DEVOTED ENTIRELY TO THE
RADIO SERVICEMAN

25 CENTS

RADIO
MAINTENANCE

SEPTEMBER 1947

SERVICING IS BIG BUSINESS
ANTENNA SYMPOSIUM
THE TELEVISION PICTURE TUBE
SERVICING FM RECEIVERS
PART III

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PHILCO TUBE TESTER, MODEL 7050. Can never become obsolete with changes in tube types, thanks to exclusive Philco Element Switching system. Built-in loose leaf chart.

See your Philco Distributor about these modern instruments—today.
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Change of address: Four weeks’ notice required for change of address. When ordering a change, please furnish an address stencil impression from a recent issue if you can. Address changes cannot be made without the old stencil as well as the new one.
The procedures outlined here will make success and profit more certain in your auto radio installation jobs.

With millions of auto radio sets in operation, and millions more potential set installations as new cars and new sets become available in volume, every serviceman needs to have a thorough understanding of available types of automobile antennas, relative efficiencies, correct installation procedures, and maintenance problems.

The purpose of an antenna is, of course, to deliver to the set a sufficiently strong signal voltage to override inherent set noise. The signal voltage should be free of ignition interference, wheel static, etc.

The vertical whip type of mast has proven the most efficient type for automobile use; and with such an antenna, the signal voltage induced by the radio wave is approximately proportional to antenna length. Maximum mast lengths, and thus maximum signal voltages, are limited by clearance requirements and by appearance considerations, many owners preferring a short aerial where the car is used primarily for city driving.

With the maximum signal voltage thus limited, it is highly important to transmit this voltage without excessive losses through the lead in cable to the set. The cable must be low in capacity for its capacity forms with the distributed capacity of the mast a circuit equivalent to a capacity voltage divider, and signal strength at the set is reduced as the lead capacity increases. A quality lead cable will not exceed one uufd per inch.

In addition, the insulating material between the cable shielding and the center conductor must have a low power factor. The makers of the best automobile antennas now have discontinued the use of asphalt impregnated paper loom insulation in the transmission cables. This material not only resulted in a high capacity lead, it also absorbed moisture in damp weather and power factor losses were serious.

Polyethylene is now used in place of the paper loom between the center conductor and the shielding on quality cables. This plastic has the lowest losses of any commercially available flexible insulating material. It was used widely in radar applications during the war, and antenna lead ins made with it have low capacity, low loss, and high Q.

One additional antenna lead in characteristic, the braided shielding, is important to a low noise level. This should be so tightly woven that no gaps are visible—so-called 100 per cent shielding. Loosely woven shielding may show as much as 50 per cent open spaces. This
results in pick up of ignition interference and is a potent source of customer complaints.

Typical lead in cables of the new and old types are shown in Fig. 1.

**Choosing the Antenna**

The choice of a car antenna is governed by available mounting locations. In order to reduce lead in losses, a location close to the set is essential. The losses for a short lead are, of course, much less than for a long lead. Aerials for installation by the serviceman commonly are made for mounting either on top of the cowl just forward of the windshield post, on top of a front fender, on the side cowl panel ahead of the car door, or (rarely) on the side of a fender.

Typical aerials for the several mounting positions are shown in Fig. 2. Type A was introduced at a time when all cars had a vertical side cowl panel. It is a proven type and very satisfactory for mounting under such conditions.

In the evolution of body styles, the so-called torpedo body style was first used on 1940 cars. On these cars, the side cowl slopes slightly inward, and in order to keep the mast vertical, a longer top insulator is used. By drilling the mounting holes at a separation dependent upon the slope of the cowl, the serviceman can make the insulators fit varying slopes and the mast will take a vertical position. This style is shown in 2B.

In order to provide an easier means of adjustment than by spacing the mounting stanchions, and also to provide a more pleasing appearance, a third type of side cowl antenna with adjustable mast angle was introduced. This type, shown in Fig. 2C, is easy to install and can be aligned for extreme sloping surfaces. It is very important to choose one which has a rugged locking feature. The antenna illustrated locks by means of two heavy set screws which bits into the disc holding the mast section.

Antennas designed for side cowl installation can, of course, be mounted on the side of the fender; but this position is recommended only on fenders which curve in toward the body at the rear where the antenna can be mounted in a protected position.

Many factory installed antennas are mounted on either the top of the cowl or the top of the fender, one reason being that several of the car manufacturers in 1941 introduced body styles which did not have a cowl panel separating the hood from the front door so that side cowl mounting was no longer possible. The trend has continued and the majority of 1946 cars cannot be fitted with a side cowl antenna.

An antenna for mounting in top cowl or top fender position presents special problems both of design and installation. The assembly mounts through a single hole, and all strains which the motion of the car sets up in the mast must be supported by a single mount. Also, the mast must be adjustable through a wide arc to compensate for the many variations in slope which will be encountered in replacement installations.

To make the mounting stronger, it has been common practice to provide braces or brackets underneath the body. These are rather difficult to install; and recently a mounting has been introduced which clamps a heavy reinforcing washer securely underneath the body metal. With this type, no braces are neces-

Fig. 1 Two types of antenna lead-in cable for automobile use: A, Polyethylene insulated type; B, older type using paper loom construction and shield can fitting. Choice of lead-in cable can have an important effect on efficiency of the automobile receiver.
sary and installation is simplified greatly. An aerial of this type is shown in Fig. 2D.

Angular adjustment of the mast is obtained by several methods, some of which are time consuming and none too secure. In the antenna illustrated, the mast section is provided with a ball which rests in a socket. The assembly can be swivelled freely for alignment, and it is then locked permanently by pressure of the cap nut which forces the ball against a special hardened seat.

Just prior to the war, in response to a demand for a particularly trim, neat appearing aerial, the concealed or disappearing type was introduced. This type has a mast assembly which slides below the body surface in the down position so that all but a few inches can be hidden. Of course, for good reception of weak signals, the mast must be extended just as with conventional types of aerials.

This concealed aerial is of more complicated design than other styles; and consequently usually gives trouble in cheap, poorly engineered models. The best concealed aerials will give long service, free from water leakage, noisy contacts, shorting or other troubles. No serviceman who values satisfied customers should use any but the best quality concealed aerial. A concealed aerial is shown in Fig. 2E.

**Installation**

Installation of a well designed antenna should be an easy and profitable job for the serviceman. The principal job is to locate and drill the mounting holes. Antennas in all styles are available which mount through ¾ inch holes. This size is within the capacity of a breast or electric drill. If a larger hole is required, a hole saw, circle cutter, or rat tail file can be used.

The mounting base must make good electrical contact with the body metal. This is insured by scraping interior body surface with any sharp edged tool such as the square end of a file to remove sound deadening felt, scale, or paint, and finishing with coarse sandpaper, emery, or steel wool.

After the mounting is inserted through the holes, the mounting nuts can be tightened with socket, open end, or crescent wrenches or even pliers.

When the mounting base is anchored securely, the lead must be attached to the antenna. With older types of leads, this was a rather fussy job in cramped quarters, but with the new plug-in type of lead, illustrated in Fig. 1A, the attachment can be made in a matter of seconds. The job is complete when the lead cable is plugged into the receptacle on the set.

**Correct Installation Procedure**

Determine suitable mounting location before drilling holes. Check exterior clearances with hood and door open. Check interior obstructions such as body braces. When sure that no obstructions will interfere at the chosen spot, center punch and drill the required holes, keeping the axis of the drill identical with the axis which will be taken by the part which will fit through the hole.

Clean around the interior surface of the hole to expose bare metal.

Insert mounting stanchions, put on lock washer, thread on mounting nuts and tighten firmly, but don't overtighten. Stop before compression causes the rubber waterproofing gasket at the bottom of the exterior mounting assembly to curl at the edges.

Connect lead in to antenna either by plugging in or by fastening to binding post. With binding post type of connection, be sure to replace cover of shield can.

Run lead to set and plug end into receptacle. If plug-on end of cable does not match set receptacle, solder on the adapter which is supplied.

**Alignment of Antenna Trimmer**

When the aerial is connected and extended, tune the set to a weak station at about 600 ke with the volume control set at maximum. Adjust the antenna trimmer condenser until maximum volume is reached, then retune the same signal and...
again adjust the trimmer. If adjusting at 600 kc does not show a marked intensity peak, tune the set to a weak station near 1400 kc and adjust on this signal.

This matches impedances between the antenna and the input circuit of the receiver and gives maximum energy transfer.

Checking the Installation

It is good practice before considering the installation complete to check it with an ohmmeter. The circuit from the mast to the contact tip on the receiver plug should have a resistance too low to read on the ordinary meter. If this is not true, the lead probably is not making good contact with the aerial, or the lead itself may be defective.

The resistance between the shell of the plug to the receiver and the body of the car should be also too low to measure. If it is not, the mounting assembly is not making a good ground where it passes through the body; and the shielding on the lead may not eliminate motor interference.

The final check should be a reading of the resistance between contact tip of the receiver plug and shell of this same plug. Any value of resistance which can be measured on the ordinary meter indicates a leakage path which must be found and eliminated.

Maintenance Procedure

The ordinary car antenna requires little maintenance. The telescoping sections should be kept clean in order to work freely. The use of a good grade of metal polish is recommended, followed by a light coating of a hard body wax.
ANTENNA SYMPOSIUM

The result of an extended survey designed to answer in one comprehensive list the many inquiries we have received about available FM and television antennas.

The antenna requirements for good FM and Television reception are much more exacting than those of ordinary AM receivers. In FM and television receivers the antennas rank in importance with the most critical components of the receivers themselves. Although the general public is apparently not yet aware of this fact, the radio serviceman certainly is, for Radio Maintenance has been receiving many requests during months past for information about FM and television antenna problems encountered by those installing these receivers. Since these problems are many and varied in each individual case is different, the staff of Radio Maintenance decided many months ago to conduct an extensive survey aimed at gathering all available data about the types of antennas suitable for home television and FM use. These are the types which will be installed in millions of homes in future months.

The antennas are listed alphabetically by manufacturer and the tables include the information necessary to determine the application and suitability of each type. Certain fundamentals should be kept in mind:

1. Due to the wide diversity of frequencies used for FM and television, it is usually advisable to make some sacrifice in gain to allow a broad frequency response.

2. Matching is an important factor, and substitution of other than the recommended transmission line can seriously impair the operation.

3. Proper height and location are necessary to bring-out the full capabilities of any type of antenna. An approach to "line of sight" conditions nearly always is helpful.

4. Location of stations should be considered in choice of directivity characteristics. If all the stations within range are in one direction a unidirectional type may give more gain, but this antenna cannot be used in locations between stations.

Abbreviations have been used as follows:

bak—bakelite
bid—bidirectional pattern
cer—ceramic
DP—dipole
FM—frequency modulation
omni—omnidirectional pattern
poly—polystyrene
refl—reflector
TV—television
uni—unidirectional pattern

We wish to thank the participating manufacturers for their cooperation in supplying the information necessary to make this symposium a success.
# FM AND TELEVISION ANTENNA SYMPOSIUM

