688-01 | D6-103 | PTE6S1 | PT611 | 6TM-S1 |
| C3 | 0.05 | 600 | P688-05 | DF-503 | PTE6S5 | PT615 | 6TM-S5 |
| C4 | 0.1 | 600 | P688-1 | DF-104 | PTE6P1 | PT601 | 6TM-P1 |
| C5 | 8.0 | 450 | PRS450/8 | | BR845A | TC71 | TVA-1704 |
| C6 | 20.0 | 450 | PRS450/20 | | BR2045A | TC75 | TVA-1709 |

CONTROLS

| Item No. | Resistance | IRC | Clarostat | Centralab | Mallory |
|---|---|---|---|---|---|
| R5 | 500K | Q13-133 | AG-60-Z, RS-2 | B-60 | U-48 |

RESISTORS

| Item No. | Resistance | Watts | IRC |
|---|---|---|---|
| R1 | 300 | 5 | |
| R2 | 5000 | 5 | |
| R3 | 47K | 2 | BTB-47K |
| R4 | 250K | 2 | |

SWITCHES

| Item No. | Description | Mallory | Centralab |
|---|---|---|---|
| S1, S2 | Single-Pole, 11-Position, Rotary | 172C | 2503 |

MISCELLANEOUS

| Quantity | Description | Quantity | Description |
|---|---|---|---|
| 1 | Chassis Box 4" x 5" x 6" | 2 | Banana Plugs |
| | | 2 | Alligator Clips |
| 3 | Banana Jacks | 3 | Knobs |

Perhaps the least desirable system utilizes only a storage battery. See Fig. 1C. This system does not provide a controllable voltage. The state of charge of the battery must also be carefully watched. Use of this system may easily result in a dead battery in the midst of a repair job and therefore is not recommended.

### *Substitution Box*

The substitution of parts is often the most rapid method of testing suspected components. The items most often substituted are resistors and capacitors. An unnecessary amount of time may be consumed in the search for a substitute item. The use of a substitution box will eliminate a great amount of this time. This substitution box offers capacitances and resistances covering a wide range of values. The desired value of a capacitor or resistor is easily selected by means of a switch. Although the exact value may not be found in the box, a value close to the original may be substituted for testing purposes. Caution must be exercised in highly critical circuits where a small change in value would have adverse effects. A test instrument of this type will more than warrant its small cost and will find applications on any test bench. Not to be overlooked is the convenience offered in addition to the time-saving element.

The substitution box illustrated in Fig. 2 may be easily constructed. This unit has four values of fixed resistances available and a variable resistance with a maximum value of 1/2 megohm. Capacitance is available from .005 mfd to 20 mfd in six steps. These values are generally sufficient for ordinary service work.

* * Please turn to page 115 * *

famous *telrex* **4-BAY**

# "CONICAL-V-BEAMS"®

## –the acknowledged champion in 1948 and

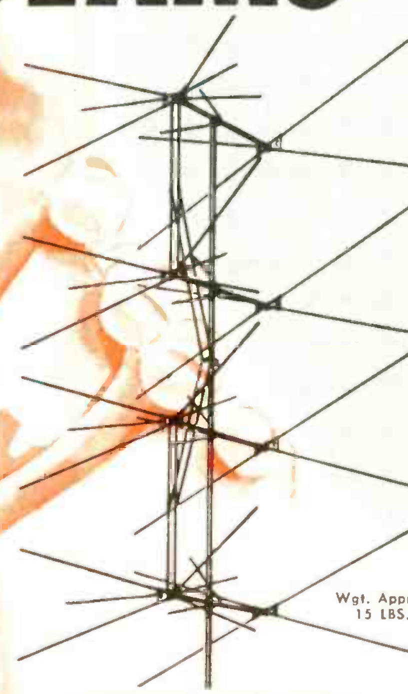
# STILL CHAMPION!

Install genuine Telrex "Conical-V-Beams," the Patented uni-directional, one transmission line array. Models for Ch. 2 to 13 or Ch. 2 to 83. See and hear the difference!

**If UHF is available or expected, install Telrex "Duo-Band Conical-V-Beam" series. The perfect for rotation hi-gain . . . hi-F-to-B all-band one transmission line array with automatic transition from low to hi band with no lossy "distribution" pads.**

"Conical-V-Beams" are designed for easy stacking as required for your particular reception area. 1 bay "C-V-B" for pri-area, 2 bay "C-V-B" for sec-area, 4 bay "C-V-B" for fringe areas.... If a 4 bay "C-V-B" does not provide a usable TV picture, TV reception is either impossible or impractical!

Broadbanded single channel highest gain hi-F-to-B yagis also available from Telrex Antenna Headquarters, builders of world renowned communication yagis for amateur or commercial use.

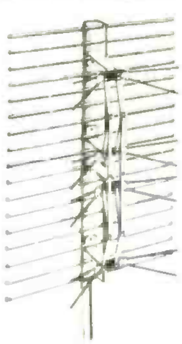


Wgt. Approx. 15 LBS.

*CHAMPION-FOR-DISTANCE*

**MODEL 8X-TV***

The Ultimate in long distance arrays. Guaranteed to out-perform any antenna or combination of cut-to-frequency antennas. When used with Duo-Band splines it comprises the ultimate from Ch. 2 to 83. Unequalled for reception up to 200 miles.



*ULTRA-HI GAIN UHF*

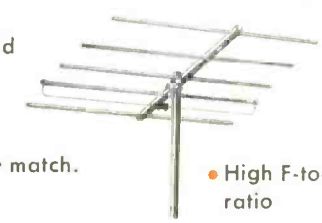
**"CONICAL-V-BEAM" MODEL 84**

- Four bay uni-directional array
- All in-phase signal addition at all frequencies with no lobe splitting
- All-aluminum light weight and rugged

*PRE-ASSEMBLED, PRECISION TUNED*

**5-ELEMENT YAGI**

- High gain, broad-band response
- Excellent 300 ohm impedance match.
- High F-to-B ratio



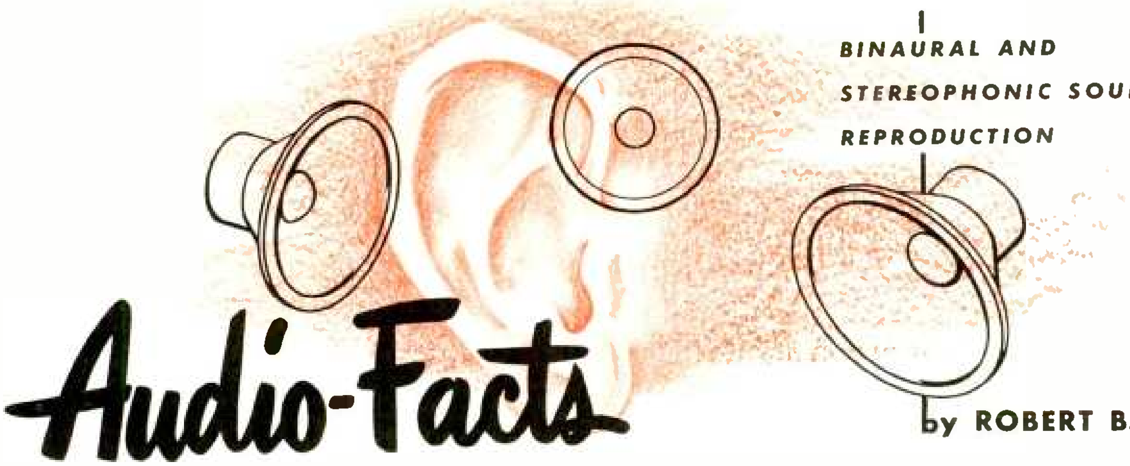
*WRITE FOR COMPLETE TELREX BULLETINS, TODAY!*

telrex INC. BETTER BY DESIGN "CONICAL-V-BEAMS"

*PATENTED

ASBURY PARK 10 NEW JERSEY

**Insist on a genuine "Conical-V-Beam." Look for the Telrex Trade-Mark!**



# Audio-Facts

## BINAURAL AND STEREOPHONIC SOUND REPRODUCTION

by ROBERT B. DUNHAM

Since most high-quality audio systems installed in homes are used mainly for the reproduction of music from the excellent present-day recordings and many musical programs broadcast via AM, FM and TV, those qualities essential for obtaining maximum listening satisfaction and pleasure receive much consideration during the development of the system. Usually, after a wide-range output free of disturbing noise and distortion has been achieved, the designer or constructor becomes concerned with the problem of bringing out in the reproduced sound that certain quality which will make it seem alive and real. This is a quality difficult to describe and name; but it is the aliveness, or presence heard and felt, which is the difference between listening to an actual live performance and hearing a reproduction over the usual sound system. The ultimate goal would be to have the sound so realistic that if one should close his eyes he would be unable to distinguish between the output from the loudspeakers and the actual live performance.

With low distortion and noise-free wide-range response always considered as basic requirements, many ideas and theories have been tried and several methods have been employed in an effort to produce the desired alive effect. Some of these are: volume expansion to increase dynamic range, special spacing and arranging of the loudspeakers to give various effects of sound sources, and even the deliberate generation of certain nonlinearities in the amplifier to simulate the peculiarities of certain sound sensations.

The excellent reproduction of music possible from such sound installations provides much pleasurable listening, but one definite condition must be considered if the desired true-to-life results are to be realized.

The clue can be had from the old stereoptican viewer of years ago or the more modern methods of the present-day stereo enthusiasts and from the current vogue of 3D movies. Here the third-dimensional effect of depth is exploited to add realism and life to the reproduced image, in both sight and sound. When listening to the original live performance or watching the actual scene, the real depth of the sight and sound is impressed upon us primarily because we normally see with two eyes and hear with two ears. Constant use and training of our eyes and ears enable us to perceive the depth in the actual thing; but in the reproduction of sound from a loudspeaker or the reproduction of a scene in an ordinary photograph, depth or the third dimension is not present. This is the effect that must be simulated or reproduced to make the reproduction appear real.

With two ears we are able to determine the location of sound in both direction and distance and also to gauge the loudness. These are the three dimensions so important in relation to reproduced music. Just why these effects are so important warrants explanation and study.

* * Please turn to page 99 * *

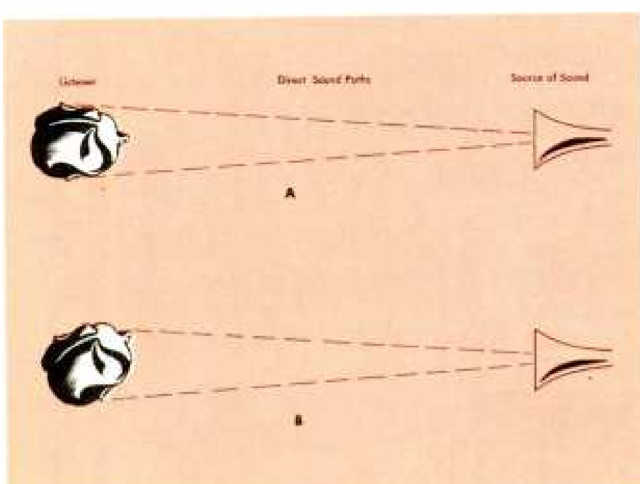



Fig. 1. Listening Binaurally to Single-Sound Source.

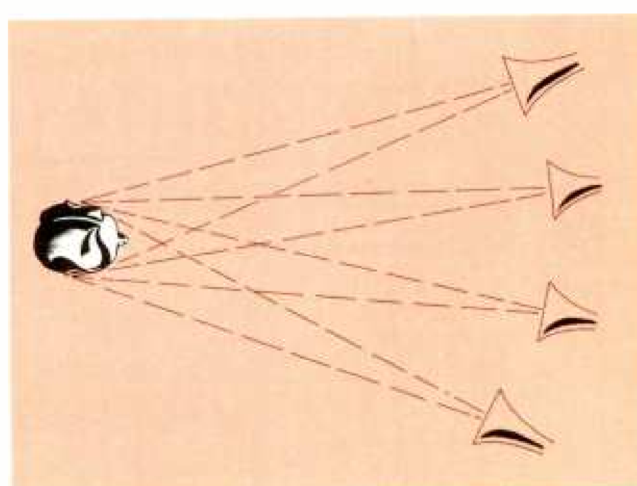


Fig. 2. Listening Binaurally to Multiple-Sound Source.

# Dollar and Sense Servicing

by John Markus

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

SQUEEZING. Housewives approaching the tomato counter at a St. Louis supermarket are somewhat startled when they hear the tomatoes speaking out loud, asking not to be squeezed. It's done with a small automatically repeating tape recorder installed under the counter, playing the recorded message: "Ladies, please do not squeeze the tomatoes. Handle them just like you would if they were your own. Atta girl, thank you."

The message repeater is made by Mohawk Business Machines, but attachments for playing endless loops of tape are available for Magnecord players and possibly for other makes as well. The machine can be cycled on a time basis, but much more effective is a photoelectric control or capacitance control that starts the message only when someone is within squeezing range of the tomatoes.

It's intriguing to plan the wording for such messages. You could use for a bushel of blushing peaches, perhaps, "Please don't pinch us until we are yours."

TAPE BOOM. Schools this year will buy 50,000 magnetic tape recorders for an outlay of over $10,000,000, according to an RCA market survey. With tape-recorder sales booming in other markets too, there'll be plenty of service business here in the months to come. Assign someone in the shop to "bone up" on the troubles of recording, erase, and playback heads, these being the commonest causes of distortion and yet the most difficult to isolate and fix.

With study time hard to find these days, it's better to have one really good specialist on each branch of electronics than to expect everyone in the shop to know everything. Other study assignments to hand out are transistors, hi-fi audio systems, UHF tuners, and industrial electronic controls.

PAINLESS PAYING. Outstanding sales-promotion idea noted in three-week tour of California's electronic industry was large window sign "PIGGY BANK TERMS" used by an appliance and television store. Sure gets across the idea dramatically that they'll make monthly payments low enough to be painless on the purse.

Time-payment sales will become more and more important next year, with economists of large companies predicting a definite recession sometime during the year. It'll start gradually, then pick up speed, and toboggan almost straight down (scaring the pants off those who don't know what's happening), until it hits bed rock at a level where business is about 20 per cent off clear across the board. Then will come a steady climb back up over a longer period, till things are again where they are today. Beyond that, the $10,000-a-year crystal gazers can't say much because it's so closely related to Washington policy and world affairs.

Should time payments be considered for television service charges? Why not? Book publishers are doing it now even, in some instances, for single books. With TV charges often running over $25, time payments would certainly take the sting off the bad news during a period of business recession.

But heed a warning — few shops are organized to collect and handle time payments efficiently. If thinking about it, talk things over with your banker first. See what the chances are in your locality for selling the paper to the bank or to another collection agency as soon as you get it.

ACCIDENTS. Checking of insurance company records by RCA revealed that the accident rate for a single antenna installer is much less than for a two-man team. It appears that one man working alone does not take unnecessary chances and is not subject to the false sense of security which two-men teams may develop.

It's also much cheaper to send out just one man these days. In most urban localities he can now align the antenna by sight and guess, using antennas on neighboring roofs as his chief guide. In fringe-signal areas a rotator with control box lets one man do the work of two and often results in sale of the rotator right on the spot.

SMORGASBORD. In most of San Diego, viewers have a choice of ten different VHF stations few of which are ever carrying the same network program. Choosing from ten different programs can be quite a problem, especially where family tastes differ radically. Only those just south of hills have difficulty in getting the Los Angeles stations.

* * Please turn to page 122 * *

See your distributor or send 10c to Sprague for a jumbo size window poster of this advertisement and full details on how you may obtain inexpensive reprints for distribution to your customers.


You'll never see your doctor advertise a special sale on appendectomies . . .
You'll never see your lawyer announce cut-rates for divorce cases . . .
You'll never see your dentist hold a "2-for-1" sale on extractions . . .

*AND You'll never see the day when you can take your TV set in for a service "bargain" and be sure you're getting a square deal!*

"Bargains" in home electronic service are as scarce as the proverbial hen's teeth! Here's why—

The expert service technician, just like other professional people, must undergo years of study and apprenticeship to learn the fundamentals of his skill. And a minimum investment of from $3000 to $6000 per shop technician is required for the necessary equipment to test today's highly complex sets. Finally, through manufacturer's training courses and his own technical journals, he must keep up with changes that are developing as fast as they ever did in medicine, law, or dentistry. Those best equipped to apply modern scientific methods are almost certain to be most economical for you and definitely more satisfactory in the long run.

Unfortunately, as in any business, there will always be a few fly-by-night operators. But patients, clients, and TV set owners who recognize that you get only what you pay for, will never get gypped. "There just ARE no service bargains"...but there is GOOD SERVICE awaiting you at FAIR PRICES!

Harry Kalker
PRESIDENT

SPRAGUE PRODUCTS COMPANY
North Adams, Mass.

**SPRAGUE**

*WORLD'S LARGEST MANUFACTURER OF ELECTRIC CONDENSERS*

# INDEX TO PHOTOFACT

**RADIO AND TELEVISION SERVICE DATA FOLDERS**

# No. 41

**Covering Folder Sets Nos. 1 thru 224**

## HOW TO USE THIS INDEX

To find the PHOTOFACT Folder you need, first look for the name of the receiver (listed alphabetically below), and then find the required model number. Opposite the model, you will find the number of the PHOTOFACT Set in which the required Folder appears, and the number of that Folder. The PHOTOFACT Set number is shown in bold-face type; the Folder number is in the regular light-face type.

**IMPORTANT—1.** The letter "A" following a Set number in the Index listing, indicates a "Preliminary Data Folder." These Folders are designed to provide you *immediately* with preliminary basic data on TV receivers pending their complete coverage in the standard, uniform PHOTOFACT Folder Set presentation.

**2.** Models marked by an asterisk (*) have not yet been covered in a standard Folder. However, regular PHOTOFACT Subscribers may obtain Schematic, Alignment Data or other required information on these models without charge by supplying make, model or chassis number and serial number. (When requesting such data, mention the name of the Parts Distributor who supplies you with your PHOTOFACT Folder Sets.)

**3.** Production Change Bulletins contain data supplementary to certain models covered in previously issued PHOTOFACT Folders, and are listed in this Index immediately following the listing of the original coverage of the model or chassis. These Bulletins should be filed with the Folders covering the models to which the changes apply.



**NOTE:** PCB denotes Production Change Bulletin

**TOP-SELLING Practical PUBLICATIONS** *distributed by* **HOWARD W. SAMS & CO., INC.**

## COYNE — FAMOUS SHOP-TESTED REFERENCE BOOKS

**TV Servicing Cyclopedia.** Covers every phase of TV, including color and UHF. Explains theory, servicing, testing, antennas, circuits, convertors—covers everything. 750 pages. Order **CTB-1**........................**$5.95**

**Practical TV Servicing.** How to service by alignment, by picture pattern; how to install antennas; how to handle any TV service problem. Data on color and UHF. 400 pages. Order **CTB-4**........................**$4.25**

**Latest Testing Instruments.** Covers proper use of all modern TV, radio and electrical testing equipment. Packed with time-saving short-cuts. Full analysis of all instrument types. 350 pages. Order **CTB-3**..............**$3.25**

**Television and Radio Handbook.** 3000 useful facts on practical radio servicing. Covers most frequently recurring problems; trouble-shooting hints. Data on UHF conversion. Practical help for speedy servicing. 375 pages. Order **CTB-5**........................**$2.75**

**Industrial Electronics.** Practical, simplified information on basic principles and practices of electronics. The ideal book for orientation in the entire field. Easy to understand. 468 pages. Order **CTB-2**..................**$3.75**

**Applied Practical Radio-Television.** Complete 5-Volume Library; 1780 pages of latest "know-how" on Radio and TV. Vol. 1, Radio & TV Principles; Vol. 2, Radio, TV and FM Receivers; Vol. 3, Radio & TV Circuits; Vol. 4, Radio & TV Testing Methods; Vol. 5, TV Servicing. Complete 5 Volume Set. Order **CTB-50**........................**$15.00**

**Applied Practical Electricity.** 8 Volume Library covering *everything* on the subject, including home wiring, motors, refrigeration, air conditioning, automotive diesel, etc. 3000 subjects. 3634 pages in 8 volumes. Order set **CTB-180**........................**$24.00**

**Electrical Trouble-Shooting.** Complete trouble-shooting course; also covers refrig., industrial electronics. 626 pages. Order **CTB-101**....**$6.95**

**Electricians Handbook.** Code requirements, rules, tables, charts, testing guides; data on motors, currents, etc. 348 pages. Order **CTB-102** **$2.75**

## BOYCE — AUTHORITATIVE TV & RADIO HANDBOOKS

**Video Handbook.** Full data on TV design, construction, production, installation, operation and servicing. 14 complete sections cover the entire field clearly and practically. 892 pages. Order **BB-2**...**$5.95**

**Radio Handbook.** 18 sections; clearly explains radio and electronic theory; covers all phases thoroughly, including parts and circuit analyses, Sound, Recording, Testing, Antennas, TV, etc. 890 pages. Order **BB-1**..................**$4.95**

**HOWARD W. SAMS & CO., INC.**

**ORDER THESE OUTSTANDING PRACTICAL BOOKS FROM YOUR PHOTOFACT DISTRIBUTOR**

# *Howard W. Sams* PHOTOFACT *Publications*

## PHOTOFACT SERVICE MANUALS

Here's the radio-TV service data that saves time and helps you earn more! Preferred and used daily by thousands of Radio and TV Service Technicians. Complete, accurate—based on analysis of the actual equipment. Uniform treatment for each model. Includes Standard Notation Schematics; full chassis photo coverage; complete circuit analysis and replacement parts data; wave forms, alignment data; record changer analysis — everything you need for quick, profitable servicing. Each volume in deluxe binding.

VOL. 1—Post-war models to Jan. 1, 1947
VOL. 2—Jan. 1, 1947—July 1, 1947
VOL. 3—July 1, 1947—Jan. 1, 1948
VOL. 4—Jan. 1, 1948—July 1, 1948
VOL. 5—July 1, 1948—Dec. 1, 1948
VOL. 6—Dec. 1, 1948—May 1, 1949
VOL. 7—May 1, 1949—Oct. 1, 1949
VOL. 8—Oct. 1, 1949—Dec. 1, 1949
VOL. 9—Dec. 1, 1949—Mar. 31, 1950
VOL. 10—Mar. 31, 1950—July 31, 1950
VOL. 11—July 31, 1950—Oct. 31, 1950
VOL. 12—Oct. 31, 1950—Jan. 1, 1951
VOL. 13—Jan. 1, 1951—Apr. 30, 1951
VOL. 14—Apr. 30, 1951—Aug. 1, 1951
VOL. 15—Aug. 1, 1951—Oct. 31, 1951
VOL. 16—Oct. 31, 1951—Jan. 31, 1952
VOL. 17—Jan. 31, 1952—Apr. 30, 1952
VOL. 18—Apr. 30, 1952—July 31, 1952
VOL. 19—July 31, 1952—Nov. 30, 1952
VOL. 20—Nov. 30, 1952—Feb. 28, 1953
VOL. 21—Feb. 28, 1953—May 31, 1953
VOL. 22—May 31, 1953—Sept. 15, 1953
VOL. 23—Sept. 15, 1953—Dec. 15, 1953

**(2) Each Volume in DeLuxe Binder..$21.00**

## PHOTOFACT FOLDER SETS

The easiest way to own the world's finest TV-Radio Service Data. Issued three sets per month—put in your standing order for them.

**(9) Per PHOTOFACT Set............$1.75**

## PHOTOFACT SERVICE DATA ITEMS

| | |
|---|---|
| (3) Deluxe Photofact Binder, Each | $3.50 |
| (3) PF INDEX Binder (holds 12 issues) | 2.50 |
| (1) Index Tabs for Sets 1-10 | .40 |
| (1) Index Tabs for Sets 11-20 | .40 |
| (1) Volume Labels for Vols. 1-10 | .25 |
| (1) Volume Labels for Vols. 11-20 | .25 |
| (1) Volume Labels for Vols. 21-30 | .25 |
| (1) Index Cards, Sets 1-100 | $2.50 per set |
| (1) Index Cards, Sets 101-200 | 2.50 per set |
| (1) Index Cards, Sets 201-300 | 2.50 per set |
| (1) Mailing envelopes | 2.70 per 100 |

**EASY-PAY PLAN:** Ask your Parts Distributor for details on our attractive Time Payment terms that enable you to own and use the PHOTOFACT Service Data Library on a convenient pay-as-you-earn basis.

## AUTO RADIO SERVICE MANUALS

**Vol. 3.** Full service data on 47 chassis (80 models) used in 1950, 1951 and 1952 auto radio receivers. 288 pages, 8½ x 11". Order **AR-3**..........**$3.00**

**Vol. 2.** Covers 60 chassis (90 models) used in 1948, 1949 and 1950 auto radios. 288 pages, 8½ x 11". Order **AR-2**..................**$3.00**

**Vol. 1.** Covers 100 auto radio models made from 1946 to 1949 by 24 manufacturers. 396 pages, 8½ x 11". Order **AR-1**..................**$4.95**

## HANDY SERVICE GUIDES

**Dial Cord Stringing Guide. Vol. 2:** Shows correct way to string dial cords in radio receivers made from 1947 through 1949. 96 pages, 5½ x 8½". Order **DC-2**..........................**$1.00**

**Vol. 1:** Covers receivers produced from 1938 through 1946. 112 pages, 5½ x 8½". Order **DC-1**..........................**$1.00**

**Radio Receiver Tube Replacement Guide.** Shows where to replace each tube in 5500 receivers made from 1938 to 1948. 196 pages, 5½ x 8½". Order **TP-1**..........................**$1.25**

## INVALUABLE TELEVISION BOOKS

**Telecasting Operations.** The only complete coverage of every phase of Telecasting, from theory through equipment, operation, maintenance, production—indispensable to anyone interested in Telecasting. 600 p., 6 x 9". Order **OH-1**..**$7.95**

**Photofact Television Course.** Gives a clear, complete understanding of TV principles, operation and practice. 208 pages, 8½ x 11". Order **TV-1**..................................**$3.00**

**TV Servicing Short-Cuts.** Describes actual TV service case histories; shows how to solve similar troubles in *any* receiver. 100 pages, 5½ x 8½". Order **TK-1**..........................**$1.50**

**TV Test Instruments.** Tells how to operate each test instrument used in TV service work. 175 pages, 8½ x 11". Order **TN-1**............**$3.00**

**UHF Converters.** Describes 21 popular converters; shows how they work. 44 pages, 8½ x 11". Order **UC-1**..........................**$1.00**

**UHF Antennas, Converters & Tuners.** Covers all antenna types, transmission lines and matching networks. UHF converters and tuners. 136 pages, 5½ x 8½". Order **UHF-1**..........**$1.50**

**Television Antennas.** 2nd Edition. Tells how to select, install and service antennas. 224 pages, 5½ x 8½". Order **TAG-1**................**$2.00**

**Servicing TV in the Customer's Home.** Short-cut methods for repairs in the field. 96 pages, 5½ x 8½". Order **TC-1**................**$1.50**

**Making Money in TV Servicing.** Tells how to set up and operate a profitable TV service business. 136 pages, 5½ x 8½". Order **MM-1**......**$1.25**

**TV Tube Location Guides: Vol. 4.** Shows tube positions and functions in hundreds of TV receivers. Helps quickly locate faulty tube. 192 pages. 5½ x 8½". Order **TGL-4**................**$2.00**

**Vol. 3.** Covers receivers not included in Vols. 1, 2 and 4. 192 pages, 5½ x 8½". Order **TGL-3**. **$2.00**

**Vol. 2** Covers receivers not included in Vols. 1 and 3. 208 pages, 5½ x 8½". Order **TGL-1**..**$2.00**

**Vol. 1.** Covers hundreds of sets made by 56 mfgrs. 208 pages, 5½ x 8½". Order **TGL-1**. **$1.50**

## AUDIO PUBLICATIONS

**Recording & Reproduction of Sound.** Oliver Read's biggest selling volume on all aspects of Audio; fully covers recording and amplifying methods and equipment. Authoritative, complete. 810 pages, 6 x 9". Order **RR-2**..............**$7.95**

**Audio Amplifiers. Vol. 4.** Full analysis of 75 audio amplifiers and tuners made during 1951 and 1952. 352 pages, 8½ x 11". Order **AA-4**..**$3.95**

**Vol. 3.** Covers 50 amplifiers and 22 tuners made during 1950. 352 pages, 8½ x 11". Order **AA-3**..............................**$3.95**

**Vol. 2.** Covers 104 amplifiers and 12 tuners produced during 1949. 368 pages, 8½ x 11". Order **AA-2**..................................**$3.95**

**Vol. 1.** Covers 102 amplifiers and tuners produced from 1946-1948. 352 pages, 8½ x 11". Order **AA-1**..........................**$3.95**

## RECORD CHANGER MANUALS

**Vol. 4.** Full service data on 38 changers and recorders made during 1951. 288 pages, 8½ x 11". Order **CM-4**..........................**$3.00**

**Vol. 3.** Covers 44 changers made in 1949 and 1950. 288 pages, 8½ x 11". Order **CM-3**...**$3.00**

**Vol. 2.** Covers 45 models made in 1948 and early 1949. 432 pages, 8½ x 11". Order **CM-2**...**$4.95**

**Vol. 1.** Covers 41 post-war models made up to 1948. 396 pages, 8½ x 11". Order **CM-1**...**$3.95**

## COMMUNICATIONS RECEIVERS

**Vol. 2.** Full analysis of 26 popular communications receivers made during recent years. 190 pages, 8½ x 11". Order **CR-2**............**$3.00**

**Vol. 1.** Covers 50 well-known models produced from 1946 to 1948. 264 pages, 8½ x 11". Order **CR-1**..................................**$3.00**

**Get these PHOTOFACT Publications at your Parts Distributor**

NOTE: PCB denotes Production Change Bulletin

**AIRLINE—Cont.**

35BR-3167A, 35BR-3168A, 35BR-3169A Tel. Rec. 221—2
35GSE-1555C (See Model 25GSE-1555A—Set 174-3)
35GSE-1556C (See Model 25GSE-1556A—Set 174-3)
35GSE-3074A Tel. Rec. (See PCB 72—Set 212-1 and Model 25GSE-3063A—Set 195-2)
35GSE-3085A Tel. Rec. (See PCB 72—Set 212-1 and Model 25GSE-3063A—Set 195-2)
35GSE-3087A Tel. Rec. (See PCB 72—Set 212-1 and Model 25GSE-3063A—Set 195-2)
35GSL-3064A, B Tel. Rec. 218—3
35GSL-3083A, B Tel. Rec. 218—3
35WG-1570B, C, 35WG-1571B, 35WG-1572B (See Model 25WG-1570A—Set 177-4)
35WG-2761C, D (See Model 15WG-2745C—Set 130-2)
35WG-2765F, G (See Model 15WG-2745C—Set 130-2)
35WG-3171A, B Tel. Rec. 222—3
35WG-3173A, B Tel. Rec. 222—3
35WG-3175A Tel. Rec. 222—3
35WG-3177A Tel. Rec. 222—3
35WG-3179A Tel. Rec. 222—3
54BR-1501A, 54BR-1502A 2-26
54BR-1503A, B, C, 54BR-1504A, B, C 3—4
54BR-1505A, B, 54BR-1506A, B 2-34
54KP-1209A, B 8—1
54WG-1801A, 54WG-1801B 4-33
54WG-2500A, 54WG-2700A 4-15
64BR-916A 3-34
64BR-916B (See Model 74BR-916B—Set 17-5)
64BR-917A 10—1
64BR-917B (See Model 64BR-917A—Set 10-1)
64BR-1051A 2-32
64BR-1051B (See Model 64BR-1051A—Set 2-32)
64BR-1205A, 64BR-1206A 10—3
64BR-1208A 16—4
64BR-1503B, 64BR-1504B (See Model 54BR-1503A—Set 3-4)
64BR-1513A, B, 64BR-1514A, B 24—4
64BR-1808A 16—5
64BR-2200A 16—4
64BR-7000A 51—2
64BR-7100A, 64BR-7110A, 64BR-7120A 57—5
64BR-7300A, 64BR-7310A, 64BR-7320A 54—4
64BR-7810A, 64BR-7820A 53—3
64WG-1050A 10—2
64WG-1050B, C, D (See Model 64WG-1050A—Set 10-2)
64WG-1052A 9—2
64WG-1052B (See Model 64WG-1052A—Set 9-2)
64WG-1207B 18—5
64WG-1511A, 64WG-1511B, 64WG-1512A, 64WG-1512B 5—5
64WG-1801C 4-33
64WG-1804A, B 4-27
64WG-1804C (See Model 64WG-1804A—Set 4-27)
64WG-1807A, 64WG-1807B 5—4
64WG-1809A, B 5—5
64WG-2007A, 64WG-2007B 5—6
64WG-2009A, 64WG-2009B 6—2
64WG-2010B 18—6
64WG-2500A (See Model 54WG-2500A—Set 4-15)
64WG-2700A, B (See Model 54WG-2500A—Set 4-15)
74BR-916B 17—5
74BR-1513B, 74BR-1514B 24—4
74BR-1812A (See Model 74BR-1812B—Set 22-2)
74BR1812B 22—2
74BR-2001A (See Model 74BR-2001B—Set 23-2)
74BR-2001B 23—2
74BR-2701A 24—5
74BR-2702A (See Model 74BR-2702B—Set 25-3)
74BR-2702B 25—3
74GSG-8400A, 74GSG-8700A 60—3
74GSG-8810A, 74GSG-8820A 52—2
74HA-8200A 58—4
74KR-1210A 41—1
74KR-2706B 35—1
74KR-2713A 43—2
74WG-925A 24—6
74WG-1050C, D (See Model 64WG-1050A—Set 10-2)
74WG-1052B (See Model 64WG-1052A, B—Set 9-2)
74WG-1054A 22—1
74WG-1054B (See Model 74WG-1054A—Set 22-1)
74WG-1056A 29—1
74WG-1057A 32—2
74WG-1207B 18—5
74WG-1509A, 74WG-1510A 27—1
74WG-1511B, 74WG-1512B (See Model 64WG-1511A—Set 5-5)
74WG-1802A 25—4
74WG-1803A (See Model 74WG-1802A—Set 25-4)
74WG-1804C (See Model 64WG-1804A—Set 4-27)
74WG-1807A, B (See Model 64WG-1807A—Set 5-4)
74WG-2002A 26—4
74WG-2004A 27—2
74WG-2007B, 74WG-2007C 5—6
74WG-2009B (See Model 64WG-2009A—Set 6-2)
74WG-2010A (See Model 74WG-2010B—Set 18-6)
74WG-2010B 18—6
74WG-2500A (See Model 54WG-2500A—Set 4-15)
74WG-2504A 28—1
74WG-2504B, C (See Model 74WG-2504A—Set 28-1)

**AIRLINE—Cont.**

74WG-2505A 18—7
74WG-2700A, B (See Model 54WG-2500A—Set 4-15)
74WG-2704A 28—1
74WG-2704B, C (See Model 74WG-2704A—Set 28-1)
74WG-2705A, B (See Model 74WG-2505—Set 18-7)
74WG-2709A 26—5
74WG-2711A (See Model 74WG-2505A—Set 18-7)
84BR-1815B, 84BR-1816B 55—3
84GAA-3967A 91—3
84GCB-1062A 52-26
84GDC-963B 51—3
84GDC-987A 53—4
84GHM-926B 55—4
84GSE-2730A, 84GSE-2731A 70—1
84GSE-3011A Tel. Rec. 82—1
84HA-1527A, 84HA-1528A (See Model 94HA-1527C—Set 67-3)
84HA1529A, 84HA1530A 85—2
84HA-1810A (See Model 84HA-1810C—Set 69-2)
84HA-1810C 69—2
84HA-3002A, 84HA-3002B Tel. Rec. 99—3
84HA-3010A, B, C Tel. Rec. (Also see PCB 11—Set 118-1) 94—2
84KR-1520A 56—4
84KR-2511A 68—4
84WG-1060A 42—1
84WG-1060C (See Model 84WG-1060A—Set 42-1)
84WG-2015A 38—1
84WG-2506 (See Model 84WG-2721A—Set 46-3)
84WG-2506B 58—5
84WG-2712A 43—3
84WG-2712B (See Model 84WG-2712A—Set 43-3)
84WG-2714A 36—2
84WG-2714F, G, H, J 56—5
84WG-2718A, 84WG-2718B, 84-WG-2720A 45—5
84WG-2721A, B 46—3
84WG-2724A 45—5
84WG-2728A (See Model 84WG-2718A—Set 45-5)
84WG-2732A, B (See Model 84WG-2712A—Set 43-3)
84WG-2734A (See Model 84WG-2718A—Set 45-5)
84WG-3006, 84WG-3008, 84WG-3009 Tel. Rec. (See Model 94-WG-3006A—Set 72-4)
94BR-1533A 88—1
94BR-2740A, 94BR-2741A, B 89—1
94BR3004, C, 94BR3005, C Tel. Rec. 91A—3
94BR-3017A Tel. Rec. 89—2
94BR-3017B Tel. Rec. (See PCB 7—Set 110-1 and Model 94BR-3017A—Set 89-2)
94GAA-3654A 95—1
94GCB-1064A 96—2
94GCB-3023A, B, C Tel. Rec. 116—2
94GHM-934A 167—3
94GSE-2735A, 94GSE-2736A 72—3
94GSE-3011, B (See Model 84GSE-3011A—Set 83-1)
94GSE-3015A Tel. Rec. 107—2
94GSE-3018A Tel. Rec. 93A—2
94HA-1527C, 94HA-1528C 67—3
94HA1529A, 94HA1530A 85—2
94WG-1059A 75—3
94WG-1804D 86—2
94WG-1811A 99—4
94WG-2742A, C, D 71—5
94WG-2745A 76—4
94WG-2746A, B, 94WG-2747A 71—5
94WG-2748A, 94WG-2749A 90—1
94WG-2748C (See Model 94WG-2748A—Set 90-1)
94WG-2749A 90—1
94WG-3006A Tel. Rec. 72—4
94WG-3006B Tel. Rec. 85—3
94WG-3008A, 94WG-3009A Tel. Rec. 72—4
94WG-3009B Tel. Rec. 85—3
94WG-3016A, B, C Tel. Rec. (See Set 110-2 and Model 94WG-9006A—Set 72-4)
94WG 3022 Tel. Rec. 85—3
94WG-3026A Tel. Rec. 85—3
94WG-3028A Tel. Rec. (See Model 94WG-3006A—Set 72-4)
94WG-3029A Tel. Rec. 85—3

**ALDENS**

114G, 116G, 117G, 120G Tel. Rec. (Similar to Chassis) 162—7

**ALGENE**

AR5U 22—3
AR6U 22—4

**ALTEC LANSING**

ALC-101 84—2
ALC-205, ALC-206 Tel. Rec. 105—3
A323B 66—2
A323C 84—2
A-333A 165—5
A-433A 165—5
303A 166—4

**AMBASSADOR**

AM17C, CB, CIM, PT, TIM Tel. Rec. 171—2
AM20C, T Tel. Rec. 171—2
A17CS, A17TS Tel. Rec. (See Model 20PC—Set 178-3)
A20CS Tel. Rec. (See Model 20PC—Set 178-3)
A21QDCS Tel. Rec. (See Model 20PC—Set 178-3)
A24QDCS Tel. Rec. (See Model 20PC—Set 178-3)
CD2020 Tel. Rec. 175—2
C1720 Tel. Rec. 175—2
C2020 Tel. Rec. 175—2
C2050 Tel. Rec. (See Model C1720—Set 175-2)
C2052 Tel. Rec. (See Model T1853—Set 197-3)

**AMBASSADOR—Cont.**

C2152, A Tel. Rec. (See Model T1853—Set 197-3)
C2150 Tel. Rec. (See Model C1720—Set 175-2)
C2155 Tel. Rec. (See Model T1853—Set 197-3)
C2420 Tel. Rec. 175—2
PL17CB, CG, PG, TM Tel. Rec. 171—2
T1720 Tel. Rec. 175—2
T2020 Tel. Rec. 175—2
14MC, MT Tel. Rec. 162—2
14MT (2nd Prod.), 14MTS Tel. Rec. 173—2
16MC, MT, MXC, MXCS, MXT, MXTS Tel. Rec. 162—2
16MT (2nd Prod.), MTS Tel. Rec. 173—2
17MC, MT, MXC, MXCS, MXT, MXTS Tel. Rec. 162—2
17MC (2nd Prod.), MCS, MT (2nd Prod.), MTS Tel. Rec. 173—2
17PC, 17PCS Tel. Rec. (See Model 20PC—Set 178-3)
17PT, 17PTS Tel. Rec. (See Model 20PC—Set 178-3)
20C Tel. Rec. 171—2
20MC, MCS, MT, MTS Tel. Rec. 173—2
20PC, 20PCS, 20PCS2 Tel. Rec. 178—3
20PT, 20PTRS, 20PTS Tel. Rec. (See Model 20PC—Set 178-3)
21CD2A, B Tel. Rec. (See Model 21C2A—Set 191-4)
21C2A, 21C2AL0 Tel. Rec. 191—4
23P Tel. Rec. 171—2
921 Tel. Rec. (See Model 21C2A—Set 191-4)
9120, LO Tel. Rec. 191—4
9121, LO Tel. Rec. (See Model 21C2A—Set 191-4)
9820, LO, 9821, LO Tel. Rec. 191—4

**AMC (AIMCEE)**

1C23 Tel. Rec. (Similar to Chassis) 139-11
1C72 Tel. Rec. (Similar to Chassis) 126—8
1171 Tel. Rec. (Similar to Chassis) 126—8
17C, CB Tel. Rec. (Similar to Chassis) 126—8
17CG, 17C3 Tel. Rec. (Similar to Chassis) 149-13
17T Tel. Rec. (Similar to Chassis) 126—8
17TG Tel. Rec. (Similar to Chassis) 149-13
17T20 Tel. Rec. (Similar to Chassis) 139-11
20CD Tel. Rec. (Similar to Chassis) 149-13
20CD2A, -1 Tel. Rec. 188—3
20C1 Tel. Rec. (Similar to Chassis) 149-13
20C2A, -1 Tel. Rec. 188—3
20C22 Tel. Rec. (Similar to Chassis) 139-11
20D, DB Tel. Rec. (Similar to Chassis) 139-11
20TG Tel. Rec. (Similar to Chassis) 149-13
20T21 Tel. Rec. (Similar to Chassis) 139-11
20T2A, -1 Tel. Rec. 188—3
21CD2A, B Tel. Rec. (See Model 20C2A—Set 188-3)
21C2A Tel. Rec. (See Model 20C2A—Set 188-3)
24T2A, -1 Tel. Rec. 188—3
114C, 114T Tel. Rec. (Similar to Chassis) 111—3
116C, 116CD, 116T Tel. Rec. (Similar to Chassis) 111—3
125P 3-27
126 16—1

**AMERICAN COMMUNICATIONS (See Liberty)**

**AMPLIFIER CORP. OF AMERICA**

ACA-100DC, ACA-100GE 63—2

**AMPLIPHONE**

10 21—1
20 21-12

**AMPRO (See Recorder Listing)**

**ANDREA**

BT-VK12 Tel. Rec. 76—5
8C-VL17 (Ch. VL17) Tel. Rec. (See Model C-VL17—Set 152-1)
BT-VL17 (Ch. VL17) Tel. Rec. (See Model C-VL17—Set 152-1)
CO-U15 27—3
CO-VK15, COVK16 (Ch. VK1516) Tel. Rec. (Also see PCB 8—Set 112-1) 103—4
COVK-125 Tel. Rec. 76—5
COVL-16 (Ch. VL16) Tel. Rec. 125—3
CO-VL19 (Ch. VL19) Tel. Rec. 168—4
CO-VM21 (Ch. VM21) Tel. Rec. 204—3
C-VK19 Tel. Rec. (See PCB 8—Set 112-1 and Model COVK15—Set 103-4)
CVK-126 Tel. Rec. 76—5
CVL-16 (Ch. VL16) Tel. Rec. 125—3
C-VL17 (Ch. VL17) Tel. Rec. 152—1
C-VM21 (Ch. VM-21) Tel. Rec. 204—3
P-163 (Ch. 163) 18—8
T16 21—2
T-U15 24—7
T-U16 21—3
T-VK12 Tel. Rec. 76—5
TVK-127B, M Tel. Rec. 76—5
TVL-12 Tel. Rec. 123—3
TVL-16 (Ch. VL-16) Tel. Rec.