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model</th>
<th>Illus. No.</th>
<th>Type Application</th>
<th>Frequency Range</th>
<th>No. of Elements</th>
<th>Directivity</th>
<th>Dimensions</th>
<th>Weight Lb</th>
<th>Insulating Material</th>
<th>Transmission Line Used</th>
<th>Special Features, Accessories, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Phenolic Corp.</td>
<td>107-104</td>
<td>4</td>
<td>DP - FM</td>
<td>88 - 108</td>
<td>1 bid</td>
<td>5' long</td>
<td>1.5</td>
<td>bak</td>
<td>200 ohm</td>
<td>5' unins. or steel mast and 75' of 300 line supplied</td>
<td></td>
</tr>
<tr>
<td></td>
<td>124-001</td>
<td>2</td>
<td>All wave wire and DP (automatic)</td>
<td></td>
<td>1 bid</td>
<td>5'1&quot; and 65' wire</td>
<td></td>
<td>polythene</td>
<td>52 ohm</td>
<td></td>
<td>65' mast, covered with polythene. 5' steel mast and 30' of 32 ohm coax. included; optional filter switches to proper antenna</td>
</tr>
<tr>
<td>Andrew Co.</td>
<td>710 Difan</td>
<td>6</td>
<td>FM and TV</td>
<td>44 - 210</td>
<td></td>
<td>10' x 4'</td>
<td></td>
<td></td>
<td></td>
<td>60' 300 ohm ribbon included, mounting kits 711 &amp; 712 extra</td>
<td></td>
</tr>
<tr>
<td>Bendix Radio</td>
<td>10900</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 bid</td>
<td>50'</td>
<td></td>
<td></td>
<td>Same as above</td>
<td></td>
</tr>
<tr>
<td>L. S. Brainch Mfg. Co.</td>
<td>170-108</td>
<td>2</td>
<td>DP and Bell, Low TV bands</td>
<td>44 - 88</td>
<td>2 unit</td>
<td>118'</td>
<td></td>
<td>bak</td>
<td>300 ohm</td>
<td>Same as above</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Folded DP &amp; Bell, FM</td>
<td>88 - 108</td>
<td></td>
<td></td>
<td>1 bid</td>
<td>70'</td>
<td></td>
<td>bak</td>
<td>300 ohm</td>
<td>Same as above</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cross DP, FM</td>
<td>88 - 110</td>
<td></td>
<td></td>
<td>2 unit</td>
<td>100'</td>
<td></td>
<td>bak</td>
<td>300 ohm</td>
<td>Same as above</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Folded DP, FM</td>
<td>88 - 108</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>bak</td>
<td>300 ohm</td>
<td>Same as above</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cross DP, FM</td>
<td>88 - 110</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>bak</td>
<td>300 ohm</td>
<td>Same as above</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 TV and FM</td>
<td>44-108; 175-210</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>bak</td>
<td>300 ohm</td>
<td>Same as above except 8' mast and choice of &quot;bazooka&quot; or dividers for matching</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dual dipole, TV</td>
<td>44 - 108</td>
<td></td>
<td></td>
<td>2 bid</td>
<td>94'</td>
<td></td>
<td>bak</td>
<td>52 ohm coax</td>
<td>8' mast, 7/8&quot; dia. &amp; 50' 72 ohm coax included. Bazookas for matching. A refl. can be added</td>
<td></td>
</tr>
<tr>
<td>Manufacturer</td>
<td>Model</td>
<td>Silou. No.</td>
<td>Type Application</td>
<td>Freq. Range</td>
<td>No. of Elements</td>
<td>Directivity</td>
<td>Dimensions</td>
<td>Weight (lb.)</td>
<td>Insulating Material</td>
<td>Transmission Line Used</td>
<td>Special Features, Accessories, etc.</td>
</tr>
<tr>
<td>--------------</td>
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<td>----------------------------------</td>
</tr>
<tr>
<td>General Electric Co.</td>
<td>F-1</td>
<td>002-7412</td>
<td>Folded DP &amp; Helix</td>
<td>PM, 60-88</td>
<td>1 bid 9&quot; x 2&quot;</td>
<td>hick</td>
<td>300 ohm</td>
<td>Same as above</td>
<td>Coaxial coupling.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>F-2</td>
<td>002-7415</td>
<td>Folded DP &amp; Helix</td>
<td>PM, 50-88</td>
<td>2 unit 9&quot;</td>
<td>hick</td>
<td>300 ohm</td>
<td>Same as above</td>
<td>Coaxial coupling.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>F-3</td>
<td>002-7416</td>
<td>Folded DP &amp; Helix</td>
<td>PM, 50-88</td>
<td>4 unit 9&quot;</td>
<td>hick</td>
<td>300 ohm</td>
<td>Same as above</td>
<td>Coaxial coupling.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** The table above provides a summary of the characteristics and specifications of various radio components produced by General Electric Co. and other manufacturers. The entries include details such as type, application, frequency range, number of elements, directivity, dimensions, weight, insulation material, transmission line used, and special features or accessories. Each entry is designed to help in identifying and selecting the appropriate radio component for specific applications. The table is a valuable resource for radio maintenance professionals and enthusiasts, offering a comprehensive overview of the components available during the period spanning from 1931 to 1947.
<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model</th>
<th>Name</th>
<th>Application</th>
<th>No. of Channels</th>
<th>Directivity</th>
<th>Dimensions</th>
<th>Weight</th>
<th>Insulating Material</th>
<th>Transmission Line</th>
<th>Special Features, Accessories, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Philco Corp.</td>
<td>FM10</td>
<td>25</td>
<td>Adj. 75' FM</td>
<td>1 bid</td>
<td>bid</td>
<td>60' x 48&quot;</td>
<td>84 lb</td>
<td>bak &amp; poly</td>
<td>150 - 300</td>
<td>A mast which simultaneously accommodates up to 5 antennas as an array or separate units is available. Also, mast in two 4' sections included.</td>
</tr>
<tr>
<td></td>
<td>FM10</td>
<td>30</td>
<td>Adj. 75' FM</td>
<td>1 uni</td>
<td>uni</td>
<td>60' x 30&quot;</td>
<td>5 lb</td>
<td>bak</td>
<td>300</td>
<td>Polarization angle of dipole sections adjustable to form V of any angle. 42' steel mast and guy plate included. Mast extensions and line available separately.</td>
</tr>
<tr>
<td></td>
<td>FM54</td>
<td>11</td>
<td>Extended 75' FM, 44-216</td>
<td>1 bid</td>
<td>bid</td>
<td>5' x 2'</td>
<td>4 lb</td>
<td>bak</td>
<td>300</td>
<td>Same as above, but 75' 300 ohm line supplied</td>
</tr>
<tr>
<td>Radio Corp. of America</td>
<td>228</td>
<td>23</td>
<td>DP, FM, TV, 14 - 108</td>
<td>1 bid</td>
<td>bid</td>
<td>2&quot; x 5&quot;</td>
<td>1.4 lb</td>
<td>bak</td>
<td>200</td>
<td>Pattern quadrilateral, 174-216; lightning arrestor, terminals and stop-off screw eye screw included. Mounting bracket No. 227 available.</td>
</tr>
<tr>
<td></td>
<td>228</td>
<td>25</td>
<td>Folded DP, FM, TV, 14 - 108</td>
<td>2 uni</td>
<td>uni</td>
<td>2&quot; x 5&quot;</td>
<td>1.4 lb</td>
<td>bak</td>
<td>200</td>
<td>Same as 228B</td>
</tr>
<tr>
<td>Harold Corp.</td>
<td>150</td>
<td>25</td>
<td>Folded multi-element - FM</td>
<td>1 uni</td>
<td>uni</td>
<td>5'</td>
<td>3 lb</td>
<td>mast</td>
<td>300</td>
<td>Mast included</td>
</tr>
<tr>
<td></td>
<td>150</td>
<td>19</td>
<td>Folded multi-element - FM</td>
<td>2 uni</td>
<td>uni</td>
<td>5'</td>
<td>3.5 lb</td>
<td>mast</td>
<td>200</td>
<td>Mast included; 194 heavier construction, otherwise identical</td>
</tr>
<tr>
<td>S/C Laboratories</td>
<td>76</td>
<td>17</td>
<td>DP and Bell</td>
<td>1 uni</td>
<td>uni</td>
<td>5'</td>
<td>15 lb</td>
<td>mast</td>
<td>150</td>
<td>Mast included</td>
</tr>
<tr>
<td></td>
<td>76a</td>
<td>19</td>
<td>Brave DP, Bell, 704A, 704B, 704C</td>
<td>1 bid</td>
<td>bid</td>
<td>51' x 4'</td>
<td>14 lb</td>
<td>bak</td>
<td>300</td>
<td>Mast included; 76A heavier construction, otherwise identical</td>
</tr>
<tr>
<td></td>
<td>76c</td>
<td>21</td>
<td>Brave DP, Bell, 704A-24, 704C-24, 704B-24</td>
<td>4 uni</td>
<td>uni</td>
<td>51' x 18&quot;</td>
<td>17 lb</td>
<td>bak</td>
<td>300</td>
<td>Mast included</td>
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<tr>
<td>Short-Antenna-Mount</td>
<td>Interceptor</td>
<td>32</td>
<td>Adj. DP &amp; Bell, FM and TV, 44 - 216</td>
<td>2 uni</td>
<td>uni</td>
<td>2 wave</td>
<td>72 ohm</td>
<td>bak &amp; poly</td>
<td>300 with U</td>
<td>Element length and spacing adjustable. U section for matching 300 ohm line, birch or maple 1½ mast, 75' 300 ohm line available</td>
</tr>
<tr>
<td></td>
<td>Sniper Mfg. Co.</td>
<td>FM00</td>
<td>DP - FM, 50-108</td>
<td>1 bid</td>
<td>bid</td>
<td>66' x 4&quot;</td>
<td>5 lb</td>
<td>bak</td>
<td>300</td>
<td>Universal mount allows 300 ohm line in vertical, and 300 ohm line in horizontal planes adjustments.</td>
</tr>
<tr>
<td></td>
<td>FM01</td>
<td>1 bid</td>
<td>DP, Bell, FM, 50-108</td>
<td>1 uni</td>
<td>uni</td>
<td>66' x 4&quot;</td>
<td>5 lb</td>
<td>bak</td>
<td>300</td>
<td>Mast included, 10 ducted construction, otherwise identical</td>
</tr>
<tr>
<td></td>
<td>FM13</td>
<td>2 uni</td>
<td>DP, Bell, FM, 44-88</td>
<td>1 bid</td>
<td>bid</td>
<td>51' x 4'</td>
<td>14 lb</td>
<td>bak</td>
<td>300</td>
<td>Mast included; 10 ducted construction, otherwise identical</td>
</tr>
<tr>
<td></td>
<td>TV13</td>
<td>2 uni</td>
<td>DP, Bell, TV, 44-88</td>
<td>1 bid</td>
<td>bid</td>
<td>51' x 4'</td>
<td>14 lb</td>
<td>bak</td>
<td>300</td>
<td>Mast included; 10 ducted construction, otherwise identical</td>
</tr>
<tr>
<td></td>
<td>Technical Appliance Corp.</td>
<td>611</td>
<td>Folded DP &amp; Bell, FM, 68 - 108</td>
<td>2 uni</td>
<td>uni</td>
<td>51' x 3'</td>
<td>7 lb</td>
<td>bak &amp; poly</td>
<td>300</td>
<td>5' wood mast 2½&quot; dia. &amp; 60' 300 ohm line included. DP &amp; Bell transformer available for all wave use.</td>
</tr>
<tr>
<td></td>
<td>500</td>
<td>25</td>
<td>Cage Type</td>
<td>1 bid</td>
<td>bid</td>
<td>5'</td>
<td>16 lb</td>
<td>mast</td>
<td>300</td>
<td>Cage shape &amp; multi-element construction provide broad band operation</td>
</tr>
<tr>
<td></td>
<td>350</td>
<td>24</td>
<td>All wave Special, 44 - 216</td>
<td>2 bid</td>
<td>bid</td>
<td>64' x 5'</td>
<td>7 lb</td>
<td>bak &amp; poly</td>
<td>300</td>
<td>Short, thick dipole connected through insulator rings to thin longer dipole giving broad band effect. 94' steel mast &amp; 65' 300 ohm line and bracket included.</td>
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<tr>
<td></td>
<td>FN60</td>
<td>1 bid</td>
<td>DP, FM, 68 - 108</td>
<td>1 bid</td>
<td>bid</td>
<td>60' x 4&quot;</td>
<td>6 lb</td>
<td>bak</td>
<td>100</td>
<td>5½' steel mast 1½&quot; dia. weatherproof &amp; 60' 300 ohm line included. Rigid steel tubing construction boom with adjustable angle. Mounting &amp; guy ring also supplied</td>
</tr>
<tr>
<td></td>
<td>FN55</td>
<td>1 bid</td>
<td>Folded DP, FM, 68 - 108</td>
<td>1 bid</td>
<td>bid</td>
<td>60' x 4&quot;</td>
<td>6 lb</td>
<td>bak</td>
<td>100</td>
<td>Mast included</td>
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<td>TV18</td>
<td>1 bid</td>
<td>DP, TV, 68 - 80</td>
<td>1 bid</td>
<td>bid</td>
<td>60' x 4&quot;</td>
<td>6 lb</td>
<td>bak</td>
<td>200</td>
<td>Mast included</td>
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<td></td>
<td>TV14</td>
<td>1 bid</td>
<td>Folded DP, TV, 68 - 80</td>
<td>1 bid</td>
<td>bid</td>
<td>60' x 4&quot;</td>
<td>6 lb</td>
<td>bak</td>
<td>200</td>
<td>Mast included</td>
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<td></td>
<td>FN50</td>
<td>2 uni</td>
<td>Bell kit for FM50 or FM500</td>
<td>2 uni</td>
<td>uni</td>
<td>60'</td>
<td>6 lb</td>
<td>bak</td>
<td>200</td>
<td>Bell kit makes single antenna into two element arrays by simply bolting rod to mast</td>
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<tr>
<td></td>
<td>TF10</td>
<td>2 uni</td>
<td>Bell kit for TV10 or TV101</td>
<td>2 uni</td>
<td>uni</td>
<td>5'</td>
<td>6 lb</td>
<td>bak</td>
<td>200</td>
<td>Uniform accessories as above</td>
</tr>
<tr>
<td>Workshop Associates</td>
<td>T077</td>
<td>1 bid</td>
<td>DP with direct &amp; Bell, TV, Channel 2</td>
<td>2 uni</td>
<td>uni</td>
<td>1.5 lb</td>
<td>72 ohm coax</td>
<td>mast</td>
<td>150</td>
<td>Separate type for each channel optimum response at one freq. also good performance on adjacent channels. 7% steel mast 10½&quot; dia. included. Rotor, cone base &amp; extra mast sections available extra cost</td>
</tr>
<tr>
<td></td>
<td>TV93</td>
<td>1 uni</td>
<td>3 3</td>
<td>1 uni</td>
<td>1.5 lb</td>
<td>72 ohm coax</td>
<td>mast</td>
<td>150</td>
<td>Same accessories as above</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TV99</td>
<td>2 uni</td>
<td>4 3</td>
<td>1 uni</td>
<td>1.5 lb</td>
<td>72 ohm coax</td>
<td>mast</td>
<td>150</td>
<td>Kit to convert FM to 3 element directive array</td>
<td></td>
</tr>
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SEPTEMBER 1947 • RADIO MAINTENANCE
WHEN television was introduced to the public in 1939, one of the serious objections raised against it by the viewing audience was that the screen was too small to provide bright, clear, and detailed pictures. The picture size was limited by the cathode-ray tube on whose face the image was traced. The largest magnetic type television tube introduced at that time was the 12AP4 which was capable of producing a picture 8 x 10 inches in size. A few electrostatic tubes of 14- and 20-inch diameters were also built, but the faces of these tubes were too round, resulting in distorted images.

Two approaches to solving this problem were tried. The first was to increase the face diameter of the tube while also making it substantially flat. The second method was to develop a small projection tube which produced an image sufficiently bright to be projected onto a screen. To date, 15-inch and 20-inch magnetic tubes have been developed, having screens of negligible curvature. The 20-inch tube is probably the largest commercial direct view tube that will be produced in view of the high cost and problems involved in its manufacture. Pictures 13 x 18 inches are obtained with the new 20-inch tubes. Projection systems, on the other hand, employ 3-, 4-, and 5-inch diameter tubes which with a suitable optical system throw an image as large as 19 x 25 inches on to a screen.

Though direct view tubes and projection systems are now developed to the point where large, good quality pictures can be produced, their main drawback is the high cost of receivers in which they are used. To meet the demands of the low-priced market, manufacturers have had to resort to the smaller, direct view tubes, compromising on picture size in order to produce a low cost receiver. However, a marked improvement has been achieved over earlier sets for the newer tubes are operated at higher voltages and give brighter, sharper pictures.

Three types of 7-inch diameter tubes are now being used in the lowest priced television receivers. In this group are the electrostatic types, 7EP4 and 7GP4, and the magnetic type 7DP4. The useful picture area of 7-inch tubes is approximately 4 x 5½ inches. The 7EP4 operates at the lowest accelerating potential, about 2500 volts. It thus requires the smallest high voltage supply and is used in receivers where cost is held to an absolute minimum. The 7GP4 is characterized by its higher accelerating potential of 4000 volts, greater light output than the 7EP4, and higher deflection sensitivity. Both tubes are electrostatically focused and deflected and have conventional electron gun designs.

The 7DP4 is the smallest mag-
magnetic tube that is now employed in television receivers. It is electrostatically focused and magnetically deflected and operates at 6000 volts. At this high voltage, it produces the brightest and sharpest picture of the 7-inch tube types. The deflection yoke and high deflection currents needed for the 7DP4 increase the cost of sets in which it is used somewhat above those employing the electrostatic tube types. A modern television receiver with a 7DP4 tube is shown in Fig. 1.

**Ion Trap**

An interesting feature of the 7DP4 is its ion trap type of electron gun. One of the characteristics of magnetic types is the ion burn that forms in the center of the screen after a few hours of operation. This ion burn appears as a brown spot about the size of a half dollar and is caused by the continual bombardment of the phosphor screen by the heavier and slower moving ions inside the cathode-ray tube. These ions are emitted from the electron gun along with the useful electrons, and are attracted by the high accelerating voltage towards the screen. To avoid this ion spot, the ion trap electron gun in combination with a magnet has been devised for magnetic tubes. As shown in Fig. 2, the first and second anode are constructed with an oblique gap which causes both electrons and ions to be deflected at right angles to the gap. The ion-trap magnet, placed at the neck of the tube behind the focus coil, applies a steady magnetic deflecting field to the electrons and bends them back along the axis of the tube. The heavier ions are not so readily affected by the magnetic field and are collected by the second anode. In this manner, the ions and electrons are separated, and the ions trapped within the gun structure. Fig. 2 shows the respective paths of the ion and electron beams.

**Magnet Adjustment**

Adjustment of the ion-trap magnet may be difficult at first for the serviceman when replacing the cathode-ray tube, for, unless the magnet is correctly positioned, the electrons will also be collected by the second anode and no illumination will appear on the tube. The ion-trap magnet should, therefore, be adjusted first before attempting to line up the focus coil and deflection yoke. The magnet is initially positioned so that the rear magnet poles are over two small flags attached to the gun. This pre-positioning insures some illumination of the screen. The final position is that which gives maximum illumination and is made by observation of the screen, while the magnet is moved forward or backward with a slight rotational movement. The clamp on the magnet is then tightened to lock the assembly securely to the neck of the picture tube.

**10-Inch Types**

The next price range of tele-
# TELEVISION CATHODE-RAY TUBE

## CHART

<table>
<thead>
<tr>
<th>Type</th>
<th>Nominal Diameter Inches</th>
<th>Overall Length Inches</th>
<th>Base</th>
<th>Bulb Contact</th>
<th>Raster Size Inches</th>
<th>Focus Method</th>
<th>Defl. Method</th>
<th>Ion Trap</th>
<th>Defl. Angle</th>
<th>Heater Volts</th>
<th>Heater Amps.</th>
<th>Typical Operating Conditions</th>
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<tbody>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td>Anode no. 2 Volts</td>
<td>Anode no. 1 Volts</td>
<td>G2 Volts</td>
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<td>5TP4</td>
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<td>11½</td>
<td>Duodecal 7 Pin</td>
<td>Recessed Small Cavity</td>
<td>3 x 4</td>
<td>E</td>
<td>M</td>
<td>No</td>
<td>50°</td>
<td>6.3</td>
<td>0.6</td>
<td>27000</td>
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<td>7DP4</td>
<td>7/3/16</td>
<td>14 1/16</td>
<td>Duodecal 7 Pin</td>
<td>Recessed Small Cavity</td>
<td>4 x 5½</td>
<td>E</td>
<td>M</td>
<td>Yes</td>
<td>50°</td>
<td>6.3</td>
<td>0.6</td>
<td>6000</td>
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<td>7EP4</td>
<td>7</td>
<td>15½</td>
<td>Medium Magnal</td>
<td>4 x 5½</td>
<td>E</td>
<td>E</td>
<td>No</td>
<td>6.3</td>
<td>0.6</td>
<td>2500</td>
<td>650</td>
<td>-60</td>
</tr>
<tr>
<td>7GP4</td>
<td>7</td>
<td>14½</td>
<td>Diheptal 12 Pin</td>
<td>4 x 5½</td>
<td>E</td>
<td>E</td>
<td>No</td>
<td>6.3</td>
<td>0.6</td>
<td>3000</td>
<td>1000</td>
<td>-60</td>
</tr>
<tr>
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<td>10½</td>
<td>17 5/8</td>
<td>Duodecal 7 Pin</td>
<td>Recessed Small Cavity</td>
<td>6 x 8</td>
<td>M</td>
<td>M</td>
<td>Yes</td>
<td>50°</td>
<td>6.3</td>
<td>0.6</td>
<td>9000</td>
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<tr>
<td>10EP4</td>
<td>10½</td>
<td>17 5/8</td>
<td>Duodecal 7 Pin</td>
<td>Recessed Ball Cap</td>
<td>6 x 8</td>
<td>M</td>
<td>M</td>
<td>Yes</td>
<td>50°</td>
<td>6.3</td>
<td>0.6</td>
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<tr>
<td>10FP4</td>
<td>10½</td>
<td>17 5/8</td>
<td>Duodecal 7 Pin</td>
<td>Recessed Small Cavity</td>
<td>6 x 8</td>
<td>M</td>
<td>M</td>
<td>No</td>
<td>50°</td>
<td>6.3</td>
<td>0.6</td>
<td>9000</td>
</tr>
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<td>12JP4</td>
<td>12</td>
<td>17½</td>
<td>Duodecal 7 Pin</td>
<td>Recessed Ball Cap</td>
<td>7½ x 10½</td>
<td>M</td>
<td>M</td>
<td>No</td>
<td>50°</td>
<td>6.3</td>
<td>0.6</td>
<td>10000</td>
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<tr>
<td>15AP4</td>
<td>15 5/8</td>
<td>20 3/16</td>
<td>Duodecal 7 Pin</td>
<td>Recessed Ball Cap</td>
<td>9½ x 12½</td>
<td>M</td>
<td>M</td>
<td>No</td>
<td>50°</td>
<td>6.3</td>
<td>0.6</td>
<td>12000</td>
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<tr>
<td>20BP4</td>
<td>20</td>
<td>28½</td>
<td>Duodecal 7 Pin</td>
<td>Medium External Cap</td>
<td>12 7/8 x 17½</td>
<td>M</td>
<td>M</td>
<td>No</td>
<td>50°</td>
<td>6.3</td>
<td>0.6</td>
<td>15000</td>
</tr>
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</table>
vision receivers includes those with 10-inch tubes, having a picture size of approximately 6 x 8. These tubes are used in both table models and consoles. The 10-inch types include the 10BP4, 10EP4, and 10FP4. The 10BP4 and 10EP4 are identical except for the high voltage accelerating terminal. The former has the recessed cavity type, while the latter uses the ball type. The electron guns of the 10BP4 and the 10EP4 are similar to the 7DP4. They are magnetically focused and deflected and have ion traps. Their normal operating accelerating voltage is 9000 volts.

**Aluminum Backing**

The 10FP4 is the newest 10-inch tube featuring several important developments. These tubes have aluminum-backed screens, which permit greater brilliancy and contrast of image. The aluminum backing on the phosphor screen is a film of microscopic thickness, which not only permits passage of the fast moving electrons to the screen, but by its reflective qualities increases the light output. At the same time, the slow moving ions cannot penetrate the aluminum layer. Therefore, no ion spot can develop on the screen, and no ion trap gun and magnet are required. Also, the glow of the cathode which is sometimes visible through the thin phosphor screen on conventional tubes is eliminated by the opaque aluminum layer.

Fig. 3 and 4 illustrate how the advantages of the aluminum backed tubes are achieved. In Fig. 3, the region in the circle is a greatly magnified section of the face of a conventional tube of which one element of the phosphor is fluorescing. Generally at least 50 per cent of the light generated in the screen is emitted towards the electron gun in the tube. Another 15-25 per cent is lost by reflection from the glass on the inside of the tube face. Thus only 25-33 per cent of the total light generated passes through the glass face in the form of useful light output.

Fig. 4 shows a tube whose screen is covered with a layer of aluminum which is thin enough to permit the electrons to pass, but sufficiently thick to serve as a good reflecting surface. Now it is seen that the light which previously would go towards the electron gun is reflected forward into the direction of viewing.

At present the 10FP4 and a few projection tubes are the only commercial types that are being aluminumized. Eventually all television tubes, operating at 9000 volts and above will probably have metal backed screens, which improve the quality of television pictures and eliminate the need for ion traps.

The 10-inch tubes have received the widest acceptance by the television industry. The picture size obtained is adequate for viewing in the home and the length of the tube itself is about the limit for table model cabinets. More recently a 12-inch diameter tube has been introduced which is almost an inch shorter than standard 10-inch tubes. It thus can be used in table models as well as consoles, and with its 7¾ x 10¾ inch image it provides a picture area about 40 per cent greater than the 10-inch tube. This 12-inch tube type is the 12FP4. It operates at an accelerating voltage of 8,000-10,000 volts and is mag-
Fig. 6 Lift mechanism for 20" tube.

Fig. 7 Television receiver with 20BP4 tube.

Fig. 8 Showing relative size and shape of old type 12AP4 and new type 12JP4 cathode-ray tubes. Though the screen diameters are the same, the new tube is approximately 7½" shorter.

netically focused and deflected. No ion trap is required with the 12JP4 since the ions are dispersed over a greater area and cause insufficient burning to be noticeable during the normal life of the tube. The 12JP4, which is only slightly higher in cost than the 10-inch tube, is being used in table models and consoles at about the same price as those with 10-inch tubes.

15-Inch Types

The 15AP4 is the newest though not the largest direct view television tube on the market. Its virtually flat face is a marked improvement over the pre-war round face 14-inch tube which was the nearest comparable size. For a tube of this large diameter, its length of 20 3/16 inches is relatively small and suitable for horizontal mounting without requiring too deep a cabinet. The 9½ x 12¾ picture obtained on the 15AP4 is a comfortable viewing size for the home as well as clubs, taverns and small auditoriums. A 15-inch tube receiver is illustrated in Fig. 5.

Typical operating voltage for the 15AP4 is 10-12,000 volts so that the power supply is only slightly larger than for the smaller 10 and 12-inch tube types. As with the 12JP4, no ion trap is required for the 15-inch tube. Up to the present, the 15AP4 has been used only in high-consoles.

The 20BP4 is the largest direct view tube found in commercial television sets and provides a 13½ x 18 inch picture which is ample for homes with large viewing rooms and for public demonstrations. Very bright images are produced at the high 12-15,000 volts at which the tube operates. The overall length of the 20BP4 is 28½ inches so that if the tube were mounted horizontally too bulky a cabinet would be needed to house it. One novel means of mounting the tube, which overcomes this objection, is shown in Fig. 6. When the cabinet is closed, the tube is supported vertically (thus the cabinet has to be only a little deeper than the 20-inch diameter of the tube). By opening the lid of the cabinet, the tube is automatically lifted into the horizontal viewing position. Fig. 7 shows a receiver which uses this type of mounting for the 20BP4. As shown, the cabinet is open and the tube is in position for viewing. To close the cabinet the cover is again lifted and the tube pivots back into the vertical position.