**ANDREA—Cont.**

125—3
T-VL17 (Ch. VL17) Tel. Rec. 152—1
T-VM21 (Ch. VM21) Tel. Rec. 204—3
2C-VL17 (Ch. VL17) Tel. Rec. 152—1
2C-VL20 (Ch. VL-20) Tel. Rec. 175—3
2C-VM21 (Ch. VM21) Tel. Rec. 204—3
Ch. VK1516 (See Model CO-VK15)
Ch. VL16 (See Model COVL-16)
Ch. VL17 (See Model C-VL17)
Ch. VL19 (See Model CO-VL19)
Ch. VL20 (See Model 2C-VL20)
Ch. VM21 (See Model C-VM21)

**ANSLEY**

32 5-27
41 (Paneltone) 4-38
53 24—8
701 Tel. Rec. 71—6

**APEX**

4B5 37—2
192A 17—6
817, 920, 924 Tel. Rec. 181—3
9120, 9121 Tel. Rec. 181—3
9820, 9820B, 9821 Tel. Rec. 181—3

**APPROVED ELECTRONIC INSTRUMENT CORP.**

FM Tuner 41—2
A-600AC 175—4
A710 177—5
A-800 176—2
A-850 175—5

**ARC**

601 25—5

**ARCADIA**

37D14-600 9—3

**ARIA**

554-1-61A 7—2

**ARLINGTON**

30T14A-056 Tel. Rec. (Similar to Chassis) 119—3
38T12A-058 Tel. Rec. (Similar to Chassis) 109—1
317T3 Tel. Rec. (Similar to Chassis) 72—4
318T4 Tel. Rec. (Similar to Chassis) 85—3
318T4S Tel. Rec. (Similar to Chassis) 85—3
318T4-872 Tel. Rec. (Similar to Chassis) 85—3
318T6A Tel. Rec. (Similar to Chassis) 85—3
318T6A-950 Tel. Rec. (Similar to Chassis) 85—3
318T9A-900 Tel. Rec. (Similar to Chassis) 78—4
321MS31C Tel. Rec. (Similar to Chassis) 182—5
518T6A Tel. Rec. (Similar to Chassis) 85—3
518T9A-918 Tel. Rec. (Similar to Chassis) 78—4
518T10A-916 Tel. Rec. (Similar to Chassis) 78—4
2318T6A-954 Tel. Rec. (Similar to Chassis) 85—3
2318T9A-912 Tel. Rec. (Similar to Chassis) 78—4

**ARTHUR ANSLEY**

LP-2, LP-3 62—4
LP-4A 82—2
LP-5 (See Model P-5—Set 108-4)
LP-6, LP6-S 136—5
LP-7 134—3
P-5 108—4
R-1 200—2
SP-1 60—4
TP-1 173—3

**ARTONE**

ARC21 Tel. Rec. 205—3
ARC71 Tel. Rec. 205—3
ARD21 Tel. Rec. 205—3
AR14L, AR17L Tel. Rec. 172—3
AR21 Tel. Rec. 205—3
AR71 Tel. Rec. 205—3
AR-23TV-1 Tel. Rec. 80—1
MST12, MST14 Tel. Rec. 170—4
14TR, 16TR Tel. Rec. 170—4
17CD (1st Prod.) Tel. Rec. 170—4
17CD (2nd Prod.) Tel. Rec. 172—3
17CRR (1st Prod.) Tel. Rec. 170—4
17CRR (2nd Prod.) Tel. Rec. 172—3
17ROG (1st Prod.) Tel. Rec. 170—4
17ROG (2nd Prod.) Tel. Rec. 172—3
20CD (1st Prod.) Tel. Rec. 170—4
20CD (2nd Prod.) Tel. Rec. 172—3
20TR Tel. Rec. 170—4
112X Tel. Rec. 170—4
203D (1st Prod.) Tel. Rec. 170—4
203D (2nd Prod.) Tel. Rec. 172—3
312 Tel. Rec. 170—4
524 76—7
819 Tel. Rec. 170—4
1000, 1001 Tel. Rec. 172—3
3163CR Tel. Rec. 170—4
8163CR, 8193CM Tel. Rec. 170—4

**ARVIN**

140P (Ch. RE-209) 25—6
150-TC, 151-TC (Ch. RE-228) 25—7
150TC, 151TC (Ch. RE-228-1) Late 39—2
152T (Ch. RE-233) 33—1
153T (See Model 152T—Set 33-1)
160T, 161T (Ch. RE-232) 49—5
182TFM (Ch. RE-237) 32—3
240-P (Ch. RE-243) 42—2
241P (Ch. RE-244, RE-254, RE-255, RE-256, RE-259) 47—3
242T, 243T (Ch. RE-251) 52—3
244P (Ch. RT-244, RE-254, RE-255, RE-256, RE-259) 47—3
250-P (Ch. RE-248) 43—4

**ARVIN—Cont.**

253T, 254T, 255T, 256T (Ch. RE-252) 53—5
264T, 265T (Ch. RE-265) 64—2
280TFM, 281TFM (Ch. RE-253) 44—2
341T (Ch. RE-274) 84—3
350P (Ch. RE-267) 69—3
350-PB (Ch. RE-267-1) 100—4
350PL (Ch. RE-277-2) 100—4
351P (Ch. RE-267) 69—3
351-PB (Ch. RE-267-1) 100—4
351-PL (Ch. RE-267-2) 100—4
352-PL, 353-PL (Ch. RE-267-2) 100—4
355T (Ch. RE-213) (See Model 356T—Set 78-2)
356T, 357T (Ch. RE-273) 78—2
358T (Ch. RE-233) (See Model 152T—Set 33-1)
360TFM, 361TFM (Ch. RE-260) 70—2
440T (Ch. RE-278) 96—3
441T (Ch. RE-278) (See Model 440T—Set 96-3)
442 (Ch. RE-91) 34—2
444, 444A (Ch. RE-200) 1—3
444AM, 444M (Ch. RE-200M) 23—3
446P (Ch. RE-280) 106—2
450T, 451T (Ch. RE-281) 110—3
460T, 461T (Ch. RE-284) 107—3
462-CB, 462-CM (Ch. RE-287-1) 116—3
480TFM, 481TFM (Ch. RE-277, RE-277-1) 107—4
482CFB, 482CFM (Ch. RE-288-1) 117—4
540T (Ch. RE-278) 143—4
542T (See Model 440T—Set 96-3)
544, 544A (Ch. RE-201) 1—7
544AR, 544R (Ch. RE-201) (See Model 544—Set 1-7)
547A (Ch. RE-242) 42—3
551T (Ch. RE-297) 154—2
552AN, 552N (Ch. RE-231) 13—9
555, A (Ch. RE-202) 13—9
553 (Ch. RE-308) 159—4
554CCB, 554CCM (Ch. RE-306) 155—3
558 (Ch. RE-204) 3-16
580TFM (Ch. RE-313) 152—2
582CFB, 582CFM (Ch. RE-310) 156—4
652-P (Ch. RE292) (See Model 650-P—Set 175-6)
654-P (Ch. RE-292) (See Model 650-P—Set 175-6)
650-P (Ch. RE292) 175—6
655 SWT (Ch. RE327) 187—2
657-T (Ch. RE307) 168—5
664, 664A (Ch. RE-206) 3-23
664, 664A (Ch. RE-206-1) 29—2
665 (Ch. RE-229) 18-10
740T (Ch. RE-278) (See Model 540T—Set 143-4)
751TR (See Model 551T—Set 154-2)
753T (Ch. RE-348) 220—2
758T (Ch. RE-350) 221—3
760T (Ch. RE-342) 223—3
2120CM (Ch. TE289-2, TE289-3) Tel. Rec. (Also See PCB 20—Set 134-1) 120—3
2121TM (Ch. TE289-2, TE-289-3) Tel. Rec. (Also see PCB 20—Set 134-1) 120—3
2122TM (Ch. TE-289) Tel. Rec. 97A—1
2123TM (Ch. TE-289-2, TE289-3) Tel. Rec. (Also see PCB 20—Set 134-1) 120—3
2124CCM (Ch. TE289-2, TE289-3) Tel. Rec. (Also see PCB 20—Set 134-1) 120—3
2126CM (Ch. TE289-2, TE-289-3) Tel. Rec. (Also see PCB 20—Set 134-1) 120—3
2160, 2161, 2162, 2164 (Ch. TE-290) Tel. Rec. 126—3
2410P (Ch. RE-244, RE-254, RE-255, RE-256, RE-259) 47—3
3100TB, 3100TM, 3101CM, 3120-TM, 3121TM (Ch. TE-272-1, TE-272-2) Tel. Rec. 80—2
3160CM (Ch. TE-276) Tel. Rec. 93—2
4080T (Ch. TE282) Tel. Rec. 104—2
4081T Tel. Rec. (See Model 4080T—Set 104-2)
4162CM (Ch. TE-286) Tel. Rec. 130—3
5170CB, CM, 5171TM, 5172CB, CM (Ch. TE-302, -1, -2, -3, -4, -5A, -6) Tel. Rec. (Also see PCB 50—Set 184-1) 142—5
5175, 5176 (Ch. TE320) Tel. Rec. 179—3
5204CM, 5206CM (Ch. TE-300) Tel. Rec. 149—3
5210, 5211, 5212 (Ch. TE-315, -1, -2, -3, -4, -5) Tel. Rec. (Also see PCB 37—Set 166-1 and PCB 50—Set 184-1) 151—5
5213TM (Ch. TE334) Tel. Rec. 191—5
6173TM (Ch. TE-331-3, -4) Tel. Rec. (See PCB 66—Set 203-1 and Model 6175TM—Set 181-4)
6173TM-UHF (Ch. TE-332) Tel. Rec. 208—2
6175TM (Ch. TE-331, -1, -2, -3, -4) Tel. Rec. (Also see PCB 66—Set 203-1) 181—4
6179TM (Ch. TE-331, -1, -2, -3, -4) Tel. Rec. (Also see PCB 66—Set 203-1) 181—4
6213TB (Ch. TE-319, -1, -2) Tel. Rec. (See PCB 67—Set 204-1 and Model 6213TM—Set 195-4)
6213TB-UHF (Ch. TE-330) Tel. Rec. 208—2
6213TM (Ch. TE-319, -1, -2) Tel. Rec. (Also see PCB 67—Set 204-1) 195—4
6213TM-UHF (Ch. TE-330) Tel. Rec. 208—2
6215CB (Ch. TE-319, -1, -2) Tel. Rec. (Also see PCB 67—Set 204-1) 195—4

NOTE: PCB denotes Production Change Bulletin

NOTE: PCB denotes Production Change Bulletin

**CARDWELL, ALLEN D.**
CE-26 .... 14—6
**CAVENDISH (See Bell Air)**
**CBS COLUMBIA (Also see Air King)**
17C18 (Ch. 817, -1) Tel. Rec. .... 188—5
17C18 (Ch. 817-2) Tel. Rec. (See Model 18C18—Set 214-2)
17M18 (Ch. 817, -1) Tel. Rec. .... 188—5
17M18 (Ch. 817-2) Tel. Rec. (See Model 18C18—Set 214-2)
17T18 (Ch. 817, -1) Tel. Rec. .... 188—5
17T18 (Ch. 817-2) Tel. Rec. (See Model 18C18—Set 214-2)
18C18 (Ch. 817-6) Tel. Rec. .... 214—2
18L18 (Ch. 817-2) Tel. Rec. (See Model 18C18—Set 214-2)
18L18 (Ch. 817-6) Tel. Rec. 214—2
18M08 (Ch. 817-2) Tel. Rec. (See Model 18C18—Set 214-2)
18M08 (Ch. 817-6) Tel. Rec. .... 214—2
18M18 (Ch. 817-6) Tel. Rec. .... 214—2
18M28, 18M38 (Ch. 817-6) Tel. Rec. (See Model 18C18—Set 214-2)
18T18 (Ch. 817-6) Tel. Rec. .... 214—2
18T28 (Ch. 817-6) Tel. Rec. (See Model 18C18—Set 214-2)
20M18 (Ch. 820, -1) Tel. Rec. .... 188—5
20M18 (Ch. 820-2) Tel. Rec. (See Model 18C18—Set 214-2)
20M28 (Ch. 820, -1) Tel. Rec. .... 188—5
20M28 (Ch. 820-2) Tel. Rec. (See Model 18C18—Set 214-2)
20T18 (Ch. 820, -1) Tel. Rec. .... 188—5
20T18 (Ch. 820-2) Tel. Rec. (See Model 18C18—Set 214-2)
21C11, B (Ch. 1021) Tel. Rec. .... 199—4
21C18 (Ch. 821) (See Model 17C18—Set 188-5)
21C21 (Ch. 1021) Tel. Rec. 199—4
21C318 (Ch. 1021) Tel. Rec. .... 199—4
21C41 (Ch. 1021) Tel. Rec. 199—4
21T11 (Ch. 1021) Tel. Rec. 199—4
22C08 (Ch. 821-6, -6A) Tel. Rec. .... 214—2
22C11, B (Ch. 1021) Tel. Rec. (See Model 21C11—Set 199-4)
22C18 (Ch. 821-6, -6A) Tel. Rec. .... 214—2
22C21 (Ch. 1021) Tel. Rec. (See Model 21C11—Set 199-4)
22C28 (Ch. 821-6, -6A) Tel. Rec. .... 214—2
22C318 (Ch. 1021) Tel. Rec. (See Model 21C11—Set 199-4)
22C38 (Ch. 821-3) Tel. Rec. (See Model 18C18—Set 214-2)
22C41 (Ch. 1021) Tel. Rec. (See Model 21C11—Set 199-4)
22C48, B, 22C58, 22C68, B, 22C-78, B (Ch. 821-4) Tel. Rec. (See Model 18C18—Set 214-2)
22L18 (Ch. 821-6, -6A) Tel. Rec. .... 214—2
22M08, 22M18 (Ch. 821-6, -6A) Tel. Rec. .... 214—2
22M28, 22M38 (Ch. 821-4) Tel. Rec. (See Model 18C18—Set 214-2)
22T11 (Ch. 1021) Tel. Rec. (See Model 21C11—Set 199-4)
22T18 (Ch. 821-6, -6A) Tel. Rec. .... 214—2
22T28, B (Ch. 821-4) Tel. Rec. (See Model 18C18—Set 214-2)
515A, 516A, 517A .... 223—4
525, 526 .... 222—4
540, 541 .... 211—4
545, 546 (See Model 540—Set 211-4)
2001 Tel. UHF Conv. .... 207—2
Ch. 817, -1 (See Model 17C18)
Ch. 817-2 (See Model 17C18)
Ch. 817-6 (See Model 18C18)
Ch. 820, 820-1 (See Model 20M18)
Ch. 820-2 (See Model 20M18)
Ch. 821 (See Model 21C18)
Ch. 821-3 (See Model 22C38)
Ch. 821-4 (See Model 22C48)
Ch. 821-6, -6A (See Model 22C08)
Ch. 1021 (See Model 21C11)
**CENTURY (Also see Industrial Television)**
226, 326 (Ch. IT-26R, IT-35R, IT-39R, IT-46R) Tel. Rec. .... 99A—7
721, 821, 921, 1021 (Ch. IT-21R) Tel. Rec. .... 97A—8
**CENTURY (20th)**
100X, 101, 104 .... 12—5
200 .... 21—5
300 .... 21—6
**CHALLENGER**
CC8 .... 63—4
CC18 .... 67—7
CC30 .... 68—6
CC60 .... 70—3
CC618 .... 66—4
CD6 .... 65—4
20R .... 69—5
60R .... 62—7
200 .... 69—5
600 .... 62—7
**CHANCELLOR (Also see Radionic)**
35P .... 30—25
**CHEVROLET**
985792 .... 6—5
985793 .... 19—6

**CHEVROLET—Cont.**
985986 .... *
986067 .... 90—2
986146 .... 28—6
986240 .... 75—5
986241 .... 58—7
986388 .... 104—5
987443 .... 189—4
986515 .... 149—5
986516 .... 150—6
986668 .... 219—2
986669 .... 224—6
**CHRYSLER (See Mopar)**
**CISCO**
1A5 .... 37—4
9A5 .... 20—3
**CLARION**
C100 .... 1—5
C101 .... 5—9
C102 .... 9—6
C103 .... 6—6
C104 .... 1—4
C105 (See Model C-104—Set 1-4)
C105A .... 6—7
C108 (Ch. 101) .... 5—8
11011 .... 17—8
11305 .... 18—11
11411-N .... 30—5
11801 .... 23—6
11802V-M (See Model 11801—Set 23-6)
12110M .... 54—5
12310-W .... 31—6
12708 .... 41—5
12801 .... 61—5
13101 .... 46—7
13201, 13203 .... 62—8
14601 .... 60—9
14965 .... 66—5
16703 Tel. Rec. .... 102—2
**CLARK**
PA-10 .... 12—6
PA-10A .... 18—12
PA-20 .... 13—12
PA-20A .... 18—13
PA-30 .... 19—7
**CLEARSONIC (See U. S. Television)**
**COLLINS AUDIO PRODUCTS**
FMA-6 .... 99—6
45-D .... 72—6
**COLLINS RADIO**
75A-1 .... 34—4
75A-2 .... 171—4
**COLUMBIA RECORDS**
202 .... 219—3
360 Series "B" .... 215—5
**COMMANDER INDUSTRIES**
Commander 3 Tube Record Player .... 17—10
CD61P .... 19—9
**CONCERTONE (See Recorder Listing)**
**CONCORD**
1N434, 1N435, 1N436 (Similar to Chassis) .... 98—5
1N437 (Similar to Chassis). 121—2
1N549 (Similar to Chassis. 38—5
1N551 (Similar to Chassis). 38—6
1N554, 1N555 (Similar to Chassis) .... 55—10
1N556, 1N557 (Similar to Chassis) .... 109—7
1N559 (Similar to Chassis). 90—7
1N560 (Similar to Chassis). 109—7
1N561, 1N562 (Similar to Chassis) .... 97—8
1N563 (Similar to Chassis). 136—10
1N819 (Similar to Chassis). 69—7
6C51B .... 19—8
6C51W .... 19—8
6E51B .... 20—4
6F26W .... 19—10
6R3ARC .... 21—7
6T61W .... 22—11
7G26C .... 20—5
7R3APW .... 21—7
1-402, 1-403 .... 45—6
1-411 .... 48—5
1-501 (See Model 6E51B—Set 20-4)
1-504 .... 55—6
1-509, 1-510 (See Model 6C51B—Set 19-8)
1-516, 1-517 .... 49—7
1-601, 1-602, 1-603 (See Model 7G26C—Set 20-5)
1-606 .... 45—7
1-608 (See Model 6F26W—Set 19-10)
1-609 (See Model 6T61W—Set 22-11)
1-611 .... 46—8
1-1201 .... 55—7
2-105 (See Model 315WL—Set 53-8)
2-106 .... 54—6
2-200, 2-201, 2-218, 2-219, 2-232, 2-235, 2-236, 2-237, 2-238, 2-239, 2-240 .... 62—9
315WL, 315WM .... 53—8
325WL, 325WN (See Model 2-106—Set 54-6)
**CONRAC**
10-M-36, 10-W-36 (Ch. 36) Tel. Rec. (See Ch. 36)
11-B-36 (Ch. 36) Tel. Rec. (See Ch. 36)
12-M-36, 12-W-36 (Ch. 36) Tel. Rec. (See Ch. 36)
13-B-36 (Ch. 36) Tel. Rec. (See Ch. 36)
14-M-36, 14-W-36 (Ch. 36) Tel. Rec. (See Ch. 36)
15-P-36 (Ch. 36) Tel. Rec. (See Ch. 36)
16-B-36 (Ch. 36) Tel. Rec. (See Ch. 36)

**CONRAC—Cont.**
17-P-39 (Ch. 39) Tel. Rec. (See Ch. 39)
18-M-39, 18-W-39 (Ch. 39) Tel. Rec. (See Ch. 39)
20-M-39, 20-W-39 (Ch. 39) Tel. Rec. (See Ch. 39)
21-B-39 (Ch. 39) Tel. Rec. (See Ch. 39)
22-P-39 (Ch. 39) Tel. Rec. (See Ch. 39)
23-M-390, 23-W-390 (Ch. 39) Tel. Rec. (See Ch. 39)
24-M-36 (Ch. 36) Tel. Rec. (See Ch. 36)
25-W-36 (Ch. 36) Tel. Rec. (See Ch. 36)
26-B-36 (Ch. 36) Tel. Rec. (See Ch. 36)
27-M-40, 27-W-40 (Ch. 40) Tel. Rec. (See Ch. 40)
28-B-40 (Ch. 40) Tel. Rec. (See Ch. 40)
29-P-40 (Ch. 40) Tel. Rec. (See Ch. 40)
30-M-40, 30-W-40 (Ch. 40) Tel. Rec. (See Ch. 40)
31-P-40 (Ch. 40) Tel. Rec. (See Ch. 40)
32-M-44, 32-W-44 (Ch. 44) Tel. Rec. (See Ch. 44)
33-B-44 (Ch. 44) Tel. Rec. (See Ch. 44)
34-P-44 (Ch. 44) Tel. Rec. (See Ch. 44)
35-M-61, 35-W-61 (Ch. 61) Tel. Rec. (See Ch. 61)
36-B-61 (Ch. 61) Tel. Rec. (See Ch. 61)
37-P-61 (Ch. 61) Tel. Rec. (See Ch. 61)
38-B-61, 38-M-61 (Ch. 61) Tel. Rec. (See Ch. 61)
39-M-61 (Ch. 61) Tel. Rec. (See Ch. 61)
40-M-64, 40-W-64 (Ch. 64) Tel. Rec. (See Ch. 64)
41-B-64 (Ch. 64) Tel. Rec. (See Ch. 64)
42-P-64 (Ch. 64) Tel. Rec. (See Ch. 64)
43-B-64, 43-M-64 (Ch. 64) Tel. Rec. (See Ch. 64)
Ch. 36 Tel. Rec. .... 110—4
Ch. 39 Tel. Rec. .... 110—4
Ch. 40 Series Tel. Rec. .... 140—4
Ch. 44 Tel. Rec. (See PCB 27—Set 148-1 and Ch. 40—Set 140-4)
Ch. 61, 64 Series Tel. Rec. .... 185—5
**CONTINENTAL ELCTRONICS (See Skyweight)**
**CONVERSA-FONE**
MS-5 (Master Station) SS-5 (Sub-Station) .... 16—7
**CO-OP**
6AWC2, 6AWC3, 6A47WCR, 6A47-WT, 6A47WTR .... 56—8
**CORONADO**
FA43-8965 Tel. Rec. (See Model 43-8965—Set 86-3)
K-21 (43-9041) Tel. Rec. .... 182—3
K-72 (43-9031) Tel. Rec. .... 182—3
K-73L (43-9030) Tel. Rec. .... 182—3
05RA1-43-7755A, 05RA1-43-7755B .... 101—2
05RA1-43-7901A .... 115—2
05RA2-43-8230A .... 162—3
05RA2-43-8515A .... 110—5
05RA4-43-9876A .... 103—7
05RA33-43-8120A .... 110—6
05RA37-43-8360A .... 102—3
05TV1-43-8945A Tel. Rec. .... 145—5
05TV1-43-9005A, 05TV1-43-9006A Tel. Rec. .... 145—5
05TV1-43-9014A Tel. Rec. .... 128—4
05TV2-43-8950A Tel. Rec. .... 141—4
05TV2-43-9010A Tel. Rec. .... 146—5
05TV2-43-9010B Tel. Rec. .... 153—2
05TV6-43-8935A Tel. Rec. .... *
15RA1-43-7654A .... 147—3
15RA1-43-7902A .... 134—6
15RA2-43-8230A .... 162—3
15RA33-43-8245A, 15RA33-43-8246A .... 174—5
15RA33-43-8365 .... 169—4
15RA37-43-9230A .... 173—5
15TV1-43-8957A, B Tel. Rec. .... 162—4
15TV1-43-8958A, B Tel. Rec. (Also see PCB 34—Set 162-1). 161—3
15TV1-43-9008A Tel. Rec. .... *
15TV1-43-9015A, B, 15TV1-43-9016A, B Tel. Rec. .... 162—4
15TV1-43-9020A, B, 15TV1-43-9021A, B Tel. Rec. (Also see PCB 34—Set 162-1) .... 161—3
15TV2-43-9012A, 15TV2-43-9013A Tel. Rec. .... *
15TV2-43-9025A, B, 15TV2-43-9026A, B Tel. Rec. .... 144—3
15TV2-43-9101A, 15TV2-43-9102A Tel. Rec. .... 152—4
15TV4-43-8948A, 15TV4-43-8949A Tel. Rec. .... 175—7
25TV2-43-9022A Tel. Rec. .... 183—4
25TV2-43-9022B Tel. Rec. (See PCB 65—Set 202-1 and Model 25TV2-43-9022A—Set 183-4)
25TV2-43-9022C Tel. Rec. (See PCB 65—Set 202-1, PCB 72—Set 212-1 and Model 25TV2-43-9022A—Set 183-4)
25TV2-43-9045A, B Tel. Rec. .... 199—5
25TV2-43-9045C Tel. Rec. (See PCB 68—Set 205-1 and Model 25TV2-43-9045A—Set 199-5)
25TV2-43-9060A Tel. Rec. .... 199—5
25TV2-43-9060B Tel. Rec. (See PCB 68—Set 205-1 and Model 25TV2-43-9060A—Set 199-5)
35RA2-43-5101A .... 214—3
35RA4-43-9856A .... 221—4
35RA33-43-8125 .... 217—5

**CORONADO—Cont.**
35RA33-43-8145 .... 224—7
35RA33-43-8225 .... 219—4
35TV2-43-9022C Tel. Rec. (See PCB 65—Set 202-1, PCB 72—Set 212-1 and Model 25TV2-43-9022A—Set 183-4)
35TV2-43-9045D Tel. Rec. (See PCB 68—Set 205-1, PCB 71—Set 211-1 and Model 25TV2-43-9045B—Set 199-5)
35TV2-43-9060C Tel. Rec. (See PCB 66—Set 205-1, PCB 71—Set 211-1 and Model 25TV2-43-9060A—Set 199-5)
45RA1-43-7910A, 45RA1-43-7911A (See Model 15RA1-43-7902A—Set 134-6)
43—2027 .... 11—3
43—5005 .... 28—36
43-6301 .... 7—4
43-6451 .... 10—10
43-6485 .... 46—9
43-6730 (See Model 43-8685—Set 11-4)
43-7601 (See Model 43-7601B—Set 10-11)
43-7601B .... 10—11
43-7602 (See Model 43-7601B—Set 10-11)
43-7651 .... 9—7
43-7652 (See Model 43-7651—Set 9-7)
43-7851 .... 47—5
43-8101 (See Model 94RA31-43-8115A—Set 81-5)
43-8130C, 43-8131C (See Model 94RA33-43-8130C—Set 82-3)
43-8160 .... 12—7
43-8177 (See Model 43-8178—Set 21-8)
43-8178 .... 21—8
43-8180 .... 10—12
43-8190 .... 19—11
43-8201 (See Model 43-8178—Set 21-8)
43-8213 .... 7—5
43-8240, 43-8241 .... 12—8
43-8305 .... 8—3
43-8312A .... 8—4
43-8330 .... 19—12
43-8351, 43-8352 .... 12—9
43-8353, 43-8354 .... 28—7
43-8420 .... 24—13
43-8470 .... 8—3
43-8471 .... 8—4
43-8576B .... 9—8
43-8685 .... 11—4
43-8965 Tel. Rec. .... 86—3
43-9030 Tel. Rec. .... 182—3
43-9031 Tel. Rec. .... 182—3
43-9041 Tel. Rec. .... 182—3
43-9196 .... 14—35
43-9201 .... 24—14
94RA1-43-6945A .... 69—6
94RA1-43-7605A .... 65—5
94RA1-43-7656A, 94RA1-43-7657A .... 73—2
94RA1-43-7751A .... 87—3
94RA1-43-8510A, 94RA1-43-8511A .... 71—7
94RA1-43-8510B, 94RA1-43-8511B .... 75—6
94RA2-43-8230A .... 162—3
94RA4-43-8129A, 94RA4-43-8130A, 94RA4-43-8130B, 94RA4-43-8131A, 94RA-43-8131B . 62—10
94RA31-43-8115A, B, 94RA31-43-8116A .... 81—5
94RA31-43-9841A .... 79—3
94RA33-43-8130C, 94RA33-43-8131C .... 82—3
94TV1-43-8940A Tel. Rec. .. *
94TV1-43-9002A Tel. Rec. .. *
94TV2-43-8970A, 94TV2-43-8971A, 94TV2-43-8972A, 94TV2-43-8973A, 94TV2-43-8985A, 94TV2-43-8986A, 94TV2-43-8987A, 94TV2-43-8993A, 94TV2-43-8994A, 94TV2-43-8995A Tel. Rec. .... 78—4
94TV6-43-8953A Tel. Rec. .. 106—3
165 (See Model 94RA31-43-8115A—Set 81-5)
197, U (See Model 94RA31-43-8115A—Set 81-5)
2027 (See Model 43-2027—Set 11-3)
5005 (See Model 43-5005—Set 28-36)
5101A (See Model 35RA2-43-5101A—Set 214-3)
6301 (See Model 43-6301—Set 7-4)
6451 (See Model 43-6451—Set 10-10)
6485 (See Model 43-6485—Set 46-9)
6730 (See Model 43-8685—Set 11-4)
6945A (See Model 94RA1-43-6945A—Set 69-6)
7601, B, 7602 (See Model 43-7601B—Set 10-11)
7605A (See Model 94RA1-43-7605A—Set 65-5)
7651, 7652 (See Model 43-7651—Set 9-7)
7654A (See Model 15RA1-43-7654A—Set 147-3)
7656A, 7657A (See Model 94RA1-43-7656A—Set 73-2)
7751 (See Model 94RA1-43-7751A—Set 87-3)
7755A, B (See Model 05RA1-43-7755A—Set 101-2)
7851 (See Model 43-7851—Set 47-5)
7901A (See Model 05RA1-43-7901A—Set 115-2)
7902A (See Model 15RA1-43-7902A—Set 134-6)
7910A, 7911A (See Model 15RA1-43-7902A—Set 134-6)
8101 (See Model 94RA31-43-8115A—Set 81-5)
8115A, B, 8116A (See Model 94RA31-43-8115A—Set 81-5)

**CORONADO—Cont.**
8120A (See Model 05RA33-43-8120A—Set 110-6)
8125 (See Model 35RA33-43-8125—Set 217-5)
8129A, 8130A, B, 8131A, B (See Model 94RA-43-8129A—Set 62-10)
8130C, 8131C (See Model 94RA33-43-8130C—Set 82-3)
8145 (See Model 35RA33-43-8145—Set 224-7)
8160 (See Model 43-8160—Set 12-7)
8177, 8178 (See Model 43-8178—Set 21-8)
8180 (See Model 43-8180—Set 10-12)
8190 (See Model 43-8190—Set 19-11)
8201 (See Model 43-8178—Set 21-8)
8213 (See Model 43-8213—Set 7-5)
8225 (See Model 35RA33-43-8225—Set 219-4)
8230A (See Model 05RA2-43-8230A—Set 162-3)
8240, 8241 (See Model 43-8240—Set 12-8)
8245A, 8246A (See Model 15RA33-43-8245A—Set 174-5)
8305 (See Model 43-8305—Set 8-3)
8312A (See Model 43-8312A—Set 8-4)
8330 (See Model 43-8330—Set 19-12)
8351, 8352 (See Model 43-8351—Set 12-9)
8353, 8354 (See Model 43-8353—Set 28-7)
8360A (See Model 05RA37-43-8360A—Set 102-3)
8365 (See Model 15RA33-43-8365—Set 169-4)
8420 (See Model 43-8420—Set 24-13)
8470 (See Model 43-8305—Set 8-3)
8371 (See Model 43-8312A—Set 8-4)
8510A, 8511A (See Model 94RA1-43-8510A—Set 71-7)
8510B, 8511B (See Model 94RA1-43-8510B—Set 75-6)
8515 (See Model 05RA2-43-8515A—Set 110-5)
8576B (See Model 43-8576B—Set 9-8)
8685 (See Model 43-8685—Set 11-4)
8945A Tel. Rec. (See Model 05TV1-43-8945A—Set 145-5)
8948A, 8949A Tel. Rec. (See Model 15TV4-43-8948A—Set 175-7)
8950A Tel. Rec. (See Model 05TV2-43-9010A—Set 146-5)
8953A Tel. Rec. (See Model 94TV6-43-8953A—Set 106-3)
8957A Tel. Rec. (See Model 15TV1-43-8957A—Set 62-4)
8958A, B Tel. Rec. (See PCB 34—Set 162-1 and Model 15TV1-43-8958A—Set 161-3)
8960 Tel. Rec. .... *
8965 Tel. Rec. (See Model 43-8965—Set 86-3)
8970A, 8971A, 8972A, 8973A Tel. Rec. (See Model 94TV2-43-8970A—Set 78-4)
8985A, 8986A, 8987A Tel. Rec. (See Model 94TV2-43-8970A—Set 78-4)
8993A, 8994A, 8995A Tel. Rec. (See Model 94TV2-43-8970A—Set 78-4)
9002A Tel. Rec. .... *
9005A, 9006A Tel. Rec. (See Model 05TV1-43-8945A—Set 145-5)
9008A Tel. Rec. .... *
9010A Tel. Rec. (See Model 05TV2-43-9010A—Set 146-5)
9010B Tel. Rec. (See Model 05TV2-43-9010B—Set 153-2)
9012A, 9013A Tel. Rec. .... *
9014A Tel. Rec. (See Model 05TV1-43-9014A—Set 128-4)
9015A, B, 9016A, B Tel. Rec. (See Model 15TV1-43-8957A — Set 162-4)
9020A, B, 9021A, B Tel. Rec. (See PCB 34—Set 162-1 and Model 15TV1-43-8958A—Set 161-3)
9022A Tel. Rec. (See Model 25TV2-43-9022A—Set 183-4)
9022B Tel. Rec. (See PCB 65—Set 202-1 and Model 25TV2-43-9022A—Set 183-4)
9022C Tel. Rec. (See PCB 65—Set 205-1 and PCB 72—Set 212-1 and Model 25TV2-43-9022A—Set 183-4)
9025A, B, 9026A, B Tel. Rec. (See Model 15TV2-43-9025A — Set 144-3)
9030 Tel. Rec. (See Model K-73L (43-9031)—Set 182-3)
9031 Tel. Rec. (See Model K-72 (43-9031)—Set 182-3)
9041 (See Model K-21 (43-9041)—Set 182-1)
9045A, B Tel. Rec. (See Model 25-TV2-43-9045A—Set 199-5)
9045C Tel. Rec. (See PCB 68—Set 205-1 and Model 25TV2-43-9045A—Set 199-5)
9045D Tel. Rec. (See PCB 68—Set 205-1, PCB 71—Set 211-1 and Model 25TV2-43-9045A — Set 199-5)
9060A Tel. Rec. (See Model 25TV2-43-9060A—Set 199-5)
9060B Tel. Rec. (See PCB 68—Set 205-1 and Model 25TV2-43-9060A—Set 199-5)
9060C Tel. Rec. (See PCB 66—Set 205-1, PCB 71—Set 211-1 and Model 25TV2-43-9060A — Set 199-5)

NOTE: PCB denotes Production Change Bulletin

NOTE: PCB denotes Production Change Bulletin

**DUMONT—Cont.**

RA-117-A1, -A3, -A5, -A6, -A7 Tel. Rec. ....................131—5
RA-119A Tel. Rec.........156—5
RA-120 Tel. Rec. (See PCB 51—Set 185-1 and Model RA-113—Set 119-5)
RA-130A Tel. Rec. (See PCB 54—Set 188-1 and Model RA-109—Set 110-7)
RA-147A Tel. Rec. (See PCB 49—Set 183-1 and Model RA-117A—Set 131-5)
RA-160, -A1 Tel. Rec. (Also see PCB 55—Set 189-1) .......179—4
RA-162, -B1, -B4, -B5, -B6, -B7, -B21 through 26 Tel. Rec. (Also see PCB 55—Set 189-1).179—4
RA-164, -A1 Tel. Rec. (Also see PCB 70—Set 194-1 and PCB 69—Set 206-1) ...........189—7
RA-165, -B1, -B2, -B3, -B6, -B7, -B21 through -B26 Tel. Rec. (Also see PCB 60—Set 194-1 and PCB 69—Set 206-1) .......189—7
RA-166, RA-167, RA-168, RA-169, RA-170, RA-171 Tel. Rec. 216—2
Andover Model RA-117-A6 (See Model RA-117A)
Andover Model RA-147A (See Model RA-147A)
Ardmore Model RA-112-A1, -A4 (See Model RA-112A)
Banbury Model RA-162-B4 (See Model RA-162)
Banbury Model RA-162-B21 through B26 (See Model RA-162)
Beverly Model RA-165-B2 (See Model RA-165)
Bradford (See Model RA-108A)
Brookville Model RA-113-B1, -B2 (See Model RA-113)
Burlingame Model RA-113-B5, -B6 (See Model RA-113)
Carlton Model RA-117-A3 (See Model RA-117A)
Chatham (See Model RA-103)
Chatham Model RA-166 (See Model RA-166)
Chatham Model RA-168, RA-169 (See Model RA-168)
Chester (See Model RA-147A)
Clifton (See Model RA-102)
Clinton Model RA-164-A1 (See Model RA-164)
Club 20 (See Model RA-106A)
Colony (See Model RA-105A)
Devon Model RA-160-A1 (See Model RA-160)
Devonshire (See Model RA-101)
Dynasty (See Model RA-162)
Essex Model RA-167 (See Model RA-167)
Fairfield (See Model RA-110A)
Flanders Model RA-162-B5 (See Model RA-162)
Guilford Model RA-111-A2, -A5 (See Model RA-111A)
Hanover Model RA-109-A2, -A6 (See Model RA-109A)
Hanover (See Model RA-109A-FAS)
Hanover II Model RA-170 (See Model RA-170)
Hanover II Model RA-171 (See Model RA-171)
Hastings (See Model RA-104A)
Lynwood Model RA-167 (See Model RA-167)
Manchu (See Model RA-106A)
Mansfield (See Model RA-108A)
Meadowbrook II (See Model RA-147A)
Milford Model RA-165-B1 (See Model RA-165)
Mt. Vernon Model RA-112-A3, -A6 (See Model RA-112A)
Newbury (See Model RA-162)
Newbury II Model RA-170 (See Model RA-170)
Newbury II Model RA-171 (See Model RA-171)
Oxford Model RA-167 (See Model RA-167)
Park Lane Model RA-117-A7 (See Model RA-117A)
Parklane (See Model RA-147A)
Putman Model RA-111-A1, -A4 Tel. Rec. (See Model RA-111A)
Revere (See Model RA-101)
Revere II Model RA-113-B3, -B4 (See Model RA-113)
Ridgewood Model RA-165-B4 (See Model RA-165)
Ridgewood "41" Model RA-167 (See Model RA-167)
Royal Sovereign (See Model RA-119A)
Rumson (See Model RA-103D)
Savoy (See Model RA-103)
Sheffield (See Model RA-103D)
Shelburne Model RA-165-B5 (See Model RA-165)
Sherbrooke Models RA-109-A3, -A7 (See Model RA-109A)
Sherbrooke (See Model RA-109A-FAS)
Sherbrooke (See Model RA-130A)
Somerset (See Model RA-162)
Somerset II Model RA-170 (See Model RA-170)
Somerset II Model RA-171 (See Model RA-171)
Stratford (See Model RA-105A)
Strathmore Model RA-117-A5 (See Model RA-117A)
Sumter Model RA-117-A1 (See Model RA-117A)
Sussex (See Model RA-105B)
Tarrytown (See Model RA-120)
Tarrytown Models RA-113-B7, -B8 (See Model RA-113)
Wakefield Model RA-165-B3 (See Model RA-164)
Wakefield "41" Model RA-167 (See Model RA-167)
Wellington (See Model RA-104A)

**DUMONT—Cont.**

Westerly Model RA-112-A2, -A5 (See Model RA-112A)
Westbury (See Model RA-105A)
Westbury II (See Model RA-109A-FAS)
Westwood (See Model RA-110A)
Whitehall (See Model RA-105A)
Whitehall II (See Model RA-130A)
Whitehall II Model RA-162-B7 (See Model RA-162)
Wickford Model RA-162-B1 (See Model RA-162)
Wimbledon Model RA-162-B6 (See Model RA-162)
Winslow (See Model RA-109A-FAS)
Winslow Model RA-109-A1, -A5 (See Model RA.109A)

**DUOSONIC**

K1, K2 ................ 19—15
K3, K4 ................ 19—16

**DYNAVOX**

AP-514 (Ch. AT).......... 28—9
M-510 ................ 15—8
Swingmaster ............ 27—7
3-P-801 ................ 36—3

**ECA**

101 (Ch. AA)........... 1—25
102 .................. 14—7
104 .................. 13—14
105 .................. 16—11
106 .................. 7—10
108 .................. 3—6
121 .................. 13—15
131 .................. 16—12
132 .................. 45—9
201 .................. 15—9
204 .................. 32—5

**ECHOPHONE**
**(Also see Hallicrafters)**

EC113 ................ 3—13
EC-306 ................ 14—8
EC-403, EC-404 ......... 22—14
TC-600 ................ 4—18
EX-102, EX-103 ......... 64—5
EX-306 (See Model EC-306—Set 14-8)

**EDWARDS**

Fidelotuner ............ 33—4

**EICOR**
**(Also see Recorder Listing)**

15 ....................135—6

**EKOTAPE**
**(See Recorder Listing)**

**ELCAR**

602 .................. 5—19

**ELECTONE**

T5TS3 ................ 12—34

**ELECTRO**

B20 .................. 14—9

**ELECTROMATIC**

APH301-A, APH301-C .... 7—11
606A, 607A ............ 5—32

**ELECTRO-TONE**

555 .................. 13—17
706, 712 (See Model 555—Set 13-16)

**ELECTRO-VOICE**

3300 Tel. UHF Conv......222—5

**ELECTRONIC CORP. OF AMERICA (See ECA)**

**ELECTRONIC SPECIALTY CO. (See Ranger)**

**E/L (ELECTRONIC LABS.)**

7S (Sub-Station) ........ 20—6
76E, K, M, W (See Model 2701—Set 4-28)
76RU ("Radio-Utiliphone") 20—6
710B, 710M, 710T, 710W, Orthosonic (Ch. 2875)....... 20—7
710PB, 710PC Orthosonic (Ch. 2887) .............. 24—16
2660 "Master Utiliphone". 8—8
2701 .................. 4—28
3000 Orthosonic ........ 31—10

**EMERSON**

501, 502 (Ch. 120000, 120029) .................. 2—1
503 (Ch. 120000, 120029) 1—18
504 (Ch. 120000, 120029) 2—1
505 (Ch. 120002)........ 8—9
505 (Ch. 120041) (See Model 523—Set 5-27)
506 .................. 6—9
507 .................. 8—10
508 (Ch. 120008)........ 7—12
509 .................. 8—10
510, 510A (Ch. 120000, 120029) .................. 5—36
511 .................. 8—10
511 (Ch. 120010) (See Model 541—Set 16-23)
512 (Ch. 120006)........ 9—12
512 (Ch. 120056)........ 26—11
514 (Ch. 120007)........ 27—8
515, 516 .............. 12—1
515, 516 (Ch. 120056)... 26—11
517 (Ch. 120010) (See Model 541—Set 16-13)
518 .................. 8—10
519 (Ch. 120030) ....... 30—7
520 (Ch. 120000, 120029) 2—1
521 (Ch. 120013, 120031) 7—13
522 .................. 8—10
523 .................. 5—37
524 .................. 17—12
525 .................. 20—8
527 (Ch. 120019) Tel. Rec. *
528 (Ch. 120038)........ 21—13
529, 529-9 (Ch. 120028).. 18—15
530 (Ch. 120006, Ch. 120056) .................. 32—6

**EMERSON—Cont.**

531, 532, 533........... 11—6
534 (Ch. 120007)........ 27—8
535 .................. 20—9
536 (Ch. 120036)........ 21—14
536A .................. 24—17
537 .................. 23—7
538 (Ch. 120051) (See Model 549—Set 26-12)
539 .................. 9—13
540A (Ch. 120042)....... 20—10
541 .................. 16—13
542 (See Model 521—Set 7-13)
543, 544 (Ch. 120046).... 19—30
545 (Ch. 120047) Tel. Rec. Photo-fact Servicer ......... 82
546 (Ch. 120049)........ 21—15
547A (Ch. 120050)....... 25—13
548 (Ch. 120051)........ 30—8
549 (Ch. 120051)........ 26—12
550 (Ch. 120006) (See Model 512—Set 9-12)
550 (Ch. 120056)........ 26—11
551A .................. 24—17
552 .................. 20—8
553A .................. 24—17
556, 557 (Ch. 120018B).... 70—4
557B (Ch. 120048B)...... 43—10
558 (Ch. 120058)........ 31—11
559A (Ch. 120059)....... 31—12
560 (Ch. 120016)........ 25—14
561 (Ch. 120001B)....... 63—7
563 (Ch. 120063B)....... 73—4
564 (Ch. 120027) (See Model 540A—Set 20-10)
565 (Ch. 120018B)....... 70—4
566 (Ch. 120051) (See Model 549—Set 26-12)
567 (Ch. 120016) (See Model 560—Set 25-14)
567 (Ch. 120042) (See Model 540A—Set 20-10)
568A (Ch. 120070A)..... 58—9
569A (Ch. 120062A)..... 42—10
570 (Ch. 120064)........ 97—3
571 (Ch. 120066) Tel. Rec. 46—25
571 (Ch. 120066B) Tel. Rec. *
571 (Ch. 120086B) Tel. Rec. 76—11
572 (Ch. 120065) (See Model 540A—Set 20-10)
573B (Ch. 120039B)...... 42—11
574 (Ch. 120064)........ 97—3
575 (Ch. 120068A, 120068B) 85—6
576A (Ch. 120069A)...... 40—5
577B (Ch. 120012B)...... 41—6
578 (Ch. 120050) (See Model 547A—Set 25-13)
579A (Ch. 120034A)..... 61—6
580 (Ch. 120064)........ 97—3
581 (Ch. 120014A, B)... 68—7
582 (See Model 548—Set 30-8)
583 (See Model 573B—Set 42-11)
584 (See Model 558—Set 31-11)
585 (Ch. 120025B) Tel. Rec. 61—7
585 (Ch. 120088B, 120090B, 120090D) Tel. Rec..... *
586 (Ch. 120023B, 120083B) 72—9
587 (Ch. 120033A, B)... 71—10
588 (See Model 547A—Set 25-13)
590 (Ch. 120101A, B) ... 87—5
591 (Ch. 120055A(..... 67—9
593 (Ch. 120063B)....... 73—4
594, 595 (Ch. 120071A).. 68—7
596 .................. 61—6
597 (Ch. 120073B)....... 90—5
599 (Ch. 120075B)....... 69—8
600 (Ch. 120103-B) Tel. Rec. (Also see PCB 9—Set 114-1).. 87—6
601 (Ch. 120075B) ....... 69—8
602 (Ch. 120072A, 120082A) .................. 56—10
603 (Ch. 120063B)....... 73—4
604A (See Model 576A—Set 40-5)
605 (Ch. 120076B)....... 66—8
606 (Ch. 120066) Tel. Rec. 46—25
606 (Ch. 120066B) Tel. Rec. *
606 (Ch. 120086B-D) Tel. Rec. .................. 76—11
606 (Ch. 120086B) Tel. Rec. 76—11
607 (Ch. 120074A)....... 90—5
608A (Ch. 120089B) Tel. Rec. .................. 84—6
609 (Ch. 120084-B) Tel. Rec. 90—6
610 (Ch. 120100A, B) ... 71—10
611, 612 (Ch. 120087B-D) Tel. Rec. .................. 76—11
613A (Ch. 120085A, B) .. 79—7
614, B, BC, C (Ch. 120110, B, BC, C) Tel. Rec........... 97—4
614D (Ch. 120095-B) Tel. Rec. ..................95A—3
615 (Ch. 120001B)....... 63—7
616 (Ch. 120100A, B).... 71—10
618 (Ch. 120090B, D) Tel. Rec. *
619 (Ch. 120092D) Tel. Rec. 76—11
620 (Ch. 120091D-QD) Tel. Rec. .................. 76—11
621 (Ch. 120098B) Tel. Rec. ..................108—5
622 (Ch. 120098P) Tel. Rec. ..................108—5
623 (Ch. 120101A, B).... 87—5
624 (Ch. 120087B-D) Tel. Rec. .................. 76—11
625 (Ch. 120105B).......103—8
626 (Ch. 120104B, 120104BJ) Tel. Rec. .................. 84—6
627 (Ch. 120107B) Tel. Rec. 76—11
628 (Ch. 120098B) Tel. Rec. ..................108—5
629 (Ch. 120114B) Tel. Rec. (See Model 631—Set 93A-6)
629B, 629C (Ch. 120120) Tel. Rec. ..................119—6
629D (Ch. 120124B) Tel. Rec. ..................116—5
630 (Ch. 120099B) Tel. Rec. ..................108—5
631 (Ch. 120109) Tel. Rec. 93A—6
632 (Ch. 120096B) Tel. Rec. ..................93A—7
633 (Ch. 120114) Tel. Rec. 93A—6
634B (Ch. 120097B)......111—4
635 (Ch. 120108)........ 92—1
636A (Ch. 120106A)...... 99—7
637, B, BC, C (Ch. 120110, B, BC, C) Tel. Rec........... 97—4

**EMERSON—Cont.**

637A (Ch. 120095-B) Tel. Rec. ..................95A—3
638 (Ch. 120087D) Tel. Rec. (See Model 571—Set 76.11)
639 (Ch. 120103B) Tel. Rec. (Also see PCB 9—Set 114-1).. 87—6
640 (Ch. 120112)......... 93—5
641B (Ch. 120125B).......120—5
642 (Ch. 120117A)........ 98—3
643A (Ch. 120111A)...... 91—4
644, B, BC, C (Ch. 120113, B, BC, C) Tel. Rec........... 97—4
645 (Ch. 120115)........ 94—4
646A (Ch. 120121A).....102—6
646B (Ch. 120121B)......102—6
647, B, BC, C (Ch. 120113, B, BC, C) Tel. Rec.... ....... 97—4
648B (Ch. 120110E) Tel. Rec. 97—4
648B (Ch. 120134B, G, H) Tel. Rec. (See PCB 48—Set 182-1 and Model 661B—Set 137-4)
649A (Ch. 120094A) Tel. Rec. ..................106—7
650 (Ch. 120113C) Tel. Rec. (See Model 614—Set 97-4)
650 (Ch. 120118B) Tel. Rec. ..................113—2
650B (Ch. 120118B) Tel. Rec. (See Model 650—Set 113-2)
650D (Ch. 120123-B) Tel. Rec. (Also see PCB 48—Set 182-1) ..................109—3
650F (Ch. 120138-B) Tel. Rec. ..................133-1A
651B (Ch. 120120) Tel. Rec. ..................119—6
651C (Ch. 120109) Tel. Rec. ..................93A—6
651C (Ch. 120124) Tel. Rec. ..................116—5
651D (Ch. 120124, B) Tel. Rec. ..................116—5
652 (Ch. 120032B)....... 98—3
653 (Ch. 120080B)....... 98—3
653B (Ch. 120136-B) ....159—5
654 (Ch. 120118B) Tel. Rec. ..................113—2
654B (Ch. 120118B) Tel. Rec. (See Model 654—Set 113-2)
654D (Ch. 120123B) Tel. Rec. (Also see PCB 48—Set 182-1) 109—3
654F (Ch. 120138-B) Tel. Rec. ..................133-1A
655B (Ch. 120123-B) Tel. Rec. ..................109—3
655D (Ch. 120123B) Tel. Rec. (See Model 650D—Set 109-3)
655F (Ch. 120138-B) Tel. Rec. ..................133-1A
656B, 657B (Ch. 120122B).111—5
658B (Ch. 120124, B) Tel. Rec. ..................116—5
658C (Ch. 120124) Tel. Rec. (See Model 629D—Set 116-5)
658D (Ch. 120124B) Tel. Rec. *
660B (Ch. 120133B) Tel. Rec. ..................131—6
661B (Ch. 120134B, G, H) Tel. Rec. (Also see PCB 48—Set 182-1) ..................137—4
662B (Ch. 120127-B) Tel. Rec. (Also see PCB 18—Set 130-1).125—6
663B (Ch. 120128-B) Tel. Rec. (Also see PCB 18—Set 130-1) 125—6
664B (Ch. 120133-B) Tel. Rec. ..................131—6
665-B (Ch. 120131-B and Radio Ch. 120130-B) Tel. Rec... .146—6
666B (Ch. 120135B, G, H and Radio Ch. 120132B) Tel. Rec. (Also see PCB 27—Set 148-1). ..133—5
667B, 668B (Ch. 120134B, G, H) Tel. Rec. (Also see PCB 48—Set 182-1) ..................137—4
669B (Ch. 120129B, D) Tel. Rec. (Also see PCB 24—Set 142-1 and PCB 47—Set 181-1). .126—5
669B (Ch. 120148-B) Tel. Rec. *
671B (Ch. 120137-B)... ..118—6
671D (Ch. 120137D) (See Model 671B—Set 118-6)
672B (Ch. 120097-B) ....131—7
673B (Ch. 120133-B) Tel. Rec. ..................131—6
674B (Ch. 120134B, G, H) Tel. Rec. (Also see PCB 48—Set 182-1) ..................137—4
675B (Ch. 120129B, D) Tel. Rec. (Also see PCB 24—Set 142-1 and PCB 47—Set 181-1)....126—5
676B (Ch. 120140B) Tel. Rec. ..................128—6
676D (Ch. 120144B, G, H) Tel. Rec. (Also see PCB 48—Set 182-1) ..................138—4
676F (Ch. 120143B) Tel. Rec. (Also see PCB 50—Set 184-1).148—6
677B, 678B (Ch. 120134B, G, H) Tel. Rec. (Also see PCB 48—Set 182-1) ..................137—4
679B (Ch. 130116-B) ....142—7
680B (Ch. 120144-B, G, H) Tel. Rec. (Also see PCB 48—Set 182-1) ..................138—4
680D (Ch. 120140B) Tel. Rec. ..................128—6
680D (Ch. 120144B, G, H) Tel. Rec. (See PCB 48—Set 182-1 and Model 676D—Set 138-4)
681B (Ch. 120140B) Tel. Rec. ..................128—6
681D (Ch. 120144B, G, H) Tel. Rec. (Also see PCB 48—Set 182-1) ..................138—4
681F (Ch. 120143B, H) Tel. Rec. (Also see PCB 50—Set 184-1) ..................148—6
683B (Ch. 120141-B) Tel. Rec. *
684B, 685B (Ch. 120134B, G, H) Tel. Rec. ..............137—4
686B (Ch. 120144B, G, H) Tel. Rec. (Also see PCB 48—Set 182-1) ..................138—4
686D (Ch. 120140B) Tel. Rec. ..................128—6

**EMERSON—Cont.**

686F (Ch. 120143B, H) Tel. Rec. (Also see PCB 50—Set 184-1) ..................148—6
686L (Ch. 120142B) Tel. Rec. (Also see PCB 50—Set 184-1).148—6
687B (Ch. 120144B, G, H) Tel. Rec. (Also see PCB 48—Set 182-1) ..................138—4
687D (Ch. 120140B) Tel. Rec. (See Model 676B—Set 128-6)
687F (Ch. 120143B, H) Tel. Rec. (Also see PCB 50—Set 184-1) ..................148—6
687L (Ch. 120142B) Tel. Rec. (Also see PCB 50—Set 184-1).148—6
688B, 689B, 690B (Ch. 120129B) Tel. Rec. (Also see PCB 24—Set 142-1 and PCB 47—Set 181-1) ..................126—5
691B (Ch. 120145-B).....160—3
692B, 693B, 694B (Ch. 120129B, D) Tel. Rec. (See PCB 24—Set 142-1, PCB 47—Set 181-1 and Model 669B—Set 126-5)
695B (Ch. 120146-B).....162—5
696B (Ch. 120144B, G, H) Tel. Rec. (See PCB 48—Set 182-1 and Model 676D—Set 138-4)
696F (Ch. 120143B, H) Tel. Rec. (Also see PCB 50—Set 184-1) ..................148—6
696L (Ch. 120142B) Tel. Rec. (Also see PCB 50—Set 184-1).148—6
697B (Ch. 120129B, D) Tel. Rec. (See PCB 24—Set 142-1, PCB 47—Set 181-1 and Model 669B—Set 126-5)
698B (Ch. 120127B) Tel. Rec. (See PCB 18—Set 130-1 and Model 662B—Set 125-6)
699D (Ch. 120160-B) Tel. Rec. ..................165-1A
700B (Ch. 120153-B) Tel. Rec. ..................169—6
700D (Ch. 120158-B) Tel. Rec. ..................166—9
701B (Ch. 120153-B) Tel. Rec. ..................169—6
701D (Ch. 120158-B) Tel. Rec. ..................166—9
701F (Ch. 120143B) Tel. Rec. (See PCB 50—Set 184-1 and Model 676F—Set 148-6)
702B (Ch. 120136-B).....159—5
703B (Ch. 120097-B).....160—4
704 (Ch. 120154-B)......184—6
705A, B (Ch. 120155A, B).208—4
706B, 707B (Ch. 120156-B) 178—5
708B (Ch. 120165-B) (See Model 706B—Set 178-5)
709A (Ch. 120162-A) Tel. Rec. ..................167—6
710B (Ch. 120146-B) (See Model 695B—Set 162-5)
711B (Ch. 120164-B) Tel. Rec. ..................183—6
711F (Ch. 120169-B) Tel. Rec. ..................206—4
712B (Ch. 120164B) Tel. Rec. ..................183—6
712F (Ch. 120169B) Tel. Rec. ..................206—4
713B (Ch. 120156-B) (See Model 706B—Set 176-5)
716D (Ch. 120163-D) Tel. Rec. ..................190—2
716F (Ch. 120168-D) Tel. Rec. (See PCB 61—Set 195-1, PCB 71—Set 211-1 and Model 716D—Set 190-2)
717D (Ch. 120163-D) Tel. Rec. ..................190—2
717F (Ch. 120168-D) Tel. Rec. (See PCB 61—Set 195-1, PCB 71—Set 211.1 and Model 716D—Set 190-2)
718B (Ch. 120150-B) .. 191—7
719D (Ch. 120163-D) Tel. Rec. ..................190—2
719F (Ch. 120168-D) Tel. Rec. (See PCB 61—Set 195.1, PCB 71—Set 211-1 and Model 716D—Set 190-21
720B (Ch. 120164-B) Tel. Rec. .................. 183—6
720D (Ch. 120169B) Tel. Rec. ..................206—4
720F (Ch. 120169 D) Tel. Rec. ..................206—4
721D (Ch. 120166-D) Tel. Rec. (Also see PCB 65—Set 202-1 and PCB 77—Set 218-1)....197—5
722D (Ch. 120163-D) Tel. Rec. .................. 190—2
724B (Ch. 120151B).... .208—5
725A (Ch. 120149A) .....209—2
727D (Ch. 120168D) Tel. Rec. (See PCB 61—Set 195.1, PCB 71—Set 211-1 and Model 716D—Set 190.2)
728D (Ch. 120166-D) Tel. Rec. (Also see PCB 65—Set 202-1 and PCB 77—Set 218-1)....197—5
731D (Ch. 120167-D and Radio Ch. 120152-B) Tel. Rec. (See PCB 65—Set 202-1 and Model 721D—Set 197-5)
732B (Ch. 120169B) Tel. Rec. ..................206—4
732D (Ch. 120164-B) Tel. Rec. (See Model 711B—Set 183-6)
733F (Ch. 120169F and Radio Ch. 120152F) Tel. Rec......206—4
734B (Ch. 120169B) Tel. Rec. ..................206—4
736B (Ch. 120171-B) Tel. Rec. (See PCB 65—Set 202-1, PCB 77—Set 218-1 and Model 721D—Set 197-5)
737A, B (Ch. 120172A, B).207—3
738B (Ch. 120150-B) (See Model 718B—Set 191.7)
740D (Ch. 120173-D) Tel. Rec. (See PCB 65—Set 202-1, PCB 77—Set 218-1 and Model 721D—Set 197-5)

NOTE: PCB denotes Production Change Bulletin

**NOTE:** PCB denotes Production Change Bulletin

NOTE: PCB denotes Production Change Bulletin

NOTE: PCB denotes Production Change Bulletin

**LINDEX CORP. (See Swank)**

**LIPAN (See Supreme)**

**LULLABY (See Mitchell)**

**LYMAN**

CM10, CM20 .......... 44—8

**LYRIC (Also see Rauland)**

546T, 546TY, 546TW..... 7-17

**MAGIC TONE**

500, 501 .......... 5-40
504 (Bottle Receiver)..... 22-18
508 (Keg Radio)......... 38—9
510 .......... 52-10
900 .......... 38—9

**MAGNAVOX**

104 Series (Ch. CT301 thru CT314) Tel. Rec. ..........161—4
Chassis AMP-101A, AMP-101B .......... 43-12
Chassis AMP-108A, AMP-108B .......... 41-10
Chassis AMP-111A, B, C.. 68-10
Chassis CR-188 (155B Regency Symphony) .......... 18-22
Chassis CR190A, CR190B.. 46-14
Chassis CR-192A, CR-192B 41-11
Chassis CR-197C ........ 37-11
Chassis CR-198A, B, C (Hepplewhite, Modern Symphony) 17-20
Chassis CR-199 ......... 63-13
Chassis CR-200A, B, C, D, E, F .......... 44—9
Chassis CR-207A, B, C, D. 41-12
Chassis CR-208A, CR-208B 43-13
Chassis Models CR-210A, CR-210B .......... 52-11
Chassis CR-211A, B...... 68-10
Chassis CT-214, CT-218 Tel. Rec. .......... 62-13
Chassis CT-219, CT-220 Tel. Rec. .......... 82—7
Chassis CT-221 Tel. Rec... 62-13
Chassis CT-222 Tel. Rec... 82—7
Chassis CT-224 Tel. Rec...97A—8
Chassis CT-232 Tel. Rec...93A—9
Chassis CT-235 Tel. Rec...97A—8
Chassis CT-236 Tel. Rec...93A—9
Chassis CT-237, CT-238 Tel. Rec. (See Set 95A-9 and Ch. CT219—Set 82-7)
Chassis CT239 Tel. Rec...93A—9
Chassis CT244, CT245, CT246 Tel. Rec. ..........93A—9
Chassis CT247, CT248, CT249 Tel. Rec. .......... *
Chassis CT250, CT251 Tel. Rec. ..........135-1A
Chassis CT252, CT253 Tel. Rec. ..........95A—9
Chassis CT255 Tel. Rec.... *
Chassis CT257, CT258, CT259, CT260 Tel. Rec........119-1A
Chassis CT262, CT263, CT264, CT265 Tel. Rec........155-10
Chassis CT266, CT267, CT269 Tel. Rec. ..........131-1A
Chassis CT-270, CT-271, CT-272, CT-273, CT-274, CT-275, CT-276, CT-277, CT-278, CT-279, CT-280, CT-281, CT-282 Tel. Rec. 148—8
Chassis CT283 Tel. Rec....155-10
Chassis CT284, CT285 Tel. Rec. ..........131-1A
Chassis CT286 Tel. Rec....155-10
Chassis CT287, CT288 Tel. Rec. ..........131-1A
Chassis CT289 Tel. Rec....155-10
Chassis CT290 Tel. Rec....131-1A
Chassis CT291, CT293 Tel. Rec. .......... 155-10
Chassis CT294 Tel. Rec....131-1A
Chassis CT295, CT296 Tel. Rec. .......... *
Chassis CT297 Tel. Rec....155-10
Chassis CT301 thru CT314 Tel. Rec. ..........161—4
Chassis CT331 thru CT349 (105 Series) Tel. Rec........168-10
Chassis CT350 thru 357 (105 Series) Tel. Rec. (See Ch. CT331—Set 168-10)
Chassis CT358 (107 Series) Tel. Rec. .......... *
Chassis CT362, CT363 (105L, M, N Series) Tel. Rec........205—6
Chassis CT372, CT373 (105L, M, N Series) Tel. Rec........205—6
Chassis MCT228 Tel. Rec..95A—9

**MAGNECORD (See Recorder Listing)**

**MAGUIRE (Also see Record Changer Listing)**

500BI, 500BW, 500DI, 500DW .......... 6-15
561BI, 561BW, 561DI, 561DW .......... 6-16
571 .......... 44-10
661, 661A .......... 12-18
700A .......... 7-18
700E .......... 15-17

**MAJESTIC**

G-414 Tel. Rec..........133—8
G-614 Tel. Rec..........133—8
G-624 Tel. Rec..........133—8
G-914 Tel. Rec..........133—8
5A410 (Ch. 4501), 5A430 (Ch. 4504) .......... 1-30
5A445, 5A445R .......... 23-12
5AK711 .......... 27-17
5AK731, 5AK780 (Ch. 5B05A) .......... 28-19
5C-2, 5C-3 ..........169-10
5LA5, 5LA6 ..........130—9
5LA7, 5LA8 ..........132—9
6FM714 (Ch. 6B02D)..... 50-10
6FM773 (Ch. 6B11D)..... 57-10
7BK758 (See Model 7J777R—Set 27-18)
7C432 (Ch. 4706)........ 14-17
7C447 (Ch. 4707) (See Model 7C432—Set 14-17)

**MAJESTIC—Cont.**

7FM877, 7FM888 (Ch. 7C11D) .......... 56-14
7JK777R (Ch. 4708R)..... 27-18
7JL866 (Ch. 7C25A)..... 60-14
7P420 (Ch. 4705)........ 26-17
7S433, 7S450, 7S470 (Ch. 4702, 4703) .......... 22-19
7TV850, 7TV852 (Ch. 18C90, 18C91) Tel. Rec. ..... *
7YR752 (Ch. 7B04A)...... 29-13
7YR753 (Ch. 7B09A-1), 7YR772 (Ch. 7B09A) .......... 42-17
8FM744 (Ch. 8B06D)..... 30-15
8FM775 (Ch. 8B08D), 8FM776 (Ch. 8B07D) .......... 29-14
8FM889 (Ch. 8C07D)..... 54-12
8JL885 (Ch. 4810B)...... 47-11
8S452, 8S473 (Ch. 4810).. 8-19
10FM891 (Ch. 10C23E) (See Model 10FM981—Set 65-8)
12C4, 12C5 Tel. Rec......108—7
12FM475, 12FM778, 12FM779 (Ch. 41201) .......... 28-20
12FM895 (Ch. 12C22E).... 59-11
12T2, 12T3 Tel. Rec.......108—7
12T6 Tel. Rec. (See Model 12C4—Set 108-7)
14C4 Tel. Rec. (See Model 12C4—Set 108-7)
14CT4 Tel. Rec.......... 133—8
14T2 Tel. Rec. (See Model 12C4—Set 108-7)
16C4, 16C5 Tel. Rec.......108—7
16CT4, 16CT5 Tel. Rec....133—8
16T2, 16T3 Tel. Rec.......108—7
17C62, 17C64, 17C65 (Series 106) Tel. Rec. (See PCB 43—Set 177-1 and Model 70—Set 153-8)
17DA (Ch. 101) Tel. Rec....127—7
17GA, 17HA (Ch. 101) Tel. Rec. ..........127—7
17T6A1, 17T6B1 (Series 106) Tel. Rec. (See Model 70—Set 153-8 and PCB 43—Set 177-1)
17T62 (Series 106) Tel. Rec. (See Model 70—Set 153-8 and PCB 43—Set 177-1)
19C6, 19C7 Tel. Rec.......133—8
20C82, 20C83, 20C84 (Series 108) Tel. Rec. (See Model 70—Set 153-8 and PCB 43—Set 177-1)
20FP88, 20FP89 (Series 109) Tel. Rec. .......... 170-10
20F82, 20F83 (Series 108) Tel. Rec. (See Model 70—Set 153-8 and PCB 43—Set 177-1)
20F85, 20F86, 20F87 (Series 108) Tel. Rec. (See Model 70—Set 153-8 and PCB 43—Set 177-1)
20F811 (Series 108) Tel. Rec. (See Model 70—Set 153-8 and PCB 43—Set 177-1)
20T8A1 (Series 108) Tel. Rec. (See Model 70—Set 153-8 and PCB 43—Set 177-1)
20T82, 20T83, 20T84 (Series 108) Tel. Rec. (See Model 70—Set 153-8 and PCB 43—Set 177-1)
21C30, 20C31 (Series 108) Tel. Rec. (See Model 70—Set 153-8 and PCB 43—Set 177-1)
21D40, 21D41 (Series 108) Tel. Rec. (See Model 70—Set 153-8 and PCB 43—Set 177-1)
21D50, 21D51 (Series 108) Tel. Rec. (See Model 70—Set 153-8 and PCB 43—Set 177-1)
21F86, 21F87 (Series 108) Tel. Rec. (See Model 70—Set 153-8 and PCB 43—Set 177-1)
21F88, 21F89 (Series 108-5) Tel. Rec. (See Model 70—Set 153-8 and PCB 43—Set 177-1)
21P67, 21P63 (Series 110, 111) Tel. Rec. .......... 221—7
21T20, 21T21 (Series 108) Tel. Rec. (See Model 70—Set 153-8 and PCB 43—Set 177-1)
22 Thru 35 (Series 106-5) Tel. Rec. (See Model 70—Set 153-8 and PCB 43—Set 177-1)
70, 72, 73 (Series 106) Tel. Rec. (Also see PCB 43—Set 177-1) ..........153—8
80FMP2 ..........137—6
120, 121, 121B (Ch. 99) Tel. Rec. (Also see PCB 37—Set 166-2) ..........127—7
141, 141B (Ch. 100), 141C (Ch. 101), 142, 142B (Ch. 100) Tel. Rec. ..........127—7
143 Tel. Rec. (See PCB 37—Set 165-2 and Model 17DA—Set 127-7)
160, 160B, 162, 163 (Ch. 101) Tel. Rec. ..........127—7
170 (Ch. 101) Tel. Rec....127—7
173 Tel. Rec. (See PCB 37—Set 166-2 and Model 17DA—Set 127-7)
700, 701 (Series 106) Tel. Rec. (Also see PCB 43—Set 177-1) ..........153—8
712, 715, 717, 718, 719 (Series 106) Tel. Rec. (Also see PCB 43—Set 177-1) ..........153—8
800, 801, 802, 803, 804 (Series 108) Tel. Rec. (Also see PCB 43—Set 177-1) ..........153—8
902, 903 (Ch. 103) Tel. Rec. ..........127—7
910, 911 (Ch. 103) Tel. Rec. ..........127—7
1042, G, GU, T Tel. Rec. (See Model 12C4—Set 108-7)
1043, G, GU, T Tel. Rec. (See Model 12C4—Set 108-7)
1142, 1143 Tel. Rec. (See Model 12C4—Set 108-7)
1244, G, GU, T, TX Tel. Rec. (See Model 12C4—Set 108-7)
1245, G, GU, T, TX Tel. Rec. (See Model 12C4—Set 108-7)
1348 Tel. Rec. (See Model 12C4—Set 108-7)
1400, B (Ch. 100) Tel. Rec. 127—5
1401 (Ch. 105) Tel. Rec. (Also see PCB 37—Set 166-2)....127—7

**MAJESTIC—Cont.**

1546, G, GU, T Tel. Rec. (See Model 12C4—Set 108-7)
1547, G, GU, T Tel. Rec. (See Model 12C4—Set 108-7)
1548, G, GU, T Tel. Rec. (See Model 12C4—Set 108-7)
1549, G, GU, T Tel. Rec. (See Model 12C4—Set 108-7)
1600, 1600B (Ch. 101) Tel. Rec. ..........127—7
1605, 1605B (Ch. 102) Tel. Rec. ..........127—7
1610, 1610B (Ch. 102) Tel. Rec. ..........127—7
1646, 1647, 1648, 1649 Tel. Rec. (See Model 12C4—Set 108-7)
1671, 1672, 1673, 1674, 1675 Tel. Rec. ..........133—8
1700C Tel. Rec. (See PCB 37—Set 166-2 and Model 17DA—Set 127-7)
1710 (Ch. 101) Tel. Rec...127—7
1710C (Ch. 101) Tel. Rec. (See PCB 37—Set 166-2 and Model 17DA—Set 127-7)
1720, 1721 Tel. Rec. (See PCB 37—Set 166-2 and Model 17DA—Set 127-7)
1900 Tel. Rec...........95A-10
1974, 1975 Tel. Rec.......133—8
2042T, 2043T Tel. Rec. (See Model 12C4—Set 108-7)
2546T, 2547T, 2549T Tel. Rec. (See Model 12C4—Set 108-7)
Ch. 5B01A (See Model 5AK711)
Ch. 5B05A (See Model 5AK731)
Ch. 6B02D (See Model 6FM714)
Ch. 6B11D (See Model 6FM773)
Ch. 7B04A (See Model 7YR752)
Ch. 7B09A (See Model 7YR772)
Ch. 7B09A1 (See Model 7YR753)
Ch. 7C11D (See Model 7FM887)
Ch. 7C25A (See Model 7JL866)
Ch. 8B06D (See Model 8FM744)
Ch. 8B07D (See Model 8FM776)
Ch. 8B08D (See Model 8FM775)
Ch. 8C07D (See Model 8FM889)
Ch. 10C23E (See Model 10FM891)
Ch. 12B26E (See Model 12FM475)
Ch. 12C22E (See Model 12FM895)
Ch. 18C90, 18C91 (See Model 7TV850)
Ch. 4501 (See Model 5A410)
Ch. 4504 (See Model 5A430)
Ch. 4506 (See Model 5A445)
Ch. 4702, 4703 (See Model 7S433)
Ch. 4705 (See Model 7P420)
Ch. 4706 (See Model 7C432)
Ch. 4707 (See Model 7C447)
Ch. 4708R (See Model 7JK777R)
Ch. 4810 (See Model 8S452)
Ch. 4810B (See Model 8JL885)
Ch. 41201 (See Model 12FM475)

**MALLORY**

TV-101 (Below Serial No. 200,000) Tel. UHF Conv.........194—7
TV-101 (Serial No. 200,000 and Above) Tel. UHF Conv...194—8

**MANTOLA (B. F. Goodrich Co.)**

R630-RP .......... 3-22
R643-PM (See Model R643W—Set 4-29)
R643W .......... 4-29
R652, R652N .......... 9-22
R654 PM, R654-PV....... 3—5
R655W (Ch. No. 501APH) 8-20
R662, R662N .......... 3-33
R664, R664-PV, R664-W.. 23-13
R-743.W (See Model R643W—Set 4-29)
R-7543 .......... 18-23
R-75143 .......... 39-12
R-75152 .......... 38-10
R-75343 .......... 39-12
R-76143 (See Model 2486—Set 25-17)
R-76162 .......... 40-10
R76262 (Fact. No. 7160-17) 51-12
R-78162 .......... 43-11
2486 .......... 25-17
92-502 (See Model R643W—Set 4-29)
92-503, 92-504 (See Model R654PM—Set 3-5)
92-505, 92-506 (See Model R664PM—Set 23-13)
92-520, 92-521, 92-522.. 68-11
92-529 ..........150—8

**MARKEL (See Record Changer Listing)**

**MARK SIMPSON (See Masco)**

**MASCO (Also see Recorder Listing)**

AC-12, AC-24 ..........222—7
ACL ..........222—7
ACS, ACS-6 ..........222—7
CM-20 ..........218—6
EMM-6 ..........216—3
IM-5 .......... 41-13
IM-10 ..........186—8
JMR .......... 31-17
JM-5 (Master Station), JR (Sub-Station) .......... 42-18
JM-10 ..........187—8
JMP-6 ..........147—7
JMP-12 ..........147—7
MA-8N ..........119—8
MA-10HF ..........112—4
MA-10EX ..........113—4
MA-12HF .......... 51-13
MA-17 .......... 14-32
MA-17N .......... 50-11
MA-17P .......... 14-32
MA-17PN .......... 50-11
MA-20HF .......... 28-21
MA-25 .......... 16-24
MA-25EX .......... 60-15
MA-25HF .......... 54-13
MA-25N .......... 43-14
MA-25NR .......... 49-12
MA-25P .......... 16-24
MA-25PN (See Model MA-25N—Set 43-14)

**MASCO—Cont.**

MA-35 .......... 21-20
MA-35N .......... 44-11
MA-35RC .......... 21-20
MA-50 .......... 30-16
MA-50N (See Model MA-5NO—Set 45-15)
MA-50NR .......... 53-14
MA-60 ..........119—9
MA-75 .......... 28-22
MA-75N .......... 52-27
MA-77, MA-77R ..........190—7
MA-121 .......... 24-21
MA-125 ..........188—8
MA-808 .......... 26-18
MAP-15 .......... 26-19
MAP-18 .......... 59-12
MAP-105 .......... 25-18
MAP-105N .......... 52-12
MAP-120 .......... 21-21
MAP-120N .......... 46-15
MB-8N ..........196—5
MB-50N .......... 58-12
MB-60 ..........127—8
MB-60 (Late) ..........148-10
MB-75 .......... 61-15
MB-77 ..........206—8
MB-125 ..........211—9
MC-10 .......... 47-12
MC-25, MC-25P .......... 17-21
MC-25N, MC-25PC, MC-25PN, MC-25RC .......... 57-11
MC-126, MC-126P ..........111—8
MCR-5 .......... 15-18
ME-8 ..........152-10
ME-18, ME-18P ..........151—8
ME-27 ..........155-11
ME-36, ME-36R ..........154—7
ME-52 ..........149—7
MHP-110 ..........114—6
MHP-110X ..........115—5
Midgetalk ..........116—7
MM-27P ..........153—9
MPA-3, MPT-4 .......... 16-25
MSD-16 ..........150—9
MU-5 ..........117—6
MU-17 ..........185—8
PR-1 ..........218—6
RK-5 (Early) .......... 33-11
RK-5, RK-5L, RK-5M, RK-5ML, RK-5SL ..........168-11
RK-5SLR ..........177—9
T-16 ..........123—8
TD-16 ..........120—8
TP-16A .......... 30-17
WF-1A ..........209—8
76, 711 .......... 20-20
86, 811 .......... 20-21

**MASON**

45-1A .......... 14-18
45-1B, 45-1P, 45-3, 45-4, 45-5 (See Model 45-1A—Set 14-18)

**MATTISON**

630-6A Tel. Rec.........218—7
630-6AB Tel. Rec........218—7

**MAYFAIR**

510, 510W, 520, 520W, 530, 530W .......... 25-20
550, 550W .......... 24-22

**McGOHAN (Don)**

MG-7 ..........195—7
MG-10B ..........190—8
MG-18B ..........191—6
MG-20-B ..........189—5
MG-30-B ..........188—9

**McGRADE**

M-100 .......... 16-27

**MECK (Trail Blazer-Plymouth)**

CD-500 (PX-5CS-EW-19) . 33-12
CE-500 (5CS-P12) ........ 34-10
CM-500 (5D7-W18) ...... 34-11
CR-500 .......... 38-11
CW-500 .......... 40-11
CX-500 .......... 48-13
DA601, DB6021 .......... 81-10
EC720 .......... 85—8
EF-730, EG-731 (Ch. 10003) 89—8
EV-760 ..........104—7
JM717C (Ch. 9021) Tel. Rec. ..........148-11
JM717C (Ch. 9032) Tel. Rec. ..........186—9
JM717C (Ch. 9040) Tel. Rec. ..........220—4
JM717CU (Ch. 9021) Tel. Rec. ..........148-11
JM717T (Ch. 9021) Tel. Rec. ..........148-11
JM-717T (Ch. 9032) Tel. Rec. ..........186—9
JM717T (Ch. 9040) Tel. Rec. ..........220—4
JM717TU (Ch. 9021) Tel. Rec. ..........148-11
JM720C, CU (Ch. 9021) Tel. Rec. ..........148-11
JM720C (Ch. 9032) Tel. Rec. ..........186—9
JM720T (Ch. 9021) Tel. Rec. ..........148-11
JM720T (Ch. 9032) Tel. Rec. ..........186—9
JM720TU (Ch. 9021) Tel. Rec. ..........148-11
JM721C, CD (Ch. 9032) Tel. Rec. ..........186—9
JM721C, D (Ch. 9040) Tel. Rec. ..........220—4
MM510T, MM512T, MM516C, MM-516T Tel. Rec..........110—9
MM614C, T (Ch. 9018) Tel. Rec. (Also see PCB 12—Set 120-1) ..........117—8
MM616C, T (Ch. 9018) Tel. Rec. (Also see PCB 12—Set 120-1) ..........117—8
MM-617C, T (Ch. 9032) Tel. Rec. (See Model JM-717C—Set 186-9)
MM617T (Ch. 9040) Tel. Rec. ..........220—4
MM619C (Ch. 9018) Tel. Rec. (Also see PCB 12—Set 120-1).117—8

**MECK—Cont.**

MM-620C, T (Ch. 9032) Tel. Rec. (See Model JM-717C—Set 186-9)
MM621C (Ch. 9040) Tel. Rec. ..........220—4
MM621RPT, RPTB (Ch. 9040) Tel. Rec. ..........220—4
MM621T (Ch. 9040) Tel. Rec. ..........220—4
M616C, T (Ch. 9023) Tel. Rec. (See Model JM717C—Set 148-11)
M620C, T (Ch. 9023) Tel. Rec. (See Model JM717C—Set 148-11)
PM-5CS-DW10 .......... 2—4
PM-5CS-PW10 .......... 12-19
RC-5C5-P .......... 1—9
RC-6A7-P6 .......... 31-19
SA-10, SA-20 ..........101—4
XA-701 Tel. Rec.......... 61-16
XE-705 (See Model XA-701—Set 61-16)
XF-777 Tel. Rec..........101—5
XL750 Tel. Rec.......... 76-14
XN-752 Tel. Rec..........101—5
XOB Tel. Rec............110—9
XP-775 Tel. Rec..........101—5
XQA Tel. Rec............110—9
XQA-776 Tel. Rec.........101—5
XQR Tel. Rec............110—9
XQ-776 Tel. Rec..........101—5
XRA, XRPT Tel. Rec.......110—9
XR-778 Tel. Rec..........101—5
XSA Tel. Rec............110—9
XSB (Ch. 9018) Tel. Rec. (Also see PCB 12—Set 120-1)....117—8
XSC, XSD (Ch. 9018) Tel. Rec. (See Model MM614C—Set 117-8 and PCB 12—Set 120-1)
XSPT Tel. Rec...........110—9
XS-786 Tel. Rec..........101—5
XTA, XTR Tel. Rec........110—9
XT-785 Tel. Rec..........101—5
XX900 Tel. Rec..........110—9
4B7 .......... *
4C7 .......... 35-14
5A7-P11, 5A7-PB11 ..... 31-18
5D7/WL18 .......... 21-22
6A6-W4 .......... 16-26
514C, T (Ch. 9018) Tel. Rec. (See Model MM614C—Set 117-8 and PCB 12—Set 120-1)
614C, 614TL (Ch. 9022) Tel. Rec. (See Model JM717C—Set 148-11)
616C, T (Ch. 9018) Tel. Rec. (See Model MM614C—Set 117-8 and PCB 12—Set 120-1)
617C, 617TL (Ch. 9022) Tel. Rec. (See Model JM717C—Set 148-11)
619C, T (Ch. 9018) Tel. Rec. (See Model MM614C—Set 117-8 and PCB 12—Set 120-1)
Ch. 9018 (See Model MM614C)
Ch. 9021 (See Model JM717C)
Ch. 9022 (See Model 614C)
Ch. 9023 (See Model M616T)
Ch. 9032 (See Model JM717C)
Ch. 9040 (See Model JM717C)

**MEDCO (See Telesonic)**

**MEISSNER**

TV-1 (Ch. 24TV) Tel. Rec.. 56-15
4E ..........172—5
5A (See Maguire Model 571—Set 44-10)
6H (See Maguire Model 661—Set 12-18)
8BT ..........161—5
8C .......... 37-12
9AJ ..........123—9
9-1065 .......... 3-15
9-1091A, 9-1091B ....... 35-15
9-1091C ..........116—8
9-1093 .......... 55-13
16A ..........105—6
24TV Tel. Rec. (See Model TV1—Set 56-15)
574 (See Maguire Model 571—Set 44-10)
661 (See Maguire Model 661—Set 12-18)
2961 Series .......... 27-19

**MERCURY (Automobile)**

GM891 (OM-18805-A) (See Ford Model GF890—Set 109-5)
SM-757 (FAF-18805-A) ...214—5
1CM747 (1M-18805) (See Ford Model 1CF743—Set 133-7)
1CM747-1 (1M-18805) ...158—5
2CM752 (FAB-18805-A) ..167—7
6MM790, -E .......... 62-12
8MM890 (Ch. 8E90) (8M-18805-B) .......... 49-13
8MM990 (8M-18805-B) ... 69-10
8MM991 (8M-18805-B), 8MM991-E (8M-18805) .......... 83—4

**MERCURY (Pacific-Mercury)**

2013 (Ch. 150-2) Tel. Rec. (Also see PCB 57—Set 190-1).172—6
2080 (Ch. 150-2) Tel. Rec. (See PCB 57—Set 190.1 and Model 2013—Set 172-6)
2081 (Ch. 150-4 and Radio Ch. 155) Tel. Rec..........198-11
2113, 2115 (Ch. 150-11, -81) Tel. Rec. (Also see PCB 57—Set 190-1) ..........172—6
2116, 2117 (Ch. 150-81) Tel. Rec. (See PCB 57—Set 191-1 and Model 2013—Set 172-6)
2181 (Ch. 150-31, -61 and Radio Ch. 155) Tel. Rec......198-11
2192 (Ch. 150-10 and Radio Ch. 160) .......... *
2217, 2218, X (Ch. 200-11) Tel. Rec. ..........216—8
2224 (Ch. 200-11) Tel. Rec. 216—8
2284 (Ch. 200-11) Tel. Rec. 216—8
2401 (Ch. 150-5, -51) Tel. Rec. (Also see PCB 57—Set 191-1) ..........172—6
4120 (Ch. 150-2) Tel. Rec. (Also see PCB 57—Set 190-1) 172—6
4220 (Ch. 150) Tel. Rec. (Also see PCB 57—Set 190-1)....172—6
4317 (Ch. 150-7, -12) Tel. Rec. .......... *

NOTE: PCB denotes Production Change Bulletin

NOTE: PCB denotes Production Change Bulletin

**MOTOROLA—Cont.**

20T1, B, 20T2 (Ch. TS-119B, C) Tel. Rec. (See PCB 53—Set 187-1 and Model 19K3—Set 122-5)
20T2A, 20T2AB (Ch. TS-307) Tel. Rec. 183—9
20T2B (Ch. TS-119B, C) Tel. Rec. (See PCB 53—Set 187-1 and Model 19K2—Set 122-5)
20T3, 20T3B (Ch. TS-307) Tel. Rec. 183—9
21C1, B (Ch. TS-292A, B, C) Tel Rec. (Also see PCB 63—Set 197-1 and PCB 73—Set 214-1). 191—13
21C1BD, BDY (Ch. WTS-292A, AY, B, BY, C, CY) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—Set 191-13)
21C1BY (Ch. TS-292AY, BY, CY) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—Set 191-13)
21C1D, DY (Ch. WTS-292A, AY, B, BY, C, CY) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—Set 191-13)
21C1Y (Ch. TS-292AY, BY, CY) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—Set 191-13)
21F1, B (Ch. TS-351, A and Radio Ch. HS-316) Tel. Rec. 173—9
21F2, B (Ch. TS-292A, B, C and Radio Ch. HS-316A) Tel. Rec. (Also see PCB 63—Set 197-1 and PCB 73—Set 214-1) 191—13
21F2BY, 21F2F, FB, FBY, FY (Ch. WTS-292A, AY, B, BY, C, CY and Radio Ch. HS-316A) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—191-13)
21F2Y (Ch. TS-292AY, BY, CY and Radio Ch. HS-316A) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—Set 191-13)
21F3, B (Ch. TS-292A, B, C) Tel. Rec. (Also see PCB 63—Set 197-1 and PCB 73—Set 214-1). 191—13
21F3BD, BDY (Ch. WTS-292A, AY, B, BY, C, CY and Radio Ch. HS-316A) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—Set 191-13)
21F3BY (Ch. TS-292AY, BY, CY and Radio Ch. HS-316A) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—Set 191-13)
21F3D, DY (Ch. WTS-292A, AY, B, BY, C, CY and Radio Ch. HS-316A) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—Set 191-13)
21F3Y (Ch. TS-292AY, BY, CY and Radio Ch. HS-316A) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—Set 191-13)
21K1, B (Ch. TS-351) Tel. Rec. 173—9
21K2, B (Ch. TS-351) Tel. Rec. 173—9
21K3, B, W (Ch. TS-351B) Tel. Rec. (See Model 21F1—Set 173-9)
21K4, A (Ch. TS-292A, B, C) Tel. Rec. (Also see PCB 63—Set 197-1 and PCB 73—Set 214-1). 191—13
21K4AY (Ch. TS-292AY, BY, CY) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—Set 191-13)
21K4B (Ch. TS-292A, B, C) Tel. Rec. (Also see PCB 63—Set 197-1 and PCB 73—Set 214-1). 191—13
21K4BD, BDY (Ch. WTS-292A, AY, B, BY, C, CY) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—Set 191-13)
21K4BY (Ch. TS-292AY, BY, CY) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—Set 191-13)
21K4C, CB, CBY, CW, CWY, CY, D, DY (Ch. WTS-292A, AY, B, BY, C, CY) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—Set 191-13)
21K4W (Ch. TS-292A, B, C) Tel. Rec. (Also see PCB 63—Set 197-1 and PCB 73—Set 214-1) 191—13
21K4WD, WDY (Ch. WTS-292A, AY, B, BY, C, CY) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—Set 191-13)
21K4WY, 21K4Y (Ch. TS-292AY, BY, CY) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—Set 191-13)
21K5, B (Ch. TS-292A, B, C) Tel. Rec. (Also see PCB 63—Set 197-1 and PCB 73—Set 214-1). 191—13
21K5BD, BDY (Ch. WTS-292A, AY, B, BY, C, CY) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—Set 191-13)
21K5BY (Ch. TS-292AY, BY, CY) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—Set 191-13)
21K5D, DY (WTS-292A, AY, B, BY, C, CY) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—Set 191-13)
21K5Y (Ch. TS-292AY, BY, CY) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—Set 191-13)
21K6 (Ch. TS-292A, B, C) Tel. Rec. (Also see PCB 63—Set 197-1 and PCB 73—Set 214-1) 191—13

**MOTOROLA—Cont.**

21K6D, DY (Ch. WTS-292A, AY, B, BY, C, CY) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—Set 191-13)
21K6Y (Ch. TS-292AY, BY, CY) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—Set 191-13)
21K7 (Ch. TS-292A, B, C) Tel. Rec. (Also see PCB 63—Set 197-1 and PCB 73—Set 214-1) 191—13
21K7D, DY (Ch. WTS-292A, AY, B, BY, C, CY) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—Set 191-13)
21K7Y (Ch. TS-292AY, BY, CY) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—Set 191-13)
21K9, Y (Ch. WTS-292A, AY, B, BY, C, CY) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—Set 191-13)
21K10, B, BY, Y (Ch. VTS-292A, AY, B, BY, C, CY) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—Set 191-13)
21K11, B, BY, Y (Ch. VTS-292A, AY, B, BY, C, CY) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—Set 191-13)
21T1, B (Ch. TS-351) Tel. Rec. 173—9
21T2, B (Ch. TS-351) Tel. Rec. 173—9
21T3 (Ch. TS-501A, B) Tel. Rec. (Also see PCB 63—Set 197-1) 191—13
21T4A (Ch. TS-324A, B) Tel. Rec. (Also see PCB 63—Set 197-1) 191—13
21T4AC, ACE (Ch. TS-292B, C) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—Set 191-13)
21T4ACY (Ch. TS-292AY, BY, CY) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—Set 191-13)
21T4EA (Ch. TS-324A, B) Tel. Rec. (Also see PCB 63—Set 197-1) 191—13
21T5A, BA (Ch. TS-324A, B) Tel. Rec. (Also see PCB 63—Set 197-1) 191—13
21T7, B, BY, Y (Ch. VTS-292A, AY, B, BY, C, CY) Tel. Rec. (See PCB 63—Set 197-1, PCB 73—Set 214-1 and Model 21C1—Set 191-13)
42B1 (Ch. HS-306) 191—14
45B12 (Ch. HS-8) 9—23
47B11 (Ch. HS-72) 29—17
48L11 (Ch. HS-113) 47—13
49L11Q, 49L13Q (Ch. HS-183) 77—7
51C1, 51C2, 51C3, 51C4 (Ch. HS-288) (See Model 5C1—Set 116-9)
51L1U, 51L2U (Ch. HS-224) (See Model 5J1—Set 100-7)
51M1U, 51M2U (Ch. HS-283) 149—8
52B1U (Ch. HS-305) 190—10
52C1 (Ch. HS-309) 191—15
52C1A (Ch. HS-309) (See Model 52C1—Set 191-15)
52C6 (Ch. HS-310) 177—10
52C6A (Ch. HS-375) (See Model 52C6—Set 177-10)
52C7 (Ch. HS-310) 177—10
52C7A (Ch. HS-310) (See Model 52C7—Set 177-10)
52C8 (Ch. HS-310) 177—10
52C8A (Ch. HS-375) (See Model 52C8—Set 177-10)
52CW1, 52CW2, 52CW3, 52CW4 (Ch. HS-329) 198—10
52H11U, 52H12U, 52H13U, 52H14U (Ch. HS-313) 176—6
52L1, A, 52L2, A, 52L3, A (Ch. HS-327, HS-357) 190—11
52M1U, 52M2U, 52M3U (Ch. HS-300) 188—10
52R11, 52R12, 52R13, 52R14, 52R-15, 52R16 (Ch. HS-289) 188—11
52R11, 52R12, 52R13, 52R14, 52R-15, 52R16 (Ch. HS-289A) (See Model 52R11—Set 188-11)
52R11A, 52R12A, 52R13A, 52R-14A, 52R15A, 52R16A (Ch. HS-317) 178—7
52R11U, 52R12U, 52R13U, 52R-14U, 52R15U, 52R16U (Ch. HS-315) 177—11
53LC1, 53LC2, 53LC3 (Ch. HS-347) 217—10
55F11 (Ch. HS-30) 4—14
55X11A, 55X12A, 55X13A 2—22
56X11 (Ch. HS-94) 28—24
57X11, 57X12 (Ch. HS-60) 28—25
58A11, 58A12 (Ch. HS-158) 52—13
58G11, 58G12 (Ch. HS-160) 64—8
58L11 (Ch. HS-114) 45—17
58R11, 58R12, 58R13, 58R14, 58R-15, 58R16 (Ch. HS-116) 49—14
58R11A, 58R12A, 58R13A, 58R-14A, 58R15A, 58R16A (Ch. HS-184) 69—11
58X11, 58X12 (Ch. HS-125) 53—15
59F11 (Ch. HS-188) 68—12
59H11U, 59H12IU (Ch. HS-210) 97—9
59L11Q, 59L12Q, 59L14Q (Ch. HS-187) 78—10
59R11, 59R12I, 59R13M, 59R14E, 59R15G, 59R16Y (Ch. HS-167) 79—10
59X11, 59X121 (Ch. HS-180) 81—11
59X21U, 59X22IU (Ch. HS-192) 98—6
61L1, 61L2 (Ch. HS-226) (See Model 6L1—Set 102-7)
62C1 (Ch. HS-299) 189—12
62C1A (Ch. HS-299) (See Model 62C1—Set 189-12)