Bulb Shape

A notable feature of modern magnetic tubes is the similarity in shape of the bulbs. The older type tubes had a 40 degree funnel angle...
In order to detect a frequency modulated wave, it is necessary to have a device whose DC output voltage rises when the IF deviates in one direction, and falls when the deviation is in the other direction. Since a frequency modulated wave of a broadcast station deviates in exact accordance with the audio modulating signal, the variations in the output DC will be a reproduction of the modulating signal.

**Slope Detection**

Fig. 1 shows how frequency modulated signals can sometimes be received on an AM receiver. The signal is detuned so that operation takes place on the side of the receiver's response curve. This is done by simply tuning the receiver to the side of the incoming signal until the center frequency is located at point A. In this figure, the IF of the standard television sound channel is used for an example. Let us assume that we are on the low side of the response curve. Then, as our incoming signal deviates higher in frequency (toward B) the receiver output increases and deviation lower in frequency (toward C) causes a decrease in output. We have thus changed frequency modulation to amplitude modulation, and our AM detector will respond properly. This method is sometimes referred to as "slope detection."

Slope detection is seldom used for the following reasons:

1. The detector is not balanced like some other types and therefore does not reject AM noise or signals.
2. The side of a response curve can seldom be made linear and distortion results. This is especially true in connection with standard broadcast FM with its deviation of ±75 kc.

Because of the second point, slope detection is sometimes found in the less expensive television receivers; the television sound channel uses a deviation of only 25 kc as compared to the broadcast FM deviation of 75 kc. The frequencies, as illustrated in Fig. 1, are those of the television sound channel. To obtain all the noise-eliminating benefits of FM, however, it is necessary to use a circuit in which both a limiting and a canceling action against noise are provided. This is usually accomplished with a discriminator.
**Coupled Circuits**

To make the operation of a discriminator clear, it is necessary to review the simple relations among currents and voltages in a double-tuned IF coil, such as shown in Fig. 2, when both circuits are tuned to resonance. The following fundamental facts apply:

1. The resonant condition causes only resistance, and no reactance, to be reflected into the primary. The primary current \( I_1 \) will, therefore, be in phase with the primary voltage \( E_1 \).

2. The voltage across the secondary, \( E_2 \) is produced by means of a mutual reactance \( M \), which results from the coupling between the coils.

3. Since this mutual inductance is a reactance, the secondary voltage \( E_2 \) is 90 degrees out of phase with the primary voltage \( E_1 \).

4. The secondary current, \( I_2 \), is in phase with the secondary voltage \( E_2 \), because of the resonant condition. The secondary current is, therefore, also 90 degrees out of phase with \( E_1 \).

Now suppose the secondary is center-tapped as shown in Fig. 3. If the center point is considered as a reference, we now have a balanced circuit, that is, the voltage across the upper half is 180 degrees out of phase with that across the lower half. Notice that with respect to the center point, \( E_x \) and \( E_y \) are equal but opposite in phase.

**Effects of Deviation**

Now consider what happens when the frequency of \( E_i \) changes. Suppose the frequency suddenly becomes higher. Since we are now off resonance in the secondary, the parallel resonant circuit becomes capacitive causing the secondary voltage to lag behind the secondary current. This means that \( E_y \) is less than 90 degrees away from \( E_1 \), and \( E_x \) is more than 90 degrees from \( E_1 \). Although these phase changes have taken place, the size (no. of volts) of \( E_x \) and \( E_y \) are substantially the same as in the resonant case. If the frequency changes to lower than resonance, the situation will be reversed as far as phase is concerned. \( E_x \) will now have a phase angle of more than 90 degrees while \( E_y \) will have an angle less than 90 degrees.

To summarize:

1. With a signal at the resonant

90 degrees while \( E_y \)'s is now less than 90 degrees.

Now suppose we arrange the circuit as shown in Fig. 4. The bottom of the primary coil has been grounded, and the top has been connected to the center tap of the secondary. Let us now investigate the voltage of the ends of the secondary with respect to ground. These voltages are labeled \( E_a \) and \( E_b \). By tracing the circuit from the low side of the primary through the coil and then through one half of the secondary, it can be seen that at any given instant:

\[
e_1 + e_2 = e_a \quad \text{and} \quad e_1 + e_y = e_b
\]

At resonance, when \( E_a \) and \( E_b \) are each 90 degrees from \( E_1 \), \( E_a \) and \( E_b \) are equal. Under off-resonance conditions, however, the changed phase relations will cause one to be larger than the other. To clarify this, refer to Fig. 5.

In Fig. 5A, two voltages, \( E_m \) and \( E_n \) are plotted. They are equal in magnitude, but less than 90 degrees apart in phase. In Fig. 5B are the same two voltages plotted more than 90 degrees apart. In each case, the voltages are added, and the sum represented by the dotted line. These diagrams show that when the phase is less than 90 degrees, the sum is larger than when the phase is greater than 90 degrees.

The same principle applies in Fig. 4. When the frequency is higher than resonance, the phase angle between \( E_1 \) and \( E_y \) is greater than that between \( E_1 \) and \( E_x \). \( E_x \), the sum of \( E_1 \) and \( E_y \), is, therefore, greater than \( E_a \), the sum of \( E_1 \) and \( E_y \). When the frequency is lower

---

**Fig. 5** Graphs of sine waves showing how two AC voltages can produce a sum voltage whose amplitude varies with a change of phase between them.
RADIO SERVICING IS BIG BUSINESS

How radio servicing developed from an obscure origin to the present level of over half a billion dollars of business annually.

by J. R. James

The origin of the first serviceman is obscure. No monument or memorial of any kind is left to his glory, and it is quite likely that he himself had no knowledge of the significant part he played. But we can speculate that Hertz, Marconi, and other early experimenters had assistants who were responsible for keeping "bugs" out of the equipment. After the first successful scientific experiments, the hearts of many adventurous souls all over the world were stirred by the possibilities of wireless communication and built their own receivers. Others built transmitters also and became the first "hams". The builder became a serviceman as soon as his equipment failed to operate. Gradually he learned more, not only about his own equipment, but also other types being used by his fellow hams and experimenters. It was not long before these pioneers were building additional sets for use in the homes of their layman friends.

Thus it was that the early serviceman was also a manufacturer. He had little trouble understanding the receivers he serviced because he had designed or, at least, built them. Gradually, as investors began to see the possibilities in the new field, capital was made available and radio receiver companies began to func-

Fig. 1 One of the early commercial two-tube "bloopers."
tion. By the year 1925, several companies had begun to produce home receivers in quantity.

Yes, they were receivers, but only those of us who were in the game at that time can appreciate how remote is the resemblance to what we have today! Let us examine the characteristics of the "super-bloopers" which so excited us back in the twenties.

**Regenerative Detectors**

For the first few years of commercial production the regenerative detector was standard; it was followed by one or two stages of audio amplification. Tube types were no problem, since four or five covered all uses in all receivers. For instance, a typical receiver of the early twenties was the Radiola No. 2, which could be bought as a two tube job, and later it would be "boosted" to a three tube by means of an extra amplifier unit.

All operation was on batteries, the most common arrangement being two D batteries and one 6 volt storage battery to light the filaments of the most used tube—the "201A" (now listed as the'01A). So prevalent was this type that a couple of extra 201A's constituted full tube equipment on any ordinary service job.

For a while the regenerative detector's radiation characteristics became a real problem, especially in crowded city sections, where one was considered lucky to get through a program without loud whistling noises from the receiver next door.

**Early Servicing Problems**

What were the servicing problems of this period? As mentioned before, tubes were nearly all of one type. There were only detectors and audio amplifiers in sets and since the same type of tube performed both functions "swapping" any tube with any other tube was part of the regular service procedure. Volume was controlled by regulating filament current with wire wound rheostats, one of which was placed in series with each filament. Tube life was enhanced by this arrangement and the writer has seen a number of 201A's which are twenty years old and still in good condition. Thoriated tungsten was used for the filaments, so when emission became low they could be "reactivated". The reactivation process consisted

---

**Radio for Everybody**

At last a simple, compact, inexpensive radio receiver is available for everyone located within reasonable distance of a broadcasting station. This is the new G. E. Radio Broadcasting Receiver Model E R-753.

Model E R-753 is no bigger than an average hand camera and is easily set up almost anywhere. Tuning is as simple as focusing a pair of field glasses. In fact any member of the family can learn how to use it in a few minutes.

The apparatus comprises a highly sensitive crystal detector, tuning inductance, condenser, and other accessories—all contained in a neat, metal E Z case. Telephone head pieces are supplied. By including G E antenna equipment A G-788 we have a complete set.

Price

<table>
<thead>
<tr>
<th>Crystal Detector Radio Receiver Model E R-753</th>
<th>$18.00</th>
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<tbody>
<tr>
<td>G E Antenna Equipment A G-788</td>
<td>$7.50</td>
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**Fig. 2** One of the few crystal sets which were built commercially for home use is described in this advertisement, which appeared in 1922.

---

**Fig. 3** The famous Grebe "Synchrophase," a battery-powered TRF receiver. This is one of the first receivers employing gang tuning, which was accomplished by a chain drive visible in the photograph.
of applying a small overload of AC voltage for a certain length of time. The voltage was then gradually lowered to normal and, when changed back to DC, produced normal emission again. Reactivating units were used extensively by early servicemen and many commercial models were sold.

The TRF Appears

While people were engrossed with such spectacular occurrences as the destruction of the dirigible Shenandoah and Lindbergh's epoch flight, mass production was developing into the radio receiver field. The TRF receiver was coming into its own; it rode in on the crest of the "roaring twenties" wave and took the radio receiver completely out of the experimental field and into the home.

Although a fairly large number of regenerative receivers had come into use, real mass production did not start until the TRF type came on the scene. The screen grid tube had not yet been developed, so early radio frequency amplifiers had to be neutralized to prevent oscillation. Several ingenious ideas were developed to provide this neutralization, of which probably Hazeltine's "neutrodyne" was the most famous.

The neutrodyne and other TRF circuits developed at about the same time made possible the use of more stable detectors, and the elimination of the noisy regenerative type. Probably stability was just as important a factor in its popularity as the added amplification provided by the RF stages. The writer will never forget the thrill of hearing an early TRF set for the first time; its relative sensitivity and quiet operation were, at that time, nothing short of amazing.

Growth of the Jobber

The serviceman now became an important factor as a separate individual instead of the combination serviceman, set builder and experimenter. During this period of radio market development the various elements forming the present structure of the industry began to appear. Certain servicemen were stocking quantities of parts for other smaller servicemen in the territory. These grew into jobbing houses. Others developed into servicing organizations and still others left service work for dealerships in appliances, radio, etc. The writer recently was reminiscing with Mr. Aaron Lippman, of the famous jobbing house which bears his name, about his early experiences as a serviceman and set producer. As early as 1922 Mr. Lippman was producing a radio of his own design, called the "Radiodyne". Later, when large scale commercial production started, service work took full time, and then the Aaron Lippman Co. was started. Today, Mr. Lippman is the owner of one of the largest and most "up-to-date" distributing houses in the country and is president of the Nu-
Don’t Miss PHOTOFACT Set No. 23!
WITH EXCLUSIVE NEW “Standard Notation” SCHEMATICS

The Greatest Service Data Development in 20 Years!

I am proud to announce to my Servicemen friends the successful development of a new system of “Standardized Schematics” that is now yours exclusively in PHOTOFACT Folders. We have worked on this project for over one year. Because we knew that uniform, standardized schematics would save you hours of time and countless headaches—would help you earn more. Now—we have developed uniform, standardized diagrams on all sets. Now—you can save time—go from diagram to diagram and see the same, easy-to-understand symbols and designations. You no longer have to puzzle out the differences in schematic notations or bang your head against queer-looking diagrams. You’ll recognize instantly the functions of all parts in any circuit. The standards used in our new diagrams are the result of the PHOTOFACT “Standards Poll” and thousands of interviews with Servicemen. I wish space would permit me to tell you more—but PHOTOFACT Set No. 23 speaks for itself. You owe it to yourself to see the new diagrams. Use them—learn what a difference they’ll make in faster, more profitable servicing.

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MAIL THIS ORDER FORM TO YOUR PARTS JOBBER TODAY—Send directly to HOWARD W. SAMS & CO., INC., 2924 E. Washington Street, Indianapolis 6, Indiana.

My (check) money order for $10.00 enclosed.

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Name

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www.americanradiohistory.com
Do you remember when Admiral Byrd made his first flight over the South pole? That was 1929, and new "worlds" were also being explored in radio development.

**Advent of AC Receivers**

Although the advent of the TRF has been mentioned as the big factor in the beginning of mass production, and the development of the radio serviceman; it was soon followed by a change even bigger and more revolutionary, namely, the transition from batteries to the AC power supply. This transition was made practical by the development of the separately heated cathode, which eliminated the hum troubles which had previously retarded attempts to make AC sets. The AC power supply, coupled with the use of screen grid tubes opened the way for radios as we know them today.

The compactness provided by using screen grid tubes and rapid development of special types of separate cathode tubes allowed the superheterodyne to be produced in large quantities and eventually to outstrip the TRF. Multipurpose tubes like the 6A8 and the 6Q7 aided in this latter change.

Midget sets came into vogue during the early thirties and AC-DC types soon became numerous. People started to become interested in short wave and foreign broadcasts, increasing the demand for the "all-wave" type.

**Need For Test Equipment**

But what of the serviceman during this period? Gradually, through the early thirties he began to realize a growing need for test equipment. He found that he needed something more than a voltmeter, and that a tube tester could save him much time and expense. He also felt the need for a signal generator for the alignment of superheterodyne and all-wave receivers.

By 1940 the developments we have mentioned had placed him in a position in which he could no longer afford to be without a set of test equipment and still carry on a successful service business. The old battery "bloopers" had only one type of tube of which you could carry a spare or two, and troubles were simple enough to be located...
MALLORY PAPER TUBULARS

YOU want quality in the paper tubulars you buy — of course! Otherwise your replacement work won’t stand up. Mallory gives you the quality you want.

But Mallory gives you quantity, too. Quantity in a wide assortment of ratings and sizes that meet all requirements that come your way.

That’s the story in a nutshell — whether you’re looking for wax impregnated cardboard tubulars or oil impregnated ones. The Mallory Catalog and your Mallory Distributor both prove that —

YOU EXPECT MORE AND GET MORE... FROM MALLORY

MALLORY

APPROVED PRECISION PRODUCTS

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA
Servicing Is BIG Business

From Page 26

with a piece of wire and a bulb or, more often, by simply looking. But now what a difference! Tube types had increased so rapidly you needed a tube manual to keep track of them. Most sets had all different types of tubes in them and the "swapping" method had become obsolete. Wiring had become very much more complicated, and a multiplicity of condensers, resistors, chokes and other paraphernalia were found where only audio transformers were before. More and more shops were installing a complete complement of test equipment. Frequency modulation receiver production was becoming a large volume business, and television was in the offing.

By 1942 one shop in New York, specializing in television maintenance, was earning over $25,000 a year.

World War II produced technological advances in every phase of radio, including AM-FM television and other consumer electronic devices.

Before the war most test instruments were designed as laboratory units and although very useful, they were expensive and often studded with adjustments and gadgets which were of no interest to the maintenance man. Today, the radio maintenance industry keeps 14 test equipment manufacturers busy producing over 100,000 test instruments annually.

The radio shop serves the public with over one-half a billion dollars worth of repair work and materials annually and buys over one hundred million dollars worth of renewal tubes, parts, etc.

Many new and important businesses serving the radio mainte-
with the NEW Precision Multi-Master Series 847

5000 AND 1000 OHMS PER VOLT DC — 1000 OHMS PER VOLT AC

High speed, 54 range, high sensitivity, AC-DC multi-range test set
Ranges to 6000 volts, 200 megohms, 12 amperes, +70 DB

Series 847 MULTI-MASTER, features "Precision" Automatic Push-Button RANGE and FUNCTION selection, affording a new "high" in positive operational efficiency and simplicity.

A rugged, high sensitivity, general purpose AC-DC test set, especially designed to withstand the continuous usage and handling associated with all phases of electronic maintenance and service, classroom instruction, production testing, etc...

- Large, easy reading 200 microampere, 4¾" meter
- All standard functions available at only two polarized tip jacks
- 200 megohm insulation resistance test range in addition to 5 self-contained ohmmeter ranges
- Recessed 6000 volt safety jacks
- Etched-Anodized aluminum panels resistant to moisture and wear

Conservatively and professionally designed, the Series 847 features the high "Precision" standards of quality, workmanship and performance.

**RANGE SPECIFICATIONS**

- 8 D.C. voltage ranges to 6000 volts at both 5000 and 1000 ohms per volt. Initial range 0-3 volts.
- 8 A.C. voltage ranges to 6000 volts at 1000 ohms per volt.
- 8 D.C. current ranges to 12 amperes.
- 6 ohmmeter ranges to 200 megohms. Initial range 0-2000 ohms with 13 ohms center scale.
- 8 decibel ranges from —26 DB +70 DB.
- 8 output ranges to 6000 volts.

Ask to see the full "Precision" line of Quality Test Instruments on display at all leading radio parts and equipment distributors. Write for new Precision 1948 Catalog. Signal Generators, Vacuum Tube Voltmeters, Tube Testers, Multi-range Test Sets, etc.

**MODEL 847-L**: modern, shallow, Bakelite laboratory type case, size 7½ x 8½ x 3" ........................................ $42.90

**MODEL 847-P**: portable, hardwood case with tool compartment and cover, size 9 x 10 x 4½" ........................................ $44.90

(Prices complete with batteries and High Voltage Test leads)
Servicing FM Receivers

From Page 21

When the input ratios are equal, no current flows through R2 and the output will be zero.

Fig. 6 Basic circuit of the Foster-Seeley discriminator. In practice, point g is usually grounded. Then the audio output appears at point h and AVC or tuning eye voltage can be obtained from the center tap of the resistor.

Fig. 7 Typical discriminator characteristic.

Fig. 8 The ratio discriminator. Below: Schematic diagram, Above: equivalent circuit discussed in the text.

than resonance, the opposite is true and \( E_a \) is less than \( E_b \).

Another way to explain the above relations is by the use of vectors. Fig. 9 shows a vector diagram for each of the three important conditions described above. Notice \( E_a \) and \( E_b \) are made larger and smaller according to the phase of secondary voltage.

In Fig 6 we have applied the voltages \( E_a \) and \( E_b \), which are AC to diodes V1 and V2, and our circuit now becomes basically a Foster-Seeley discriminator. These AC voltages are rectified and filtered and produce the DC voltage \( E_a \) and \( E_b \). These DC voltages are proportional to \( E_a \) and \( E_b \) respectively and have the polarities indicated on the diagram.

Now the discriminator output is the voltage between points g and h. Since \( E_a \) and \( E_b \) oppose each other, the total voltage is equal to the difference in magnitude and will have the polarity of the larger voltage. At resonance these voltages are equal and the total voltage (g to h) is zero. At a frequency higher than resonance, \( E_a \) is larger than \( E_b \). The total output voltage will then be \( E_a \) minus \( E_b \) with h positive and g negative. When the frequency is lower than resonance, the polarity of the output will be reversed, and the voltage will be \( E_b \) minus \( E_a \).

Thus when the IF changes above and below the resonant frequency, the discriminator output will vary in magnitude in the same way. This circuit is known as the Foster-Seeley type of discriminator.

Fig. 7 shows the characteristic typical of a good discriminator. The curve of amplitude versus frequency should remain straight (linear) for all frequencies within the deviation range.

Ratio Detector

In order to eliminate noise effectively, when a conventional discriminator is used, it is necessary to precede this stage with a limiter.
Now...

you can use it anywhere!

Measures voltage resistance ... and current

ABOUT THE HANDIEST METER in the service field! In one instrument, for one price, you get an electronic voltmeter, ohmmeter, and ammeter ... battery-operated to make it completely independent of power-line sources.

Use it to test car radios, farm sets, railroad signal equipment, aircraft radio, industrial electronic devices ... opens up hundreds of profitable new opportunities beyond the limits of power lines.

With it you can measure both a-c and d-c voltages to 1000 volts, resistance to 1000 megohms, and direct current to 10 amperes. A new low-cost, RCA crystal probe can be attached if you want to make v-h-f measurements.

Most important, this instrument is easy on batteries. They last up to 10 months in normal service. A neon pilot light flashes when the instrument is on ... serves as a reminder to turn the instrument off when not in use.

Linearity and stability are excellent.

Here is one of the best buys in test equipment on the market today. We'll be glad to send you complete descriptive and price information on this time and money saver. See it at your RCA Test Equipment Distributor.

TEST AND MEASURING EQUIPMENT
RADIO CORPORATION of AMERICA
ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N. J.

RADIO MAINTENANCE • SEPTEMBER 1947
and high gain IF stages, because the discriminator itself responds to amplitude variations unless previously "clipped" by the limiter. A circuit which demodulates FM waves without responding to amplitude variations, the ratio detector, is shown in basic form in Fig. 8A. The secondary circuit L2C2 is similar to that of the Foster-Seeley discriminator with a relatively high Q (about 200) being necessary for good design. Again we use the instantaneous sum of the two applied potentials $E_{1a}$ and $E_{1b}$, although the diode $V_1$ has been reversed so that the diodes are now in series. When the FM wave is at the center or resting frequency, the potentials applied to both diodes are equal. When the FM wave deviates above resonance (10.775 megacycles), $E_{1a}$ is greater than $E_{1b}$ by some ratio, say 12 volts to 8 volts. When the FM wave deviates below resonance (10.625 megacycles) $E_{1a}$ will be less than $E_{1b}$ by a ratio of 8 volts to 12 volts. Thus, except at resonance, there always exists some ratio between the voltages applied to the two diodes. A detector whose output is made proportional only to this ratio, (which is changing at an audio rate), becomes independent of amplitude variations and does its own limiting. Such a device is the ratio detector. An equivalent circuit (Fig. 8) will simplify the discussion. The RC network R.C. is connected in series with the two diodes, the direction of electron flow being such that the top of $C_5$ will be negative, and the bottom positive. The time constant of $R_1C_5$ is quite long, about 2 of a second, so that its potential remains relatively fixed even for the lowest frequency audio variations. Actually the charge in $C_5$ is a function of the average carrier strength. This potential is shown as a battery of 10 volts magnitude and tapped at the center (Fig. 8).

To this center point is connected one end of the volume control $R_2$. The other end of the volume control is connected to the junction of $C_3$ and $C_4$. While a fixed potential of 10 volts is used at this time, it must be remembered that this potential may vary slowly with changes in the average carrier strength. $L_2$ is shown in two sections with generators $E_{D1}$ and $E_{D2}$ representing the induced voltages for any given deviation of the FM wave. The conditions which must be present in this circuit are as follows:

First, the ratio of $E_{D1}$ and $E_{D2}$ must equal the ratio $E_1$ to $E_2$.

$$\frac{E_{D1}}{E_{D2}} = \frac{E_1}{E_2}$$

Secondly, the sum of $E_1$ and $E_2$ must always equal the charge in $C_5$, which is $E_3$.

$$E_1 + E_2 = E_3$$

Assume that $E_{D1} = 5$ and $E_{D2} = 5$.

If no drop exists in the diodes, then

$$\frac{E_1}{E_2} = 5$$

and no current can flow through $R_2$. Thus at the resting frequency of the FM wave, the DC output will be zero.

Going above resonance next, assume that

$$\frac{E_{D1}}{E_{D2}} = \frac{8}{2} = \frac{E_1}{E_2}$$

Under this condition current will flow through $R_2$, and the drop across $R_2$ will be 3 volts and positive at the junction of $C_3$ and $C_4$, thus producing the positive half of the audio cycle.

Deviating below resonance:

$$\frac{E_{D1}}{E_{D2}} = \frac{2}{8} = \frac{E_1}{E_2}$$

Current will now flow in the reverse direction through $R_2$, producing the negative half of the audio cycle.

In the rejection of amplitude modulation, the action is as follows. Suppose that a sharp increase in the carrier amplitude caused the ratio of

$$\frac{E_{D1}}{E_{D2}}$$

to become $\frac{16}{4}$.

The ratio obviously remains the same but the amplitude has doubled. However, $E_1 - E_2$ remains fixed as determined by $E_a$, and the amplitude change can not take place. $E_a$ tends to get higher, but the time constant of $R_1C_4$ is made so large that noise pulses or amplitude modulation are too rapid to change this voltage. If the carrier level should

---

**Fig. 9** Vector relations in the Foster-Seeley and ratio discriminators.

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To Page 38

SEPTEMBER 1947 • RADIO MAINTENANCE

32
SWAP • BUY • SELL
WANTED—New or used for experimenting and locals. Also key空白 和 coil, and various radio parts. Write Ray, 324 Ohio Ave., Keokuk, 1, Ia.

FOR SALE—R-C tube & set receiver. Complete, good hear blank, plus transformer—$15.

WANTED—New or used for bldg. radio broadcast station. Write Bob, 324 Ohio Ave., Keokuk, 1, Ia.

WANTED—New or used for repairing. Write Bob, 324 Ohio Ave., Keokuk, 1, Ia.

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CONTROL AND SWITCH KIT

A new kit of controls, known as the Junior Control Cabinet, has been introduced by the International Resistance Co., 401 N. Broad St., Philadelphia. This kit is an assortment of nine 1/2, 1, and 2 meg. controls plus four switches and four special shafts. The assortment is factory-packed in a cardboard cabinet finished in blue, yellow, and silver. The four drawers with twelve compartments are individually identified.

HIGH FIDELITY SPEAKER

Altec Lansing’s new two-way speaker with a multicellular horn reproduces the entire FM range of 80-15000 cycles per second. Distortion and intermodulation are minimized, and a wide angle of high frequency distribution is provided by the design of the high frequency horn. For complete technical information, write to Altec Lansing Corporation, 250 West 57 St., New York 19, New York.

FM SIGNAL STRENGTH METER

The Factometer, an AC operated portable AM-FM receiver equipped with a signal strength meter, is a product of the Bendix Radio Division of Bendix Aviation Corporation. It is completely self-contained, including a telescoping antenna. With this instrument, relative field strengths of signals can be determined by readings on the meter and most favorable locations for FM receivers can be ascertained. "Dead spots" in certain parts of houses can thus be avoided. The Factometer can also be used for general FM demonstration purposes.
Here's Why Your Antenna Installations Will Give LONGER-LASTING PERFORMANCE with Federal's Intelin H-F Transmission Lines

1. Their unusually low attenuation losses assure the most efficient transfer of energy between antenna and receiver or transmitter.