**MOTOROLA—Cont.**

62C2 (Ch. HS-299) 189—12
62C2A (Ch. HS-299) (See Model 62C2—Set 189-12)
62C3 (Ch. HS-299) 189—12
62C3A (Ch. HS-299) (See Model 62C3—Set 189-12)
62CW1 (Ch. HS-324) 196—7
62L1U, 62L2U, 62L3U (Ch. HS-308) 183—10
62X11U, 62X12U, 62X13U (Ch. HS-314) 175—14
63L1, 63L2, 63L3 (Ch. HS-361) 222—8
65F11 (Ch. HS-31) 6—19
65F12 (See Model 65F11—Set 6-19)
65F21 (Ch. HS-26) 4—12
65L11, 65L12 (Ch. HS-7) 8—22
65T21, 65T21B (Ch. HS-32) 1—1
65X11A, 65X12A, 65X13A, 65-X14A, 65X14B (Ch. HS-2) 4—8
67F11, 67F12, 67F12B (Ch. HS-63) 31—20
67F14 (Ch. HS-122) 55—15
67F61BN (Ch. HS-69) 44—14
67L11 (Ch. HS-59) 31—21
67X11, 67X12, 67X13 (Ch. HS-58) 30—20
67XM21 (Ch. HS-64) 32—14
68F11, 68F12, 68F14, 68F14B, 68F14M 58—13
68L11 (Ch. HS-119) 45—18
68T11 (Ch. HS-144) 54—14
68X11, 68X12 (Ch. HS-127), 68X-11A, 68X12A (Ch. HS-127A) 56—16
69L11 (Ch. HS-175) 76—15
69X11, 69X121 (Ch. HS-181) 82—9
72XM21 (Ch. HS-303) 176—7
72XM22 (See Model 72XM21—Set 176-7)
75F21 (Ch. HS-91) 19—21
75F31 (Ch. HS-36), 75F31A, B (Ch. HS-36A), 76F31 (Ch. HS-98) 29—18
77FM21 (Ch. HS-89), 77FM22, 77-FM22M, 77FM22WM, 77FM23 (Ch. HS-97) 33—13
77XM21, 77XM22, 77XM22B (Ch. HS-102) 34—12
78F11, 78F11M (Ch. HS-150), 78F-12M (Ch. HS-155) 56—17
78FM21, 78FM21M (Ch. HS-132), 78FM22M (Ch. HS-128) 59—13
79FM21, 79FM21B, 78FM21R (Ch. HS-178) 88—7
79XM21, 79XM22 (Ch. HS-168) 85—9
85F21 (Ch. HS-22) 6—20
85K21 (Ch. HS-52) 5—3
88FM21 (Ch. HS-133) 54—15
91FM21 (Ch. HS-230A) (See Model 19F1—Set 111-9)
92FM21, A, B, BA (Ch. HS-316A) (See Model 21F1—Set 173-9)
95F31, 95F31B (Ch. HS-39) 95F33 (Ch. HS-38) 19—22
99FM21R (Ch. HS-170) 80—10
107F31, 107F31B (Ch. HS-87) 33—14
309 63—14
400 99—10
401 131—12
401A 179—8
403 216—5
405 (Ch. AS-13) 3—8
405M (See Set 21-25 and Model 405—Set 3-8)
408 38—12
409 (See Model 408—Set 38-12)
412 215—10
500 98—7
501 133—10
501A 148—12
503 221—8
505 (Ch. AS-14) 4—37
508 39—13
509 (See Model 508—Set 39-13)
553 224—10
600 97—10
603 (See Mopar Model 603—Set 65-9)
604 (See Mopar Model 704—Set 106-9)
605 (Ch. AS-15) 5—1
606 (See Mopar Model 606—Set 133-9)
607 (See Mopar Model 607—Set 170-11)
608 39—14
608 (Mopar) (See Mopar Model 608—Set 207-4)
609 (See Model 608—Set 39-14)
700 100—8
701 137—8
702 (Ch. BT-2 and 6-2) 197—7
705 (Ch. AS-16) 7—19
708 40—12
709 (See Model 708—Set 40-12)
800 103—10
801 138—6
802 (Ch. BT-2 and P8-2) 197—7
804 (See Mopar Model 804—Set 67-12)
808 (See Mopar Model 808—Set 107-6)
814 (See Mopar Model 814—Set 137-7)
Ch. AS-13 (See Model 405)
Ch. AS-14 (See Model 505)
Ch. AS-15 (See Model 605)
Ch. AS-16 (See Model 705)
Ch. AS-22 (See Model BK-6)
Ch. BT-2 197—7
Ch. HS-2 (See Model 65X11A)
Ch. HS-6 (See Model 5A1)
Ch. HS-7 (See Model 65L11)
Ch. HS-8 (See Model 45B12)
Ch. HS-15 (See Model 5A5)
Ch. HS-18 (See Model WR6)
Ch. HS-22 (See Model 85F21)
Ch. HS-26 (See Model 65F21)
Ch. HS-30 (See Model 55F11)
Ch. HS-31 (See Model 65F11)
Ch. HS-32 (See Model 65T21)
Ch. HS-36 (See Model 75F31)
Ch. HS-36A (See Model 75F31A)

**MOTOROLA—Cont.**

Ch. HS-38 (See Model 95F33)
Ch. HS-39 (See Model 95F31)
Ch. HS-50 (See Model 55X11A)
Ch. HS-52 (See Model 85K21)
Ch. HS-58 (See Model 67X11)
Ch. HS-59 (See Model 67L11)
Ch. HS-60 (See Model 57X11)
Ch. HS-62 (See Model 5A7)
Ch. HS-62A (See Model 5A7A)
Ch. HS-63 (See Model 67F11)
Ch. HS-64 (See Model 67XM21)
Ch. HS-69 (See Model 67F61BN)
Ch. HS-72 (See Model 47B11)
Ch. HS-87 (See Model 107F31)
Ch. HS-89 (See Model 77FM21)
Ch. HS-91 (See Model 75F21)
Ch. HS-94 (See Model 56X11)
Ch. HS-97 (See Model 77FM22)
Ch. HS-98 (See Model 76F31)
Ch. HS-102 (See Model 77XM21)
Ch. HS-108 (See Model VK-101)
Ch. HS-113 (See Model 48L11)
Ch. HS-114 (See Model 58L11)
Ch. HS-116 (See Model 58R11)
Ch. HS-119 (See Model 68L11)
Ch. HS-122 (See Model 67F14)
Ch. HS-124 (See Model 78F11)
Ch. HS-125 (See Model 58X11)
Ch. HS-127 (See Model 68X11)
Ch. HS-127A (See Model 68X11A)
Ch. HS-128 (See Model 78FM22M)
Ch. HS-132 (See Model 78FM21)
Ch. HS-133 (See Model 88FM21)
Ch. HS-137 (See Model VF102)
Ch. HS-144 (See Model 68T11)
Ch. HS-150 (See Model 78F11)
Ch. HS-155 (See Model 78F12M)
Ch. HS-158 (See Model 58A11)
Ch. HS-160 (See Model 58G11)
Ch. HS-167 (See Model 59R11)
Ch. HS-168 (See Model 79XM21)
Ch. HS-170 (See Model 99FM21R)
Ch. HS-175 (See Model 69L11)
Ch. HS-178 (See Model 79FM21)
Ch. HS-180 (See Model 59X11)
Ch. HS-181 (See Model 69X11)
Ch. HS-183 (See Model 49L11Q)
Ch. HS-184 (See Model 58R11A)
Ch. HS-187 (See Model 59L11Q)
Ch. HS-188 (See Model 59F11)
Ch. HS-192 (See Model 59X21U)
Ch. HS-210 (See Model 59H11U)
Ch. HS-223 (See Model 5M1)
Ch. HS-224 (See Model 5J1U)
Ch. HS-226 (See Model 6L1)
Ch. HS-228 (See Model 5C1)
Ch. HS-230 (See Model 19F1)
Ch. HS-234 (See Model 16F1)
Ch. HS-242 (See Model 5R11U)
Ch. HS-243 (See Model 5X11U)
Ch. HS-244 (See Model 5H11U)
Ch. HS-245 (See Model 6X11U)
Ch. HS-246 (See Model 9FM21)
Ch. HS-247 (See Model 8FM21)
Ch. HS-249 (See Model 5M1)
Ch. HS-250 (See Model 5J1)
Ch. HS-253 (See Model 17F1)
Ch. HS-258 (See Model 5C2)
Ch. HS-259 (See Model 5X21U)
Ch. HS-261 (See Model 17F5)
Ch. HS-262 (See Model 5C3)
Ch. HS-264 (See Model 6F11)
Ch. HS-265 (See Model 7F11)
Ch. HS-270 (See Model 5C4)
Ch. HS-271 (See Model 5C5)
Ch. HS-272 (See Model 5C6)
Ch. HS-283 (See Model 51M1U)
Ch. HS-289, A (See Model 52R11)
Ch. HS-299 (See Model 62C1)
Ch. HS-300 (See Model 52M1U)
Ch. HS-302 (See Model 17F11)
Ch. HS-303 (See Model 72XM21)
Ch. HS-305 (See Model 52B1U)
Ch. HS-306 (See Model 42B1)
Ch. HS-308 (See Model 62L1U)
Ch. HS-309 (See Model 52C1)
Ch. HS-310 (See Model 52C6)
Ch. HS-313 (See Model 52H11U)
Ch. HS-314 (See Model 62X11U)
Ch. HS-315 (See Model 52R11U)
Ch. HS-316 (See Model 21F1)
Ch. HS-317 (See Model 52R11A)
Ch. HS-319 (See Model 17F12)
Ch. HS-324 (See Model 62CW1)
Ch. HS-327 (See Model 52L1)
Ch. HS-329 (See Model 52CW1)
Ch. HS-347 (See Model 53LC1)
Ch. HS-357 (See Model 52L1)
Ch. HS-361 (See Model 63L1)
Ch. M-5 (See Model AR96-23)
Ch. OB (See Model SROB)
Ch. P6-2 197—7
Ch. P8-2 197—7
Ch. TS-3 (See Model VT-101)
Ch. TS-4B Thru J (See Model VT-71)
Ch. TS-4J Late (See Model VT-73)
Ch. TS-5 (See Model VK101)
Ch. TS-7 (See Model VF-102)
Ch. TS-8 (See Model VF103)
Ch. TS-9, TS-9A, TS-9B, TS-9C (See Model VT105)
Ch. TS-9D (See Model VT105)
Ch. TS-9E, TS-9E1 (See Model VK106)
Ch. TS-14, A, B (See Model 10VK-12)
Ch. TS-15 (See Model VT121)
Ch. TS-15C, TS-15C1 (See Model 12VK18B)
Ch. TS-16, A (See Model 16VF8B)
Ch. TS-18, A (See Model 7VT1)
Ch. TS-23, A, B (See Model 12-VK11)
Ch. TS-30, A (See Model 12VK15)
Ch. TS-52 (See Model 16K2L)
Ch. TS-53 (See Model 12K2)
Ch. TS-60 (See Model 16F1)
Ch. TS-67 (See Model 19F1)
Ch. TS-74 (See Model 16K2)
Ch. TS-88 (See Model 14K1)
Ch. TS-89 (See Model 16F1BH)
Ch. TS-94 (See Model 16K2BH)
Ch. TS-95 (See Model 17K1A)
Ch. TS-101 (See Model 19K2)
Ch. TS-114 (See Model 14T3)
Ch. TS-114A (See Model 14T3X1)
Ch. TS-115 (See Model 14K1BH)

**MOTOROLA—Cont.**

Ch. TS-118 (See Model 17F1)
Ch. TS-118A, B (See Model 17T3X1)
Ch. TS-119, A (See Model 19K2E)
Ch. TS-119B (See Model 20F2)
Ch. TS-119C, C1, D (See Model 20K3)
Ch. TS-172 (See Model 17K1BE)
Ch. TS-174 (See Model 17F6BC)
Ch. TS-214 (See Model 17T5A)
Ch. TS-216 (See Model 14T4)
Ch. TS-220 (See Model 17K9)
Ch. TS-221, -A (See Model 17K5E)
Ch. TS-228 (See Model 17F11)
Ch. TS-236 (See Model 17K8)
Ch. TS-275 (See Model 14P2)
Ch. TS-292A, B, C (See Model 21C1)
Ch. TS-292AY, BY, CY (See Model 21C1Y)
Ch. TS-307 (See Model 20K6)
Ch. TS-314A, B, TS-315A, B (See Model 17K10E)
Ch. TS-324, A, B (See Model 21T4A)
Ch. TS-324AY, BY (See Models 21T4A and TK-19M)
Ch. TS-325, A, TS-326, A (See Model 17F12)
Ch. TS-326Y (See Models 17F12 and VTK-17M)
Ch. TS-351, A, B (See Model 21F1)
Ch. TS-395, -02 (See Model 17F13)
Ch. TS-400A (See Model 17T11E)
Ch. TS-401 (See Model 17F12D)
Ch. TS-408A (See Model 17F13C)
Ch. TS-408Y (See Models 17F13C and TK-19M)
Ch. TS-410A (See Model 17T13)
Ch. TS-410Y (See Model 17T13Y)
Ch. TS-501A (See Model 21T3)
Ch. TS-501Y (See Models 21T3 and TK-24M)
Ch. VTS-292A, AY, B, BY, C, CY (See Model 21K10, Y)
Ch. VTS-410 (See Model 17T14)
Ch. VTS-410Y (See Model 17T14Y)
Ch. WTS-292A, AY, B, BY, C, CY (See Model 21C1BD, BDY)
Ch. 1A 134—8
Ch. 1B 136—11
Ch. 2A 197—7
Ch. 2M 197—7
Ch. 8A 46—16
Ch. 10A 106—10

**MUNTZ**

M30 (Ch. TV-16A1) Tel. Rec. 108—8
M31 (Ch. TV-16A2) Tel. Rec. 108—8
M31 (Ch. TV17A2) Tel. Rec. 116—10
M31R (Ch. TV17A3) Tel. Rec. (See Model M32 (Ch. TV17A3)—Set 116-10)
M31R, M32 (Ch. TV-16A3) Tel. Rec. 108—8
M32 (Ch. TV17A2) Tel. Rec. 116—10
M32 (Ch. TV17A3) Tel. Rec. 116—10
M32R (Ch. TV17A3) Tel. Rec. (See Model M32 (Ch. TV17A3)—Set 116-10)
M33 (Ch. TV17A4) Tel. Rec. 116—10
M34 (Ch. TV17A4) Tel. Rec. (For TV Ch. only see Model M33—Set 116-10)
M41, M42 (Ch. TV17A3A) Tel. Rec. (See Model 1750)
M46 (Ch. TV17A7) Tel. Rec. (See Model 2053)
M49 (Ch. TV17A7) Tel. Rec. (See Model 2053)
M-158 Tel. Rec. 97A—10
M-159 Tel. Rec. 97A—10
M-159A, B Tel. Rec. 97A—10
M-169 Tel. Rec. 96—6
317T2 (Ch. 37A2) Tel. Rec. (See Model 2055—Set 207-5)
321T1, 321T2 (Ch. 17B2) Tel. Rec. (See Model 2055—Set 207-5)
324T2 (Ch. 17B8) Tel. Rec. (See Model 2763A—Set 208-7)
1750, 1751, 1752 (Ch. 17A3A) Tel. Rec. (See PCB 33—Set 159-3 and Model M31—Set 116-10)
2053 (Ch. 17A7) Tel. Rec. (See PCB 33—Set 159-3 and Model M31—Set 116-10)
2053-A (Ch. 17B1, 17B2) Tel. Rec. (See Ch. 17B1—Set 163-8)
2054 (Ch. 17A7) Tel. Rec. (See PCB 33—Set 159-3 and Model M31—Set 116-10)
2054-A (Ch. 17B1, 17B2) Tel. Rec. (For TV Ch. only see Ch. 17B1—Set 163-8)
2055 (Ch. 17A7) Tel. Rec. (See PCB 33—Set 159-3 and Model M31—Set 116-10)
2055 (Ch. 17B2, Above Serial No. 369500 or Ch. 17B6, Above Serial No. 3619500) Tel. Rec. 207—5
2055-A (Ch. 17B1, 17B2) Tel. Rec. (See Ch. 17B1—Set 163-8)
2055A, AU (Ch. 17B2, Above Serial No. 369500 or Ch. 17B6, Above Serial No. 3619200) Tel. Rec. 207—5
2055-B (Ch. 17B2) Tel. Rec. (See Ch. 17B2—Set 163-8)
2055B (Ch. 17B2, Above Serial No 369500 or Ch. 17B6, Above Serial No. 3619500) Tel. Rec. 207—5
2056 (Ch. 17A7) Tel. Rec. (See PCB 33—Set 159-3 and Model M31—Set 116-10)
2056-A (Ch. 17B1, 17B2) Tel. Rec. (See Ch. 17B1—Set 163-8)
2060 Tel. Rec. 164—6
2066 (Ch. 17B2, Above Serial No. 369500 or Ch. 17B6, Above Serial No. 3619500) Tel. Rec. 207—5
2158A (Ch. 17B2, Above Serial No. 369500 or Ch. 17B6, Above Serial No. 3619500) Tel. Rec. 207—5

NOTE: PCB denotes Production Change Bulletin

NOTE: PCB denotes Production Change Bulletin

PHILCO—Cont.

48-461 ................ 38—15
48-464 ................ 26—20
48-472, 48-472-1 ....... 43—15
48-472 (Revised) ....... 48—18
48-475 ................ 40—14
48-482 ................ 30—24
48-485 ................ 47—19
48-700 Tel Rec.......... 68—13
48-1000 (Code 121) Tel. Rec. *
48-1000, 48-1000-5 (Code 122) Tel. Rec. ............ 53—17
48-1000 (Code 125) Tel. Rec. *
48-1001, 48-1001-5 (Code 121 and 122) Tel. Rec.......... 53—17
48-1050, 48-1050-5 (Code 122) Tel. Rec. ............ 53—17
48-1200 ............... 29—20
48-1201 ............... 31—25
48-1253 ............... 36—17
48-1256 ............... 34—18
48-1260 ............... 31—25
48-1262 ............... 35—19
48-1263 ............... 32—18
48-1264 ............... 36—18
48-1266 ............... 39—15
48-1270 ............... 42—20
48-1274, 48-1276 ....... 41—17
48-1282 ............... 35—18
48-1283 (See Model 48-1282—Set 35-18)
48-1284 ............... 45—20
48-1286 ............... 51—15
48-1290 ............... 47—18
48-2500, 48-2500-5 Tel. Rec. (Codes 121 and 122).... 89—10
49-101 ................ 87—8
49-500, 49-500-I ....... 48—19
49-501, 49-501-I ....... 56—18
49-503 ................ 52—15
49-504, 49-504-I ....... 54—17
49-505 ................ 53—18
49-506 ................ 48—19
49-601 ................ 42—21
49-602 ................ 41—18
49-603 ................ 59—15
49-605, 49-607 ......... 58—15
49-900-E, 49-900-I ...... 49—16
49-901 ................ 56—19
49-902 ................ 51—16
49-904 ................ 58—16
49-905 ................ 52—16
49-906 ................ 57—16
49-909 ................ 55—17
49-1002 (Code 121) Tel. Rec. ..................... 91A—10
49-1040 (Code 121) Tel. Rec. ..................... 91A—10
49-1040 (Code 123) Tel. Rec. 92—5
49-1075 (Codes 121 and 122) Tel. Rec. ............... 93A—11
49-1076 (Code 122) Tel. Rec. ..................... 93A—11
49-1076 (Code 123), 49-1077 (Code 122) Tel. Rec.... 92—5
49-1100 ............... 47—19
49-1101 ............... 55—17
49-1150 (Codes 121 and 123) Tel. Rec. ............... 70—6
49-1150 (Codes 122, 124) Tel. Rec. ..................... 92—5
49-1175 (Codes 121 and 123) Tel. Rec. (Code 121)....... 70—6
49-1175 (Codes 122, 124) Tel. Rec. ..................... 92—5
49-1240 (Codes 121, 123) Tel. Rec. ..................... 93A—11
49-1240 (Code 124) Tel. Rec. 92—5
49-1275 (Code 121) Tel. Rec. ..................... 93A—11
49-1278 (Code 122) Tel. Rec. ..................... 93A—11
49-1278 (Code 123), 49-1279 (Code 122), 49-1280 (Code 121) Tel. Rec. ............ 92—5
49-1401 ............... 45—21
49-1404 (See Model 49-1405—Set 54-24)
49-1405 ............... 54—24
49-1450 (Codes 121A or B, 123A or B, 123T A or B) Tel. Rec. 77—8
49-1475 (Codes 121A, B, 123A, B, 123T A, B) Tel. Rec..... 77—8
49-1480 (Code 121A, B, 123A, B, 123T A, B) Tel. Rec..... 77—8
49-1600 ............... 50—13
49-1601 (See Model 49-1600—Set 50-13)
49-1602, 49-1603, 49-1604, 49-1605 ............... 55—18
49-1606, 49-1607 ....... 53—19
49-1609, 49-1611 (See Model 49-1606—Set 53-19)
49-1613 ............... 91—9
49-1615 ............... 64—9
50-T701 (Code 121), 50-T702 (Code 122) Tel. Rec.......... 140—7
50-T1104 (Code 123) Tel. Rec. (Also see PCB 29—Set 154-1) ..................... 114—9
50-T1105, 50-T1106 Tel. Rec. *
50-T1400, 50-T1401, 50-T1402 (Code 121) Tel. Rec. (Also see PCB 29—Set 154-1)..... 114—9
50-T1403, 50-T1404 (Codes 121 and 122) Tel. Rec. (See PCB 29—Set 154-1 and Model 50-T1104—Set 114-9)
50-T1403 (Code 125), 50-T1404, 50-T1406 (Codes 123, 124, 125) Tel. Rec. ............ 115—8
50-T1406 (Codes 121 and 122) Tel. Rec. (See PCB 29—Set 154-1 and Model 50-T1104—Set 114-9)
50-T1430 (Code 121) Tel. Rec. (Also see PCB 29—Set 154-1). 114—9
50-T1432 (Code 122) (See PCB 29—Set 154-1 and Model 50-T1104—Set 114-9)
50-T1432 (Code 124) Tel. Rec. ..................... 115—8
50-T1443 (Codes 122, 123) Tel. Rec. ................ 94—7
50-T1476, 50-T1477, 50-T1478, 50-T1479 Tel. Rec....... 128—11
50-T1481, 50-T1482 Tel. Rec. ..................... 128—11
50-T1483 Tel. Rec....... 93A—12

PHILCO—Cont.

50-T1484 Tel. Rec........ 128—11
50-T1600 Tel. Rec. (Code 121) ..................... 91A—10
50-T1600 (Code 122) Tel. Rec. ..................... 110—10
50-T1606 (Code 131) Tel. Rec. (See Model 50-T1600, Code 121—Set 91A-10)
50-T1630 Tel. Rec........ 99A—8
50-T1632, 50-T1633 Tel. Rec. ..................... 91A—10
50-T1632, 50-T1633 (Code 122) Tel. Rec. ............ 110—10
50-520, 50-5201 ........ 73—9
50-522, 50-522-I, 50-524. 78—11
50-526 ................ 96—8
50-527, 50-527-I ....... 80—11
50-620 ................ 85—11
50-621 ................ 89—11
50-920, 50-921, 50-922... 88—8
50-925 (Code 123) 50-926 99—12
50-1420, 50-1421, 50-1422, 50-1423 ................ 97—11
50-1720 ............... 93—8
50-1721, 50-1723, 50-1724 98—9
50-1725 ............... 93—8
50-1726 ............... 91—9
50-1727 ............... 86—7
51-PT1207, 51-PT1208 Tel. Rec. ..................... 136—12
51-PT1234 Tel. Rec...... 136—12
51-PT1282 Tel. Rec...... 136—12
51-T1443B, L, M, X, XL (Code 121) (Ch. 31, A1) Tel. Rec... 125—10
51-T1443P, PM, PL, PW (Code 121) (Ch. 3P1, AP1 and Radio Ch. RT-4) Tel. Rec......... 123—11
51-T1601, T, 51-T1602 (Code 121) (Ch. 33, C1) Tel. Rec.... 138—7
51-T1601, T, 51-T1602 (Code 122) (Ch. 32, C1) Tel. Rec... 138—7
51-T1604 (Code 121) (Ch. C, L) Tel. Rec. (See PCB 20—Set 134-1 and Model 50-T1600—Set 110-10)
51-T1604 (Code 122) (Ch. B, L) Tel. Rec. (See PCB 20—Set 134-1 and Model 50-T1600—Set 110-10)
51-T1606 (Codes 121 and 122) Tel. Rec. (See PCB 20—Set 134-1 and Model 50-T1600—Set 110-10)
51-T1606 (Code 131) Tel. Rec. (See Model 50-T1600, Code 121—Set 91A-10)
51-T1606 (Code 132) Tel. Rec. (For Defl. Ch. see Model 50-T1600 (Code 121)—Set 91A-10, for RF Ch. see Model 50-T1600 (Code 122)—Set 110-10)
51-T1607 (Code 121) (Ch. 33, C1) Tel. Rec. ........... 138—7
51-T1607 (Code 122) (Ch. 32, C1) Tel. Rec. ........... 138—7
51-T1634 (Code 121) (Ch. C, L) Tel. Rec. (See PCB 20—Set 134-1 and Model 50-T1600—Set 110-10)
51-T1634 (Code 122) (Ch. B, J) Tel. Rec. (See PCB 20—Set 134-1 and Model 50-T1600—Set 110-10)
51-T1634 (Code 123) (Ch. 33, C1) Tel. Rec. ........... 138—7
51-T1634 (Code 124) (Ch. 32, C1) Tel. Rec. ........... 138—7
51-T1800 Code 121) (Ch. 33, C2) Tel. Rec. ........... 148—13
51-T1800 (Code 122) (Ch. 32, C2) Tel. Rec. ........... 148—13
51-T1830 (Code 121) (Ch. 33, C2) Tel. Rec. ........... 148—13
51-T1832 (Code 121) (Ch. 33, C2) Tel. Rec. ........... 148—13
51-T1833 (Code 121) (Ch. 3P1, CP1) Tel. Rec........... 135—10
51-T1834 (Code 121) (Ch. 33, C2) Tel. Rec. ........... 148—13
51-T1835 (Code 121) (Ch. 3R2, CR3) Tel. Rec........... 135—10
51-T1836 (Code 123) (Ch. 34, C3) Tel. Rec. ........... 148—13
51-T1836 (Code 125) (Ch. 33, C2) Tel. Rec. ........... 148—13
51-T1838 (Code 124) (Ch. 3R2, CR3) Tel. Rec........... 135—10
51-T1870 (Code 121) (Ch. 3P1, CP1) Tel. Rec........... 135—10
51-T1871 (Code 121) (Ch. 3P1, CP1) Tel. Rec........... 135—10
51-T1871 (Code 122) (Ch. 35, CP1) Tel. Rec. ........... 135—10
51-T1872 (Code 121) (Ch. 3P1, CP1 and Radio Ch. RT-4) Tel. Rec. ..................... 135—10
51-T1872 (Code 122) (Ch. 35, CP1 and Radio Ch. RT-4) Tel. Rec. ..................... 135—10
51-T1874 (Code 121) (Ch. 3P1, CP1 and Radio Ch. RT-4) Tel. Rec. ..................... 135—10
51-T1875 (Code 121) (Ch. 3P1, CP1 and Radio Ch. RT-2) Tel. Rec. (For TV Ch. see Set 135-10, for Radio Ch. see Model 51-T2102—Set 132-10)
51-T1876 (Code 121) (Ch. 3P1, CP1 and Radio Ch. RT-4) Tel. Rec. ..................... 135—10
51-T2102 (Code 122) (Ch. 35, F2) Tel. Rec. ........... 132—10
51-T2130 (Code 121) (Ch. 35, F2) Tel. Rec. ........... 132—10
51-T2132 (Code 121) (Ch. 35, F2) Tel. Rec. ........... 132—10
51-T2133 Code 121) (Ch. 3R2, FR2) Tel. Rec. ........... 132—10
51-T2134 (Code 124) (Ch. 35, F2) Tel. Rec. ........... 132—10
51-T2136 (Code 124) (Ch. 35, F2) Tel. Rec. ........... 132—10
51-T2138 (Code 124) (Ch. 3R2, FR2) Tel. Rec. ........... 132—10
51-T2170 (Code 121) (Ch. 35, F2 and Radio Ch. RT-4) (For TV Ch. see Model 51-T2102—Set 132-10, for Radio Ch. see Model 51-T1833—Set 135-10)

PHILCO—Cont.

51-T2175, 51-T2176 (Code 124) (Ch. 35, F-2 and Radio Ch. RT-2) Tel. Rec. ............ 132—10
51-530 ................ 122—7
51-532 ................ 122—7
51-534 ................ 122—7
51-537, 51-5371 ........ 126—10
51-629 ................ 136—13
51-631 ................ 106—12
51-632 ................ 136—13
51-930, 51-931, 51-932... 153—11
51-934 ................ 102—10
51-1330 ............... 130—11
51-1730, 51-1730 (L)..... 140—8
51-1731, 51-1732 ....... 124—7
51-1733, 51-1733 (L), 51-1734 ..................... 137—9
52-T1610 (Code 122) (Ch. 32, C1) Tel. Rec. (See Model 51-T1601, Code 122—Set 138-7)
52-T1612 (Code 122) (Ch. 32, C1) Tel. Rec. (See Model 51-T1601, Code 122—Set 138-7)
52-T1802 (Code 123) (Ch. 37, C2) Tel. Rec. (See Model 51-T1800—Set 148-13)
52-T1802 (Code 124) (Ch. 71, G1) Tel. Rec. (Also see PCB 57—Set 191-1) ............. 179—9
52-T1804 (Code 122) (Ch. 32, C2) Tel. Rec. (See Model 51-T1800—Set 148-13)
52-T1804 (Code 123) (Ch. 37, C2) Tel. Rec. (See Model 51-T1800—Set 148-13)
52-T1808 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
52-T1808 (Code 122) (Ch. 33, C2) Tel. Rec. (See Model 51-T1800—Set 148-13)
52-T1810M (Code 122) (Ch. 33, C2) Tel. Rec........... 148—13
52-T1810L, M (Code 123) (Ch. 37, C2) Tel. Rec........... 148—13
52-T1812 (Code 122) (Ch. 33, C2) Tel. Rec. ............ 148—13
52-T1812 (Code 123) (Ch. 37, C2) Tel. Rec. ............ 148—13
52-T1820 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
52-T1821, 52-T1822 (Code 124) (Ch. 71, G1) Tel. Rec. (Also see PCB 57—Set 191-1).... 179—9
52-T1831 (Code 122) (Ch. 33, C2) Tel. Rec. (See Model 51-T1800—Set 148-13)
52-T1839 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
52-T1839 (Code 122) (Ch. 33, C2) Tel. Rec. (See Model 51-T1800—Set 148-13)
52-T1839 (Code 123) (Ch. 37, C2) Tel. Rec. (See Model 51-T1800—Set 148-13)
52-T1840 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
52-T1840 (Code 122) (Ch. 33, C2) Tel. Rec. ............ 148—13
52-T1840 (Code 123) (Ch. 37, C2) Tel. Rec. ............ 148—13
52-T1841L (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
52-T1841L (Code 123) (Ch. 37, C2) Tel. Rec. (See Model 51-T1800—Set 148-13)
52-T1842 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
52-T1842 (Code 122) (Ch. 33, C2) Tel. Rec. ............ 148—13
52-T1842 (Code 123) (Ch. 37, C2) Tel. Rec. ............ 148—13
52-T1842L (Code 124) (Ch. 33, C2) Tel. Rec. (See Model 52-T1842—Set 148-13)
52-T1844 (Code 121) (Ch. 41- D1, D1A) Tel. Rec. (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
52-T1844 (Code 122) (Ch. 33, C2) Tel. Rec. ............ 148—13
52-T1844 (Code 123) (Ch. 37, C2) Tel. Rec. ............ 148—13
52-T1844 (Code 124) (Ch. 33, C2) Tel. Rec. ............ 148—13
52-T1845 (Ch. 3R2, CR2) (Code 124) Tel. Rec. (See Model 51-T1833—Set 135-10)
52-T1850 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
52-T1850-W (Code 124) (Ch. 71, G1) Tel. Rec. (Also see PCB 57—Set 191-1) ............ 179—9
52-T1882 (Code 121) (Ch. 44, D4, D4A) Tel. Rec. (Also see PCB 57—Set 191-1) ......... 181—9
52-T1882, W (Code 122) (Ch. 35, CP1 and Radio Ch. RT-4) Tel. Rec. (For TV Ch. see Model 51-T2102—Set 132-10, for Radio Ch. see Model 51-T1833—Set 135-10)
52-T1883 (Code 121) (Ch. 44, D4, D4A) Tel. Rec. (Also see PCB 57—Set 191-1) ......... 181—9
52-T2106, 51-T2108, 52-T2110 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (Also see PCB 56—Set 190-1) ..................... 171—9
52-T2110 (Code 122) (Ch. 35, F2) Tel. Rec. (See Model 51-T2102—Set 132-10)

PHILCO—Cont.

52-T2120 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (See PCB 57—Set 190-1 and Model 52-T2106—Set 171-9)
52-T2120 (Code 124) (Ch. 71, G1) Tel. Rec. (Also see PCB 57—Set 190-1) ............. 179—9
52-T2122, L (Code 121) (Ch. 41, D1, D1A) Tel .Rec. (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
52-T2140 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (Also see PCB 56—Set 190-1) ......... 171—9
52-T2142 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
52-T2142 (Code 122) (Ch. 35, F2) Tel. Rec. (See Model 51-T2102—Set 132-10)
52-T2144 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (Also see PCB 56—Set 190-1) ....... 171—9
52-T2145X (Code 121) Tel. Rec. ..................... 159-1A
52-T2145X (Code 125) (Ch. 44, D4, D4A) Tel. Rec. (Also see PCB 57—Set 191-1) ....... 181—9
52-T2150, W, 52-T2151, L (Code 124) (Ch. 71, G1) Tel. Rec. (Also see PCB 57—Set 191-1). 179—9
52-T2151 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
52-T2157 (Code 125) (Ch. 42, G2) Tel. Rec. ............ 186—10
52-T2175 (Code 124) (Ch. 35, F-2 and Radio Ch. RT-6) Tel. Rec. (For TV Ch. see Model 51-T2102—Set 132-10, for Radio Ch. see Set 159-2A)
52-T2176 (Code 124) (Ch. 35, F-2 and Radio Ch. RT-6) Tel. Rec. (For TV Ch. see Model 51-T2102—Set 132-10, for Radio Ch. see Set 159-2A)
52-T2182 (Code 121) (Ch. 44, D-4, D-4A and Radio Ch. RT-6) (For TV Ch. see PCB 57—Set 191-1 and Set 181-9, for Radio Ch. see Set 159-2A)
52-T2224 (Code 121) (Ch. 41, D1, D-A) Tel. Rec. (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
52-T2244 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (Also see PCB 56—Set 190.1)
52-T2245 (Code 121) (Ch. 44, D4, D4A) Tel. Rec. (Also see PCB 57—Set 181-1) ......... 181—9
52-T2252 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (See PCB Set 191-1) ............. 181—9
52-T2252 (Code 124) (Ch. 71, G1) Tel. Rec. (Also see PCB 57—Set 191-1) ............. 179—9
52-T2253 (Code 121) (Ch. 44, D4, D4A) Tel. Rec. (Also see PCB 57—Set 191-1) ....... 181—9
52-T2254 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
52-T2256 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (See PCB 57—Set 190-1 and Model 52-T2106—Set 171-9)
52-T2258 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
52-T2259 (Code 121) (Ch. 41, D1, D1A) Tel. Rec. (See PCB 56—Set 190-1 and Model 52-T2106—Set 171-9)
52-T2282, 52-T2283 (Code 121) (Ch. 44, D-4, D-4A and Radio Ch. RT-6) (For TV Ch. see PCB 57—Set 191-1 and Set 181-9, for Radio Ch. see Set 159-2A)
52-540, 52-540-I, 52-541, 52-541-I, 52-542-I ........ 154—10
52-544, 52-544-I, 52-544-W ..................... 163—9
52-640, 52-641 ......... 153—12
52-643 ................ 161—7
52-940, 52-941, 52-942.. 156—9
52-944 ................ 169—12
52-1340 (Codes 121, 122). 160—8
53-T1824 (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (Also see PCB 83—Set 224-1) ....... 201—7
53-T1824 (Code 124) (Ch. 71, G1) Tel. Rec. (Also see PCB 57—Set 191-1) ............. 179—9
53-T1825 (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (Also see PCB 83—Set 224-1) ....... 201—7
53-T1825 (Code 124) (Ch. 71, G1) Tel. Rec. (Also see PCB 57—Set 191-1) ............. 179—9
53-T1826 (Code 123) (Ch 81, H-1, H-1A) Tel. Rec. (Also see PCB 83—Set 224-1) ....... 201—7
53-T1826 (Code 124) (Ch. 71, G1) Tel. Rec. (Also see PCB 57—Set 191-1) ............. 179—9
53-T1827, -F, -HM (Code 126) (Ch. 91, J-1) Tel. Rec. (See PCB 66—Set 203-1 and Model 53-T1853—Set 185-10)
53-T1827, -F, -HM (Code 128) (Ch. 91, J-2) Tel. Rec. (See PCB 66—Set 203-1, PCB 82—Set 223-1 and Model 53-T1853—Set 185-10)
53-T1852, F, L (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (Also see PCB 83—Set 224-1)..... 201—7
53-T1852 (Code 124) (Ch. 71, G-1) Tel. Rec. (See PCB 57—Set 191-1 and Model 52-T1802—Set 179-9)
53-T1852HM (Code 123) (Ch. 81, H-1) Tel. Rec. (See Model 53-T1824—Set 201-7)

PHILCO—Cont.

53-T1852L (Code 123) (Ch. 81, H-1) Tel. Rec.......... 201—7
53-T1852L (Code 124) (Ch. 71, G-1) Tel. Rec. (See PCB 57—Set 191-1 and Model 52-T1802—Set 179.9)
53-T1853, L (Code 126) (Ch. 91, J1) Tel. Rec. (Also see PCB 66—Set 203-1) ........... 185—10
53-T1853, L (Code 128) (Ch. 91, J-2) Tel. Rec. (See PCB 66—Set 203-1, PCB 82—Set 223-1 and Model 53-T1853—Set 185-10)
53-T1854, L (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (Also see PCB 83—Set 224-1)..... 201—7
53-T1883 (Code 125) (Ch. 44, G4) Tel. Rec. ............ 196—11
53-T1884 (Code 125) (Ch. 44, G-4 and Radio Ch. RT-9) Tel. Rec. (TV Ch. Only)..... 196—11
53-T1886, L (Code 125) (Ch. 44, G-4 and Radio Ch. RT-9) Tel. Rec. (TV Ch. Only)..... 196—11
53-T2124, L (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (Also see PCB 83—Set 224-1).... 201—7
53-T2125, L (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (Also see PCB 83—Set 224-1).... 201—7
53-T2125, L (Code 124) (Ch. 71, G1) Tel. Rec. (See PCB 57—Set 191-1 and Model 52-T1802—Set 179-9)
53-T 2126 (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (Also see PCB 83—Set 224-1) ....... 201—7
53-T2126 (Code 125) (Ch. 42, G2) Tel. Rec. ............ 186—10
53-T2127 (Code 126) (Ch. 91, J1) Tel. Rec. (Also see PCB 66—Set 203-1) ............. 185—10
53-T2152, L (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (Also see PCB 83—Set 224-1).... 201—7
53-T2152, L (Code 124) (Ch. 71, G1) Tel. Rec. (See PCB 57—Set 191-1 and Model 52-T1802—Set 179-9)
53-T2183 (Code 125) (Ch. 44, G-4 and Radio Ch. RT-9) Tel. Rec. (TV Ch. only)......... 196—11
53-T2225, L (Codes 123 and 133) (Ch. 81, H-1, H-1A) Tel. Rec. (Also see PCB 83—Set 224-1) ..................... 201—7
53-T2226 (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (Also see PCB 83—Set 224-1) ......... 201—7
53-T2227 (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (Also see PCB 83—Set 224-1) ......... 201—7
53-T2228 (Code 126) (Ch. 91, J1) Tel. Rec. ............ 185—10
53-T2228 (Code 128) (Ch. 91, J-2) Tel. Rec. (See PCB 66—Set 203-1, PCB 82—Set 223-1 and Model 53-T1853—Set 185-10)
53-T2255 (Code 133) (Ch. 81, H1) Tel. Rec. ............ 201—7
53-T2260 (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (Also see PCB 83—Set 224-1) ....... 201—7
53-T2260 (Code 125) (Ch. 42, G2) Tel. Rec. ............ 186—10
53-T2262 (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (Also see PCB 83—Set 224-1) ....... 201—7
53-T2262 (Code 125) (Ch. 42, G2) Tel. Rec. ............ 186—10
53-T2264 (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (Also see PCB 83—Set 224-1) ....... 201—7
53-T2264 (Code 125) (Ch. 42, G2) Tel. Rec. ............ 186—10
53-T2266, L (Code 126) (Ch. 91, J-1) Tel. Rec. (Also see PCB 66—Set 203-1) ........... 185—10
53-T2266, L (Code 128) (Ch. 91, J-2) Tel. Rec. (See PCB 66—Set 203-1, PCB 82—Set 223-1 and Model 53-T1853—Set 185-10)
53-T2268 (Code 126) (Ch. 91, J1) Tel. Rec. (Also see PCB 66—Set 203-1) ............. 185—10
53-T2269 (Code 126) (Ch. 91, J1) Tel. Rec. (Also see PCB 66—Set 203-1) ............. 185—10
53-T2269 (Code 128) (Ch. 91, J-2) Tel. Rec. (See PCB 66—Set 203-1, PCB 82—Set 223-1 and Model 53-T1853—Set 185-10)
53-2270 (Code 126) (Ch. 91, J1) Tel. Rec. (Also see PCB 66—Set 203-1) ............. 185—10
53-T2270 (Code 128) (Ch. 91, J-2) Tel. Rec. (See PCB 66—Set 203-1, PCB 82—Set 223-1 and Model 53-T1853—Set 185-10)
53-T2271 (Code 126) (Ch. 91, J1) Tel. Rec. (Also see PCB 66—Set 203-1) ............. 185—10
53-T2271 (Code 128) (Ch. 91, J-2) Tel. Rec. (See PCB 66—Set 203-1, PCB 82—Set 223-1 and Model 53-T1853—Set 185-10)
53-T2272, L (Code 123) (Ch. 81, H1) Tel. Rec............ 201—7
53-T2273 C, M (Code 126) (Ch. 91, J1) Tel. Rec. (Also see PCB 66—Set 203-1) ........... 185—10
53-T2273, C (Code 128) (Ch. 91, J-2) Tel. Rec. (See PCB 66—Set 203-1, PCB 82—Set 223-1 and Model 53-T1853—Set 185-10)
53-T2274 (Code 123) (Ch. 81, H-1, H-1A) Tel. Rec. (Also see PCB 83—Set 224-1) ....... 201—7
53-T2285, L (Code 126) (Ch. 94, J-4 and Radio Ch. RT-8) Tel. Rec. ..................... 213—5
53-T2285S (Code 126) (Ch. 94A, J-4 and Radio Ch. RT-8) (See Model 53-T2285—Set 213-5)
53-T2286 (Code 126) (Ch. 94, J-4 and Radio Ch. RT-8) Tel. Rec. ..................... 213—5



NOTE: PCB denotes Production Change Bulletin

# PF INDEX Subject Reference Table

The following Subject Reference Table for the *PF INDEX and Technical Digest* is intended to provide a ready reference to subjects in the various articles that have appeared in issues Nos. 24 through 41 inclusive.

The table has been divided into major-subject headings in common usage in the electronic field. These are listed in alphabetical order, and a descriptive breakdown of the material is then given under these classifications. Under the subject listing, the name of the article appears in italics and is followed by the issue number of the *PF INDEX and Technical Digest* in which it was published. With the issue number given, the page may be found by referring to the Table of Contents of that issue.

All subjects which are treated extensively enough in the text to be helpful in servicing or understanding the operation of a circuit are listed in this Subject Reference Table.