2. Their uniformity and permanence of characteristics permit peak receiver performance, without annoying distortion from locally-induced interference.

3. Their flexibility and outstanding resistance to weathering, moisture and abrasion contribute to years of trouble-free service.

In the five items listed here, there's a high-frequency cable for practically every antenna application. The K-1128 75-ohm line, for transmitter use—the K-1079 and K-1046 lines for general FM and Television service. The smooth oval cross-section of these 75, 100, and 300-ohm lines prevents the accumulation of foreign matter, thereby maintaining stable capacity characteristics. The K-32 and KT-51 coaxial cables offer peak performance for applications where locally-induced interference is severe.

For complete information and prices on these cables, see your local distributor. For other high-frequency cables—write to Federal, Dept. D-182.

### DATA FOR FEDERAL H-F CABLES

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Federal Telephone and Radio Corporation

KEEPING FEDERAL YEARS AHEAD... is IT&T's world wide research and engineering organization, of which the Federal Telecommunication Laboratories, Nutley, N.J., is a unit.

Export Distributors: International Standard Electric Corp., 67 Broad St., N.Y.C.
THE Associated Radio Service Dealers of Columbus, Ohio, break into our column for the first time with the following letter (the first of many letters we hope) from J. P. Graham: "You will find enclosed the June issue of the Associated Radio Service Dealer's News. The News is issued monthly about the 20th, so to arrive half way between meetings, which are held monthly on the first Wednesday evening of the month. The News is always of three or four pages along the line as is reflected in our June issue. The writer is the Editor and has been since the ARSD News first saw the light over three years ago.

Our present President is Lou Riebel, owner of Riebels Appliance Store of Columbus. Our organization was formed on November 11, 1943, exclusively for service dealers, in other words self-employed or owners of service stores and membership is by invitation only, thus assuring a control of the type of dealer members. Servicemen employees cannot become members, but are invited to all technical meetings. All servicemen are invited (both in and out of the organization) to every technical meeting. You will note the announcement of the coming technical meeting in our ARSD News.

The Associated Radio Service Dealers are incorporated and include in their membership practically all the best and the largest service organizations in Columbus. All parts jobbers are associate members as well as several radio set distributors. These jobbers pay the same dues that any member pays, that is $24.00 a year.

Each monthly meeting is started with a good dinner, of which the ARSD pays $1.00 toward the cost for each member. Each quarter we hold an Associate Jobber's meeting at which time all the jobbers attend the dinner at no cost to them.

With few exceptions we have experienced wonderful co-operation of our parts jobbers, particularly in eliminating selling across the counter to those not in the trade and selling these fellows at wholesale prices. Right now we are circulating petitions among all service organizations in the town suggesting that the jobbers restrict trade discounts to the trade. We are experiencing wonderful co-operation from the non-members in the signing of the petitions.

We have had, for over two years, co-operative weekly advertising of the type you will note by the enclosed copy; we have now discontinued this type of advertising and are having erected seven of the reflector type billboards on the main roads to the approach to our city. ARSD had a booth at our State Fair last year, and right at a time when you could not buy a radio, we gave several away. The booth was laid out with complete shop testing equipment, which was furnished by one of our Associate Jobber members.

As you will note, our annual ARSD picnic will be held on the third of August. Over 125 attended our first picnic last year, and we expect at least 150 this year. Each of our members display our "Certified" Radio Service Dealer insignia and all of our advertising is built around it, so that those re-

In the last few years, there has been a marked increase in organizational activity in the trade. Feeling that the reader would like to know more about the organizations and their activities, Radio Maintenance is inaugurating this column containing correspondence received from servicemen's organizations. If you are a member of an organization, we would like to hear about the activities of your group.

---

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THERE IS A CERTIFIED RADIO SERVICE DEALER NEAR YOU!

Entrust your radio to a dealer who displays this emblem. You are assured of reliable service with quality parts and honest value.
Meets EVERY Testing Requirement BETTER

NEW model 3413 tube tester

With the new Model 3413 you can make your settings instantly—just snap the switch up or down. You actually "picture" the circuit. Usually not more than five of the ten lever switches need be set, yet you have individual control of each tube element. Many other convenient features make Model 3413 the buy of its field—such as the handy, built-in SPEED-ROLL tube chart, the larger easy-reading meter, the handsome new case with streamlined design. For either counter or portable use you will find Model 3413 a quality-packed tester that you'll be proud to own. Write today. Address Dept. W97.
Most customers just don't like substitutions. A good tailor will never resort to making repairs with materials that "almost" match. Neither will a capable, experienced service man gamble with results by making cartridge replacements in phonograph pickup arms with cartridges that "might work."

There is only one safe and sure way to make cartridge replacements and that is duplication of the original. The pickup cartridge is the most vital component of any phonograph circuit. To change this circuit with the introduction of an unknown quantity is very apt to result in entirely unsatisfactory performance.

Astatic's many types of cartridges are necessary to satisfy the great variety of electrical and mechanical specifications demanded by set manufacturers and to supply service men with the proper parts for perfect replacements.

---

**Servicing FM Receivers**

suddenly drop, the potential $E_2$ would still be maintained, and this drop would not appear in the output.

Since the potential across $C_3$ varies with the average carrier strength, it serves as an excellent source of AVC voltage.

An important advantage is the fact that there is no "threshold" effect in the ratio detector; that is, there is no minimum carrier level necessary to cause noise attenuation as with limiter circuits.

---

**The Organizations**

requiring service will readily identify a member.

We have just 33 members, quality not quantity is what we are trying to obtain. But if the number of members may seem small to you, it represents one out of every three service organizations listed in the Columbus Telephone Directory, and you must remember our organization is strictly for radio service dealers, the owners of the business.

Wishing you success with your splendid magazine, which the writer has subscribed to, through our store, since the very first issue."

J. P. Graham, Editor

Associated Radio Service Dealers

A report from the Associated Radio Service Men of Central Pennsylvania follows:

"At our regular business meeting on June 3rd, we elected the following officers for the coming year. They take office on July 1st.

Gordon Phipps, President.
Louis Steffan, Vice-president.
A. R. Guild, Treasurer.
Carl W. Smith, Corresponding Secretary.
John Barsophy, Recording Secretary.

The Secretary of the Federation of Radio Servicemen's Associations of Pennsylvania—Art Guild—told us some of the plans for the forthcoming convention of radio service-
Simpson Model 315 Signal Generator

Here's a test signal source that maintains its accuracy under constant use. The Simpson Model 315 Signal Generator produces fast and accurate "trouble-shooting" every time. The reason is as clear as its signal: this generator is Simpson engineered and built.

Like all Simpson test equipment, Model 315 is made almost entirely within the various Simpson plants. This, plus our tremendous investment in expensive production tools, is your assurance that Simpson testers will not quickly become obsolete and will be of unvarying quality.

An investment in the Model 315 is an investment in lifetime, trouble-free service.

---

The Model 315 Signal Generator has a big nine-inch meter type dial, with hair-line pointer, for high readability. Smooth vernier control permits close settings.

Circuit: Electron coupled circuit assures extreme stability and output uniformity throughout the band. Three tubes are utilized in the circuit — full wave rectifier, modulator and oscillator. Standard 50% modulation at 400 cycles is used.

Output: Signal is controlled through an ingenious step attenuator of the ladder type. Volume level of each step is regulated by a smooth non-inductive control which provides an R.F. output from a few microvolts to .15 volts and a 400 cycle output from zero to 3.5 volts.

Bands: Six R.F. coils provide ranges of 75-200; 200-600; 600-1700 kilocycles and 1.5-4; 4-12; 10-30 megacycles. Coils are designed to retain original inductance regardless of temperature or humidity changes. A special switch automatically eliminates "dead spots." Frequency accuracy is 1%.

Shielding: Coils, attenuator and signal selector are individually shielded. Oscillator and modulator assemblies are sealed in a rigidly welded, entirely enclosed chassis. An effective line filter is used. Even the line cord is shielded. Result: leakage is negligible.

Calibration: Each coil is individually calibrated to close tolerances against crystal standards by means of variable inductance and variable minimum capacitance. Tests show negligible changes over long periods of time under extreme temperature and humidity variations.

Size 16" x 10" x 6". Weight, 15 lbs. Shipping weight, 20 lbs.

Dealer's Net Price: $67.35 For 220 Volt 50 or 60 cycle add: 7.50

SIMPSON ELECTRIC COMPANY
5200-5218 Kinzie Street, Chicago 44, Illinois
men in Philadelphia this September. All of us are looking forward to this event as a sort of milestone."

John Barsphony, Secretary

“A delegation of members of the Vancouver section of the Associated Radio Technicians of British Columbia motored to Chilliwack on Wednesday, June 4th to attend an organization meeting at the Empress Hotel for the purpose of forming a Fraser Valley Branch of the A.R.T. of B.C.

The large attendance of Radio Technicians included representatives from every Fraser Valley business district from White Rock to Hope. The discussions showed all are keenly interested in placing the radio repair trade on the highest possible level of reliability and efficiency by co-operating in good fellowship, by identifying the honest and competent through their association with the A.R.T. and at the same time encourage the beginner to improve himself in the use of modern methods and fairness, thus protecting the radio owner from exploitation by the incompetent and dishonest.

The employer also gains as he has an authoritative body to gauge the competence and ability of his staff or those he may desire to employ in the future.

Al Johns, Pres. of the Vancouver A.R.T. welcomed the gathering and called on Fred Stucky to introduce the groups to each other; Wilf Munton recalled some of the accomplishments of the association since its foundation in 1929 (and consequent incorporation under the societies act in 1934) and outlined a few of the aims and objects by reading excerpts from the constitution; Bill Fitkin described the methods used by the examining board to grade the members; Monte Lennox explained the treasurer’s view of the financial angles of the association.

After a very active discussion Jim Fraser of Abbotsford was elected Secretary pro-tem till June 16th when a meeting is planned to

The Organizations

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with the new **PYRAMID**

"**TUBE-U-LAR**"

**PAPER CAPACITOR**

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**PYRAMID ELECTRIC COMPANY**

155 OXFORD STREET, PATERSON, N.J.
Next we present an analysis of the Buick model 980744-5 which is typical of good quality automobile receivers. It will be noticed in the schematic that all coils used are equipped with adjustable slugs. A ganged permeability (slug) tuner provides the tuning and tracking. Slugs S1, S2 and S3 are mechanically connected in the tuning unit to provide this tracking.

**Impedance Coupled RF Stage**

A combination resistance and impedance coupling is used between the RF and mixer stages. A schematic of this section is given in Fig. 3. Up to the mixer grid resistor R2, ordinary resistance coupling is used. But between the top of this grid resistor and the grid itself we find a parallel tuned circuit. The voltage between point A and ground, which is the RF output of the 6SK7, appears across C1, since the other side of this condenser goes to ground. But this condenser is also a part of the tuned circuit. The RF voltage is thus injected into the resonant circuit, which builds up a relatively high voltage on the grid for the desired signal.

The oscillator circuit of this receiver is a little unusual, as shown in Fig. 4. At A we see the usual "tapped coil" type of oscillator circuit and at B is type used in this receiver. At A, even though there is only one coil, notice that it is divided into two parts with the cathode tapped between them. The part from a to b is effectively between...
Ward sets the stage

-for a “boom” in FM and Television aerial sales

An intensive consumer advertising campaign in the Saturday Evening Post and leading newspapers is convincing millions of present and prospective FM and Television set owners that:

1. Quality reception is difficult, if not impossible, without a good outside dipole antenna.

2. Ward "Magic Wand" FM and Television Aerials offer the finest FM and Television reception at modest cost.

Alert radio dealers are finding this campaign exceedingly helpful in creating extra sales and profitable installation jobs. In addition these dealers are winning satisfied customers who can now enjoy the true beauty of FM or television reception.

Available in straight or folded dipoles for both FM and television bands (reflector kits available), Ward "Magic Wand" Aerials are products of the world's largest makers of aerials for car and home.

Listing at only $9.00 to $12.00 (reflector kit $5.25) they are priced to encourage volume sales and an adequate profit margin.

Phone or see your nearest Ward distributor today for full details on how to capitalize on this hard-hitting consumer advertising for Ward "Magic Wand" FM and Television Aerials; or write direct to:

THE WARD PRODUCTS CORPORATION
1523 East 45th Street, Cleveland 3, Ohio

DIVISION OF THE GABRIEL COMPANY

EXPORT DEPT.: C. W. Brandes, Mgr., 4900 Euclid Ave., Cleveland 3, Ohio.

IN CANADA: Atlas Radio Corp., 560 King St., W., Toronto, Ont., Canada.

FM-TELEVISION AERIAL OPPORTUNITY!
WARD PRODUCTS CORP.,
1523 East 43rd St., Cleveland 3

Please advise how I can profit from your national advertising for "Magic Wand" FM and Television Aerials.

NAME
COMPANY NAME
ADDRESS
STATE ______ CITY AND ZONE ______
MY JOBBER IS ______
The Television Picture Tube

which meant that the electron beam had to be deflected through this angle for full picture size. The newer magnetic tubes have a 50 degree funnel angle, permitting a shorter funnel and overall tube length. The relative shapes of the old and new type bulbs is shown in Fig. 8. Though the new bulbs have the advantage of being shorter, the wider deflecting angle requires greater deflecting currents.

In Fig. 9, the sizes and shapes of the 7-, 10-, 12-, 15-, and 20-inch tubes are compared. Note that the larger picture sizes are obtained by virtue only of the added bulb length, but the deflecting angle of all the tubes is the same. In other words, if the accelerating potentials were the same, the same deflecting current required for a 7-inch tube would be sufficient for a 20-inch tube. However, the deflecting coil current varies as the square root of the accelerating voltage. Thus the 10-inch and 12-inch tubes which operate at about the same accelerating potential have the same deflecting currents, which are a little higher than the 7-inch tube requirements. A single 6B6, (the conventional type 807 which has been modified for television sweep circuits), is capable of handling the deflecting currents of the horizontal sweep amplifiers used for 7-, 10-, and 12-inch tubes. Two sections of a double triode type 6SN7 in parallel are adequate for the vertical deflection amplifiers. The current requirements of the higher voltage 15- and 20-inch tubes are slightly above the maximum ratings of a single 6B6, hence, two are used in parallel for the horizontal sweep. Two sections of one 6SN7 in parallel will provide sufficient vertical sweep for the 15AP4 and 20BP4.

Projection Systems

Projection systems work on the principal of magnifying a small intensely brilliant picture formed on a small cathode-ray tube. Because the transmission efficiency of a lens is low, the light output of the cathode-ray tube has to be much higher than on a direct-view tube. To obtain these brighter pictures, projection tubes have to be operated at voltages as high as 30,000 volts.

A single projection system is shown in Fig. 10. The tube is mounted vertically in the cabinet, and the light projected by a refractive lens system onto a 45 degree angle mirror, which in turn throws the picture onto a translucent screen. This method of projection has not, however, been employed in home receivers, because the cost of a quality refractive lens with high transmission efficiency is excessive. A cheaper and more efficient means of projection has been used in movie theaters.
**Circuit Analysis**

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![Circuit Diagram](image)

**Fig. 4** Similarity between the conventional "topped coil" (Hartley) oscillator and the type used in the receiver described in the text.

grid and cathode; that from b to c is between cathode and ground (through which it couples to the screen). In Fig. 4B the only difference is that the sections are separated and have become individual coupled coils. Coil X corresponds to section a-b and coil Y to section b-c.

This receiver also features a type of phase inverter circuit which doesn't appear very often. Refer to the full schematic of the set. The signal output of the first audio amplifier (6S7 triode) is passed through the coupling condenser C2 and appears at point d. Between this point and ground, the audio frequency current passes through one half of audio frequency inductor L1. By auto-transformer action, an equal voltage with a 180 degree phase relation is induced in the other half of the inductor. This latter signal voltage is applied to the grid of the second push-pull tube and the proper balanced output obtained.

---

**Another MASCO Prize Winning Package of ROFIT**

**Dual Speed PORTABLE DISC RECORDER**

With Single Play-Back

**NEW! With Every Facility of the Professional Type Recorder**

Sensation of the Chicago Show... because distributors and dealers recognized the big market for this disc recorder and play back... broadcast stations, talent agents, schools, churches, lecture halls, night clubs and people who entertain at home.

It has 3 separate input jacks, providing for 1. direct recording from microphone, 2. direct recording electronically from a phonograph (dubbing), 3. direct recording from radio to record. Selector switch on panel allows for simple change of function.

Volume level indicator eye assures accurate recording level. Separate volume and tone controls allow for any desired volume or tone setting.

Complete with heavy duty 6 in. P.M. Alnico V Speaker and kit of 5 matched tubes.

Add 5% West of Rockies

Contact your local Masco distributor for immediate delivery. For descriptive literature or other information write directly to factory, Dept. C

**FEATURES**

- Combined recorder and P.A. system.
- Recording and play-back both 78 and 33 1/3 RPM.
- Electronic volume level indicator.
- Heavy duty 6 in. Alnico V Speaker.
- Separate volume and tone controls.
- Five tubes including rectifier.
- Separate jack for external speaker.
- Adjustable cutting head.
- Separate motor switch.
- Fused circuit.

**MARK SIMPSON MANUFACTURING CO., Inc.**

32-28 49th Street, Long Island City 3, N.Y.

**SOUND SYSTEMS and Accessories**

Ravenswood 8-5810-1-2-3-4

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**S.S.S.**

"Servicing by Signal Substitution"

Learn about this modern dynamic approach to radio servicing with ONLY BASIC TEST equipment...

...fully described in a 120 page book available from your Precision Distributor or Factory at 25c.

...Schools are invited to inquire regarding quantity orders from our Educational Division.

**PRECISION APPARATUS COMPANY INC.**

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Manufacturers of Fine Test Equipment.

RADIO - TELEVISION - ELECTRICAL - LABORATORY
Try this overload test on your favorite power resistor. Here's a GREENOHM on 500% overload. It's hot enough to light a cigarette. Yet its special cold-setting inorganic cement coating doesn't soften, bubble or change. When cooled, it doesn't crack, peel, flake. Yes, GREENOHMS can take it. They're tough.

Other GREENOHM advantages are: Excellent heat-shock qualities. Minimum through-coating leakage. Wire winding unimpaired in manufacture. No wire corrosion because cement does not contain usual water glass. In fixed and adjustable types; 5 to 200 ohms; standard resistance values.

★ Ask Our Jobber...
Order Greenohms. Try them in your work. Give them any comparative tests you wish. You be the judge. Ask for bulletin "Why Cement-Coated Power Resistors?" Or write us.

Fig. 13 New U.S. Television tavern type receiver using projection system. The picture size is 25 x 19 inches.

The Television Picture Tube

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developed, based on the Schmidt optical system, which has been used for many years in reflective astronomical telescopes. The Schmidt principle, as applied to projection television systems, is illustrated in Fig. 11. The cathode-ray tube is mounted vertically facing downward and projects its picture toward a spherical reflecting mirror. The mirror collects most of the light from the tube and transmits it to a 45 degree mirror, thence to a vertical translucent surface. An intervening lens molded of lucite corrects the spherical aberration caused by the reflecting mirror. The transmission efficiency of this system is much higher than that shown in Fig. 10.

A variation of the Schmidt principle is shown in Fig. 1. Instead of projecting into a 45 degree mir-

TELEVISION • FM

BROAD-BAND
HIGH FRONT TO
BACK RATIO
NO REFLECTIONS
EXTREME LIGHT WEIGHT
MECHANICALLY RIGID

S/C LABS Antennas are designed for maximum electrical efficiency and mechanical strength. Guaranteed to withstand any severe wind storm and outlast any other antenna. Constructed entirely of finest grade aluminum tubing and castings. In stock all types of FM, Television and Amateur Antennas.

MANUFACTURERS' INQUIRIES INVITED S/C LABS PRODUCTS AVAILABLE AT THE BETTER DEALERS

Send for circular
S/C LABORATORIES, INC.
20 VAN WAGENEN ST., NEWARK 4, N. J.
NOW!

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All data and basic knowledge in radio and electronics digested into 12 sections...

in a complete, quick to find, easy to read, handbook form.

Plan every operation in radio and electronics with the Radio Data Book. This new radio bible will be your lifelong tool... you will use it every day, on the board, at the bench, in the field! Use it for construction, troubleshooting and testing. The RADIO DATA BOOK will be your invaluable aid in design, experiment and in layout. It will help you improve your production better, faster and easier. In any and every operation in radio and electronics, you will use the RADIO DATA BOOK!

The RADIO DATA BOOK is a work of complete authority, prepared by engineers with many years of practical experience. They have been assisted by the Boland & Boyce staff of editors skilled in preparing electronics manuals for the U. S. Signal Corps for many years. These men have worked for several years gathering material for this book... all the knowledge of radio principles and operation... all the statistics... all the newest developments in electronics... every possible angle and detail. Eighteen months were spent digesting this material into the most concise, the clearest, and the most readable form. The result is this invaluable manual... The RADIO DATA BOOK. Whether you use this book for general reference, for scientific instruction, or for education, one thing is certain—the practical help, the daily usefulness you will derive from it will prove to be worth many, many times its astonishingly low price!

Advanced Sale... first printing, Only 10,000 available... To make sure to get your RADIO DATA BOOK, mail your order NOW!

MAIL THIS COUPON TODAY!

BOLAND & BOYCE INC., PUBLISHERS
460 BLOOMFIELD AVE. MONTCLAIR 3, N. J.

Please send me a copy of
THE RADIO DATA BOOK Enclosed is $5.00.

NAME
ADDRESS

CITY ZONE

STATE

BOLAND & BOYCE INC., PUBLISHERS

www.americanradiohistory.com
NEW! SENSATIONAL! 12" TELEVISION KIT BY TRANSVISION

It's TOPS IN TELEVISION VALUE!

4½ times bigger picture than with 10 inch tube. Applied Transmission lends the field with a magnificent 12 inch Television Kit! Engineered for easy, rapid assembly.

CHECK THESE FEATURES—Standard Model
1. The Tops in Television! Buy it and have several hundred dollars with this outstanding television receiver!
2. 12 inch picture tube (magnifique type). Picture tube is 1½ square inches (1½ times bigger picture than with 10" tube). 2.4". Elctrically focused and pre-tuned for full brightness and contrast.
3. Two stages of second grid tubes for full brilliance of picture. 3 stages of high fidelity, pre-tuned and pre-focused. 3 stages of audio pre-tuned and aligned.
4. Cut-off switch eliminates unused tubes when set to 59-210 mc.
6. 25 x 75 square inches (magnetic field for picture). Picture dimensions 30 x 30 inches.
7. 20 tubes and 12 inch picture tube. Stable, engineered and pre-tuned picture for long life.
8. Transvision gives 9,000 volts second anode potential for brilliance and contrast. 3 stages of electron L.F. selector tuned and pre-focused. 9 stages of medium pre-tuned and aligned.
9. High fidelity FM sound reproduction.
10. It's magnificent picture—nearly 1½ times bigger picture than with other television channels. Picture produced with 3 tubes, 12 inch picture tube. Complete instructions for easy assembly. Nothing more to buy than the kit. SPYIALLY DESIGNED FOLDED DIPOLE to buy.
11. DE LUXE MODEL WITH SUPERB BUILT-UP FM RADIO.
12. Lifetime of receiver is 15 years. 13. Cabinet comes in black finish (all 13 base to top). New Cabiets—black and silver model with beautiful, polished wood finish available at moderate additional cost. 14. Flat, deep picture with 2½ high x 1½ deep. 15. 250 watt transformers to carry the load.
16. 500 Watts, 115 Volts, 60 Cycles.

ANTENNA with 60 ft. of all-in-radio, and requires no other tubes.

TRANSMISSION INC., Dept. R.M., 385 North Ave., New Rochelle, N. Y.

For Faster Soldering WELLEr SOLDERING GUN

5-SECOND HEATING Ready to solder in 5 seconds.

LESS TIP RETINNING Heats only when needed.

FAST COOLING Ideal for service calls.

100 Watts 115 Volts 60 Cycles

WELLER MFG. CO. 812 Packer St., Easton, Pa.


The Organizations

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5000 members and elect a full slate of directors.

S. Beyer, Publicity Associated Radio Technicians of B. C.

Mr. Beyer reports further:

"The regular meeting of the Vancouver Associated Radio Technicians was held on June 9th with Pres. Al Johns presiding. The minutes of the last regular and executive meetings were read..."
RECENTLY I was reading a medical article outlining the methods used in the second World War to prevent the high mortality from infection and gas gangrene as was the case in the first World War. While the new drugs were given great credit, it was stressed again and again that careful thoroughness in cleansing the wound and in cutting away the injured tissue were prime factors in the lowered death rate.

Debridement is the technical term for this surgical removal of macerated tissue, and the article emphasized that it was necessary to be absolutely certain that this process was complete. In fact, it was better to remove a little healthy tissue than to leave some doubtful material that could destroy all the rest of the work and the patient himself.

Perhaps it seems a long way to you from a discussion of surgical problems to the problems of radio servicing, but it really is not. With the human factor removed, the problems are very similar. The serviceman is called upon to operate upon an ailing receiver and to restore it to its former state of health. To do so, he must first make a complete examination and diagnosis of the set's condition. He is aided in this, just as is the surgeon, by a number of complicated instruments that permit him to see and hear things that the unaided senses cannot detect.

Finally he determines the treatment called for and proceeds with the removal of defective parts and their replacement with new ones. Sooner or later, though, he is confronted by this surgeon's problem of thorough debridement. By that I mean he is forced to decide upon what parts are to be left in the receiver and what ones are to be replaced.

The surgeon does not like to cut away any more tissue than absolutely necessary, for to do so is to increase the length of the operation, to increase the shock of the operation, and to enlarge the job that nature must perform in replacing the material removed.

The serviceman's problem is more nearly one of ethics and craftsmanship. As an ethical serviceman, he does not wish to replace a single part that is not absolutely needed, but as a craftsman who takes pride in his work, he wants to do a thoroughly good job that will last. Added to this, there is often a personal knowledge of the customer's limited means that causes the serviceman to wish to "go as easy" on the total cost of repairs as possible.