NOTE: PCB denotes Production Change Bulletin

NOTE: PCB denotes Production Change Bulletin

**RAYTHEON—Cont.**

Ch. 4D16-A (See Model CR-41)
Ch. 4P12, A (See Model PR-51, A)
Ch. 10AX22 (See Model M701)
Ch. 12AX22 (See Model C1102)
Ch. 12AX26, 12AX27 (See Model C-1104B)
Ch. 14AX21 Tel. Rec. (See Model C-1401)
Ch. 16AX23, 25, 26 (See Model C-1602)
Ch. 16AY28 (See Model C-1615B)
Ch. 16AY211 (See Model C-1615A) (Also see PCB 19—Set 132-1)
Ch. 16AY212 (See Model M-1626)
Ch. 17AY21 (See Model C-1714B)
Ch. 17AY21A (See Model C-1729)
Ch. 17AY24 (See Model C-1715A)
Ch. 17AY27 (See Model RC-1720A)
Ch. 17T1 (See Model C-1735A)
Ch. 17T2 (See Model M-1734A)
Ch. 20AY21 (See Model C-2001A)
Ch. 21AY21 (See Model C-2103A)
Ch. 21T1 (See Model C-2108)
Ch. 21T2 (See Model C-2109A)
Ch. 21T3 (See Model C-2112A)

**RECORDIO (Wilcox-Gay)**

1B10 ... 149—10
1C-10 ... 146—9
1J10 (Ch. 1J1) ... 128—12
2A10 ... 163—10
6A10, 6A20 (Ch. 6A) ... 10—27
6B10, 6B20, 6B30, 6B32 ... 8—27
7D42, 7D44 (Ch. 7D1) ... 52—18
7E40, 7E44 ... 47—20
8J10, 8J50 ... 62—17
9G10 ... 91—10
9G40M, 9G42 ... 86—9
9H40B ... 89—13
Ch. 1J1 (See Model 1J10)
Ch. 6A (See Model 6A10)
Ch. 7D1 (See Model 7D42)

**REELEST (See Recorder Listing)**

**REGAL (TOK-FONE)**

Tok-Fone (20-watt Amp.) ... 13—27
AP40, ARP400, ARP450 ... 15—26
BP48 ... 49—18
C473 ... 217—12
C-527 ... 182—9
CD31 Tel. Rec. (See Model 16T31—Set 80-14)
CD36 Tel. Rec. ... *
CR761 ... 50—16
CR762 ... 195—11
FM78 ... 68—14
L-7* ... 5—18
P-175 ... 183—12
W700 (See Model W800—Set 14-26)
W800, W801 ... 14—26
W900, W901 ... 13—28
16T31 Tel. Rec. ... 80—14
16T36 Tel. Rec. ... *
17HD31, 17HD36 Tel. Rec. 147—10
17T22, 17T22DX Tel. Rec. 143—13
19C31, 19C36 Tel. Rec. ... 147—10
19D31, 19D36 Tel. Rec. ... 147—10
20C22, 20C22DX Tel. Rec. 143—13
20C31, 20C36 Tel. Rec. ... 147—10
20D22, 20D22DX Tel. Rec. 143—13
20D31, 20D36 Tel. Rec. ... 147—10
20HD31, 20HD36 Tel. Rec. 147—10
20T22, 20T22DX Tel. Rec. 143—13
22D17, 22D17DX, 22D19, 22D19DX Tel. Rec. ... 143—13
205 ... 26—23
208 (See Model W800—Set 14-26)
271 ... 210—7
472 ... 217—12
575 ... 210—8
747 ... 27—22
777 ... 53—21
1007 Tel. Rec. ... 83—9
1030, 1031 Tel. Rec. ... 80—14
1049 ... 17—28
1107 ... 41—19
1207, 1208 Tel. Rec. ... 83—9
1230 Tel. Rec. ... 80—14
1500 ... 38—19
1607 Tel. Rec. ... 83—9
1708, 1708DX Tel. Rec. ... 143—13
1749 ... 28—29
1877 ... 182—10
2217, 2217DX, 2219, 2219DX Tel. Rec. ... 143—13
7152 ... 70—8
7162 ... 69—12
7163 ... 66—14
7251 ... 40—16

**REGENCY**

RC-600 Tel. UHF Conv. ... 200—8

**REMBRANDT**

721, 1606, 1606-15, 1950 Tel. Rec. ... 65—11

**REMLER**

MP5-5-3 ... 8—28
5300B, 5300B1, 53001 ... 23—18
5310 ... 40—17
5400, 5410 ... 44—19
5500 "Scottie Pup" ... 27—23
5505 "Scottie Pup" (See Model 5500—Set 27-23)
5510 "Scottie Pup" ... 27—23
5515 "Scottie Pup" (See Model 5500—Set 27-23)
5520, 5530 "Scottie Junior" 27—23
6000 ... 77—9

**RENARD**

L-1A, PT-1A, 185T-1 ... 9—28

**REVERE (See Recorder Listing)**

**ROLAND**

4T1 ... 213—7
5C1 ... 215—11
5T1E ... 205—8
5T1V ... 208—10
5T2M ... 204—9
5X1, 5X2 ... 217—13
6T1M ... 216—9
8FT1M ... 214—9
8XF1, 8XF2 ... 211—11

**ROYAL (Lee)**

AN150, AN160 ... 179—11
20CP, 201W Tel. Rec. (Similar to Chassis) ... 149—13

**SCOTT (E. H.)**

Musicale ... 44—20
Music Control, Dynamic Noise Suppressor ... 46—21
"Ravenswood" Tel. Rec. ... 150—11
6T11, 6T11A Tel. Rec. (Also see PCB 4—Set 105-2) ... 52—19
13A Tel. Rec. ... *
16A ... 40—18
300 Tel. Rec. ... *
310 ... 154—11
400 Tel. Rec. (See PCB 4—Set 105-2 and Model 6T11—Set 52-19)
510 ... 103—14
515 ... 165—11
710, 710A, 710X Tel. Rec. 150—11
720 Tel. Rec. ... *
800-B ... 14—27
800BT Tel. Rec. (For TV Ch. see PCB 4—Set 52-19, for Radio Ch. see Model 800-B—Set 14-27)
817C (Ch. 9029, 9031) Tel. Rec. (See Model 820C—Set 178-9)
817C (Ch. 9036, 9037, 9038, 9039) Tel. Rec. ... 217—14
817CU (Ch. 9029, 9031) Tel. Rec. (See Model 820C—Set 178-9)
817T (Ch. 9029, 9031) Tel. Rec. (See Model 820C—Set 178-9)
817 T (Ch. 9036, 9037, 9038, 9039) Tel. Rec. ... 217—14
817T (Ch. 9036, 9037, 9038, 9039) Tel. Rec. ... 217—14
817TU (Ch. 9029, 9031) Tel. Rec. (See Model 820C—Set 178-9)
820C Tel. Rec. ... 178—9
820CU Tel. Rec. ... 178—9
820T, 820TU Tel. Rec. (See Model 820C—Set 178-9)
821C, CB, D, T, TB (Ch. 9036, 9037, 9038, 9039) Tel. Rec. ... 217—14
910 Tel. Rec. ... 150—11
920 Tel. Rec. ... *
924W Tel. Rec. ... 176—11
1000 ... 180—8
1510 ... 181—11
Ch. 9036, 9037, 9038, 9039 (See Model 817C)

**SCOTT (H. H.)**

111-B ... 143—14
112-B ... 144—8
120-A ... 183—13
210-A ... 79—15
210-B ... 145—9
211-A ... 81—14
214-A (120-A, 220-A) ... 183—13
220-A ... 183—13

**SEARS-ROEBUCK (See Silvertone)**

**SEEBURG (See Record Changer Listing)**

**SENTINEL**

1U-284GA ... 22—25
1U-284I, 1U-284NA, 1U-284NI, 1U-284W ... 1—2
1U-285P ... 6—27
1U-293CT ... 29—29
1U-293I, 1U-293T, 1U-293W 1—14
1U-294I, 1U-294N, 1U-294T 1—11
1U312PG, 1U312PW ... 103—15
1U-313I, 1U-313W ... 39—21
1U-314E, 1U-314I, 1U-314W ... 38—21
1U-316PM, 1U-316PT ... 48—22
1U-335PG, PI, PM, PW ... 105—9
1U338-I, 1U338-R, 1U338-W ... 122—9
1U339-K ... 111—12
1U340-C ... 129—10
1U342K ... 155—14
1U-343 ... 212—6
1U-344 ... 211—12
1U345P ... 183—14
1U-346 ... 209—11
1U416 Tel. Rec. ... 117—12
1U419, 1U420 Tel. Rec. ... 115—9
1U420B Tel. Rec. ... 124—9
1U421, 1U422 (Series "YA") Tel. Rec. (See PCB 16—Set 126-1 and Model 412—Set 100-11)
1U423 Tel. Rec. (Also see PCB 19—Set 132-1) ... 124—9
1U423B, 1U423-17 Tel. Rec. (See PCB 19—Set 132-1 and Model 1U423B—Set 125-9)
1U424 Tel. Rec. (Also see PCB 19—Set 132-1) ... 124—9
1U424-17 (See PCB 19—Set 132-1 and Model 1U424—Set 124-9)
1U-425 Tel. Rec. ... 127—10
1U428 Tel. Rec. (See Model 1U425) ... 127—10
1U429, 1U430, 1U431 Tel. Rec. (See PCB 25—Set 144-1 and Model 1U420B—Set 124-9)
1U-432 Tel. Rec. (Also see PCB 21—Set 136-1) ... 127—10
1U435 Tel. Rec. (See PCB 21—Set 136-1 and Model 1U425—Set 127-10)
1U438, 1U439, 1U440, 1U441, 1U-443, 1U444 (Series "XD, XXD, 2XD") Tel. Rec. ... 157—9
1U446, 1U447 (Series "XD, XXD, 2XD") Tel. Rec. (See Model 1U438—Set 157-9)
1U447-A, 1U448-A, 1U449-A, 1U-450-A, 1U451-A Tel. Rec. 178—10
1U-448, 1U-449, 1U-450 (Series "XD, XXD, 2XD") Tel. Rec. (See Model 1U-438—Set 157-9)
1U-454, 1U-455, 1U-456, 1U-457 Tel. Rec. (Also see PCB 63—Set 197-1) ... 191—17
1U-458, 1U-459, 1U-460, 1U-461 Tel. Rec. ... 199—10
1U462, 1U463 (Ch. 2WA) Tel. Rec. ... 205—9
L-284I, L-284NA, L-284NI, L-284-NR, L-284W ... 23—19

**SENTINEL—Cont.**

284GA ... 22—25
284I ... 1—2
284NA, 284NI ... 1—2
285P ... 6—27
286P, 286PR ... 23—20
289T ... 6—28
292K ... 16—30
293 Series ... 1—14
293-CT ... 29—22
293I, 293T, 293W ... 1—14
294 Series ... 1—11
294I, 294N, 294T ... 1—11
295-T ... 22—26
296B, 296M ... 46—22
302-I, 302-T, 302-W ... 33—23
305-I, 305-I-3, 305-W, 305-W3 ... 3—24
309-I, 309-N, 309-R, 309-W 28—30
312PG, 312PW ... 103—15
313-I, 313-W ... 39—21
314-E, 314-I, 314-W ... 38—21
315-I, 315-W ... 40—19
316PM, 316PT ... 48—22
332 (See Model 313-I—Set 39-21)
333 (See Model 315-I—Set 40-19)
335PG, PI, PM, PW ... 105—9
338-I, 338-R, 338-W ... 122—9
339-K ... 111—12
340-C ... 129—10
342K ... 155—14
343 ... 212—6
344 ... 211—12
345P ... 183—14
346 ... 209—11
400TV Tel. Rec. ... 73—11
401, 402 Series Tel. Rec. ... 70—9
405TVM Tel. Rec. ... 73—11
405 Series Tel. Rec. ... 70—9
406 Series Tel. Rec. ... 70—9
407 Series Tel. Rec. ... *
409 Series Tel. Rec. ... *
411 Series Tel. Rec. (See Model 401 Series—Set 70-9)
412, 413, 414, 415 (Series YA, YB, YC, YD, YE, YF) Tel. Rec. (Also see PCB 4—Set 105-2) ... 100—11
416 Tel. Rec. ... 117—12
419, 420 Tel. Rec. ... 115—9
420B Tel. Rec. ... 124—9
421, 422 Tel. Rec. (See PCB 16—Set 126-1 and Model 412—Set 100-11)
423, 424 Tel. Rec. (Also see PCB 19—Set 132-1) ... 124—9
423B, 423-17 Tel. Rec. (See PCB 19—Set 132-1 and Model 423B—Set 124-9)
424 Tel. Rec. (Also see PCB 19—Set 132-1) ... 124—9
424-17 Tel. Rec. (See PCB 19—Set 132-1 and Model 424—Set 124-9)
425 Tel. Rec. ... 127—10
428 Tel. Rec. ... 127—10
429, 430, 431 Tel. Rec. (See PCB 25—Set 144-1 and Model 1U-420B—Set 124-9)
432 Tel. Rec. (Also see PCB 21—Set 136-1) ... 127—10
435 Tel. Rec. (See PCB 21—Set 136-1 and Model 425—Set 127-10)
438, 439, 440, 441, 443, 444 (Series "XD, XXD, 2XD") Tel. Rec. ... 157—9
446 (Series "XD, XXD, 2XD") Tel. Rec. (See Model 438—Set 157-9)
452, 453 Tel. Rec. (See Model 1U-447-A—Set 178-10)
454, 455, 456, 457 Tel. Rec. (Also see PCB 63—Set 197-1) . 191—17
458, 459, 460, 461 Tel. Rec. (See Model 1U-458—Set 199-10)
462, 463 (Ch. 2WA) Tel. Rec. ... 205—9
464, 465, 466 (See Model 1U-454—Set 191-17)
Ch. 2WA (See Model 462)

**SETCHELL-CARLSON**

53 (Ch. 152) Tel. Rec. ... 209—12
150 Tel. Rec. ... 144—9
151-A17, 151-A17-LR, 151-B17, 151-B17-LR, 151-B20, 151-B20-LR, 151-C20, 151-C20-LR Tel. Rec. ... 155—15
416 ... 2—14
427 ... 21—29
437 ... 39—22
447 ... 40—20
458-RD ... 106—13
469 ... 99—15
531 (Ch. 152) Tel. Rec. ... 209—12
570 ... 97—15
2500, 2500LP Tel. Rec. ... 144—9
5301, 5302 (Ch. 122) Tel. Rec. ... 209—12
Ch. 152 (See Model 53)

**SHAW**

Ch. 224 (Runs 301, 302, 303, 304, 304-1, -2, 305, 305-2) Tel. Rec. ... 202—8

**SHERATON**

C-26B, M (Ch. 260-C) Tel. Rec.*
C-26B24 (Ch. 260-C) Tel. Rec. *
C-26M24 (Ch. 260-C) Tel. Rec. *
C30B, M Tel. Rec. ... 176—13
C30B24, C30M24 Tel. Rec. 176—13
C-2125 (Ch. 250XL Series) Tel. Rec. ... 218—10
T-26M, B (Ch. 260-C) Tel. Rec.*
T30M Tel. Rec. ... 176—13
T-1755 (Ch. 250XL Series) Tel. Rec. ... 218—10
T-2155 (Ch. 250XL Series) Tel. Rec. ... 218—10
17MT20 (Ch. 530DX Series) Tel. Rec. ... 210—9
21BC10, 21BD10, 21BT10 (Ch. 530DX Series) Tel. Rec. ... 210—9
21MC10, 21MD10 (Ch. 530DX Series) Tel. Rec. ... 210—9
21MT10U (Ch. 530DX Series) Tel. Rec. ... 210—9
Ch. 260-C (See Model C-26B)
Ch. 250XL (See Model C2125)
Ch. 530DX (See Model 17MT20)

**SHERIDAN ELECTRONICS (See Vogue)**

**SIGNAL**

AF252 ... 37—19
141 ... 44—21
241 ... 33—25
341-A ... 39—23
341-T ... 25—25

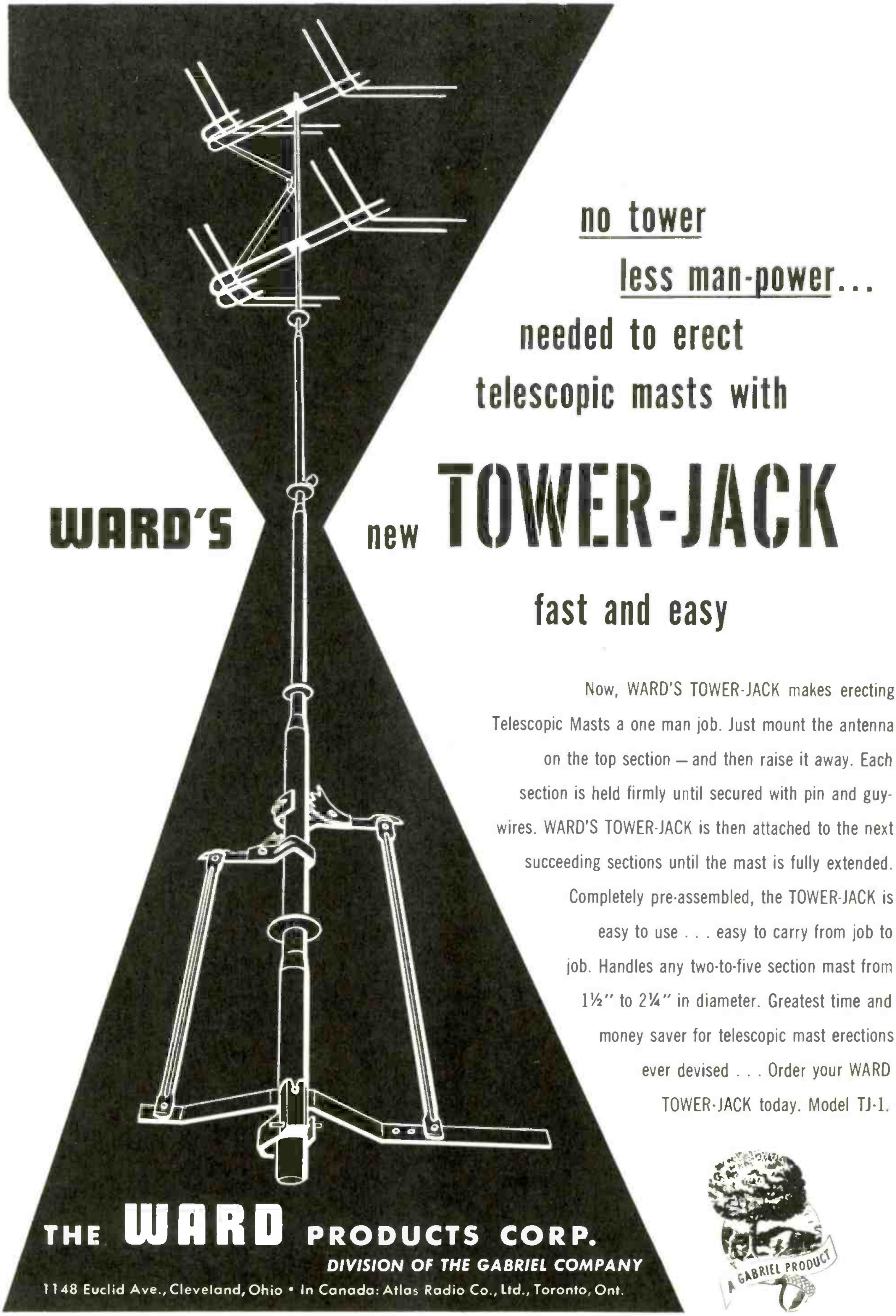
**SILVERTONE (Also see Changer and Recorder Listing)**

1, 2 (Ch. 132.878) ... 101—10
5, 6 (Ch. 132.881) ... 144—10
10, 11 (Ch. 132.896) ... 144—11
15, 16 (Ch. 132.884, -1, -2) 141—12
18 (Ch. 132.877) ... 140—11
20 (Ch. 132.877) ... 140—11
25, 27 (Ch. 478.238) ... 161—8
33 (Ch. 548.363) ... 111—13
41, 41A (Ch. 135.245) ... 101—11
51, 53 (Ch. 132.887) ... 112—8
54, 56 (Ch. 132.888) ... 115—10
64, 65 (Ch. 101.859-2) ... 113—8
67 (Ch. 101.859-1, -2) (See Model 64—Set 113-8)
67B (Ch. 101.859-2) (See Model 64—Set 113-8)
69 (Ch. 100.201) ... 162—10
72 (Ch. 134.111) ... 142—11
101 (Ch. 549.100) Tel. Rec. 102—12
101A (Ch. 549.100-1) Tel. Rec. ... 102—12
102 (Ch. 549.100-2) Tel. Rec. *
102A (Ch. 549.100-3, -7) Tel. Rec. ... 161—9
105 (Ch. 132.882) Tel. Rec. *
106, 107 (Ch. 132.889-1) Tel. Rec. *
106, 107 (Ch. 132.889-2) Tel. Rec. ... 149—12
108 (Ch. 549.100) Tel. Rec. 102—12
110, A (Ch. 478.303, A) Tel. Rec. (See Model 125—Set 104-10)
111 (Ch. 110.700) Tel. Rec. *
112 (Ch. 478.289) Tel. Rec. 118—9
113 (Ch. 110.700) Tel. Rec. *
114 (Ch. 478.302) Tel. Rec. (See Model 125—Set 104-10)
115 (Ch. 110.499-7A, B, 8A, B) Tel. Rec. *
116, 116A (Ch. 110.700-1, -10) Tel. Rec. ... 139—13
120 (Ch. 478.311) Tel. Rec. 115—11
125 (Ch. 478.257) Tel. Rec. 104—10
125B (Ch. 478.257-1) Tel. Rec.*
127-12 (Ch. 110.700) Tel. Rec. *
131, 131A (Ch. 110.700-1, -10) Tel. Rec. ... 139—13
132 (Ch. 110.499-1) Tel. Rec. (See Model 9123—Set 79-16)
133 (Ch. 100.107 and Radio Ch. 100.043) Tel. Rec. ... 156—12
134 (Ch. 110.700-2, -20) Tel. Rec. *
135 (Ch. 110.499-7A, B, 8A, B) Tel. Rec. *
137 (Ch. 549.100-1 and Radio Ch. 101.831-1) Tel. Rec. (For TV Ch. See Model 101—Set 102-12, for Radio Ch. see Model 8127—Set 41-20)
138 (Ch. 549.100-3 and Radio Ch. 101.831-1) Tel. Rec. (For TV Ch. see Model 102A—Set 161-9, for Radio Ch. see Model 8127—Set 41-20)
139 (Ch. 110.700) Tel. Rec. *
140 (Ch. 110.700 Tel. Rec. *
141 (Ch. 132.889-1) Tel. Rec. *
141 (Ch. 132.889-2) Tel. Rec. ... 149—12
142 (Ch. 100.115 and Radio Ch. 100.959) Tel. Rec. *
143 Tel. Rec. (See Model 143A—Set 121-12)
143A (Ch. 100.111) Tel. Rec. ... 121—12
144 (Ch. 478.312 and Radio Ch. 478.240) Tel. Rec. ... 160—11
149 (Ch. 100.107-1) Tel. Rec. (See Model 133—Set 156-12)
150-14 (Ch. 478.338) Tel. Rec. ... 142—12
151-16, 151-17 (Ch. 528.630-1) Tel. Rec. *
152.16, 16A (Ch. 549.102, 549.-102-2) Tel. Rec. *
159 (Ch. 478.309) Tel. Rec. 115—11
160-12 (Ch. 549.100-4) Tel. Rec. ... 97A—12
161-16 (Ch. 100.112) Tel. Rec. ... 99A—10
162-17 (Ch. 110.700-10) Tel. Rec. ... 139—13
163-16 (Ch. 478.319) Tel. Rec. ... 157—10
164-14 (Ch. 478.313) Tel. Rec. *
165-16 (Ch. 100.120) Tel. Rec. ... 144—12
166-16 (Ch. 478.339) Tel. Rec. *
166-17 (Ch. 478.339-A) Tel. Rec. *
167-16, 167-16A (Ch. 549.101, -1) Tel. Rec. *
168-16 (Ch. 549.100-3) Tel. Rec. ... 161—9
169-16 (Ch. 549.102, 549.102-2) Tel. Rec. *
170-16 (Ch. 549.102, 549.102A) Tel. Rec. *
173-16 (Ch. 110.700-10) Tel. Rec. ... 139—13
175-16, A (Ch. 549.100-5, -6, -7, -8, -9) Tel. Rec. ... 161—9
176-19 (Ch. 549.100-6) Tel. Rec. ... 161—9
177-19 (Ch. 110.700-40) Tel. Rec. ... 139—13
179-16, 180-16 (Ch. 132.890) Tel. Rec. ... 130—12
185-16 (Ch. 549.101-2) Tel. Rec. *
186-19 (Ch. 549.101-3) Tel. Rec. *
187-16, 188-16 (Ch. 110.700-10) Tel. ec. (See Model 116—Set 139-13)
189-16 (Ch. 110.700-1, -10) Tel. Rec. ... 139—13

**SILVERTONE—Cont.**

191-16 (Ch. 110.700-50) Tel. Rec. *
194-16, 195-16 (Ch. 132.890) Tel. Rec. ... 130—12
210 (Ch. 132.880) ... 109—12
215 (Ch. 528.174) ... 117—13
217, 218 (Ch. 528.174) (See Model 215—Set 117-13)
220 (Ch. 528.173) ... 110—13
222, 223, 224 (Ch. 528.173) (See Model 220—Set 110-13)
225 (Ch. 528.171-1) ... 107—8
237 (Ch. 488.237) ... 145—10
238 (Ch. 548.360-1, 548.361) (See Model 239—Set 115-12)
239 (Ch. 548.360-1, 548.361) ... 115—12
245 (Ch. 548.358-1) ... 107—9
246 (Ch. 137.906) ... 111—14
249 (Ch. 548.360-1, 548.361) ... 115—12
1017, 1018 (Ch. 528.210, -1, -2) ... 183—11
1032 (Ch. 528.196) ... 183—15
1035, A (Ch. 528.195, -1, -2) ... 215—12
1040, 1045 (Ch. 528.194) . 181—12
1040A (Ch. 528.194-1) (See Model 1040—Set 181-12)
1045A (Ch. 528.194-1) (See Model 1040—Set 181-12)
1052 (Ch. 132.011) ... 174—10
1052A (Ch. 132.011-1) (See Model 1052—Set 174-10)
1053 (Ch. 132.011) ... 174—10
1053A (Ch. 132.011-1) (See Model 1053—Set 174-10)
1054 (Ch. 132.012) ... 173—12
1054A (Ch. 132.012-1) (See Model 1054—Set 173-12)
1055 (Ch. 132.012) ... 173—12
1055A (Ch. 132.012-1) (See Model 1055—Set 173-12)
1058, 1059 (Ch. 101.860) . 162—11
1062, 1063 (Ch. 101.860) . 162—11
1066 (Ch. 100.202) ... 162—10
1116-16 (Ch. 110.700-90), 1117-17 (Ch. 110.700-96) Tel. Rec. *
1117-17 (Ch. 110, 700-100, -104) Tel. Rec. ... 201—8
1130-17 (Ch. 110.700-96) Tel. Rec. *
1130-17, 1130A-17 (Ch. 110.700-100, -104) Tel. Rec. ... 201—8
1135-17 (Ch. 110.700-96) Tel. Rec. *
1141-20 (Ch. 110.700-93) Tel. Rec. *
1141-20 (Ch. 110.700-120) Tel. Rec. ... 201—8
1145-20 (Ch. 110.700-140) Tel. Rec. ... 201—8
1150-14 (Ch. 478.361, A) Tel. Rec. *
1161-17 (Ch. 110.702-10) Tel. Rec. ... 205—10
1162-16 (Ch. 110.700-90) Tel. Rec. *
1162-17 (Ch. 110.700-96) Tel. Rec. *
1162-17 (Ch. 110.700-100, -104) Tel. Rec. ... 201—8
1166-17 (Ch. 478.339-B) Tel. Rec. *
1171-17 (Ch. 110.702-10, -50) Tel. Rec. ... 205—10
1172-17 (Ch. 110.700-100, -104) Tel. Rec. ... 201—8
1173-20 (Ch. 110.700-140) Tel. Rec. ... 201—8
1176-21 (Ch. 100.208) Tel. Rec. ... 165—12
1181-20 (Ch. 110.700-120) Tel. Rec. ... 201—8
1183-21 (Ch. 110.700-150) Tel. Rec. ... 201—8
1184-20 (Ch. 528.631, -1) Tel. Rec. ... 181—13
1186-21 (Ch. 100.208) Tel. Rec. ... 165—12
1188-20 (Ch. 110.700-140) Tel. Rec. ... 201—8
1191-17 (Ch. 110.700-97) Tel. Rec. *
1239 (Ch. 488.237) (See Model 237—Set 145-10)
1260 (Ch. 456.150, -2) Tel. Rec. *
1261 (Ch. 456.150-2) Tel. Rec. *
1266 (Ch. 456.150, -2) Tel. Rec. *
1268-21 (Ch. 456.150-1) Tel. Rec. *
1270-21 (Ch. 456.150-1) Tel. Rec. *
1271-21 (Ch. 456.150-1) Tel. Rec. *
1272-21 (Ch. 456.150-1) Tel. Rec. *
1273-21 (Ch. 456.150-1) Tel. Rec. *
1274-21 (Ch. 456.150-1) Tel. Rec. *
1275-21 (Ch. 456.150-1) Tel. Rec. *
1300 (Ch. 319.200), 1300-1 (Ch. 319.200-1) ... 90—10
1301 (Ch. 319.190) ... 91—11
2001, 2002 (Ch. 132.878) (See Model 1—Set 101-10)
2003, 2004, 2005, 2006 (Ch. 757.-110) ... 211—13
2007 (Ch. 757.100) ... 198—12
2009, 2010, 2011, 2012, 2013 (Ch. 132.022) ... 196—14
2014, 2015, 2016 (Ch. 132.021) ... 196—15
2022 (Ch. 132.027) ... 197—11
2023, 2024, 2025, 2026, 2027 (Ch. 132.896-1) (See Model 10—Set 144-11)
2028 (Ch. 528.230) ... 203—8
2035A (Ch. 528.195, -1, -2) ... 215—12
2041 (Ch. 528.235) ... 208—11
2041 (Ch. 528.235-1) (See Model 2041—Set 208-11)
2056 (Ch. 132.026-3) ... 207—9
2060, 2061 (Ch. 101.861, -1) ... 203—9
2063, 2064 (Ch. 101.860, -1) (See Model 1058—Set 162-11)
2100 (Ch. 110.700-100, -104) Tel. Rec. ... 201—8
2100A (Ch. 110.817-1) Tel. Rec. ... 217—15
2101 (Ch. 647.023) Tel. Rec. ... *

NOTE: PCB denotes Production Change Bulletin


no tower
less man-power...
needed to erect
telescopic masts with
WARD'S new TOWER-JACK
fast and easy
Now, WARD'S TOWER-JACK makes erecting Telescopic Masts a one man job. Just mount the antenna on the top section — and then raise it away. Each section is held firmly until secured with pin and guy-wires. WARD'S TOWER-JACK is then attached to the next succeeding sections until the mast is fully extended. Completely pre-assembled, the TOWER-JACK is easy to use . . . easy to carry from job to job. Handles any two-to-five section mast from 1½" to 2¼" in diameter. Greatest time and money saver for telescopic mast erections ever devised . . . Order your WARD TOWER-JACK today. Model TJ-1.
THE WARD PRODUCTS CORP.
DIVISION OF THE GABRIEL COMPANY
1148 Euclid Ave., Cleveland, Ohio • In Canada: Atlas Radio Co., Ltd., Toronto, Ont.
A GABRIEL PRODUCT

NOTE: PCB denotes Production Change Bulletin

NOTE: PCB denotes Production Change Bulletin

NOTE: PCB denotes Production Change Bulletin

NOTE: PCB denotes Production Change Bulletin

NOTE: PCB denotes Production Change Bulletin

NOTE: PCB denotes Production Change Bulletin

## RECORD CHANGERS

(CM-1) indicates service data also available in Howard W. Sams 1947 Record Changer Manual. (CM-2) indicates service data available in Howard W. Sams 1948 Record Changer Manual. (CM-3) indicates service data available in Howard W. Sams 1949, 1950 Record Changer Manual. (CM-4) indicates service data available in Howard W. Sams 1951, 1952 Record Changer Manual.



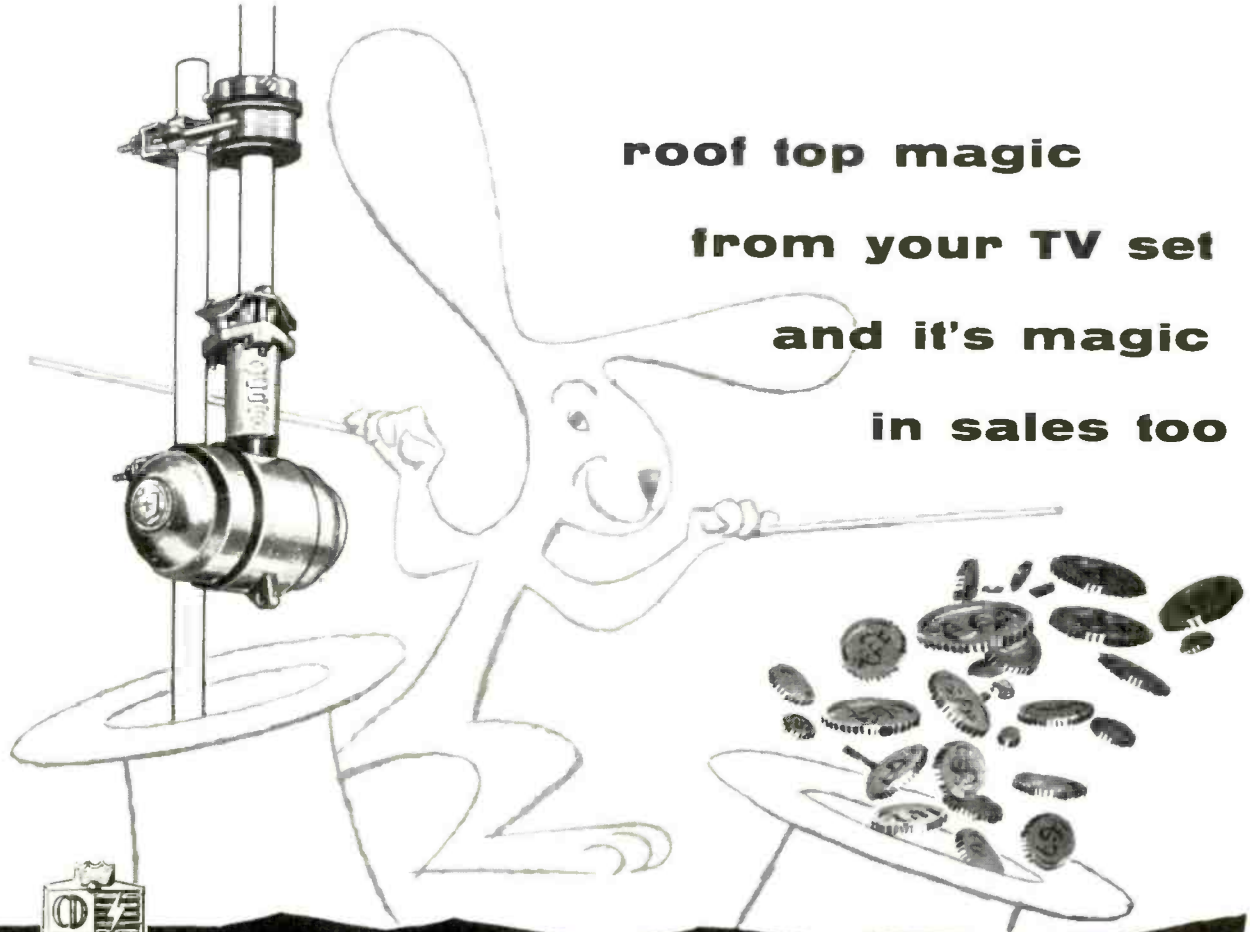
## RECORDERS





NOTE: PCB denotes Production Change Bulletin

# roof top magic from your TV set and it's magic in sales too

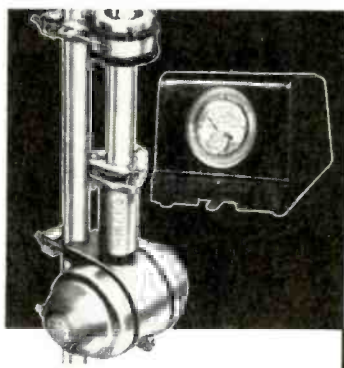


# the C★D★R Rotors

NATIONALLY PROMOTED IN TELEVISION

★ There's real MAGIC to the CDR ROTOR! The way it IMPROVES any TV picture is magic ... the way it sells ... is magic! BUT ... the real answer is quality manufacture of a proven design! That adds up to continued dependable performance ... CDR ROTORS ARE BUILT TO LAST ... built to perform under any conditions!

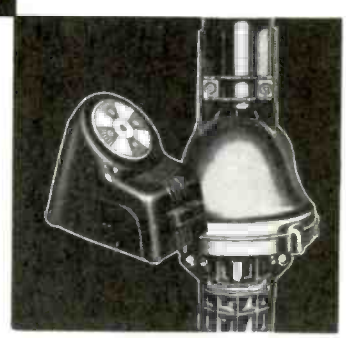
NOW ... MORE IN DEMAND THAN EVER BEFORE with the BIG consumer advertising campaign in full swing ... if you don't have your BIG CDR PROMOTION KIT with selling and advertising aids ... write us for your kit ... to help you sell EVEN MORE!



**TR-12** . . . a special combination value consisting of complete rotor including thrust bearing ... handsome modern design cabinet with meter control dial ....... $47.95

**TR-11** . . . same as TR-12 without thrust bearing $44.95

**TR-2** . . . the HEAVY DUTY rotor especially suited for special TV antenna installations. Complete rotor with "Compass Control" cabinet having illuminated "perfect pattern" dial. $49.95



THE RADIART CORPORATION
CLEVELAND 13, OHIO

THE CORNELL-DUBILIER ELECTRIC CORP.
SOUTH PLAINFIELD, N.J.

## Shop Talk
(Continued from page 7)

positioned so that the end containing the terminating resistor points directly at the receiving antenna near the house. This generally requires only an alignment by eye. The third step is the erection and orientation of the home antenna. At both installations, keep the lengths of the transmission lines as short as possible to reduce the losses.

The installation at the receiver is shown in Fig. 4. Since the input impedance of the set is 300 ohms and the input impedance of the rhombic is more than twice this, some sort of matching device must be employed between the two units. In the Huffsmith installation, the open-wire line was gradually tapered down from a 6-inch spacing to a 1-inch spacing at the receiver. This was done gradually over a distance of 15 feet.

The foregoing rhombic relay system, while designed originally for VHF use, may be employed for ultra-high frequency reception after the dimensions have been scaled down appropriately. Since the losses are higher at UHF than at VHF, poorer over-all performance may be expected. The system requires a fairly high signal level in the transmitting rhombic, and the results will be unsatisfactory in areas where the signal available to the initial receiving element is low. Finally, if you are thinking of using this idea yourself, remember how narrow the response pattern is. A hair's turn one way or the other can mean the difference between success or failure.

REVIEW. "Troubleshooting Horizontal Deflection Circuits," by Frank DeFina, Radio-Television Service Dealer, July 1953, Cowan Publishing Corp., New York, $2.00 per year.

One approach to the solution of the problem of trouble in the horizontal-deflection system is described in this article by Mr. DeFina. This is one section of the television receiver which gives the service technician more than its share of difficulty. One reason for this stems from the fact that frequently the B+ voltage which is supplied to the horizontal oscillator is obtained from the boosted B+ network. The latter voltage, in turn, depends upon the proper functioning of the oscillator. In effect then, we have a dog-chasing-its-own-tail situation; and when the boost voltage fails below its normal value, the problem is to determine whether this is caused by a defect in the oscillator or whether the trouble lies beyond the oscillator, perhaps in the horizontal-output or damper-tube circuits.

Horizontal-deflection circuits can be divided into two groups with reference to boost voltage distribution. These are:

1. Where the horizontal-oscillator, plate-supply voltage is obtained directly from the low-voltage DC power supply of the receiver.

2. Where the horizontal oscillator, among other circuits, is supplied B+ voltage from the boost circuit.

Consider the first group. A boost voltage is developed, and it is used to supply voltages to the plates of the horizontal-deflection amplifier, to the vertical amplifier, possibly to the first anode of the picture tube, and possibly to the vertical oscillator. It is not used to power the horizontal oscillator or the horizontal discharge tube, if the latter stage should exist. In this event, any decrease in the boost voltage cannot affect the deflection waveform coming into the grid of the horizontal-output amplifier. Thus, if it is found

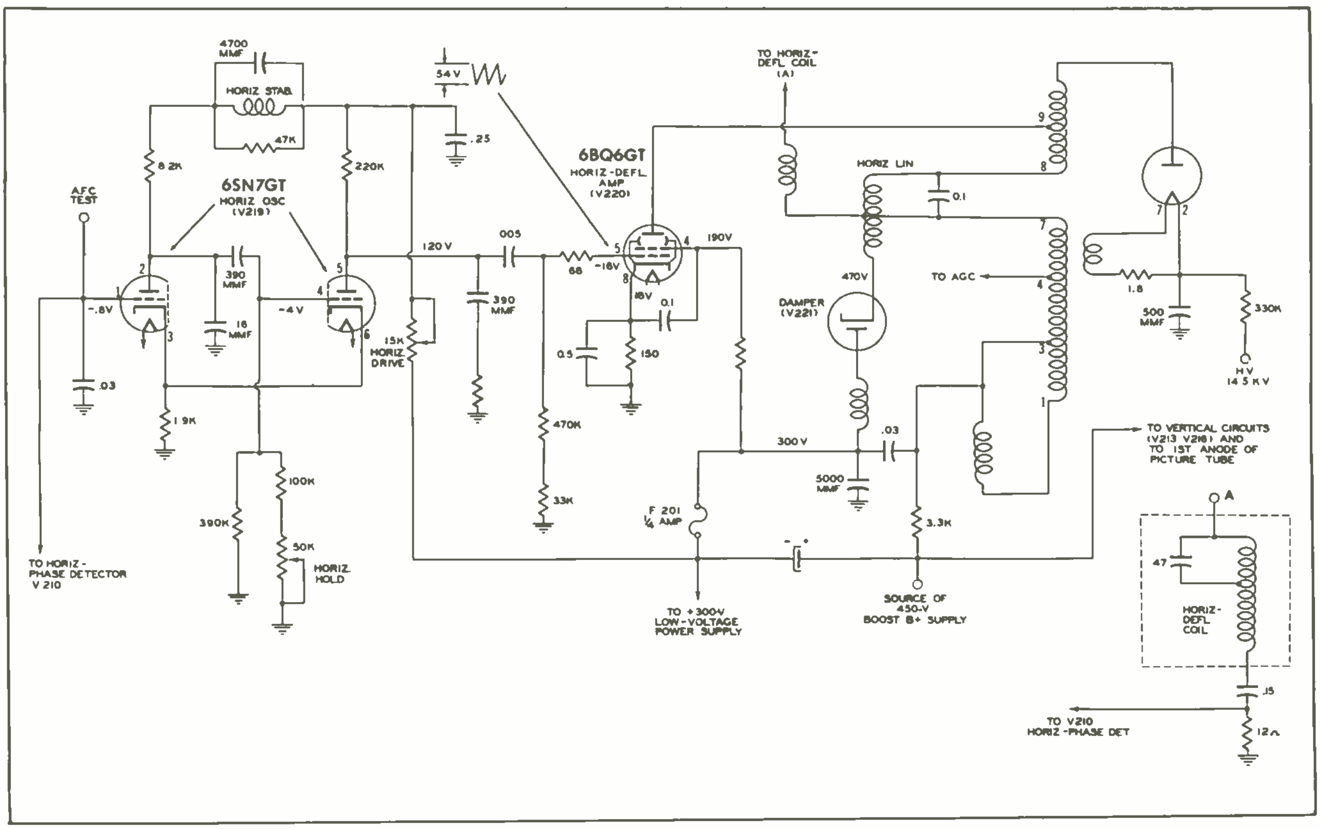
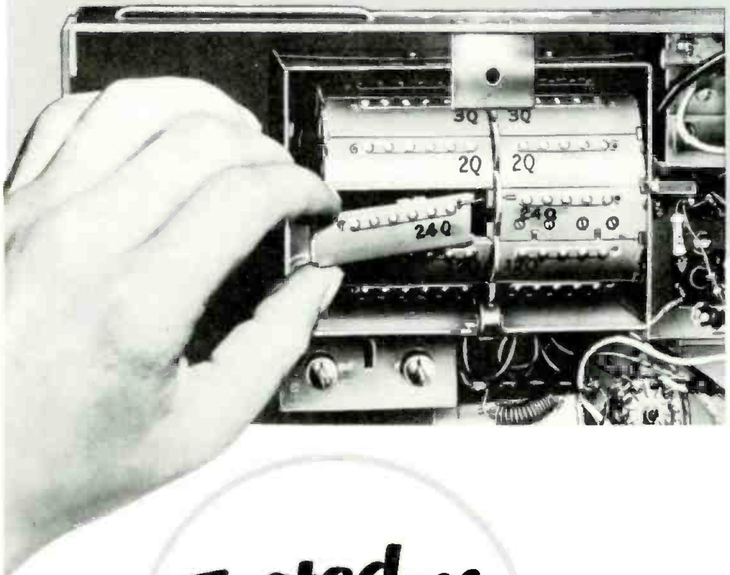



**Fig. 5. Horizontal-Deflection Circuits of Some Models of DuMont TV Receivers.**

# In the fast growing UHF market

# STANDARD UHF Strips

# bring Volume Sales!



**Now!**
**10,000,000**
STANDARD TUNERS
IN OPERATION—EACH A
PROSPECT NOW OR LATER
FOR UHF STRIPS

***Tested...***
**proven for sharp high quality UHF reception**

### Of Standard UHF strips, an independent survey concluded:

"Satisfactory results were obtained in every case. After making the necessary oscillator slug adjustment, no further adjustments were required. The units were very stable and any retuning which was required during warm-up was hardly noticeable."

### Check these Sales Building Features!

- Economy of UHF strips wins fast acceptance. The customer makes no large investment—additional UHF strips may be substituted as stations go on the air.
- Ease and simplicity of installation saves valuable time.
- Absolute, positive detent tuning—no fishing for channel. Tune UHF as easily, as perfectly as VHF.
- Adjust fine tuning smoothly, without effort.
- No outside cabinet to take up space—no adjustments, wires or extra parts of any sort.

**IN TV IT'S STANDARD**

*Standard*
COIL PRODUCTS CO. INC.
CHICAGO · LOS ANGELES · BANGOR, MICH.

**Send for this brochure Today—FREE!**

Get more facts on how to order UHF strips, how to install. Write Standard Coil Products Co., Inc., 2085 N. Hawthorne Ave., Melrose Park, Ill.

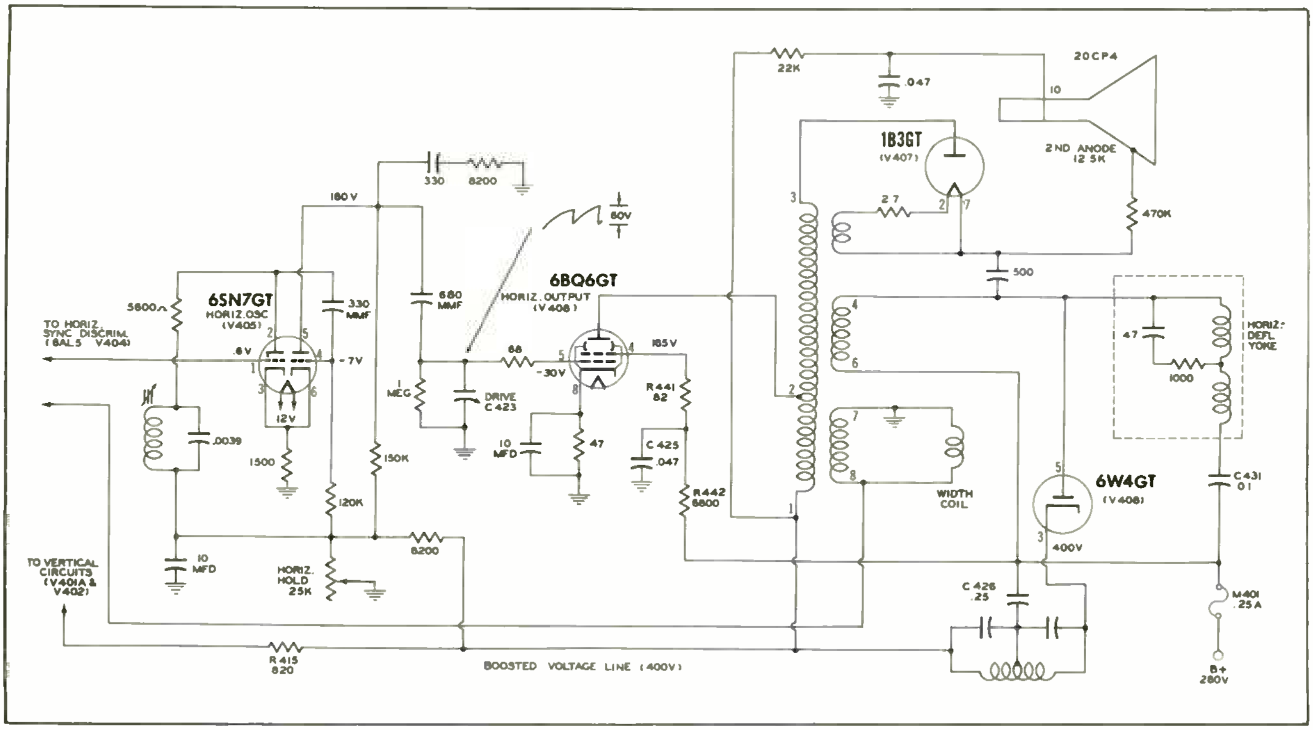



**Fig. 6. The Horizontal-Deflection Circuits of an Admiral Model 21F1 Receiver.**

that the boost voltage is below normal, then one of the first steps after tube testing or substitution would be to check the wave shape and amplitude at the grid of the horizontal-output amplifier. If these prove to be all right, you know that the trouble must lie in the horizontal-output stage or in the damper stage. On the other hand, if the waveform or its amplitude are not what they should be at the grid of the output amplifier, then the place to seek the defect is in the circuits that precede the output amplifier.

An example of a receiver that falls within the first category is shown in Fig. 5. This is a Du Mont Model 17T350 receiver. The horizontal oscillator (this is the tube marked V219) receives its plate voltage from the 300-volt terminal of the low-voltage power supply. Boost voltage (here 450 volts) is applied to the plate of V220, the horizontal-deflection amplifier; to V213 and V216 in the vertical circuit; and to the first anode of the picture tube.

In the event that the high voltage is low (leading to no raster, to a dim raster, or to blooming) or if the boost voltage is below normal, then the various tubes in the horizontal section should be checked. If they are found to be good, the next test would be made at the grid of the output amplifier. A negative bias value of 16 volts should be present at this grid, together with a deflection wave amplitude of 54 volts peak to peak. If measurements indicate that trouble is located ahead of V220, disconnect the plate and screen voltages of V220, (to prevent possible damage to the tube due to excessive current flow); then confine your search to the circuits of V219).

The fact that the boost voltage is not used to power the stages prior to the output amplifier leads to a straightforward service approach. Consider, however, the second class of receivers. In these a low boost voltage can stem either from insufficient drive to the horizontal-output amplifier or can be caused by some defect beyond the output amplifier. Insufficient drive does not necessarily mean that there is trouble in the horizontal oscillator; it may very well be due to the fact that low boost voltage is being applied to the oscillator stage in the first place.

In such situations, the use of an auxiliary supply designed to take the place of the boost voltage of the receiver is suggested. The argument is this. Since we do not know in these interrelated circuits whether it is the low boost voltage or the oscillator circuit itself that is causing insufficient grid drive, let us remove one of the variables by bringing in a supply which is independent of the receiver operation.

The method of doing this is as follows. Take a variable DC power supply, and connect it in series with the low-voltage power supply of the receiver. That is, the negative terminal of the variable supply connects to the positive terminal of the receiver supply which then becomes the positive terminal of the boost voltage. Thus the variable supply is furnishing that portion of the boost voltage which is normally supplied by the boost circuits. Since the B-terminal of variable supply is not grounded, it is a good precaution to mount this unit on a wooden board. If the supply is mounted on a metal chassis, be careful not to touch the chassis, since this will be positive by an amount equal to the output of the low-voltage power supply of the receiver.

There are many types of variable DC power supplies, and the choice is left to the reader.* The author used two types, one of which produced DC voltages variable from 70 to 250 volts at a current rating of approximately 50 ma. Because of the low-current rating, this supply is useful only when the boost voltage is to be applied to the horizontal-oscillator circuit alone. It cannot be applied directly to other circuits because of the heavier current requirement.

The second variable-voltage DC power supply used was capable of providing 60 to 300 volts at a current drain of 200 ma. This unit could

*Articles describing suitable supplies have appeared in various radio and television magazines from time to time. A variable DC-power-supply kit is also being marketed.


*Presenting*

# "RECTIFIER RED"

***the new product-line color for***

# *Federal*

## MINIATURE SELENIUM RECTIFIERS

FEDERAL—the *original* miniature—is saying goodbye to *gray*. The new bloom is *"Rectifier Red"* . . . a striking color that instantly tells servicemen they're getting the rectifier efficiency and long life that created tens of millions of profit opportunities for radio-TV servicing . . . tells them they're getting the *quality* that keeps Federal miniatures the best-seller in America's vast and growing rectifier replacement market!

Look for *"Rectifier Red"*. . . get the performance that *clicks* . . . the replacement profit that *sticks*! See your Federal Distributor for Federal miniatures in handy 8-unit kits . . . in quantity lots . . . or in individual packages sold through Federal's self-service rectifier dispenser . . . on hundreds of counters! See *your* "FTR" Distributor now, or write to Dept. F-7118.

***"America's first and largest manufacturer of selenium rectifiers"***

***Federal***

***Telephone and Radio Company***

100 KINGSLAND ROAD, CLIFTON, N. J.

*In Canada:* Federal Electric Manufacturing Company, Ltd., Montreal, P. Q.
*Export Distributors:* International Standard Electric Corp., 67 Broad St., N. Y.

be substituted directly for the boost voltage supply not only to the horizontal oscillator but to the output amplifier as well. It is claimed that the first supply will suffice for most work but that the second heavier unit is best for all-round use.

As an illustration of how the auxiliary supply is used, assume that an Admiral Model 21F1 series receiver exhibited no raster but that the sound was normal. Fig. 6 shows the horizontal-deflection circuits of this receiver. The boost voltage measured 260 volts instead of the normal 400 volts. All tubes in the horizontal-deflection system were checked, and all were found to be good. The trouble then had to be elsewhere in this system, and the following procedure was employed to find the defect.

The picture-tube socket was pulled off the picture-tube base, and the high-voltage lead was disconnected from the side of the tube. No high voltage was present on the high-voltage lead, and the boost voltage remained at 260 volts.

With the set off, the 6BQ6GT tube, the 1B3GT rectifier, and the 6W4GT damper were removed from their sockets. This action completely inactivated the horizontal-output section. In addition, one end of resistor R415 was lifted so that any possible defects in the vertical-oscillator circuit or vertical-output circuit would not affect the boost voltage.

The next step was to develop artificially a boost voltage that could be used by the horizontal oscillator. The negative ungrounded terminal of the variable-voltage power supply was connected to the fuse M401 which is in the B+ line of the receiver. The positive terminal of the ungrounded variable-voltage power supply was then connected to pin No. 3 of the 6W4GT damper-tube socket with the tube still removed. This placed the variable-voltage power supply effectively in series with the B+ supply of the receiver. Both the set and the variable power supply were turned on. The voltage from fuse to ground was about 280 volts, which is normal, and the variable supply was adjusted to add 120 volts to it so that the voltage from pin No. 3 of the 6W4GT socket to ground was 400 volts.

A scope was connected from pin No. 5 of V406 to ground and showed a peak-to-peak voltage of 70 volts available for the grid drive. This indicated that the horizontal oscillator would be operative if the proper boost voltage were supplied to it.

Had the peak-to-peak drive voltage been about 40 volts or less, troubleshooting of the horizontal-oscillator circuit from pin No. 1 of V405 to pin No. 5 of V406 would have been in order.

R415 was reconnected, and the boost voltage dropped very slightly because of the added current drain of the vertical circuit. The scope pattern still retained the same peak-to-peak value.

Thus far, we have eliminated the horizontal-oscillator circuit and the vertical system as possible sources of trouble. The defect, then may exist in the horizontal-output circuit from V406 to the deflection yoke. This leaves in this circuit the horizontal-output transformer, the deflection yoke, the width coil, the linearity coil, and several resistors and capacitors. (Tubes were checked previously.) The resistors and capacitors can be checked by measurement or substitution. The width coil can be removed from the circuit by unsoldering one end. The linearity coil will not cause the symptoms noted unless it is open, and this can be readily determined. Resistance measurement of the horizontal-deflection yoke will often reveal its condition. However, any doubt can be eliminated by substituting another unit known to be good.

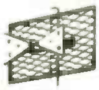
If none of the foregoing tests disclose the trouble, then attention can be directed to the output transformer. Resistance measurements may sometimes be useful in revealing a defective transformer, but a reading that appears to be normal is not conclusive proof that the unit is not defective. When all other possibilities have been exhausted, substitution is the best manner of checking.

In the present case history, it turned out (according to Mr. DeFina) that the horizontal and vertical winding of the yoke had somehow been interchanged, which is certainly not a common trouble. This would be discovered by a resistance measurement, as indicated in the foregoing. The trouble is actually unimportant in this case; what is important is the approach which is used to locate the trouble. With the auxiliary-power-supply method, the service technician can positively determine whether the cause for a low boost voltage stems from a defect ahead of or after the grid of the horizontal-output amplifier.

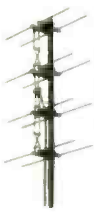
Milton S. Kiver

# 15 reasons why VEE-D-X IS YOUR BEST CHOICE

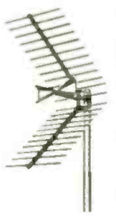
## UHF ANTENNAS



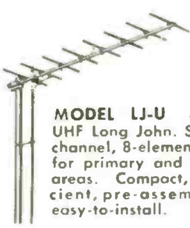
**MODEL BT-U** — The aristocrat of Bow-Tie antennas. Superior in both construction and performance. Can be stacked for extra gain. Compare!



**MODEL CA-U** — Famous Co-linear that has highest gain of all broad band fringe area UHF antennas. Also available in Dual Jr. models for specific area requirements.



**MODEL COR-U** — The Corner Reflector has 40% higher gain than a single Bow-Tie. Finest construction with rugged Fiberglas boom and solid aluminum elements. Minimizes probing.



**MODEL LJ-U** — The UHF Long John. Single-channel, 8-element yagi for primary and fringe areas. Compact, efficient, pre-assembled, easy-to-install.

**MODEL LLJ-U** —The most powerful of all single channel UHF antennas. Has rugged Fiberglas boom and solid aluminum elements.

**MODEL UQT** — Famous Ultra Q-Tee all-channel (2-83) UHF-VHF antenna. Has printed circuit filters — ideal for primary areas.

*Lic. A.A.K. Pats. 2,422,458; 2,282,292; 2,611,086; others pending.

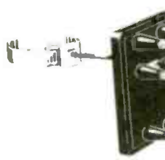
3 NEW IMPROVED MODELS OF THE FAMOUS

## VEE-D-X MIGHTY MATCH

**Finest Most Efficient Cross-over Network Filters Ever Perfected**

**NEW MM-40**—(Yellow case) (For combining separate UHF and VHF antennas to a single transmission line.) New, more efficient patented* printed circuit. Amazingly low insertion loss. New type terminals. New moisture-resistant case.

**NEW MM-40A** — The ideal single line termination filter for use at set or converter having separate terminals for UHF and VHF. Patented* printed circuit.



**NEW MM-25** (green case) — Permits the use of a single transmission line between separate high and low channel VHF antennas. New improved patented* printed circuit. Amazingly low insertion loss. New type terminals. New moisture-resistant case.

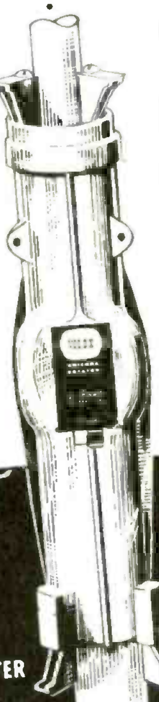
## VEE-D-X tra Special

the one and only all-channel yagi

### Model SP

**HIGH GAIN FRONT-TO-BACK DIRECTIVITY**

Think of it — all the desirable features of a yagi — yet with all-channel performance in a single, easy-to-install antenna. Technically, the VEE-D-X-tra Special is a 9-element hi-low yagi (5-elements on high channel — 4 on low) "T" matched. The hi-low sections are phased together with a new isolation filter MM-25. The ideal antenna for all-channel power—for directivity—and for eliminating interference from unwanted stations. A honey for use with VEE-D-X Rotator.



## NEW VEE-D-X UNIVERSAL LIGHTNING ARRESTER

**For UHF — VHF — AM — FM**
***Takes all popular transmission lines flat tubular oval round open wire***

**MODEL ULA is the finest, most efficient lightning arrester ever perfected. Completely eliminates the need for separate lightning arresters for each type of transmission line. This one arrester takes 'em all. Compact, clean-cut, inexpensive and employs newly developed printed circuits. It literally obsoletes all other lightning arresters.**

## NEW VEE-D-X ANTENNA ROTATOR

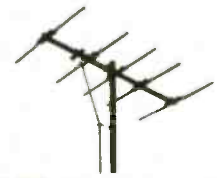
**Acclaimed the finest in design, construction and performance. Clean-cut, in-line styling. Fast and easy to install. Beautifully styled Control Console operates with convenient downward pressure. Choice of two colors.**


### FREE

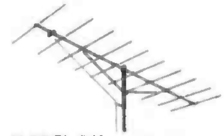
***Write for your copy of this complete new 36 page pocket guide to the world's finest antenna systems.***

## VHF ANTENNAS

**MODEL JC** — For the most powerful single channel performance. A popular 5-element yagi. Easy-to-install.

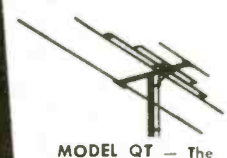


**MODEL DC** — The famous VEE-D-X low cost 5-element yagi with original VEE-D-X Delta Match construction.



**MODEL DX** — The famous economy super power yagi. Has 30% higher gain on high channels than any other 10-element yagi. Delta Match and boom braced.

**NEW BROAD BAND YAGIS** — Finest of all. Available in both 10-element "X" series and 5-6 element "V" series, each in 3 cuttings, cover entire VHF channel range.



**MODEL QT** — The brilliant Q-Tee all-channel VHF antenna with patented* printed circuit channel separators. New improved construction and performance. Can be stacked for additional gain.

*La Pointe*

**ELECTRONICS INC.**

DEPT. PF12, ROCKVILLE, CONN.

**UHF Field Survey**
(Continued from page 17)

times at a distance of 10 to 15 miles or even more from the transmitter tower. What is oftentimes considered satisfactory performance under these conditions is far from optimum, and an external antenna would provide a marked improvement in the quality of the picture received. When making a UHF installation for a receiver which has been operating under these conditions, it might be well to consider the advisability of using a VHF-UHF antenna. With this arrangement, UHF reception can be provided as well as an improvement in VHF reception.

We next selected a site a few miles southwest of position 2. This location, which is designated as position 3 on the map, is approximately the same distance from the transmitter tower as position 2. It was also pointed out to us that there is only a difference of a few feet in elevation between the two positions.

The test site at position 3 can be seen in Fig. 1E. Notice the background of trees which are about 30 feet in height and which therefore affected our readings only at the lower antenna elevations. It is probable that this accounted for the greater increase in signal strength which we obtained above the 29-foot level. The readings which were recorded are shown graphically in Fig. 8. A stacked bow tie was used at this position. The minimum reading at the 24-foot level was 175, while the 57-foot elevation produced a reading of 420. As was expected, a nearly linear rise in signal strength occurred as we increased the antenna height. There is a very slight dip in the graph, however, beginning at the 42-foot level.

By referring again to the graph of Fig. 6, note that the readings obtained at Virginia Beach (position 2) with the same stacked bow-tie antenna were considerably lower. As a matter of fact, the maximum reading obtained there was less than the minimum reading at position 3. After checking the terrain between the transmitter tower and each of these test sites, we concluded that they were very nearly the same with the exception of the greater number of tall trees, particularly pine trees, that lie between the transmitter tower and position 2. These then must have contributed to the greater signal loss experienced at position 2.

One might ask, "What does this specific case have to do with the average installation?" On the surface it would seem that it is a special case, but similar conditions are very apt to be present at any installation point. Keep in mind that the distance from the transmitter cannot be used conclusively as a guide for selecting an antenna, since the actual signal strength may vary according to the surrounding terrain. The tests performed at positions 2 and 3 show this quite well.

Next we selected a site in Great Bridge, Virginia, which placed the city of Norfolk between the test point and the transmitting tower. This location is identified by the position numbers 4 and 5 on the map of Fig. 2 and is approximately 25 miles from the transmitter.

Again we used a stacked bow tie for making our measurements. Thus our readings can be compared directly with those obtained at positions 2 and 3 using the same antenna. The location of position 4, where our first test at Great Bridge was made, is pictured in Fig. 1C. The camera was pointed in the direction of the transmitting tower when this photograph was taken. Our purpose in making this particular test was to see what effect the extremely tall trees would have on UHF reception. As can be seen in Fig. 1C, the trees and foliage are quite dense. There are many trees in excess of 80 feet in height. The trailer was placed so that our tower was only a few feet from and directly behind one of the trees. The graph in Fig. 9 shows the results of the tests at this position. Note the extremely low signal level that was present up to the 49-1/2-foot level. At this point, there was a sudden increase in signal pickup as the antenna height was increased. This sudden rise occurred after the antenna was raised above the nearby tree. Should a similar situation exist in an actual installation, it would be wise to select a point that is not shielded by the tree or mount the antenna sufficiently high to clear it. The rise and fall of the meter was very noticeable as the antenna passed near the limbs extending from the tree. If the antenna were mounted permanently, movement of the limbs would cause a fluctuating signal. This, of course, is to be avoided whenever possible.

We then moved our test unit about 50 feet to the northeast (position 5) where we could pick up the signal without having it pass through the tall trees which were present at our previous position.

Photograph G in Fig. 1 shows a view of the new position as seen when looking in the direction of the transmitter. Again we raised the stacked bow-tie antenna in the air and obtained a series of readings which are graphically presented in Fig. 9. Notice that although the pattern has a number of dips, it is

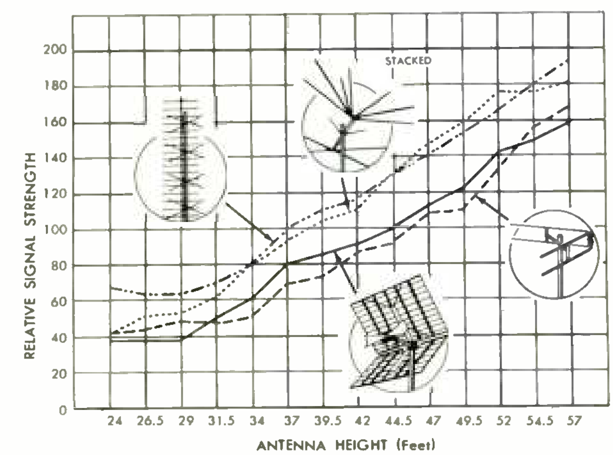



**Fig. 7. Vertical Field-Strength Patterns of Several Antennas Tested at Position 2 (Virginia Beach).**

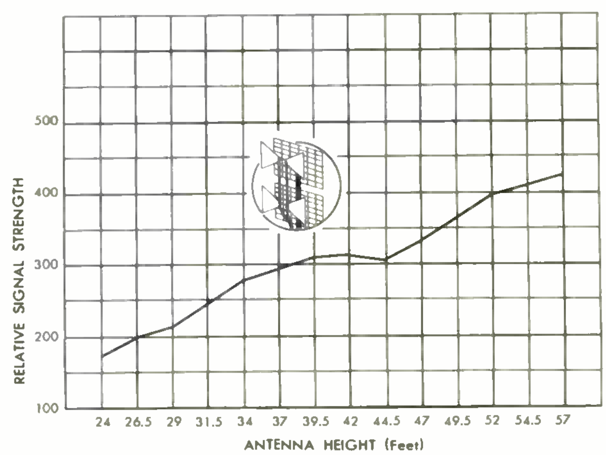



**Fig. 8. Vertical Field-Strength Pattern at Position 3 (Oceana).**

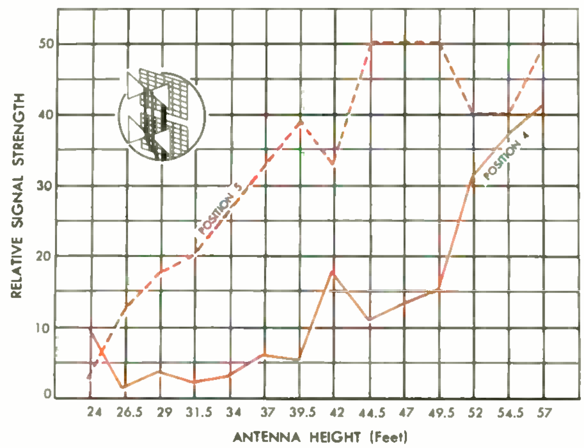



**Fig. 9. Comparison of Field-Strength Patterns Illustrating the Effect of Dense Foliage on a UHF Signal.**

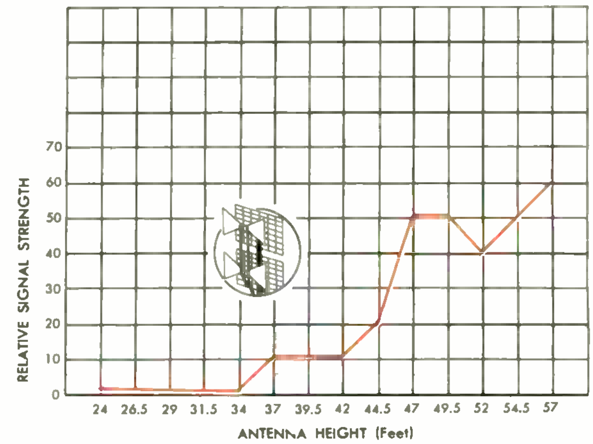



**Fig. 10. Vertical Field-Strength Pattern at Position 6 (Elizabeth City).**

considerably better at lower elevations than the pattern secured at position 4. The tests at positions 4 and 5 substantiated the observations which we had made at Pinewell (position 1) concerning the adverse effect which dense trees have upon a UHF signal.

In order to study the conditions in the fringe area served by the UHF station, we journeyed to Elizabeth City, North Carolina, which is approximately 46 miles from the transmitter. Position 6 marks this location on the map of Fig. 2. We set up the tower in relatively open terrain, and tried various antennas. The pictures which we secured, even with high-gain antennas, were very snowy and could not be considered satisfactory. In order to get a perceptible indication of field strength we were obliged to use a more sensitive instrument than the unit which we had employed up to that time. Consequently, the relative figures of field strength which appear on the graph of Fig. 10 should not be compared to readings on the other graphs in this report. Fig. 10 does show, however, that an elevation of 34 feet above the ground was necessary before a measurable signal was received.

Delving for a possible explanation of why the signal was poorer than we had anticipated it would be, we consulted a map of the area. We noticed that a considerable portion of the L-shaped Dismal Swamp lies between Elizabeth City and Norfolk. See Fig. 2. This geographical feature may be partly responsible for the low signal strength at Elizabeth City. The thick overgrowth of vegetation, the large trees, and the generally wet conditions in the swamp may all be contributing factors, particularly when their effects on UHF signals are considered.

We moved on to test position 7 which is marked on the map of Fig. 2 about three miles north of South Mills. A view of this position can be seen in Fig. 1A. The signal strength proved to be somewhat higher than it was at Elizabeth City (position 6). The graph of Fig. 11 shows the results obtained with two antennas, our standard stacked bow tie and a four-bay conical with reflector. A distinct vertical pattern is evident from the graph. It seems probable that this pattern resulted from the canceling and supporting effects of a reflected signal.

Test position 8 was established at a point approximately 30 miles from the transmitter. At this position we noticed a sharp rise in signal strength over that which we had found at the two previous positions. We attributed this development to the fact that the major portion of the swamp was to the south and west of our position and to the fact that the land between us and the transmitter site was dry and level for the most part. Fig. 12 shows the results of a series of measurements which we made using the stacked bow-tie antenna. Notice the nearly linear rise in signal strength with increase in antenna height. Observe also that a reading of 80, which we have established as the minimum field strength

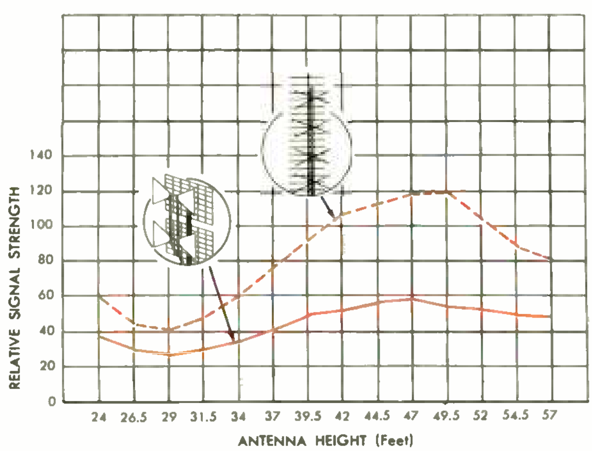



**Fig. 11. Vertical Field-Strength Patterns at Position 7 (South Mills).**

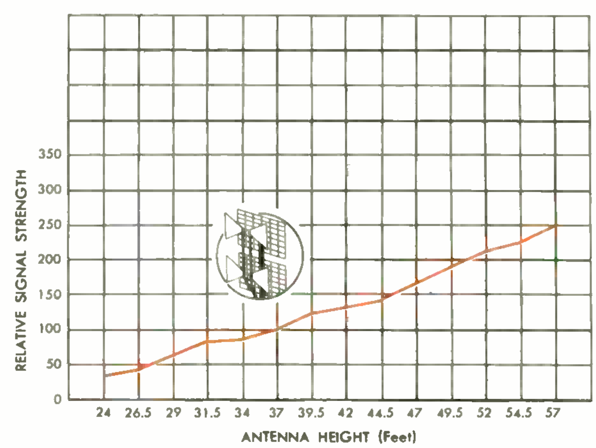



**Fig. 12. Vertical Field-Strength Pattern at Position 8.**

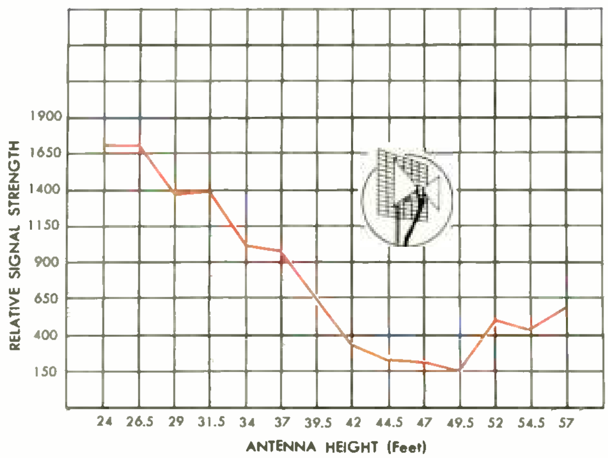



**Fig. 13. Vertical Field-Strength Pattern at Position 9 (End of Willoughby Spit).**

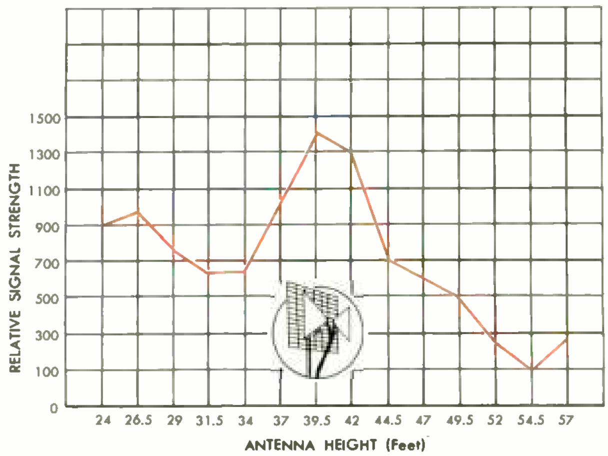



**Fig. 15. Vertical Field-Strength Pattern at Position 10.**

for a satisfactory picture, was reached at a height of 31 1/2 feet. A maximum reading of 250 was noted at the 57-foot level.

The Norfolk area offered our field crew an opportunity to check UHF reception where the signal path is entirely over water. We chose three test positions along the shore of Chesapeake Bay for this study. These locations are indicated on the map of Fig. 2 as positions 9, 10, and 11. Position 9 was established at the very tip of what is known as Willoughby Spit, a narrow peninsula five miles south of the transmitter site. The body of water across which the signal must travel can be seen by looking at the map of Fig. 2. A single bow-tie antenna with reflector was employed at this point as well as at the other positions along the bay shore. The signal strength was very high at position 9, as indicated by the graph of Fig. 13. Moreover, a remarkable variation in signal level was observed when the antenna was raised. Instead of a signal increase with greater height, we found that the maximum signal was received at the lowest tower height. The readings dropped off as the tower was elevated until at the 49-1/2-foot point they reached a minimum value. It is probable that this phenomenon was produced by the canceling and supporting effects of signals which followed reflected paths from the surface of the water.

A special test was conducted at position 9. We connected a short length of lead-in to the single bow-tie antenna and held the antenna aloft by hand. The graph in Fig. 14 shows the results of measurements taken at antenna elevations that were from 2 to 9 feet. Note that a relative field-strength reading of 4,000 was obtained with the antenna 9 feet above the ground! It would seem then that a very simple antenna installation could be employed at a location of this kind. Very possibly an antenna mounted below roof level would provide more signal pickup than one on a mast above the house.

At position 10, a large two-story house was situated between the trailer tower and the transmitter site. Fig. 16, a picture taken in the direction of the transmitter, shows this building. The obstruction presented by the house may have influenced the measurements taken at position 10. Fig. 15 is a graph of the readings which were obtained with the single bow-tie antenna. Again the rise and fall of signal strength with antenna height indicate the presence of water-reflected signals.

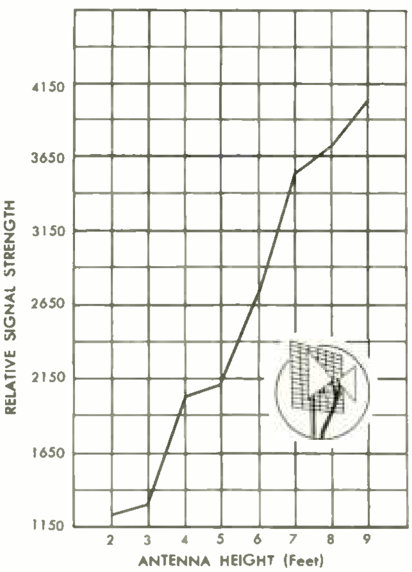



**Fig. 14. Field Strength at Low Antenna Elevations (Position 9).**


**Fig. 16. Test Position 10 as Viewed in the Direction of the Transmitter.**

# UNSURPASSED

-audio fidelity

-furniture beauty

## NEW V-M tri-O-matic® 555

### HIGH FIDELITY PHONOGRAPH

**These V-M 555 features are PROOF of QUALITY**

■ THREE 5" matched ultra-wide range speakers with heavy duty Alnico 5 magnets. ■ 50 to 12,000 c.p.s. response from special, ceramic all-weather "flip-under" cartridge with 2 new type **SAPPHIRE NEEDLES.** ■ Exclusive, resonance-free aluminum **DIE CAST TONE ARM.** ■ **4 TUBE PERFORMANCE** from 3 tube (plus rectifier) amplifier with push-pull output and dual purpose tube. ■ **NEGATIVE CATHODE** feed back circuit minimizes intermodulation distortion. ■ **FULL RANGE CONTROL** with conveniently located tone and volume controls. ■ Free 12" LP Demonstration Record. **WORLD FAMOUS V-M CHANGER** eliminates record holders that grip the grooves, records **LOWERED** (not dropped) to spindle shelf. Siesta Switch automatically shuts off everything (amplifier too) after last record plays. **TWO FURNITURE FINISHES,** mahogany or limed oak. Handsome modern design, finest quality construction.


UL Approved

Look for the

MADE BY V-M CORPORATION,
BENTON HARBOR 7, MICHIGAN
world's largest manufacturer of phonographs and record changers exclusively.

---

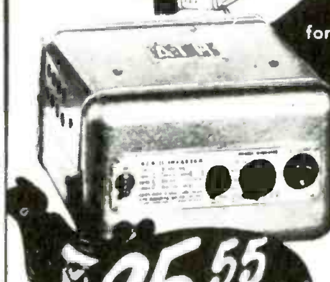
*Attention!!* • EXECUTIVES • SALESMEN • PUBLIC OFFICIALS • POLICEMEN • FIREMEN • OUTDOOR MEN REPORTERS • FIELD INSPECTORS • DOCTORS • LAWYERS, ETC.

# DICTATE IN YOUR CAR

*with* **ATR**

## INVERTERS

for changing your battery current to A.C. *Household* CURRENT *Anywhere* .... in your own car!!



**ATR INVERTERS** . . . especially designed for operating standard 110 volt A.C. Tape Recorders, Wire Recorders, Dictating Machines and Electric Razors IN YOUR CAR.

$25.55 AND UP

EASY TO INSTALL

EASY TO OPERATE

There is an **ATR INVERTER** for most applications for Inverting D.C. Voltages (ranging from 6 volts D.C. to 220 volts D.C.) to 110 volts A.C. . . . Specially Designed for operating A.C. Radios, Tape Recorders, Wire Recorders, Dictating Machines, Electric Razors, Record-Changers, Television Sets, Amplifiers, Address Systems, Radio Test Equipment and most small electrical and electronic devices FROM D.C. VOLTAGES IN AUTOMOBILES, BUSES, TRUCKS, SHIPS, TRAINS, PLANES AND IN D.C. DISTRICTS.

*Additional information available upon request.*

**FREE !! ATR INVERTER!**
. . . given away every 30 days to lucky registrant of preceding month. Mail a postcard as your registration request today!

**A VALUABLE TIME SAVER FOR:**

- **TRAVELLING SALESMEN**—Dictate reports in your own car. Send your dictated reports in daily to your home office or sales manager.
- **FIELD INSPECTORS & INVESTIGATORS**—Dictate your field inspection reports in the field—on the spot. Give the complete story factually and completely. Include your clients recordings also.
- **DOCTORS**—Dictate and record your house calls on the completion of your call while everything is fresh in your mind. Have these records for transcription by your office girl.
- **LAWYERS**—Record evidence in the field at your client's premises. Obtain factual and complete witness reports, etc.
- **EXECUTIVES**—Dictate in your car all business matters while on trips for pleasure or business.
- **PUBLIC OFFICIALS**—Dictate complete field reports in your car. Obtain recorded opinions and expressions of Mr. Public in the field. Dictate your business reports while traveling.
- **POLICE SQUAD CARS**—Dictate accident reports right on the scene complete and factual. Include witness recordings at the same time. Have the complete story available by dictation.
- **FIRE TRUCKS**—Dictate your fire reports factually and complete on the scene and include witness reports. Have the complete story.
- **AMBULANCES**—Dictate complete reports of your ambulance run. Include witness recordings, etc.
- **ADVERTISING AGENCIES**—Use AC operated animated or illuminated displays in or on the car.
- **FISHERMEN & HUNTERS**—Use your electric razor on camping trips, operating in your car. Also small home radios and other electrical or electronic items.
- **CAMPERS**—Make your camping and outing trips more exciting using mix-masters, tape recorders or wire recorders operating from your car battery.
- **WAREHOUSE & MATERIAL HANDLERS**—Dictate your inventory and material handling reports on the scene, in the warehouse, yard, or wherever you may be.

| TYPE | Input DC Volts | AC Output 60 Cycles | Output Wattage Intermittent | Output Wattage Continuous | List Price | RECOMMENDED APPLICATIONS |
|---|---|---|---|---|---|---|
| 6-LIF<br>12-LIF | 6<br>12 | 110 volts<br>110 volts | 40<br>50 | 35<br>35 | $25.55<br>25.55 | For operating small flea-power AC motors, electric razors, small radios and small portable dictating machines having wattage consumption less than 35 watts. |
| 6-RSD<br>12-RSD | 6<br>12 | 110 volts<br>110 volts | 85<br>125 | 75<br>100 | 39.25<br>39.25 | Recommended for operating small AC motors, Radio Sets, PA Systems, Amplifiers, and Radio Test Equipment having input wattage consumption within continuous output wattage ratings indicated. |
| 6-ISQ-F<br>12-ISQ-F | 6<br>12 | 110 volts<br>110 volts | 85<br>125 | 75<br>100 | 49.95<br>49.95 | Especially recommended for operating dictating machines, wire recorders, tape recorders, and small AC motors and electronic or electrical apparatus having input wattage consumption within continuous output wattage ratings indicated. |
| 6T-HSG<br>12T-HSG | 6<br>12 | 110 volts<br>110 volts | 175<br>250 | 150<br>200 | 96.45<br>96.45 | For operating large tape recorders, wire recorders, PA Systems, amplifiers, and small TV sets having input wattage consumption within the continuous output wattage ratings indicated. |

*See your jobber or write factory* ✓ NEW MODELS ✓ NEW DESIGNS ✓ NEW LITERATURE

"A" Battery Eliminators, DC-AC Inverters, Auto Radio Vibrators

**ATR AMERICAN TELEVISION & RADIO Co.**
*Quality Products Since 1931*
SAINT PAUL 1, MINNESOTA—U. S. A.

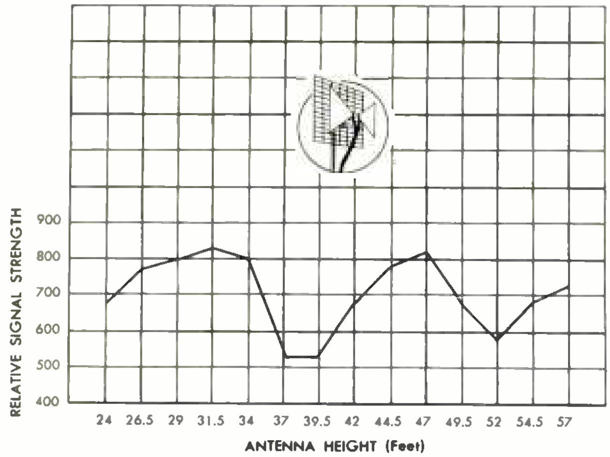



**Fig. 17. Vertical Field-Strength Pattern at Position 11.**

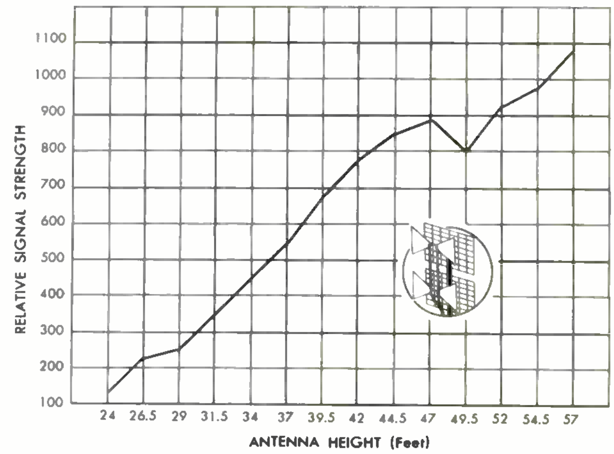



**Fig. 18. Vertical Field-Strength Pattern at Position 12.**

The third test position in this series (position 11) was established at Lyn Haven, a point along the shore approximately 14 miles from the transmitter. See the map in Fig. 2. The graph of readings obtained at this position is presented in Fig. 17. It is interesting to compare this graph with the readings made at position 10 (Fig. 15). Notice that the variation of signal strength at position 11 produces two maximum points and two minimum points; whereas, that at position 10 follows a slower and stronger cycle. This is due to the different distances from the transmitter at the two places. Besides, the two-story house at position 10 required about a 40-foot antenna elevation before the signal variation became uniform, while the signal at position 11 rose and fell regularly from the lowest tower height on up.

The final series of test positions were set up at various places in and near the city of Norfolk. Position 12 was established near the heart of the city in a district of apartment houses. The court of a private garage was selected for the test site. The buildings which surround this court are quite high, and we expected difficulty from their proximity. However, the graph of readings in Fig. 18 shows that the signal rose sharply with antenna height except for a dip at the 49 1/2 foot level. It would appear then that even in a congested area such as this a strong UHF signal may be secured with proper antenna positioning.

Position 13 was established farther out in a suburban residential area. This area is approximately 15 miles from the transmitter, and the signal path is over a considerable portion of eastern Norfolk. A single bow tie with reflector was used at this position, and the test results are graphically presented in Fig. 19. Compare this graph with Fig. 17, which is the result of a test with the same antenna at Lyn Haven (position 11) along the bay shore. The distance to the transmitter site is approximately equal from each location. In one case, however, the signal path is over water; and in the other, it is over land for the most part. The signal was noticeably weaker at position 13, and height was necessary for maximum signal reception.

At a point approximately 18 miles from the transmitter, test position 14 was established. See the map in Fig. 2. Four different antennas were checked at this location, and the results of these measurements are charted in Fig. 20. Notice the way in which the signal strength rises with antenna elevation up to about 35 feet. Above 35 feet the signal strength fluctuates in a manner indicating the presence of ground reflections. The graph shows that the stacked bow tie and the stacked conical performed in very nearly the same manner. Performance ratings on channels higher in the UHF spectrum cannot be assumed from the results of this one test.

The final test position in the Norfolk survey was conducted at a point in southern Norfolk about 17 miles from the transmitter. Fig. 1B

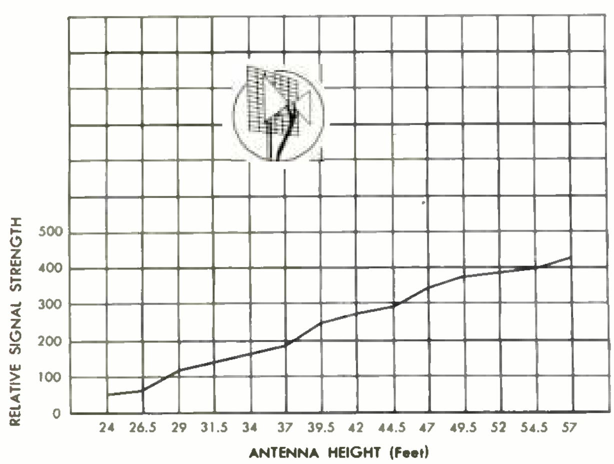



**Fig. 19. Vertical Field-Strength Pattern at Position 13.**

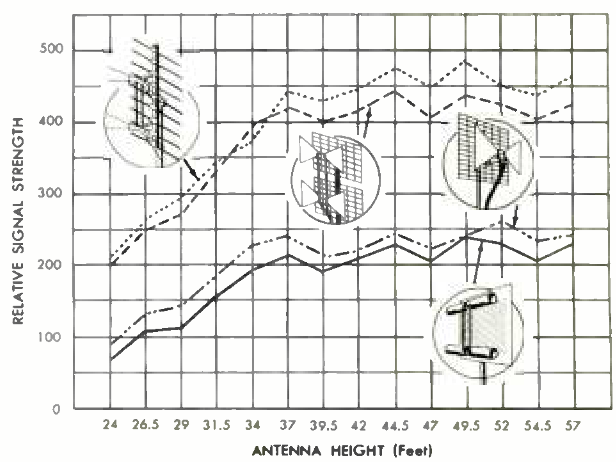



**Fig. 20. Vertical Field-Strength Patterns at Position 14.**

is a photograph taken at this spot. On the map of Fig. 2, it is indicated as position 15. We put up a stacked bow-tie antenna and took a series of measurements which are shown on the graph of Fig. 21. The signal strength increased in a linear fashion with antenna height, and the picture which was received was very satisfactory.

We found from our study of conditions in Norfolk that in many cases where poor reception was being blamed on low field strength of the signal the fault actually rested in the antenna installations themselves. Sometimes it was a matter of the antenna not being properly oriented; frequently lead-in losses

---

List of the particular antennas which were used in the Norfolk survey:

- Amphenol 114-059 (stacked V)
- Channel Master 406 (double-corner reflector)
- JFD 400 (corner reflector)
- Radiart U-4 (stacked dipole with reflector)
- Telrex 440 (UHF-VHF stacked-conical V-beam)
- Telrex 750 (single bow tie with reflector)
- Telrex 775-P (single bow tie with parabolic reflector)
- Telrex 755 (stacked bow tie with reflector)
- Telrex 800-2X (stacked conical with reflector)
- Telrex 850-P (stacked conical with parabolic reflector)
- Trio UBT-4 (double-stacked conical with reflector)

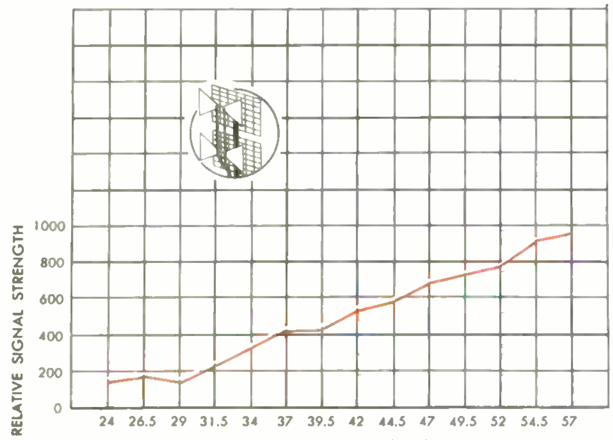
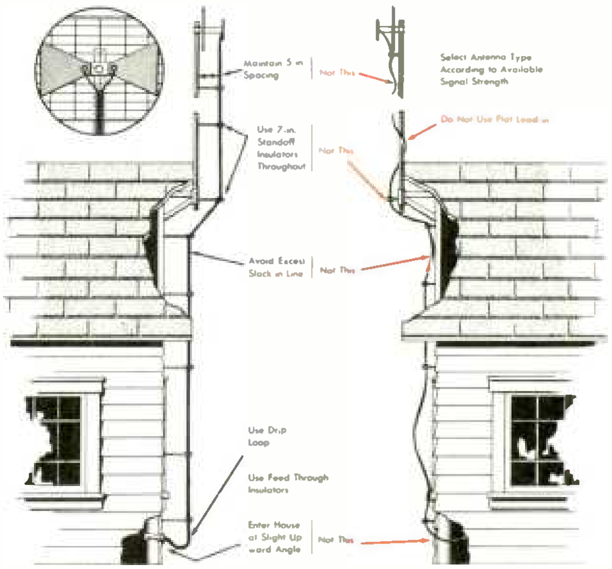



**Fig. 21. Vertical Field-Strength Pattern at Position 15.**




*(Right)*

**Fig. 22. Comparison of Good and Bad UHF Installations.**

were exaggerated by insufficient spacing away from conducting materials; occasionally antenna height and placement were not given enough consideration by the installer; and sometimes it was a matter of the antenna not having enough gain for the particular signal conditions in the area. As exemplified by our Pinewell experience, distance from the transmitter should not be the sole basis for choosing a UHF antenna. Terrain between the receiver site and the transmitter should be considered. The threat of poorer reception under adverse weather conditions must be kept in mind by the installer when recommending an antenna. The drawings in Fig. 22 illustrate two UHF installations. The sketch shown on the left depicts an ideal installation and points out practices which are recommended for best UHF reception. By way of comparison, the drawing on the right shows an installation in which many of these practices were not followed.

May the experience or suggestions included in the foregoing be of assistance to you in your UHF work.

W. W. Hensler and Glen E. Slutz

**Test Probes**
(Continued from page 35)

mended for high-impedance circuits whenever frequency is a determining factor. The cathode-follower probe shown in Fig. 3E and appearing schematically in Fig. 4E may be constructed without too much difficulty. Further information on its construction appears in the PF INDEX and Technical Digest for January-February, 1952.

### *Peak-to-Peak Probes*

Measurement of peak-to-peak voltages on the VTVM is possible with the use of the following probe. The peak-to-peak probe consists of a dual diode tube with one section rectifying the positive peak and the other section rectifying the negative peak. Schematic representation of this probe is shown in Fig. 4F. The rectified outputs are added across the two 5-megohm resistors and applied to the VTVM. Peak-to-peak values may be read directly on the DC-meter scale. Values below 5 volts require special calibration. Peak-to-peak voltage measurements are particularly useful in television servicing. Caution must be exercised not to exceed the voltage capabilities of the diodes. These probes are usually designed for use with a specific VTVM.

### *Special Probes*

Specialized test equipment may require the use of probes particularly suited to that one piece of equipment. In such instances, the manufacturer usually supplies the data concerning the types. However, these special-purpose probes may be of a similar type to those described in this article. Understanding the basic types of probes will be of assistance in using the special probes.

It might be well to keep in mind the following points:

1. When purchasing a test probe, select the one suitable for your particular piece of test equipment.

2. Know its advantages and its limitations.

3. Use it properly.

The foregoing information is summarized in Chart 1. The applications shown in this chart are representative of those commonly employed.

DON R. HOWE

## The Narrow Picture
(Continued from page 21)

If the receiver under test employs a series-filament circuit, take measurements of the filament voltages on the various tubes in the horizontal-deflection system. Should one or more of these voltages appear to be low, investigate the series-filament supply line, particularly the resistances of voltage-dropping resistors in the line. Often a resistor used in a filament circuit only needs to change value a few ohms to affect appreciably the filament voltages on the tubes in series with it. The effect of low filament voltage on an amplifier tube is to lower its efficiency; and when this occurs in a horizontal-deflection system, the picture can suffer a decrease in width as a result.

Some forms of service literature provide the service technician with illustrations of the oscilloscope wave patterns which can normally be found at various points in a receiver. The peak-to-peak voltage of these waveforms are also specified in many instances. This data can be utilized to good advantage by the technician who desires to check closely into the operation of a set. One important waveform check point in the horizontal-deflection system is at the control grid of the horizontal-output tube. If a distorted or low-amplitude wave pattern is found on this grid, the technician may have a clue to the general location of the trouble that is causing a narrow picture. Oscilloscope checks made farther along in the circuits of most horizontal-deflection systems should be conducted with auxiliary


equipment. This is advised because of the very high pulse voltages which are present in the circuits following the horizontal-output tube. A capacitance voltage divider is recommended as a piece of auxiliary equipment generally used to view these high-amplitude pulses on a scope.

### Measures When No Defects Are Found

In case no defects in a receiver are uncovered and yet a narrow picture persists, the service technician should first investigate service-literature sources closely for notice of a production change in the receiver model which he is testing. Sometimes a manufacturer will act during production to correct an epidemic of narrow-picture troubles in a new model. Although the first runs of the new model may reach the market with tendencies toward narrow pictures, the later production runs will incorporate changes that increase the picture width. If the service technician encounters one of the early receivers having a narrow picture, he can with the help of the production-change bulletin make the circuit alterations necessary to correct the trouble.

There are two measures which can be tried as a last resort. A 0.05-mfd capacitor placed across the width coil may increase the width of the picture, or it may be found that by opening the width coil entirely sufficient picture width is attained.

Although this discussion has been based on the one symptom of a narrow picture, there will very likely be other symptoms associated with it. When taken together, they may give a better indication of the true nature of the trouble.

Glen E. Slutz

*"Better make sure first that it's equipped with a Jensen needle."*

**Service Shop on Wheels**
(Continued from page 9)

however, that are essential in any shop. They are: some means for measuring voltage and resistance, a scope, and a sweep generator. A wattmeter is also very useful since it provides a means of determining at all times the power-source voltage. This mobile shop included, in addition to the aforementioned test instruments, a capacity checker and a tube tester.

The test instruments were suspended between two pipes (welded to form a frame in the truck) by rubber bands about 1 1/2 inches wide. However, since these photographs were taken the owner decided to change this system for a more rigid mounting. He now has them mounted on metal straps but still suspended between the pipes.

There are a number of ways to obtain power for the bench work in the mobile shop. One of the simplest methods is to run an extension cord into the home of the set owner. The line should be long and of extra heavy-duty wire so that there will not be too much voltage drop in the line. If the customer lives in an apartment, he can probably show you where to plug in the line without too much trouble. There is usually an outlet in the hall for vacuum cleaners. The disadvantage of the extension cord is that the truck must be parked very close to the house or apartment building.

Another good method is provided by using a gasoline-engine-driven power generator capable of delivering 750 watts or more. If this unit is mounted inside the truck, the exhaust pipe MUST be run outside. These units have good regulation and prove quite satisfactory, but they are very noisy if located inside the truck. They may be mounted on a small trailer to make more room in the truck and to keep out some of the noise.

The mobile shop we are discussing employs still another method. The regular generator on the truck engine was removed and replaced with a heavy-duty, three-phase alternator. The alternator supplies 120 volts across each leg of the output. With a delta-star transformer, it is capable of delivering 1,200 watts of power. The big advantage of the alternator is its compactness; its main disadvantage is that the frequency varies with engine speed. At engine idle, the frequency is approximately 300 cycles. This high frequency causes the edge of the raster to be wavy or jagged, since the power-line frequency is not locked to the frame frequency.

An inverter may be used for very small and quick repair jobs. The drain must be kept small, because most inverters have a maximum capacity of 150 watts continuous use.

Stocking the truck is about the biggest and most important job of all when setting up a mobile service shop. The requirements are very nearly the same as those for a stationary shop. With parts bins built into the truck, as shown in Fig. 3, it is possible to carry ample stock without much difficulty. One thing should be obvious to anyone. That is, the more stock that can be carried in the truck, the more time will be saved. It may be well to note here a few parts and components that should not be overlooked. Naturally a complete kit of resistors and capacitors of most-used values (including filter capacitors) should be included in the stock. More and more selenium rectifiers are being used in TV sets, so that a good selection of them should be included. A number of the following replacement components should also be stocked: horizontal-output transformers, vertical-output transformers, and deflection yokes. Make sure that the parts stocked are not special components for one particular chassis, unless the mobile shop does work for a distributor or store which handles one brand. It is also a good idea to stock a few indoor antennas. As for tools and hardware, the service technician usually has his own preferences.

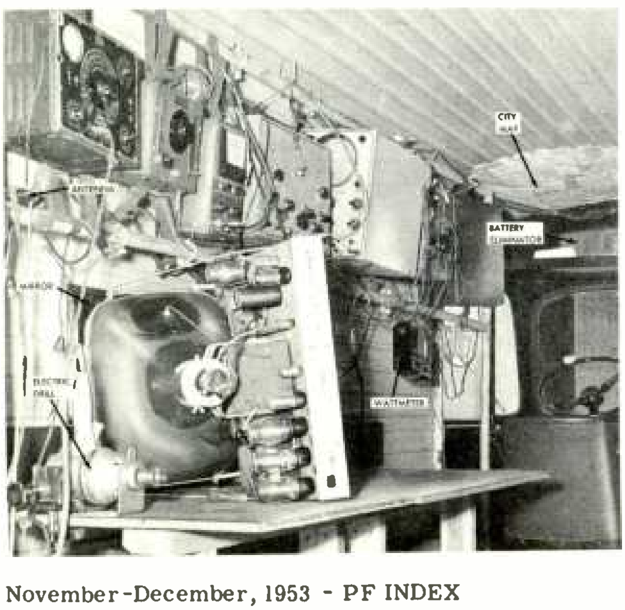
Any truck used for service work should be painted in colors that will be attractive and eye catching. The first thing that the person looking at the truck should notice, after seeing that it is a TV truck, is the fact that it is a mobile shop offering service at the home. It is generally

*(Below)*

**Fig. 2 Inside view of Mobile Service Shop Showing Bench and Instruments**

*(Right)*

**Fig. 3 Inside View of Mobile Service Shop Showing Lights and Parts Bins**




agreed that most customers dislike having their sets go to a repair shop because they can never tell when they will get them back. They do not know how loaded up the shop may be. Even the service technician cannot usually say. Therefore, it is good advertising to have the printing on the truck in very large letters. Any advertising for the mobile shop should emphasize the point that servicing is done at the home.

To speed up the locating of a customer's home, the owner of the shop in this article installed a map of the city and vicinity (see Fig. 2) in the ceiling of the truck above the driver's seat.

One should not overlook the fact that the mobile service shop has its limitations and disadvantages as well as its advantages. For example, no matter how the instruments are mounted, they will still get shaken up somewhat. This will sooner or later lead to instrument failures and inaccuracies. The owner and operator of the unit we are discussing has had very little trouble with his instruments; however, he does not do much work which takes him on very rough roads.

Something that should be avoided is investing everything in the truck so that the whole business depends on the use of the truck. It is logical to assume that it will need repairs occasionally. Therefore, if everything is in the truck, you are temporarily out of business.

With a mobile shop, the technician has the same telephone problem as the one-man stationary shop. He either must rent telephone-answering service or hire someone to stay at the home shop when he is making house calls. There is one other alternative, that of renting a telephone transcriber from the telephone company. The only trouble with a transcriber is that the service technician must return to the shop to take off any messages.

We sincerely hope that this discussion has answered the questions of our many readers who have been inquiring about mobile service shops.

We wish to express our thanks to Raymond J. Kiefer, owner and operator of Ray's TV Mobile Shop, for his splendid cooperation during the preparation of this article.

HENRY A. CARTER

**Audio Facts**

(Continued from page 47)

The sketch in Fig. 1A shows the direct path from the source of a sound to the ears of a listener. It is apparent at once to the listener that the sound comes from the front, with the distance of the source and the intensity of the sound also registering. The ability to do this is due mostly to hearing binaurally, that is, with two ears.

If, as in Fig. 1B, the listener's head is turned to one side, the sound affects one ear very differently than the other. The path of the sound leads directly into one ear but only indirectly to the other. The latter ear is shielded from the sound by the listener's head but not from the echoes and reverberations of the sound always present to some extent. The difference of intensity and time delay or phase of the sound heard by one ear, as compared to that heard by the other, is the basis of binaural hearing. If the head is turned to the other side, the effect upon the ears will be reversed, leaving no doubt as to the location of the sound source.

When multiple sounds are heard as in Fig. 2 there will be no doubt that there are numerous sound sources, and the loaction of one in respect to the others can be very apparent.

If a hand is held over one ear it would still be possible to get some idea of the location of the sound, especially if the source is visible, for the eyes are a wonderful aid in accommodating the ears to such a situation. Even the sense of feeling is a help in orientation with sound.

A good test of listening with one ear, or monaurally, is to put on a hearing aid and try to understand a conversation in a group of people or even to orient yourself in respect to the sounds. This experience can be very strange and thoroughly confusing. The effect would still be the same if two earpieces were used, since the microphone and single channel of the usual hearing aid would still be strictly one-eared.

In Fig. 3 a microphone is placed in front of a number of sound sources. The microphone hears the sounds monaurally in the same manner as the hearing aid. The same would be true even if two or more microphones were used as in Fig. 4, since their outputs are mixed together and fed into one line. There is just one total sound output even though it is made up of a number of sounds.

With the microphone in Fig. 3 or the microphones in Fig. 4 picking up the sound which is then channeled through an amplifier to the loudspeaker in Fig. 5, the loudspeaker becomes the sound source to the ears. Since the loudspeaker is the source of the single mixture of sounds and since the original sources are not visible, we have lost all orienting effects of location of the original individual sound sources with respect to the microphones during pickup. The sounds with their echoes and reverberations are present in the mixture of sound, but there is no way of placing them in their correct perspective via the single-channel reproduction through the loudspeaker.

When two or more loudspeakers are connected to the single channel, as in Fig. 6, the effect is similar to that in Fig. 5. If they are placed far apart, the spread may be noticeable but will still be a single sound. Divider networks can be used to direct the high frequencies to one loudspeaker and the low frequencies to another, thereby spacing the frequency spectrum out over a larger area sometimes with unique results. It would be only by chance if a high-frequency-producing instrument and a low-frequency-producing instrument were in the same relative positions as the high-frequency and low-frequency loudspeakers. Even though they were, the high harmonics or overtones of the high-frequency loudspeaker and the rest of the tones would be reproduced by the low-frequency one.

No matter how many loudspeakers or microphones are employed in the system, it is still one-eared or monaural if only a single channel is used.

To overcome the monaural effect, a binaural or stereophonic system must be used to obtain the desired third dimension. Fig. 7 illustrates a true binaural setup composed of two microphones and a pair of headphones. The left micro-

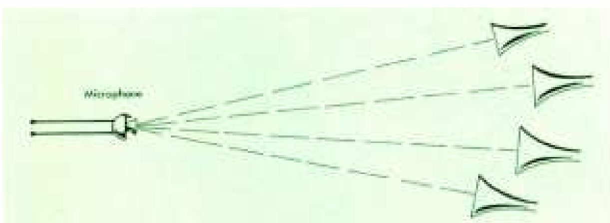



**Fig. 3. Single-Channel Pickup of Multiple Sounds With Single Microphone.**

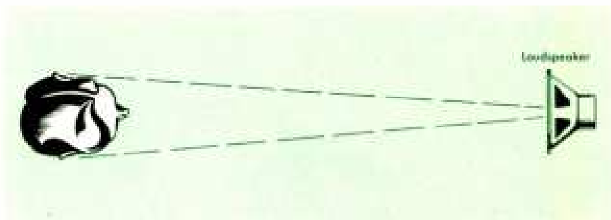



**Fig. 5. Listening With Two Ears to Single-Channel System With Single Loudspeaker.**

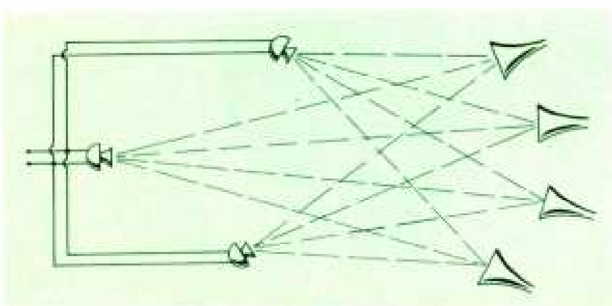


**Fig. 4. Single-Channel Pickup of Multiple Sounds With Multiple Microphones.**

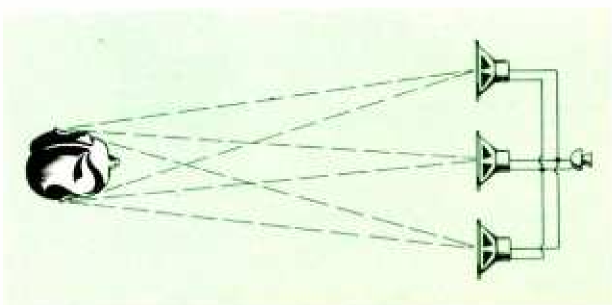


**Fig. 6. Listening With Two Ears to Single-Channel System With Multiple Loudspeakers.**

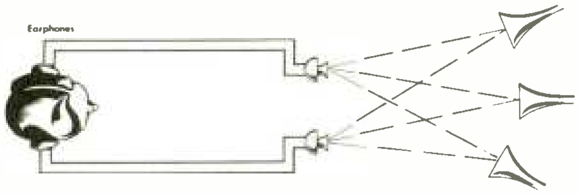
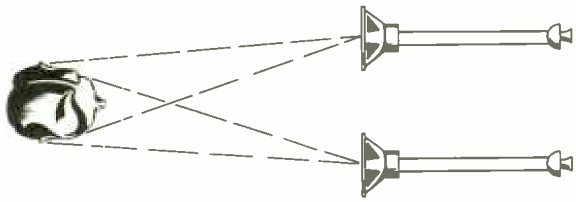
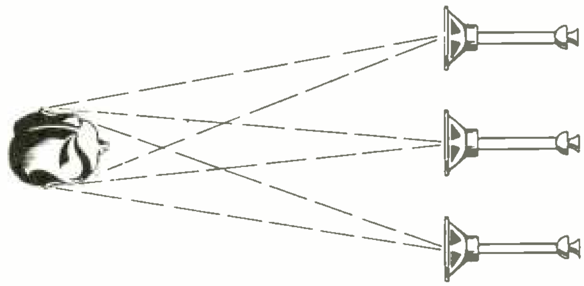



Fig. 7. Listening With Headphones to True Binaural System.





(Left)

Fig. 8. Listening to Binaural (?) System With Two Loudspeakers.

(Above)

Fig. 9. Listening to Three-Channel Sterophonic System.

phone is connected only to the third earphone, and the right microphone is connected to the right headphone. This makes two separate channels. With the microphones spaced about six inches apart (the average distance between the ears) they pick up the sound in the same manner that the ears would if they were in the same position. The left ear hears what the left microphone picks up, and the right ear hears what the right microphone picks up. If the source of the sound moves, it is as easy to follow the sound as though the ears were in the positions of the microphones. This true binaural action has been demonstrated and used many times.

The sound can be recorded on dual-track tape or dual-band records and played back through headphones with the same results. Headphones are not the most satisfactory way to listen to music with enjoyment, expecially in the company of other people. So we want to use loudspeakers instead.

With the microphones spaced at a suitable distance from each other and connected each to its own loudspeaker, we now have a two-channel system (Fig. 8) similar to that using headphones; but in this setup, we have something different which disturbs the binaural effect. The left ear hears both the left loudspeaker and the right loudspeaker, while the right ear also hears both. Each loudspeaker reproduces only the output from its particular channel, but the ears are hearing from both of them a strange effect of a sound mixture which is not truly binaural.

The resulting sound can be very effective and enjoyable or it can be very disturbing and disappointing. With correct placement of the microphones and the correct wide spacing of the loudspeakers, the left ear will hear the left loudspeaker more predominantly and

# the master

## of television signal generators

- more sweep
- greater RF output
- better stability
- increased accuracy
- unlimited flexibility
- lower cost

**model TVG-2**


*See your electronics distributor or write.*

**JACKSON**

"service engineered" test equipment

JACKSON ELECTRICAL INSTRUMENT CO.
DAYTON 2, OHIO

IN CANADA:
THE CANADIAN MARCONI CO.

---

# AUDELS TV SERVICE

## TELLS HOW TO SOLVE TV TROUBLES AND ANSWERS TV QUESTIONS

AUDELS TELEVISION SERVICE MANUAL covers T.V. information at your finger ends. Shows good receiver adjustment and How to Get Sharp, Clear Pictures, How to Install Aerials—Avoid Blurs, Smears, Interference and How to Test. Explains Color Systems and Methods of Conversion. IT PAYS TO KNOW! Over 380 PAGES & 225 ILLUSTRATIONS explaining operating principles of Modern Television Receivers.

Just Out!


**1001 FACTS**
**19 CHAPTERS**

Placement of Television Receivers—Receiver Controls; Test Patterns & Adjustments—Television Interference—Interference Traps—Television Antennas & Transmission Lines—Master Antenna Systems—Antenna Installation Procedure—Television Broadcasting—Television Receiver Fundamentals—Circuit Description of Typical Receiver—Television Picture Tubes—Projection Type Receivers—Television Testing Instruments—Television Servicing—Trouble Shooting—Color Television—Television Terms.

**$2 POST PAID**

**7 DAYS FREE TRIAL**
GET THIS PRACTICAL ASSISTANCE FOR YOURSELF

**AUDEL, Publishers, 49 W. 23rd St., N.Y.**
Mail me postpaid for 7 Days examination AUDELS TELEVISION SERVICE MANUAL (Price $2). If O.K. I will mail you $2, otherwise I will return book.

---

# WIRE WARNING!

## WHY

pay more for questionable quality* tubular TV lead-in wire?

**subject to patent infringement.*

## LOOK (JSC)

for highest quality license-labeled* Tubular TV Wire . . .

**JSC Tubular Wire is manufactured under license of Amphenol Pat. 2543696.*

## DEMAND (JSC)

the most for your wire dollar . . . get BOTH Quality**! AND Low Price**!

***JSC—Highest in Quality . . . Lowest in Price*

### JSC NEW Twin Tubular TV Lead-In Wire...

***The best low loss, low cost 300 ohm lead-in for UHF and VHF television.***

Rain, snow, dirt or salt deposits do not materially affect impedance and electrical efficiency.
JSC tubular construction contains and protects the concentrated field of energy and reduces to a minimum high ratio signal losses.

UHF JSC VHF

*Always Look for Orange and Blue Disc of Quality* the right ear will hear the loudspeaker on the right side. Such a setup will give a very striking binaural or more exactly a stereophonic effect, if the listener is in the correct position.

Very effective results can be obtained with the two-channel loudspeaker systems; but some peculiar and odd effects can be noted at times, even when the listener is in the rather limited area for best listening. The listener may receive a distinct impression of the third dimension but not be able to locate the source of the sound in its correct position. If the source of the sound moves, such as in a performance on a stage, the source may have a tendency to jump from one speaker to the other. These effects can be reduced and very satisfactory stereophonic reproduction obtained by adding to the system a third channel which includes an additional microphone and loudspeaker, as shown in Fig. 9.

With the three-channel system, the sound can be located with much greater accuracy and also followed more naturally because of the smoother movement. The desired effects can be heard over a much larger area than possible with a two-channel system.

As can be seen, some of these systems can become quite elaborate, with two or three of each of the components being required in order to establish the separate channels. Actually a binaural or stereophonic system can be assembled quite easily and with few complications, depending upon the requirements to be met and the demands or inclinations of the persons involved.

Equipment for these applications is available and is becoming increasingly more so as the activity increases in this type of operation. Very satisfactory preamplifiers and amplifiers are available at very reasonable prices.

Tape recorders capable of recording two and three channels on a single tape are manufactured by several companies. These include the required number of recording and playback channels to produce results suitable for use both by the professional and by the listener in the home.

Binaural records are available with the two channels recorded in separate bands which are to be played back with two pickups. There has also been placed upon the market a tone arm which mounts two pickups correctly spaced for playback of these recordings.

Some broadcasters have used their FM stations to broadcast one channel and their AM stations to transmit the other channel in binaural broadcasts. The listener using an FM receiver for one channel and an AM receiver for the other can achieve a binaural effect in his home. This has been done on fairly regular schedules in some areas.

The conclusion that can be drawn from all of this is that a lot of work is being done in connection with binaural and stereophonic sound reproduction. That is very true, in fact this experimenting and work has been carried on for years. So much has been done along these lines that only a few points can be lightly touched upon here.

The terms binaural and stereophonic have been used since they are the familiar names given to this type of sound reproduction. There has been quite a little controversy concerning the correctness of the name binaural; but it has become the commonly used term for the two-channel system, particularly the one with headphones and some two-channel systems using loudspeakers. Stereophonic is becoming accepted as the correct designation for the two-channel and especially for the three-channel loudspeaker systems where the effect may not be strictly binaural but is definitely third dimensional.

Interest is increasing in this type of sound reproduction, and we will attempt to report further developments as they are made. The articles and publications listed below contain information on this subject:

Stereophonic Reproduction
by James Moir
Audio Engineering, Oct. 1952

Binaural or Stereophonic
by R. J. Tinkham
Audio Engineering, Jan. 1953

Binaural Public Address
by Charles F. Adams
Audio Engineering, Feb. 1953

It's Trinaural
by Hollis Alpert
High Fidelity, Sept.-Oct. 1953

Hi Fi for Two Ears
by Charles Fowler
High Fidelity, Jan.-Feb. 1953

Robert B. Dunham


Fifty million people will see REGENCY in LIFE, HOUSE BEAUTIFUL, HOUSE AND GARDEN, ATLANTIC MONTHLY, SATURDAY REVIEW and on Nation-Wide Television!
They'll be asking YOU for REGENCY . . . Don't disappoint them! Sell them!
NO MORE
constant up and down!
viewing on the run!
REGENCY DOES AWAY WITH "JACK-IN-THE-BOX" TELEVIEWING WITH A UNIVERSAL
TV REMOTE CONTROL FOR 20,000,000 SETS!
A NEW PRINCIPLE IN REMOTE CONTROL DEVICES!
• It works on as much as 100 feet of cable (permits running cable around room periphery)!
• Changes channels!
• Sharpens Contrast!
• Brightens the picture!
• Controls volume!
• Adjusts the picture from where it is seen!
Regency
MODEL RT-700
$69.95 LIST
Regency
DIVISION OF I.D.E.A., INC.
Makers of VHF Boosters, FM Boosters, UHF Converters, Professional High Fidelity Equipment and Television Remote Control.
Burton browne advertising

## Compatible Color TV

(Continued from page 25)

lated by this signal. Before being fed to the balanced modulator for the $E_I$ signal, the carrier goes through a phase-shifter stage. Here it is changed in phase by 90 degrees to $\cos(\omega t + 33^o)$. Then it is fed to the balanced modulator where it is modulated by the $E_I$ signal.

The outputs of the two modulators are first combined to form a single chrominance signal and then combined with the monochrome signal to form the complete color-picture signal $E_M$. The color-picture signal is then applied to the radio-frequency transmitter for transmission.

### *Color Receiver*

Fig. 3 shows a block diagram of the video section of a receiver for the reception of the NTSC color-picture signal. The video portion of the receiver consists of three different sections: monochrome channel, chrominance channel, and the matrix which combines the two channels. The stages preceding the second detector are of the conventional type; therefore, they are not shown.

The total color-picture signal is applied to the first video amplifier from the output of the second detector. After being amplified to the proper level, the signal is fed to both the monochrome channel and the chrominance channel through two different paths. The monochrome signal passes through a delay line and an amplifier and then is applied to the matrix unit. The delay line provides a delay of approximately 1.0 microsecond, which is necessary for the simultaneous arrival of the monochrome signal and the other signals at the matrix unit. The monochrome channel performs substantially the same function as that performed in standard monochrome receivers; that function is to amplify the luminance information to a level that is suitable for application to a picture tube. However, in the color receiver, the monochrome signal is passed through the matrix unit before it arrives at the picture tube.

The chrominance signal at the output of the first video amplifier is first passed through a bandpass filter, which limits the bandwidth of the signal from approximately 2 to 4.4 megacycles. This filter attenuates the low-frequency monochrome components and the sound carrier but passes the color subcarrier and its sidebands. The complete color subcarrier signal is then applied to two demodulator stages.

Demodulation of the color signal is accomplished by a pair of synchronous detectors. Here the chrominance signal is demodulated into the original color-difference signals. One demodulator is for detection of the $E_Q$ voltage and another for the $E_I$ voltage. These are shown in Fig. 3 as Q and I demodualtors.

Both the Q and I demodulators receive the complete color signal along with a synchronous local subcarrier which is generated by the local oscillator within the receiver. One component of the local subcarrier having the phase $\sin(\omega t + 33^o)$ is applied to the Q demodulator. Another component of the local subcarrier having the phase $\cos(\omega t + 33^o)$ is applied to the I demodulator.

The information which is used to re-establish the reference frequency and phase at the receiver is transmitted by a few cycles of the reference signal having the phase $\sin(\omega t + 180^o)$. This reference signal (color burst) is positioned on the horizontal-blanking pulse following the line-synchronizing pulse. As has been mentioned before, its frequency is that of the chrominance subcarrier (3.579545 megacycles).

Before being applied to the matrix unit, the $E_Q$ and $E_I$ signals are passed through low-pass filter networks. The $E_Q$ signal is band limited by a 0.6 megacycle low-pass filter. Then it is fed to an $E_Q$ phase splitter the outputs of which provide the positive and negative $E_Q$ signals which are necessary for mixing in the matrix.

The detected $E_I$ signal at the output of the $E_I$ demodulator is fed to a low-pass filter which limits the $E_I$ channel bandwidth to approximately 2 megacycles and provides high-frequency time-delay compensation. From the detected, filtered $E_I$ signal, the two signals necessary for the matrix are obtained from an $E_I$ amplifier stage and an $E_I$ phase-inverter stage. A positive $E_I$ signal is obtained from the plate circuit of the $E_I$ amplifier, while the negative $E_I$ signal is obtained from the plate of the $E_I$ phase inverter.

Entering into the matrix unit are four different signals which are required for the mixing process. These signals are a positive and a negative $E_Q$ signal, a positive and a negative $E_I$ signal, and the monochrome signal. In the matrix unit, these signals are proportionately mixed to form at the output the red, green, and blue picture-tube drive signals $E_R$, $E_G$, and $E_B$.

### *Final NTSC Color-Transmission Standards*

The following section is taken from the final NTSC color-transmission standards as submitted to the FCC. It pertains to specifications that have been set down by the NTSC for transmission of the complete color-picture signal. **

* * Please turn to page 107 * *

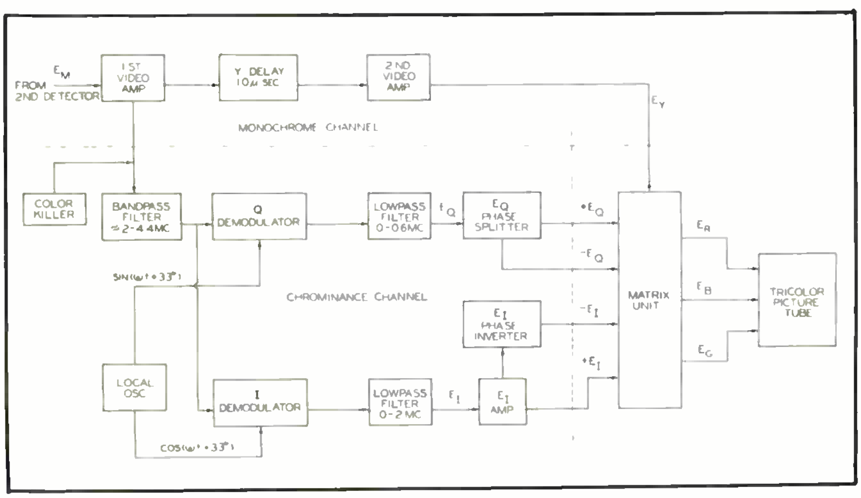



**Fig. 3. Block Diagram of Video Section of a Color Receiver.**

** National Television System Committee, "Petition for Adoption of Transmission Standards for Color Television," before the Federal Communications Commission, Wash., D.C., July 21, 1953, NTSC — G—378, pp. 9-11.

THE COMPLETE COLOR-PICTURE SIGNAL

A. General Specifications

The color-picture signal shall correspond to a luminance (brightness) component transmitted as amplitude modulation of the picture carrier and a simultaneous pair of chrominance (coloring) components transmitted as the amplitude modulation sidebands of a pair of suppressed subcarriers in quadrature having the common frequency relative to the picture carrier of + 3.579545 mc ±0.0003 per cent with a maximum rate of change not to exceed 1/10 cycle per sec per sec.

B. Delay Specification

A sine wave, introduced at those terminals of the transmitter which are normally fed the color picture signal, shall produce a radiated signal having an envelope delay, relative to the average envelope delay between 0.05 and 0.20 mc, of zero microseconds up to a frequency of 3.0 mc; and then linearly decreasing to 4.18 mc so as to be equal to -0.17 microseconds at 3.58 mc. The tolerance on the envelope delay shall be ± 0.05 microseconds at 3.58 mc. The tolerance shall increase linearly to ±0.1 microsecond down to 2.1 mc and remain at ±0.1 microsecond down to 0.2 mc.[1] The tolerance shall also increase linearly to ±0.1 microsecond at 4.18 mc.

C. The Luminance Component

1. An increase in initial light intensity shall correspond to a decrease in the amplitude of the carrier envelope (negative modulation).

2. The blanking level shall be at (75 ±2.5) per cent of the peak amplitude of the carrier envelope. The reference white (luminance) level shall be (12.5 ±2.5) per cent of the peak carrier amplitude. The reference black level shall be separated from the blanking level by the setup interval, which shall be (7.5 ±2.5) per cent of the video range from the blanking level to the reference white level.

3. The over-all attenuation versus frequency of the luminance signal shall not exceed the value specified by the FCC for black and white transmission.

D. Equation of Complete Color Signal

1. The color-picture signal has the following composition:

$$E_M = E'_Y + \left[E'_Q \sin(\omega t + 33^\circ) + E'_I \cos(\omega t + 33^\circ)\right]$$

where

$$E'_Q = 0.41\,(E'_B - E'_Y) + 0.48\,(E'_R - E'_Y)$$

$$E'_I = -0.27\,(E'_B - E'_Y) + 0.74\,(E'_R - E'_Y)$$

$$E'_Y = 0.30\,E'_R + 0.59\,E'_G + 0.11\,E'_B$$

The phase reference in the above equation is the phase of the (color burst + 180°), . . . . The burst corresponds to amplitude modulation of a continuous sine wave.

NOTES: For color-difference frequencies below 500 kc, the signal can be represented by

$$E_M = E'_Y + \left\{\frac{1}{1.14}\left[\frac{1}{1.78}(E'_B - E'_Y)\sin\omega t + (E'_R - E'_Y)\cos\omega t\right]\right\}$$

In these expressions the symbols have the following significance:

$E_M$ is the total video voltage, corresponding to the scanning of a particular picture element, applied to the modulator of the picture transmitter.

$E'_Y$ is the gamma-corrected voltage of the monochrome (black-and-white) portion of the color picture signal, corresponding to the given picture element.[2]

$E'_R$, $E'_G$, and $E'_B$ are the gamma-corrected voltages corresponding to red, green, and blue signals during the scanning of the given picture element.

The gamma-corrected voltages $E'_G$, $E'_R$, and $E'_B$ are suitable for a color-picture tube having primary colors with the following chromaticities in the CIE system of specification:

| | x | y |
|---|---|---|
| Red (R) | 0.67 | 0.33 |
| Green (G) | 0.21 | 0.71 |
| Blue (B) | 0.14 | 0.08 |

and having a transfer gradient (gamma exponent) of 2.2 associated with each primary color.[3] The voltages $E'_R$, $E'_G$, and $E'_B$ may be respectively of the form $E_R^{1/\gamma}$, $E_G^{1/\gamma}$, and $E_B^{1/\gamma}$ although other forms may be used with advances in the state of the art.

$E'_Q$ and $E'_I$ are the amplitudes of two orthogonal components of the chrominance signal corresponding respectively to narrow-band and wide-band axes, as specified in paragraph D.5.

The angular frequency $\omega$ is $2\pi$ times the frequency of the chrominance subcarrier.

The portion of each expression between brackets represents the chrominance subcarrier signal which carries the chrominance information.

2. The chrominance signal is so proportioned that it vanishes for the chromaticity of CIE Illuminant C ( X = 0.310, Y = 0.316).

3. $E'_Y$, $E'_Q$, $E'_I$ and the components of these signals shall match each other in time to 0.05 microsecond.

4. A sine wave of 3.58 mc introduced at those terminals of the transmitter which are normally fed the color-picture signal shall produce a radiated signal having an amplitude, (as measured with a diode on the RF transmission line supplying power to the antenna) which is down (6 ±2) db with respect to a radiated signal produced by a sine wave of 200 kc. In addition, the amplitude of the radiated signal shall not vary by more than ±2 db between the modulating frequencies of 2.1 and 4.18 mc.

5. The equivalent bandwidths assigned prior to modulation to the color-difference signals $E'_Q$ and $E'_I$ are given by Table I.

TABLE I

Q-channel bandwidth

at 400 kc less than 2 db down
at 500 kc less than 6 db down
at 600 kc at least 6 db down

I-channel bandwidth

at 1.3 mc less than 2 db down
at 3.6 mc at least 20 db down

6. The angles of the subcarrier measured with respect to the burst phase, when reproducing saturated primaries and their complements at 75 per cent of full amplitude, shall be within ± 10° and their amplitudes shall be within ± 20 percent of the values specified above. The ratios of the measured amplitudes of the subcarrier to the luminance signal for the same saturated primaries and their complements shall fall between the limits of .8 and 1.2 of the values specified for their ratios. Closer tolerances may prove to be practicable and desirable with advance in the art.

[1] Tolerances for the interval of 0.0 to 0.2 mc should not be specified in the present state of the art.

[2] Forming of the high-frequency portion of the monochrome signal in a different manner is permissible and may in fact be desirable in order to improve the sharpness on saturated colors.

[3] At the present stage of the art it is considered inadvisable to set a tolerance on the value of gamma and correspondingly this portion of the specification will not be enforced.


# That's for Me for TV!

# insl-x
## INSULATING SPRAY

**Higher dielectric strength than any other insulating spray on the market! Proven by twenty years of use by leading component parts manufacturers— Now packaged in easy-to-use Spra-tainer especially for you!**

Contract service calls cost money. Spray every TV installation with Insl-x E-16 and eliminate return calls. The extremely high dielectric strength of Insl-x E-16 assures positive insulation. Insl-x dries to a hard but extremely flexible finish of unusual thickness.

Use Insl-x, the material that was designed to do one specific job—INSULATE.

*Specify Insl-x E-26 for complete insulation of electrical equipment and wiring.*

**Insulate everything in TV set except moving parts and tubes! Spray antenna and all connections. Prevent corona, arcing. Keep out moisture, rust.**

### TECHNICAL DATA

Dielectric strength, 800 to 1200 v/m • Drying time, 3 to 5 minutes • Hard, yet retains great flexibility. Adhesion excellent to all conventional assembly surfaces including ceramic, anodized aluminum and phenolic • Highly resistant to chemicals and moisture.

**insl-x E-33**

***For Safely Handling "Hot" Wires***

Do away with the uncertain protection of taped tool handles. Insl-x E-33, the material used by major utility companies for insulating linesmen's tools, is now available to you!

Just dip tool handles—Insl-x E-33 dries to a tough, smooth coating that provides absolute protection. In bright red for quick, positive tool identification.

**See your jobber, or write for complete technical data, Dept. 211**

**INSL-X SALES COMPANY, 26 Rittenhouse Place, Ardmore, Pennsylvania**

*Insl-x Products are available in bulk for spray, dip, and brush application.*

**UHF**

(Continued from page 29.)

that it gets AC power through the outlet socket in the rear of the converter. This socket may be seen in Fig. 9. With this setup, the ON-OFF switch of the receiver is left in the ON position at all times; and power to both converter and receiver is controlled by the switch on the converter. In the VHF position of the function switch, the converter is kept in a stand-by condition; and the signal from the VHF antenna is connected to the input of the television receiver. In the UHF position of the switch, the converter unit is placed in operation; and after setting the channel selector on the TV receiver to either channel 5 or 6, the desired UHF channel may be obtained by rotating the tuning knob on the converter. Some slight improvement in reception may be gained by adjusting the fine-tuning control on the receiver. The signal input for the converter may be obtained either from the small built-in UHF antenna which comes with the converter unit or from an external UHF antenna connected to the UHF input terminals.


**Figure 6. Silverline Model 63A, UHF All-Channel Converter.**

The Silverline converter employs double-tuned preselector circuits, a crystal mixer, and a stage of IF amplification. It also has its own self-contained power supply. The RF-tuned circuits are of the transmission-line type. They consist of quarter-wave, end-tuned, coaxial lines. To lengthen the tuned lines electrically for resonance at a particular frequency within the UHF band, capacitive tuning is employed at the open end of each line. The variable ganged capacitor used in this application (see Fig. 8) is of a type similar to those used in conventional low-frequency applications. Each line is tuned by four rotor blades.

Fig. 7 is a complete schematic diagram of the Silverline Model 63A, UHF converter. The section enclosed by dotted lines at the lower left of the schematic is a pictorial drawing of the tuned lines in the converter. The item numbers in the pictorial drawing correspond with the numbering on the respective electrical symbols in the schematic.

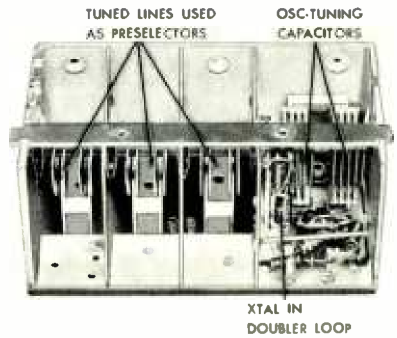



**Figure 8. View of Preselector Sections and Local Oscillator in Silverline Converter (Shield Removed for Photograph).**

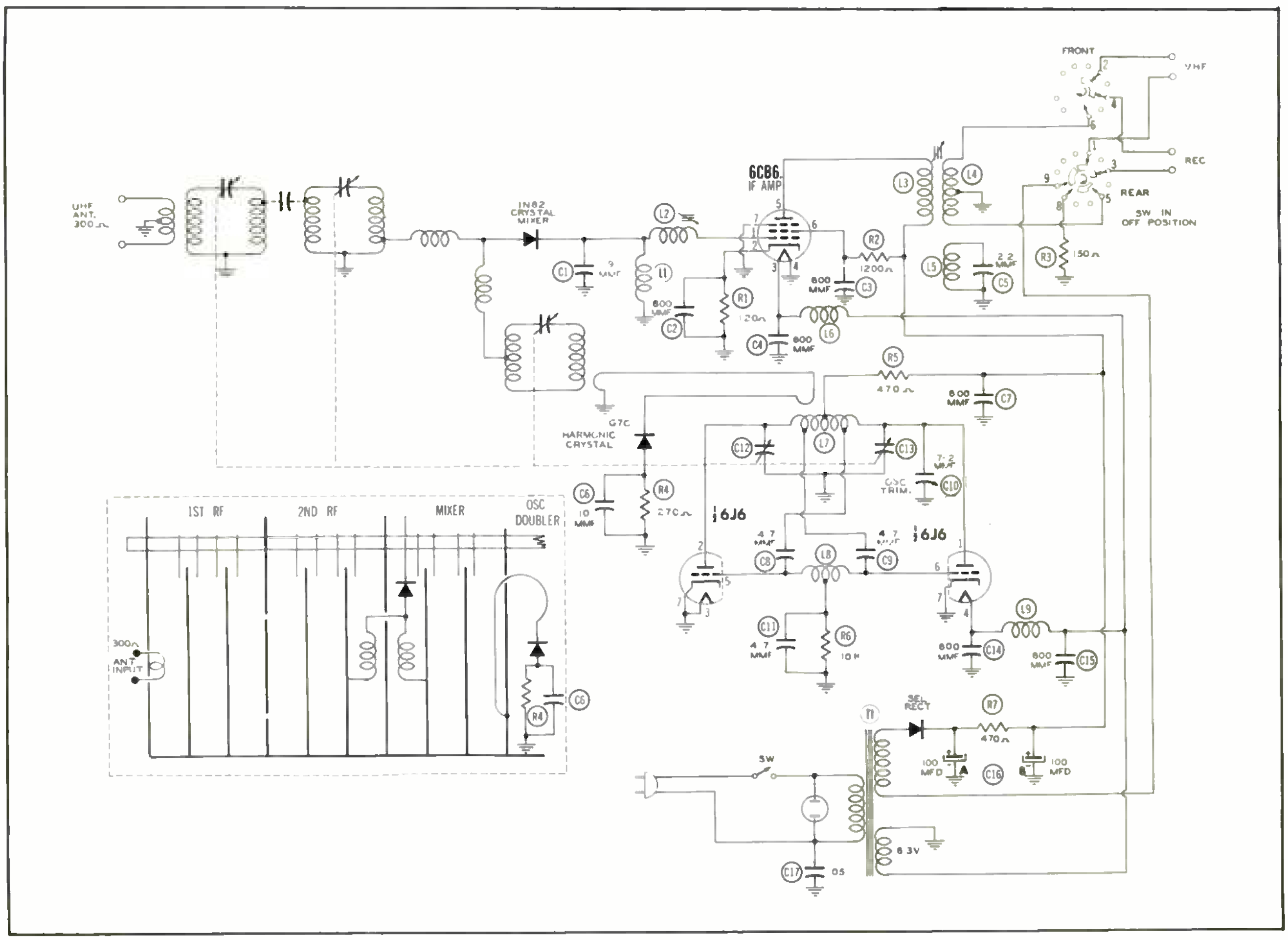



**Figure 7. Schematic and Partial Pictorial Drawing of Silverline Model 63A, UHF Converter.**


IMPACT IN UHF
FINCO
series 500
Great
Engineered To Give HIGHEST GAIN and NARROWEST PATTERNS to solve difficult "GHOST" problems in the FRINGE AREA AND IN CLOSE TO THE STATION
This great series once again reaffirms Finco leadership! Model 502 is a 2-bay unit of the colateral* type with a "snap-out" screen for instantaneous installation. Model 504 is the 4-bay version, highly effective in super fringe areas where ultra high gain is consistantly required. Both models feature high front to back ratio and excellent impedance match to 300 OHM line for low signal fringe areas. Completely preassembled — corrosion proof aluminum throughout (including screen) — one antenna, one transmission line!
IMPACT Through Advertising
LOCAL NEWSPAPERS
LIFE
FARM MAGAZINES
RADIO
TELEVISION
FINCO IS A NAME YOUR CUSTOMERS KNOW BECAUSE OF THIS POWERFUL NATIONAL ADVERTISING PROGRAM!
Both Units available in 3 models which peak on channel ranges shown below and maintain high gain on balance of frequencies:
#502A — channels 14-32
#502B — channels 29-55
#502C — channels 53-83
#504A — channels 14-32
#504B — channels 29-55
#504C — channels 53-83
Patent No. 2,566,287
THE FINNEY COMPANY
DEPT. PF-311 • 4612 ST. CLAIR AVE. CLEVELAND 3, OHIO

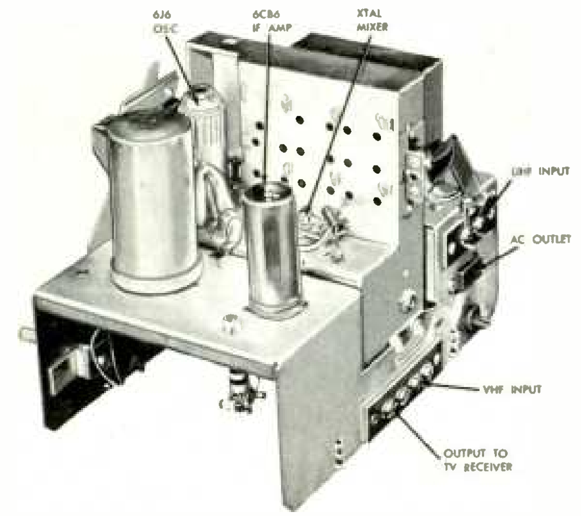



Figure 9. View of Silverline Model 63A, UHF Converter Showing Top Chassis Components and External Connections.

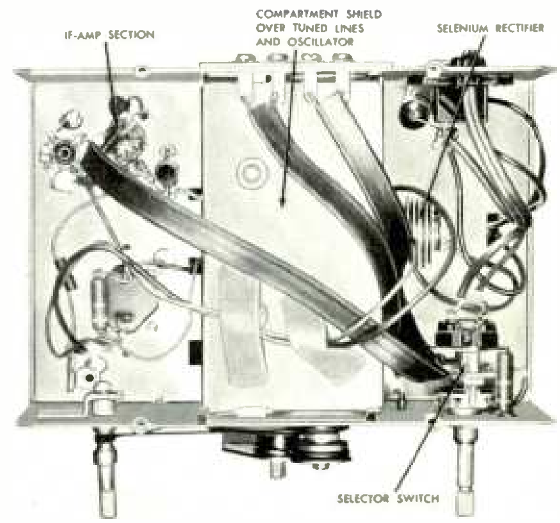



Figure 10. Bottom Chassis View of the Silverline Model 63A, UHF Converter.

The UHF local oscillator is a twin-triode 6J6 tube in a push-pull circuit. This circuit is also tuned by rotor plates that are ganged on the tuning element, as shown in Fig. 8. The signal from the local oscillator circuit is loop-coupled to the oscillator doubler. Note in the schematic that a crystal diode is employed in series with the coupling loop in order to provide rectification of the oscillator signal and thus effect more efficient doubling action. To stabilize this action further, the crystal is biased by means of the network composed of R4 and C6. Heterodyning takes place in the crystal-mixer circuit, and the resultant IF output is amplified by the 6CB6 pentode and fed by transformer coupling to the TV-receiver input.

An under-chassis view of the converter with the shield over the tuned lines and with the oscillator in place is shown in Fig. 10. Note the power supply with its selenium

# RCA WR-89A crystal-calibrated marker generator

# Continuously tunable ...from 19 to 260 Mc.


**ONLY $242^50**

Suggested User Price

## for use in alignment of TV and FM receivers and electronic equipment

VERSATILITY is the word for the new RCA WR-89A. It will furnish an rf carrier of crystal accuracy for use in alignment of television receivers, communications equipment, and other electronic equipment operating in the frequency range of 19-260 Mc. The generator is continuously tunable and may be calibrated at 2.5-Mc intervals throughout its tuning range by means of a built-in, harmonic, crystal oscillator of high accuracy. A separate crystal oscillator also provides a fixed output frequency of 4.5 Mc for use in aligning intercarrier-if amplifiers and discriminators.

When an external rf signal is fed into the WR-89A, the generator may also be used as a heterodyne frequency meter for measuring the frequency of the external signal.

A wide choice of modulation is also available. A front-panel control permits selection of 4.5-Mc modulation for placing a marker on the response curve when dual markers are needed; simultaneous modulation at 4.5 Mc and 600 cps for alignment of FM discriminators, 600-cps modulation for producing horizontal bars on a TV kinescope; and 100-150 kc variable modulation for producing vertical bars on a kinescope and for checking band-width of FM discriminators.

## SPECIFICATIONS

**Variable-Frequency Oscillators:**
- Frequency Ranges (on Fundamentals) ... 19-55 Mc, 55-260 Mc

**Output Voltage:**
- On VFO Ranges ... at least 0.1 rms volt
- On 4.5 Mc ... at least 0.1 rms volt
- Total Length of Dial Scale ... 144 inches approx.
- Fine Tuning Drive Ratio ... 11.6 to 1

**RF Attenuator:**
- Range of Attenuation ... at least 60 db
- Type ... Single-piston capacitor
- Output Cable Impedance ... 90 ohms

**2.5-Mc Crystal Calibrator:**
- Accuracy ... ±0.01%
- Total Number of Check Points ... 96

**4.5-Mc Crystal Oscillator:**
- Accuracy ... ±0.02%

**Internal Modulation** ... 4.5 Mc, 4.5 Mc & 600 cps, 600 cps, 100-150 Kc
**External Modulation Frequency** ... up to at least 10 Mc
**Power Supply** ... 105-125 volts, 50-60 cps
**Power Consumption** ... 55 watts
**Dimensions** ... 10" high, 13½" wide, 7½" deep

**Get full details today from your RCA Distributor**

GET FULL DETAILS from your RCA Distributor ... or request Bulletin through PHOTO FACT INDEX

**RCA® RADIO CORPORATION of AMERICA**
TEST EQUIPMENT — HARRISON, N. J.

rectifier; also note the IF-amplifier circuitry and the ribbon twin leads which cross over the shield. In order to remove the shield, it is necessary to unsolder these leads and bend the lugs on the terminal strip up and out of the way.

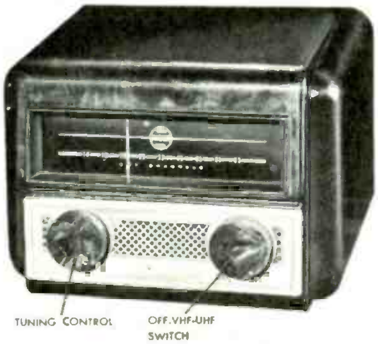



Figure 11. Turner Model TV-3, UHF Converter.

***UHF Converter***
***Turner Model TV-3***

The Turner Model TV-3, UHF converter is designed to permit reception of UHF television signals on channels 5 or 6 on a standard television receiver. The unit is pictured in Fig. 11. A slide-rule type of dial is employed. The knob on the lower left of the front panel controls the tuning; the one at the right is the function selector having positions of OFF, VHF, and UHF. This converter has at the back an AC receptacle which may be used to provide power for the television receiver. This makes it possible to turn on both receiver and

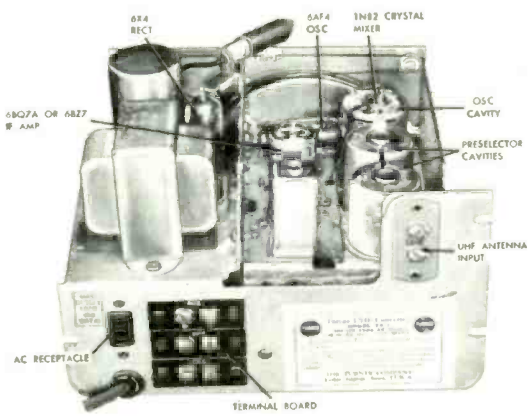



Figure 12. Top Chassis of Turner Model TV-3.

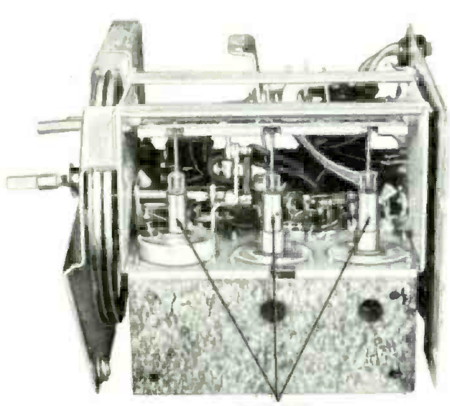



Figure 13. Side View of Turner Model TV-3 with Shields Removed Showing Underside of Tuner.

# PAMPER

**YOUR TV AND RADIO SETS WITH DEPENDABLE**

# OHMITE®

**REPLACEMENTS**

## *Little Devil*® COMPOSITION RESISTORS

Tiny, yes . . . but what dependability, ruggedness, and stability! And they provide an *extra* margin of safety—being rated at 70C rather than 40C. Completely sealed and insulated by molded plastic, they meet all JAN-R-11 requirements . . . are available in ½, 1, and 2-watt sizes in all RTMA values.

## TYPE AB NOISE-FREE POTENTIOMETERS

Because the resistance material in these units is solid-molded—not sprayed or painted on—continued use has practically no effect on the resistance. Often, the noise-level *decreases* with use . . . and they provide exceptionally long, trouble-free service. Rated at 2 watts, with a good safety factor.

## BROWN DEVIL® AND DIVIDOHM® RESISTORS

BROWN DEVIL fixed resistors and DIVIDOHM adjustable resistors are favorite vitreous-enameled units! DIVIDOHM resistors are available in 10 to 200-watt sizes; BROWN DEVILS in 5, 10, and 20-watt sizes.

**OHMITE MFG. CO.**
3644 W. Howard St.
Skokie, Ill.
(Suburb of Chicago)

*Be Right With . . .*

**OHMITE**

**RHEOSTATS • RESISTORS • TAP SWITCHES**

---

**COMPACT DEPENDABLE EFFICIENT**

# *Rotary Power* by Carter

**THE NEW *Custom***

### DC-AC CONVERTER

These latest of all Carter DC to AC Converters are specially engineered for professional and commercial applications requiring a high capacity source of 60 cycle AC from a DC power supply. Operates from storage batteries, or from DC line voltage. Three "Custom" models, delivering 300, 400, or 500 watts 115 or 220 V. AC. Wide range of input voltage, 12, 24, 32, 64, 110 or 230 V. DC. Unequalled capacity for operating professional recording, sound movie equipment and large screen TV receivers. Available with or without manual frequency control feature.


## WRITE TODAY FOR CATALOG

Carter Rotary Power Supplies are made in a wide variety of types and capacities for communications, laboratory and industrial applications. Used in aircraft, marine, and mobile radio, geophysical instruments, ignition, timing, etc. WRITE TODAY for complete Dynamotor and Converter Catalogs, with specifications and performance charts on the complete line.

**Carter MOTOR CO.**
2651 N. Maplewood Ave.
Chicago 47

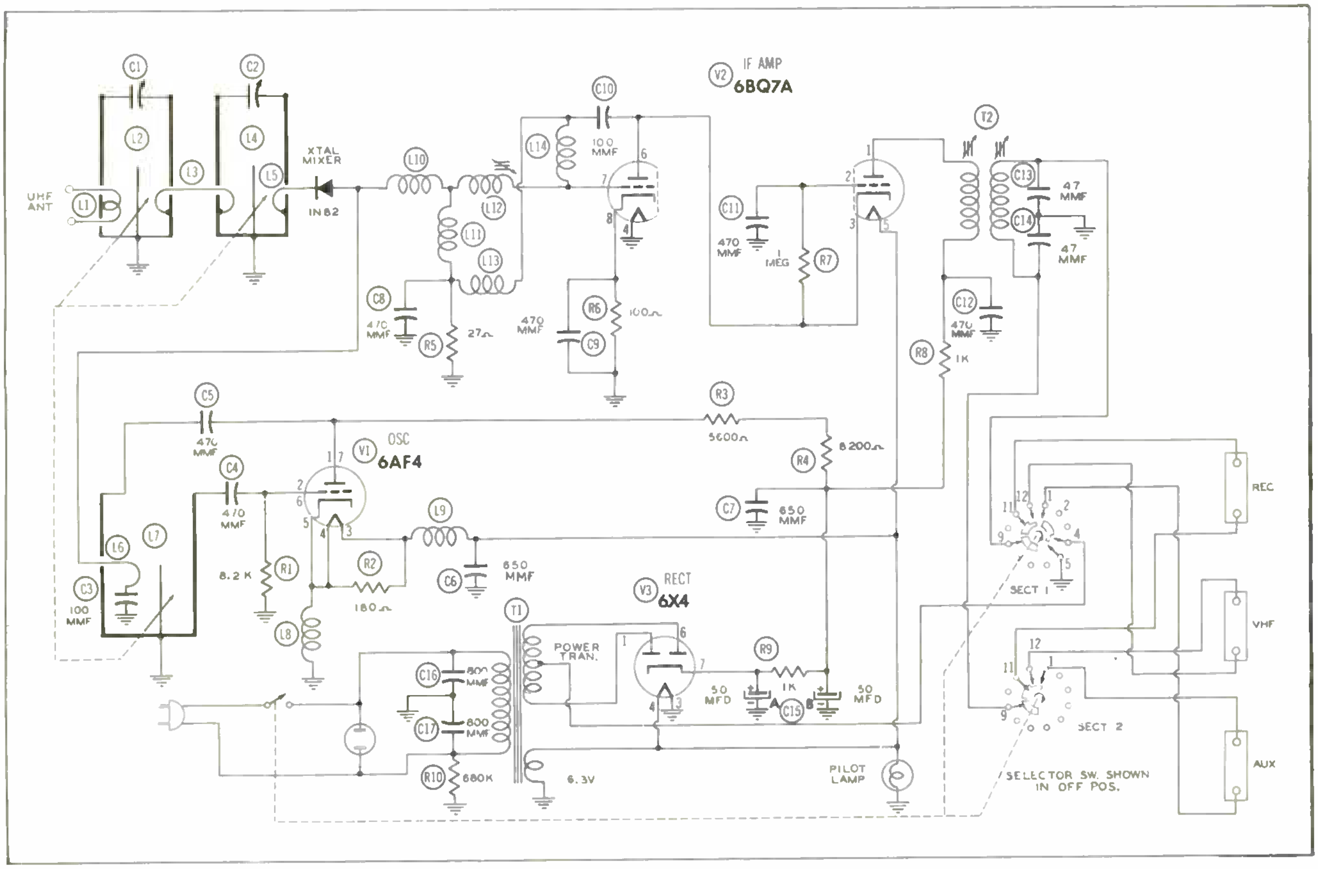



Figure 14. Schematic of Turner Model TV-3.

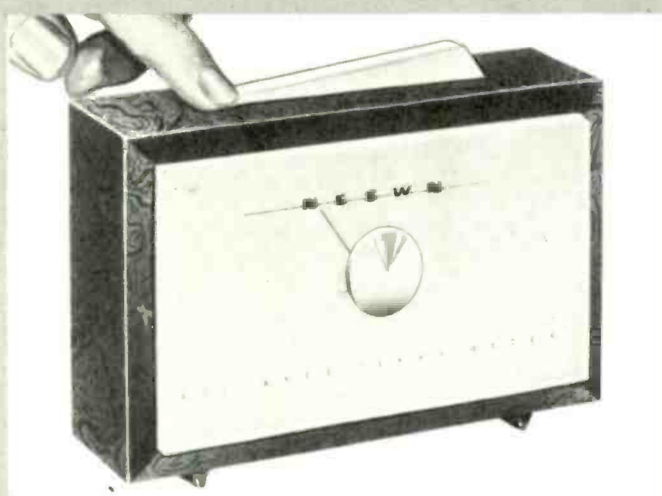
converter with the converter function switch alone. Therefore, in the VHF position of this switch, power is applied both to the television receiver and to the dial light and tube heaters of the converter. At the same time, the VHF antenna is connected through the switch to the antenna input on the receiver.

In the UHF position, power is applied to both the converter and the receiver. The VHF antenna is disconnected, and the output of the UHF converter is connected to the antenna terminals of the receiver. When a combination UHF-VHF antenna is employed, the lead-in from the antenna is connected to the VHF antenna terminals of the converter. Then a short length of twin lead is run between the converter terminals marked AUX and those marked UHF.

The Turner TV-3 converter employs three capacitively tuned coaxial cavities, two for the preselector and one for the 6AF4 oscillator. See Fig. 12. Both the preselector and the oscillator feed a 1N82 crystal-diode mixer, the output of which is amplified by a cascode IF amplifier using a 6BQ7A or a 6BZ7 tube. The power supply consists of a transformer and a 6X4 rectifier followed by an RC filter. The schematic diagram of this converter is shown in Fig. 14.

The 6AF4 oscillator tube is mounted horizontally with its socket set into its associated coaxial cavity. It may be removed for replacement, however, by prying out the snap button which sets into the vertical wall adjacent to the 6X4 tube socket. A side view of the converter, with shields removed, is shown in Fig. 13. Notice the three-ganged brass slugs which capacitively tune each of the cavities.

Glen E. Slutz



MODEL T-10 features finger-tip electrical control. Highly accurate. $44.95

Outstanding Alliance Tenna-Rotors now have added sales appeal . . . in smart, modern styling by Reinecke & Associates, famous industrial designers.

# Fast-selling NEW models alliance TENNA·ROTOR

MODEL U-83 is the *only* fully automatic rotator. $44.95

Both models . . . T-10 and U-83 . . . are attractive, harmonize with any interior. Here's strong, new buy appeal for famous Alliance Tenna-Rotor!

## NEW ALLIANCE TV CONVERTER!

Another Alliance TV aid widely advertised over television and in newspapers! Quick-easy installation . . . attractively styled . . . easy to operate. Used and recommended by leading set manufacturers! Proved and preferred in the field! $42.50

**ALLIANCE MANUFACTURING COMPANY • ALLIANCE, OHIO**

# A STOCK GUIDE FOR TV TUBES

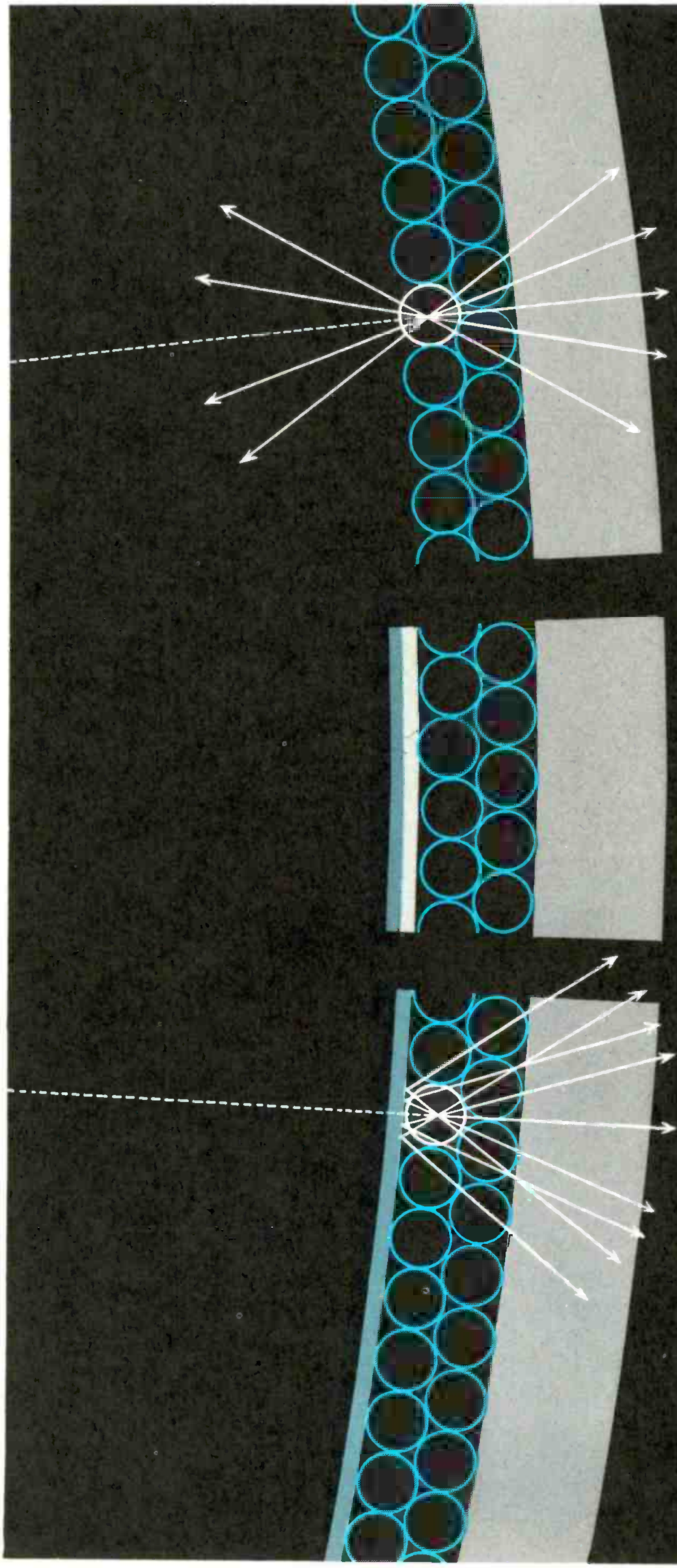
The figures in the chart below have been revised to include production of TV receivers since the compilation of the chart which appeared in PF INDEX and Technical Digest for September-October, 1953.

For additional information on the recommended use of this chart, refer to PF INDEX and Technical Digest for May-June, 1953.

| | 46-53 Models | 52 & 53 Models | | 46-53 Models | 52 & 53 Models | | 46-53 Models | 52 & 53 Models | | 46-53 Models | 52 & 53 Models |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1AX2* | - | - | 6AT6 | 4 | 3 | 6BZ7 | 2 | 4 | 6W4GT | 32 | 34 |
| 1B3GT | 40 | 44 | 6AU5GT | 4 | 4 | 6C4 | 10 | 10 | 6W6GT | 7 | 12 |
| 1V2 | - | - | 6AU6 | 136 | 126 | 6CB6 | 90 | 138 | 6X4 | - | - |
| 1X2 | 6 | 2 | 6AV5GT | 2 | 4 | 6CD6G | 7 | 9 | 6X5GT | 1 | 1 |
| 1X2A | 4 | 6 | 6AV6 | 14 | 17 | 6CL6* | - | - | 6X8 | 3 | 5 |
| 5U4G | 43 | 47 | 6AX4, | 3 | 1 | 6J5 | 3 | 3 | 6Y6G | 3 | 1 |
| 5V4G | 8 | - | 6AX5GT | 2 | 3 | 6J5GT | 2 | 1 | 7C5 | 1 | - |
| 5Y3GT | 3 | 2 | 6BA6 | 16 | 11 | 6J6 | 34 | 31 | 7N7 | 3 | 1 |
| 6AB4 | 3 | 3 | 6BC5 | 11 | 8 | 6K6GT | 17 | 10 | 12AT7 | 15 | 14 |
| 6AC7 | 9 | 9 | 6BE6 | 4 | 6 | 6L6GA | - | - | 12AU6 | 1 | - |
| #6AF4* | - | - | 6BF5 | 1 | 1 | 6S4 | 8 | 10 | 12AU7 | 45 | 27 |
| 6AG5 | 38 | 11 | 6BF6* | - | - | 6SH7 | - | - | 12AV7 | 4 | 4 |
| 6AG7 | 3 | 3 | 6BG6G | 14 | 6 | 6SL7GT | 4 | 3 | 12AX4 | 2 | 4 |
| 6AH4GT | 1 | 3 | 6BH6 | 9 | - | 6SN7GT | 79 | 88 | 12AX7 | 4 | 5 |
| 6AH6 | 7 | 10 | 6BK5 | - | 2 | 6SN7GTA* | - | - | 12AZ7 | - | 1 |
| 6AK5 | 4 | 4 | 6BK7 | 3 | 6 | 6SQ7 | - | - | 12BH7 | 8 | 12 |
| 6AL5 | 78 | 79 | 6BK7A* | - | - | 6SQ7GT | 3 | 3 | 12BX7 | - | - |
| #6AN4* | - | - | 6BL7GT | 5 | 9 | #6T4* | - | - | 12BY7 | - | 2 |
| 6AQ5 | 13 | 13 | 6BN6 | 3 | 2 | 6T8 | 14 | 15 | 12BZ7* | - | - |
| 6AQ7GT | 2 | 2 | 6BQ6GT | 16 | 25 | 6U8 | 4 | 7 | 12SN7GT | 7 | 5 |
| 6AS4* | - | - | 6BQ7 | 6 | 15 | 6V3 | 2 | 4 | 25BQ6GT | 3 | 5 |
| 6AS5 | 2 | 2 | 6BQ7A* | - | - | 6V6GT | 22 | 20 | 25L6GT | 6 | 6 |
| | | | | | | | | | 25W4GT | 2 | 2 |
| | | | | | | | | | 25Z6 | 1 | - |
| | | | | | | | | | 5642 | 2 | 2 |

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

* New tubes recently introduced.



## In the Interest of Quicker Servicing

(Continued from page 45)

Additional positions are available on the switch, if an additional value should be required for special applications. Test leads with alligator clips are provided for easy attachment to test points.

The location of parts is shown in Fig. 3. The entire unit occupies a space of only 4 inches by 5 inches by 6 inches. A schematic of the substitution box appears in Fig. 4.

When using the capacitors, it is suggested that the test leads be shorted together after each test. This action will remove any remaining charge that is on the capacitors. It is also recommended that values not be changed while the unit is connected to a circuit.

### New Uses for Old Tubes

Rectifier tubes, such as the 5Y3G or 5U4G, are frequently replaced because of low emission. The inability of the cathode to furnish sufficient electrons renders these tubes useless for ordinary purposes. Since they may be utilized for a special function, these tubes should not be discarded.

Weak rectifier tubes may be used for making tube-substitution tests under the following conditions. If a rectifier tube with an open filament is found, the service technician may be hesitant to substitute a new tube. There is always the possibility that a short in the B+ circuit would damage the new tube. This is particularly true in receivers with an unfused power supply. The weak tube may be substituted to check this condition. If no short is apparent and the tube continues to operate normally, it may be replaced with a new tube. The set may then be checked for normal operation. The saving in new rectifier tubes will more than compensate for the additional time required for this method. It is suggested that a piece of adhesive tape, or similar material, be placed on the base of the old tube. This will permit easy identification of the weak tube and will eliminate any possibility of mistaking it for a new tube.

DON R. HOWE

**Examining Design Features**

(Continued from page 41)

frequency response is varied and changes the quality of the picture.

The normal position for the Hi-Lite control is in the center position. By rotating the switch to the right (clockwise direction) the high-frequency response is increased. This will often add a crispness to the picture, particularly to old faded films. Rotation in the opposite direction will in most cases reduce ringing or halo effect in the picture. It is also instrumental in smearing snow which sometimes improves a picture being received from a distant station.

It may be well to instruct the set owner that the Hi-Lite control should always be adjusted when he has changed back to a local station after viewing a program from a distant station.

***TRUETONE 2D2315A***

The Truetone 2D2315A utilizes an AFC discriminator which is by no means new but which may need some explaining. Instead of using two synchronizing pulses and

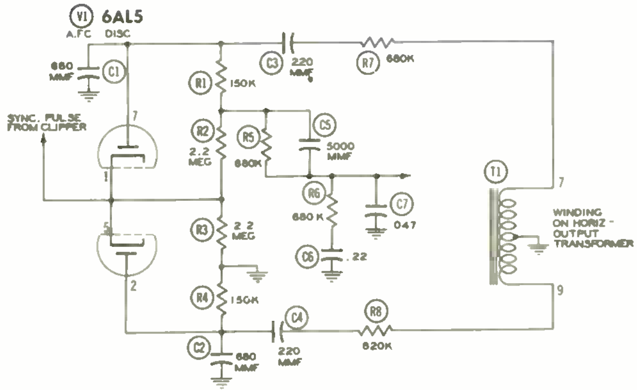



**Fig. 6. Partial Schematic of Truetone 2D2315A.**

one feedback voltage, this set uses two feedback voltages of opposite polarity and one synchronizing pulse.

The feedback voltages are obtained from a separate winding of the horizontal-output transformer (see Fig. 6); then they are integrated and applied to the plates of the 6AL5. The horizontal synchronizing pulse is applied to both rectifier sections at the cathodes, which are tied together. The pulses which appear at both cathodes are naturally of identical polarity and phase. The feedback voltages are of the same frequency as the multivibrator. If a phase shift occurs, it causes one section of the 6AL5 to conduct more than the other. This action unbalances the voltages appearing across R2 and R3 and creates a change in bias on the grid of the multivibrator. In this manner, the AFC output synchronizes the horizontal multivibrator.

controls for the VHF and UHF grouped close together.

Switching from VHF to UHF is done by simply pulling out on the UHF-tuning control knob and turning to the desired channel. The tuning shaft is equipped with a collar which engages slide switch S1 shown in Fig. 7 for switching from one tuner to the other. The same switch is also used to turn on the proper pilot light. Ganged to S1 is slide switch S2 which switches the antenna from the VHF tuner to the UHF tuner, or vice versa.

There are two ways that the UHF dial may be set so that proper calibration is provided. One way is to set the dial on channel 54. Loosen the set screw (see Fig. 7), turn the shaft just below the tuner until the rocker arm is horizontal, then tighten the set screw. A more accurate method is to tune in the

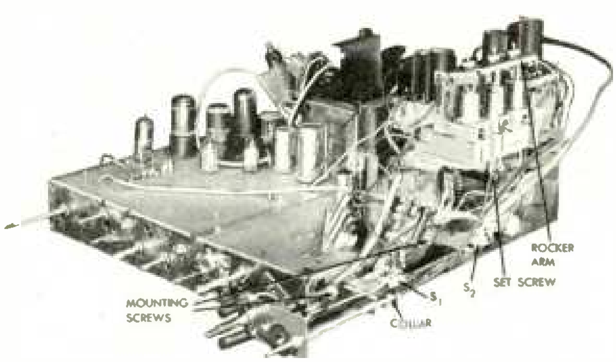



**Fig. 7. Chassis View of Zenith L2593H Showing UHF Tuning Assembly.**

### *ZENITH L2593H*

An entirely different method for mounting the UHF tuner is used in the Zenith L2593H, as may be viewed in Fig. 7.

By positioning the UHF tuner above the chassis, the manufacturer has conserved much-needed space without involving a larger chassis and cabinet. It also places the UHF-tuner tubes where they can be easily changed, and still it leaves the tuning

picture and sound of a known channel, to loosen the set screw, and to turn the tuning knob until the dial is on the correct channel and then tighten the screw.

For positioning the knobs, the UHF controls may be shifted by loosening the mounting screws and sliding the assembly in the direction desired.

HENRY A. CARTER

**Dollars and Sense Servicing**

(Continued from page 49)

FRUSTRATION. In many of the new branches of electronics, production and demand have grown so far ahead of basic research that engineers can't put their fingers on all the variables. Transistors are an example; even now, when a batch is made up, they don't know whether they'll get the equivalent of a type 01A tube, a 26, a 6C4, or what. All of this is quite frustrating for engineers who like to know what they're doing. It's just as nerve-wracking as working on a TV set that continues misbehaving after you've tried everything logical and are down to guess-and-try as a last resort.

UHF TOTALS. In the first year of UHF, counting from Portland's KPTV turning on the juice, some 2,000,000 UHF receivers and converters are in use and in trade pipelines, according to "Television Digest." These fall into three categories: 800,000 sets equipped at the factory for UHF; 850,000 converters for installation in the field; and 350,000 sets of strips for converting VHF tuners in the field. Right now there are no shortages of UHF sets.

SOUNDHUNTING. Latest fad in Europe is collecting strange sounds. It's called creative use of magnetic tape recorders, and soundhunters exchange their on-tape sound creations just as philatelists exchange stamps.

Unusual variations of customary sounds, peculiar voices, queer cadences, chance events and strange sounds of any kind are collected. As a refinement, advanced collectors mix them up at various levels to obtain weird sound creations for entertaining friends on dark and dreary nights. Freddy Weber of Geneva, Switzerland is general secretary of the International Soundhunters Federation, having members in France, Belgium, Germany, Austria and Switzerland.

John Markus

# TV SUPPLEMENTARY SHEET NO. 6

| MODEL & CHASSIS | PART # | CATALOG # | FUNCTION | DESCRIPTION | LIST PRICE |
|---|---|---|---|---|---|
| **R C A** | | | | | |
| 17T150<br>17T151<br>17T163<br>17T172K<br>17T173K<br>17T174K | 76171<br>942157-1 | AT-95<br>FKS-1/4<br>SWA | Vol./Sw. | 500K Tap 250K Ω carbon--SPST | $1.85<br>.60 |
| | 76443 | RTV-136 | Vert./Hor. Hold | 1 Meg./50K Ω Conc. Dual carbon | $3.10 |
| | 76444<br>76445 | Order From MFR. | Contrast/ Bright. | Special Conc. Shaft | |
| CHASSIS<br>KCS66C •<br>KCS66D | 76447<br>971382-10 | AG-44-S<br>FKS-1/4 | AGC | 50K Ω carbon | $1.25 |
| | 76448<br>971382-2 | AG-84-S<br>FKS-1/4 | Height | 2.5 Meg. Ω carbon | $1.25 |
| | 76449<br>971382-11 | AG-11-S<br>FKS-1/4 | Vert Lin. | 1500 Ω carbon | $1.25 |
| **SCOTT** | | | | | |
| 820C | VC-12120B | AG-19-S<br>FKS-1/4 | Vert. Lin. | 5000 Ω carbon | $1.25 |
| | VC-12121C | AG-84-S<br>FKS-1/4 | Height | 2.5 Meg. Ω carbon | $1.25 |
| | VC-12127B | RTV-297 | Contrast/ Vol./Sw. | 750 Tap 500/250K Ω Conc. Dual carbon--SPST | $4.30 |
| | VC-12131 | AG-44-S<br>KSS-3 | Hor. Hold | 50K Ω carbon | $1.25 |
| | VC-12132D | AG-83-S<br>KSS-3 | Vert. Hold | 1.5 Meg. Ω carbon | $1.25 |
| | VC-12135 | AG-49-S<br>FKS-1/4 | Bright. | 100K Ω carbon | $1.25 |
| 924W | VC-12120B | AG-19-S<br>FKS-1/4 | Vert. Lin. | 5000 Ω carbon | $1.25 |
| | VC-12121C | AG-84-S<br>FKS-1/4 | Height | 2.5 Meg. Ω carbon | $1.25 |
| | VC-12122 | A10-1500<br>FKS-1/4 | Focus | 1500 Ω 4W-W.W. | $1.85 |
| | VC-12127B | RTV-297 | Contrast/ Vol./Sw | 750 Tap 500/250K Ω Conc. Dual carbon SPST | $4.30 |
| | VC-12131 | AG-44-S<br>KSS-3 | Hor. Hold | 50K Ω carbon | $1.25 |
| | VC-12132 | AG-83-S<br>KSS-3 | Vert. Hold or Bright. | 1.3 Meg. Ω carbon | $1.25 |
| | VCA-12134 | AG-52-S<br>FKS-1/4 | Hor. Drive | 150K Ω carbon | $1.25 |
| **SEARS-ROEBUCK** | | | | | |
| 1146-20 | N22464-17 | RTV-258 | Contrast Vol./Sw. | 25K/3 Meg. Tap 1 Meg. Conc. Dual carbon--SPST | $4.30 |
| | N22464-18 | AG-49-S<br>KSS-3 | Bright. | 100K Ω carbon | $1.25 |
| CHASSIS<br>132 014 | N22464-19 | Order From MFR. | Tone | 2 Meg. carbon--DPST (Special Switch) | |
| | N22464-20 | RTV-259 | Vert. Lin./ Height. | 3000/2.5 Meg. 2W-W.W. carbon Conc. Dual | $3.10 |
| | N22464-22 | AG-61-S<br>KSS-3 | Vert. Hold | 1 Meg. Ω carbon | $1.25 |
| | N22464-23 | AG-44-S<br>KSS-3 | Hor. Hold | 50K Ω carbon | $1.25 |
| **SENTINEL** | | | | | |
| 1U438<br>1U439<br>1U440<br>1U441<br>1U443<br>1U444 | 28E43 | AG-44-S<br>FKS-1/4 | Hor. Hold | 50K Ω carbon | $1.25 |
| | 28E45 | AG-55-S<br>FKS-1/4 | Height | 250K Ω carbon | $1.25 |

| MODEL & CHASSIS | PART # | CATALOG # | FUNCTION | DESCRIPTION | LIST PRICE |
|---|---|---|---|---|---|
| 438<br>439<br>440<br>441<br>443<br>444 | 28E54 | A43-75<br>FKS-1/4 | Hor. Cent. | 60 Ω 2W-W.W. | $1.25 |
| | 28E64 | RTV-213 | Bright./ Vol./Sw. | 35K/500K Ω Conc. Dual carbon--SPST | $3.70 |
| | 28E65 | AG-8-S<br>RS-2 | Contrast | 1000 Ω carbon | $1.25 |
| | 28E67 | AG-11-S<br>FKS-1/4 | Vert. Lin. | 2000 Ω carbon | $1.25<br>• |
| Series<br>2XD, XD, XXD | 28E72 | AG-83-S<br>FKS-1/4 | Vert. Hold | 2 Meg. Ω carbon | $1.25 |
| | 28E75 | AG-52-S<br>KSS-3 | Tone | 150K Ω carbon | $1.25 |
| | 28E78 | RTV-339 | Vert. Cent. | 80 Ω C.T. 2W-W.W. | $1.85 |
| | 28E81 | Order From MFR. | Video Plate Load | 1000 Ω 1W-W.W. | |
| 1U-438<br>1U-439<br>1U-440<br>1U-441<br>1U-443<br>1U-444<br>1U-446<br>438<br>439<br>440<br>441<br>443<br>444<br>446 | 28E43 | AG-44-S<br>FKS-1/4 | Hor. Hold | 50K Ω carbon | $1.25 |
| | 28E45 | AG-55-S<br>FKS-1/4 | Height | 250K Ω carbon | $1.25 |
| | 28E54 | A43-75<br>FKS-1/4 | Hor. Cent. | 60 Ω 2W-W.W. | $1.25 |
| | 28E64-3 | RTV-248 | Bright./ Vol./Sw. | 35K/500K Ω Conc. Dual carbon--SPST | $3.70 |
| | 28E65 | AG-8-S<br>RS-2 | Contrast | 1000 Ω carbon | $1.25 |
| | 28E67 | AG-11-S<br>FKS-1/4 | Vert. Lin. | 2000 Ω carbon | $1.25 |
| | 28E72 | AG-83-S<br>FKS-1/4 | Vert. Hold | 2 Meg. carbon | $1.25 |
| CHASSIS<br>YD<br>YA<br>YB<br>YC | • 28E72 | AG-83-S<br>FKS-1/4 | Focus | 2 Meg. Ω carbon | $1.25 |
| | 28E75 | AG-52-S<br>KSS-3 | Tone | 150K Ω carbon | $1.25 |
| | 28E78 | RTV-339 | Vert Cent | 80 Ω C.T. 2W-W.W. | $1.85 |
| | 28E81 | Order From MFR. | Video Load Adj | 1000 Ω 1W-W.W. | |
| • | Used Only With Electrostatic Picture Tube. | | | | |
| 1U-447A<br>1U-448A<br>1U-449A<br>1U-450A<br>1U-451A | 28E43 | AG-44-S<br>FKS-1/4 | Hor Hold | 50K Ω carbon | $1.25 |
| | 28E54 | A43-75<br>FKS-1/4 | Hor. Cent. | 60 Ω 2W-W.W. | $1.25 |
| | 28E64-3 | RTV-248 | Bright./ Vol./Sw | 35K/500K Ω Conc. Dual carbon--SPST | $3.70 |
| | 28E65 | AG-8-S<br>RS-2 | Contrast | 1000 Ω carbon | $1.25 |
| | 28E72 | AG-83-S<br>FKS-1/4 | Vert. Hold | 2 Meg. Ω carbon | $1.25 |
| | • 28E72 | AG-83-S<br>FKS-1/4 | Focus | 2 Meg. Ω carbon | $1.25 |
| | 28E75 | AG-51-Z<br>KSS-3 | Tone | 120K Ω carbon | $1.25 |
| | 28E78 | RTV-339 | Vert. Cent. | 80 Ω C.T. 2W-W.W. | $1.85 |
| | 28E79 | AG-55-S<br>FKS-1/4 | Height. | 250K Ω carbon | $1.25 |
| | 28E80 | AG-44-S<br>FKS-1/4 | Vert. Lin. | 50K Ω carbon | $1.25 |
| | 28E81 | Order From MFR. | Video Output Plate Load | 1000 Ω 1W-W.W. | |
| • | Use Only With Electrostatic Focus Picture Tubes. | | | | |

Form No. 752725010-5M-12/52



This supplementary sheet is for use as an up-to-the-minute addition to your Clarostat TV Manual. Manuals are available through your distributor or directly from Clarostat. Price $1.00.

**CLAROSTAT MFG. CO., INC.**
**DOVER, NEW HAMPSHIRE**

# PF INDEX

AND TECHNICAL DIGEST

INDEX TO ADVERTISERS
November-December 1953 Issue



# + More or Less −

## YOU HAVE TO BE HUNGRY TO FIGHT

This thought has been advanced, recently, in connection with the state of affairs in the pugilistic profession. If we interpret correctly, it means that a driving need must be present to develop the full potential of the individual participant. Complacency and full diet, it seems, create a belief that customer or consumer, as the case may be, will settle for considerably less than best performance. If so, move over, boys, and get ready for company . . . a good portion of the electronic industry seems headed your way.

The electronic industry, and, more particularly, its precocious child - television - have certainly been running on a full diet. It has been very pleasant to all parties to see the growth and the opportunity in this field, and to know that these opportunities offer the capacity for the same rate of growth in the future, provided (1) that intelligent planning is used for development, and (2) that the execution of such planning serves the best interest of the consumer.

It is all very well to plan production schedules and sales quotas on the constantly expanding, nation-wide television market. But lest this rosy glow confuse you, remember the amount of work and skill extended on behalf of all activities contributing to the present growth of television. The manufacturer, the retailer, the installer, the service technician, the stations, and networks have all been importantly responsible. The catch is, that some -if not all- of these activities are in danger of joining the "Let George Do It" philosophy.

The growth of television to a true nation-wide status will probably parallel the experiences in radio broadcast service expansion to the same status. Initially, there were a limited number of radio broadcast stations, and reception obtained was of the D-X variety, corresponding roughly, to fringe-area TV. As the number of stations grew, and as network services were supplied to them, the necessity for reception from distant stations was reduced. Expansion was so great, in fact, that present-day radio listeners seldom depend on stations outside of their immediate area for program content. As an example, our home city has a station affiliated with each of the national radio network services.

If television, then, is to achieve nation-wide status, it must have a proportionate amount of stations to adequately and competitively serve all the market areas. Such a number of stations must perforce be assigned throughout the 12-channel VHF allocation and the 70-channel UHF allocation structure. Since the 12-channel VHF structure existed, in the main, pre-freeze, there is not a great possibility of additional assignments therein. Add this to the simple mathematical fact that the 70-channel spectrum is almost six times as great as the 12-channel allotment and the future accent of nation-wide television is not too hard to predict.

When the ultimate UHF predominance is considered, doesn't it seem odd that the steps taken for protection of this market through satisfaction of the customer, up to this point have been woefully inadequate. As a matter of fact, in too many cases definite prejudice against UHF services has been created. Manufacturers, for example, still apply a great deal of their concern to "VHF only" equipment and markets; installers and service technicians, either through carelessness or unfamiliarity, have made too many unsatisfactory installations; stations, in many cases, have made their bows with inadequate power and facilities, with a resultant very poor impression, and network services, preoccupied with the "lush" VHF primary services, have been apparently reluctant to give the struggling newcomer the affiliation he so desperately needs in any competitive market.

Add all of this up, and you can certainly see the parallel. If we wait until we reach the hungry state before correcting the ills, we have performed a needless disservice to our customers, our industry, our economy, and ourselves.

J.R.R.


# WHY SYLVANIA PRODUCTS MEAN BETTER BUSINESS!

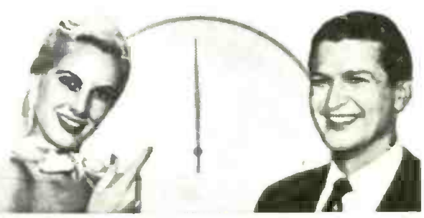
YOU'RE really on board the *better-profit* special when you feature Sylvania Picture Tubes and Receiving Tubes.

Your customers know Sylvania as a pioneer in the development of fine radio and television products. From the very beginning, the name Sylvania has stood for the highest possible quality. And, as the industry has progressed and expanded, Sylvania has taken great care to maintain its recognized leadership.

*Now, due to advanced manufacturing techniques and precision testing methods, Sylvania tubes can point to outstanding records, both in long life and fine performance. Today 7 of the 10 leading set manufacturers use Sylvania Picture Tubes and Receiving Tubes.*

So, if you want *recognized quality* working on your side . . . *sell Sylvania!* Call your local Sylvania Distributor for the latest fall prices and money-making promotion offers, or write to: Sylvania Electric Products Inc., Dept. 3R-1611, 1740 Broadway, New York 19, N. Y.

**Television keeps telling about Sylvania quality**

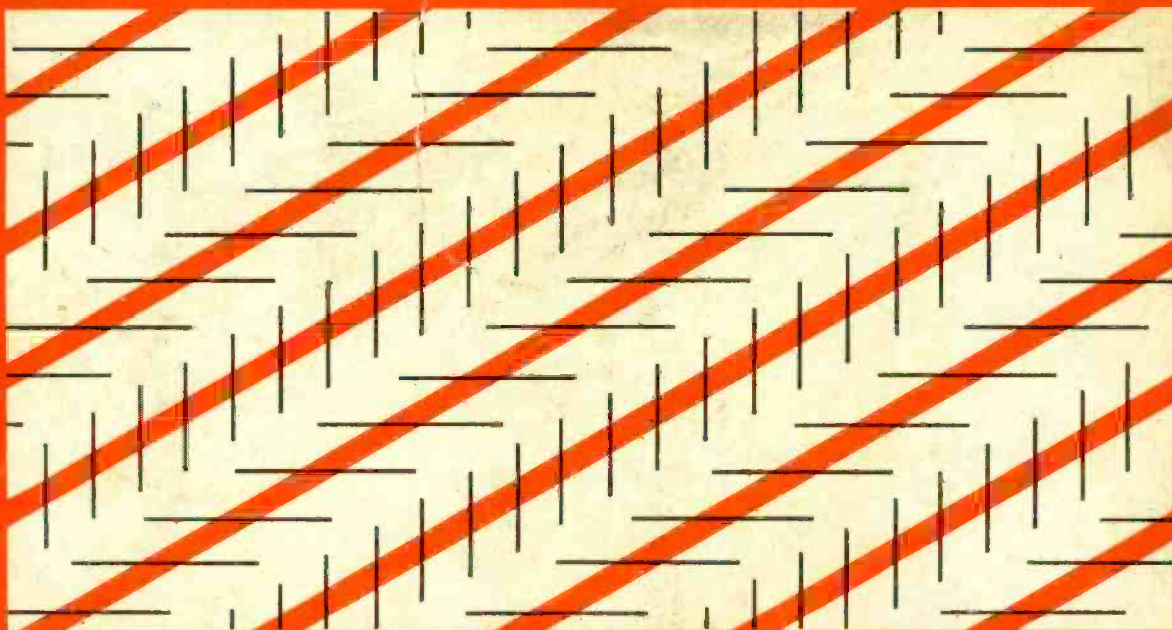


Sylvania's popular nation-wide television show "Beat the Clock" continues to tell millions of your customers week after week, all through the year, about the unbeatable quality of Sylvania products.

**SYLVANIA**

LIGHTING • RADIO • ELECTRONICS • TELEVISION

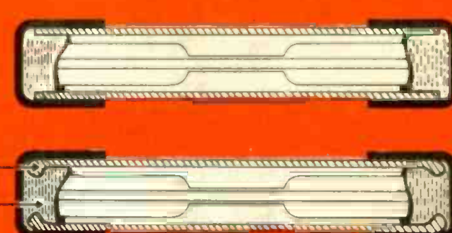
In Canada: Sylvania Electric (Canada) Ltd.
University Tower Bldg., St. Catherine Street, Montreal, P. Q.



# THINGS ARE NOT AS THEY SEEM...

The long lines are strictly parallel—
that they appear otherwise is an optical illusion.

This fuse merely has the metal caps cemented to the glass.




The difference between these two fuses is no illusion . . .

This Littelfuse has the caps locked to glass like this.

The ends of the glass are formed[A]. The solder which is bonded in a separate operation to the cap reflows through the small aperture and spreads out to form a permanent collar-button lock[B] between cap and glass—impervious to moisture and vibration. The exclusive Littelfuse feature eliminates fuse failure due to loose caps.

*Littelfuse leads all other fuse manufacturers in design patents on fuses. Lock-cap assembly patent no. 1922642*

**LITTELFUSE**

DES PLAINES, ILLINOIS

*Burton browne advertising*