Some compromise between a first-class repair job and a relatively inexpensive one would seem to be indicated, but it is fallacious reasoning that leads to this conclusion. From repeated experience I have learned—and I am confident you old-timers will bear me out—the only way to repair a radio is to correct every single fault you find in it.

Filter condensers that are "a little weak," volume controls that are just a trifle noisy, tubes that are in the questionable category, resistors that have been charred by temporary overloads—every one should be ripped out and replaced with new units with the same inexorable honesty that the surgeon employs in his debridement, and here is why:

Every job you turn out is more than just a job in itself. It is an integral part of your reputation. As such, no consideration will be given
The Organizations

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and adopted. Monte Lennox gave a report on the financial status of the association, followed by Jim Summerby giving the highlights of the Chillawack meeting of Fraser Valley Radio Technicians; Sid Summers gave an outline of speakers and films he hoped to have available for future meetings.

Wilt Munton has plans for a bigger and better convention this year, with tentative dates Sept. 24-25th. Most manufacturers and jobbers have promised full co-operation in supplying exhibits.

Bunny Cosman reported that the annual A.R.T. picnic will be held at Bowen Island Aug. 10th; this will be a change of scenery from previous years.

Non-members as well as members are invited to attend both the Convention and the picnic, with a good time assured to all who are able to attend.

Following the regular business of the meeting Sid Summers introduced the guest speaker, Mr. J. E. Gibbard, U.B.C. graduate, past president of Vancouver United Nations Society and delegate to the U. N. Assembly at San Francisco in 1945. Mr. Gibbard gave a very interesting description of the functions of the various councils and Committees by comparing them with present forms of national governments, stating that some of his remarks may not be new to the audience but that they are well worth repeating to refresh memories. He concluded by explaining how the general public can participate in its operation through the United Nations Societies formed in most cities in many countries.

The meeting adjourned at 10:15 P.M.”

S. Beyer, Publicity Associated Radio Technicians of B. C.

The Industry Presents

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INTERCOMMUNICATOR

The new 1947 "CALLMASTER" electronic intercommunicator features improved sensiti

tivity and power output. The cabinets are of the mahogany plastic type. The Model CM-10 is shown is a "master and sub" combination and permits two way communication between two remote locations. They are sold as a "packaged" unit and are easily installed by the user.
A GADGET which is useful for checking a speaker voice coil for cracking and buzzing due to intermittent and mechanical troubles can be built as shown in the diagram. One hundred and ten volt power is supplied to the primary of the output transformer, and the test leads connected to the voice coil of the speaker being tested. Advance the wire wound resistor until the 60 cycle hum is heard in the speaker. This hum should be steady and the bulb should not flicker. Otherwise, an intermittent condition is indicated.

R. P. Acland
55 West Street

**Dummy Tube**

In an AC-DC set, we often wish to remove one tube to help analyze the trouble, but are prevented from doing so by the series arrangement of the filaments. A “dummy tube” will solve this problem. A tube with low emission but whose filament is still good can be used if we remove all the base prongs except those connected to the filament. If we remove a tube with similar filament rating and replace it with the dummy, that circuit has been made dead and we can test accordingly.

Royce Nevin
8 Circlewood
Tuscaloosa, Ala.

**Adapting Pilot Lamps**

When you need a pilot lamp with a bayonet type base and have only the screw type on hand, the latter can be converted by depositing bumps of solder on opposite sides of the base to serve as pins.

The screw base will slip into the bayonet socket and the solder bumps will lock the lamp in place. The best

To Following Page

ORDER YOUR SALES AIDS FROM THIS NEW CATALOG

Here's your catalog of Cunningham sales aids... just off the press. It describes the exciting new group of Cunningham posters, Comuras, illustrated signs, and many other business-builders... tells you how these displays bring customer attention to your store and shop. A handy order form comes with each copy. GET YOURS TODAY FROM YOUR CUNNINGHAM DISTRIBUTOR.

**Cunningham Electron Tubes**

A product of
RADIO CORPORATION OF AMERICA
Harrison, N. J.

To Following Page
Make Money!

ASSEMBLING COIN RADIOS

Thousands of dollars have been made during the past year by wide awake radio Servicemen who have installed coin radios in hotels, hospitals, motels, and tourist cabins.

Great demand . . . No experience necessary.

Just three steps . . . average profit 25% if sold outright . . . are much more if operated on a rental basis.

We supply complete chassis with six tubes, quarter coin slots . . . one or two timer ready to place in walnut cabinet. Furnished with full lock and coin box.

Fill out order blank and mail to

EICHEL ELECTRONIC CORP.
EVANSVILLE 8, INDIANA

Paint Sprayer

A simple and efficient paint Sprayer for radio panels, cabinets, etc., can be produced by harnessing the power from a vacuum cleaner. The sprayer mechanism is obtainable in any hardware or appliance shop. After removing the dust bag from the vacuum cleaner, connect the sprayer head by means of the flexible cable to that point where the dust bag had been attached. The flexible cable is a part normally supplied with the machine and, therefore, does not represent any additional expense. A push-button affair on top of the sprayer head controls the flow of paint.

C. C. Erhart
Brooklyn, N. Y.
60-61 Myrtle Ave.

Dial Cord Guide

In some sets in which dial cords are used, trouble is experienced with the cord slipping off the drive shaft. This trouble can usually be eliminated by filing a slight groove around the shaft. A small rat tail file can be used for this purpose.

Conrad Stoss
832 Mohn St.
Enhaut, Pa.

One way to protect those parts used for temporary substitution testing is to mount them on a piece of fiber as shown in the picture, using a small screw or stud on each end and a lug for support. This eliminates warped and twisted wire leads and makes it easy to get good contact with test prods.

Albert Rodriguez
601 W. 140 St.
New York 31, N. Y.
The new catalogue J-4, containing complete information on various types of DC dry electrolytic capacitors, is available from the Pyramid Electric Company. Included are metal tube, cardboard wax impregnated, and metal can types. The new type F-1 radio noise filter is also described. The catalogue is printed in two colors on a good grade of paper. It is available free of charge by writing to the Pyramid Electric Company, 155 Oxford, Paterson, New Jersey.

Three new catalogues are now obtainable from the David Bogen Company. No. P6-47A is copiously illustrated with photographs in its 24 pages. All sorts of PA equipment, including amplifiers of up to 70 watts output, booster amplifiers, multi-channel preamplifiers, microphones, speakers, record players, and other items are included. No. C5-47P catalogue describes Bogen inter-communicator systems and units along with auxiliary equipment. A page is included on planning different types of intercommunication systems. The third catalogue, No. C5-47S, describes centralized sound systems suitable for schools, hotels, hospitals, stores, and the like. Any or all of these catalogues are available without charge by writing to David Bogen Company, Inc., New York 12, New York.

A 24-page brochure on universal electronic parts, ESD-93, radio service, has been published by the Specialty Division of General Electric Company's Electronics Department.

The new publication lists the price, specifications, and other data on sixteen parts in the division's line. Resistors, controls, antennas, the variable reluctance pickup, and loudspeakers are among the parts described in the new brochure.

Copies of ESD-93 may be secured from General Electric distributors or by writing the Specialty Division, G-E Electronics Department, Syracuse, N. Y.

The Alden Products Company has published two charts covering tube caps and tube cap connectors. All types are listed in tabular form with a cross-sectional, dimensioned drawing of each. Uses and types of wire suitable are described. Write to Alden Products Company, 117 North Main Street, Brockton 64, Mass., for this free information.

The Walsco catalog No. 46 contains listings and photographs of various types of hardware and miscellaneous items necessary in the service shop. A complete line of screws, nuts, wing nuts, washers, cable clamps, brackets, and many other similar items are featured. There is also much information on cements, glue, cleaning fluids, scratch remover, and the like. This catalog may be obtained without charge by writing to Walter L. Schott Company, 9306 Santa Mon.
Trade Literature

→ From Preceding Page

rica Boulevard, Beverly Hills, California.

Information on vitreous enameled resistors is presented in a very complete form in the Lectrohm bulletin No. 99. This booklet has 15 pages printed in two colors and features a clear photograph of each resistor type and tabulated data about current and power ratings. Also included is a chart which can be used to determine the physical size of a resistor of a given power rating. Available free of charge by writing to Lectrohm Incorporated, 5125 W 25th Street, Cicero 50, Illinois.

The Sangamo catalog No. 76 contains full information about paper, oil filled, mica, and silver mica condensers manufactured by the Sangamo Company. Both transmitting and receiving condensers of the midget, can, molded bakelite, and cased types are included. To obtain this 15-page, three color catalog write to Sangamo Electric Company, Springfield, Ill.

Over the Bench

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to your good intentions in trying to hold the cost down. All that will count is whether or not you did a good job. Ironically enough, the very person you tried to help will often be the first to turn against you when the doubtful part you left in his set fails, even though you explained the case clearly to him at the time.

Customers may raise their eyebrows at a comparatively high repair charge, but if the receiver works splendidly, they will bring it back to you the next time it needs service. On the other hand, any charge is exorbitant for a half-repaired set. If any doubt lingers in your mind, just consider which of these two statements you would rather hear about your work:

"His work is not too good, but he is cheap."

"His prices are high, but he turns out first-class work."

You are probably wondering about the cases in which the customer brings you a set and tells you that he wants it repaired just as cheaply as possible. This is usually the case when he intends to sell the receiver. In that case, I go over the set just as thoroughly as I do any receiver and make a careful note of every fault that I can find. Then I call up the customer and tell him the entire list, explaining what effect each repair, or the lack of it, will have on the operation of the receiver. When he has made his decision as to what he wants done, I do exactly that; but—and this is important—I list all the faults I found, both on his bill and on my copy; and I write opposite the ones not corrected that such was the customer's wish. This is my protection in case he keeps the set and a failure of the doubtful parts does

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READ RADIO MAINTENANCE MAGAZINE EVERY MONTH!

RADIO MAINTENANCE fills a breach that has existed in the radio field for a long time. Already 30,000 technicians read RADIO MAINTENANCE every month from coast to coast because it is devoted entirely to them. You too will read RADIO MAINTENANCE forward and backward each month because the RADIO MAINTENANCE staff, skilled in preparing electronics manuals for the Signal Corps for many years, specializes in the preparation of articles on every phase of radio maintenance in series form which may be filed and used for reference. The leading articles cover everything on television, FM and AM; Test Equipment; Electronic Appliances; Tools; Antennas; Alignment, Troubleshooting; Repair, Construction; Pick-Ups and Sound Amplification and Reproduction Equipment. Also, in RADIO MAINTENANCE each month there are departments on hints and links, the latest news of the trade, reviews of trade literature, radio men's opinions, new products, and news from the organizations.

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SEPTEMBER 1947 • RADIO MAINTENANCE
occur, or in case he tells the purchaser that he had me give it a complete overhaul just prior to the sale.

Let me repeat once more: be thorough in your service work. Do not let a set leave the shop with a fault of which you are aware but which you have not corrected.

I know that it takes will power to do this. It is so easy to ignore a small item that the customer has not mentioned. Often the difference in performance does not seem worth the work involved. For example, it is common to put a dead set on the bench, locate a shorted condenser and replace it, replace the set in the cabinet and then discover after it has been bolted into position that there is slightly more hum present than should be there. When the speaker was out of the baffle, the 120 cycle note could hardly be heard, and it still is not bad in the cabinet, but you know in your heart that there is a filter condenser in that receiver that should be replaced. What you do about it determines what kind of a serviceman you are.

The discipline of forcing yourself to yank the chassis out and put in the new condenser carries its own reward. In the future, in order to avoid doing unnecessary work of this kind, you will be much more thorough in your checking on the bench. That is what you want to achieve. **Servicing Is Big Business**

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The RMA has been created. The RMA is establishing a service clinic at their own expense for the purpose of solving various servicing problems.

The serviceman’s job has now become highly technical. Slipshod or unplanned methods or equipment cannot be tolerated. He must produce high quality with maximum efficiency.

The serviceman is a businessman. He is part of an industry which has grown larger every year since its beginning regardless of the state of the national economy.

Today radio servicing is a big business. From the first servicemen of old, who were combination set builders, experimenters, and hobbyists, the industry has grown to be specialized. The service technicians of 1947 do one half a billion dollars worth of business in the United States each year! Every twelve months he buys a hundred million dollars worth of replacement parts, tubes, and test equipment, largely from jobbers who make them available. Many of these jobbers are themselves former servicemen.

Since the volume of service calls has been proportional to the number of sets in service, and since the number of receivers in use is increasing at a rate of five million per year, it is evident that the service industry will grow for many years to come.

---

**JOHN RIDER SAYS...**

**Calibrate Periodically**

Periodic calibration of test equipment should be a rigid requirement in all radio service shops. Granted that radio service measurements are less critical than those required in radio engineering, the need for ascertaining whether voltage, current and resistance indications are correct, and that signal source frequency calibrations are right, is definite.

Confidence in one’s testing apparatus cannot be developed unless its proper operation is known. This not only assures longer life for the equipment and enables greater familiarity with the units, but also permits rapid diagnosis without any hesitancy or doubt.

---

**A. C. 110-VOLT MOTORS**
Selsyn Synchro Differential—New in Original Package.
A Bargain at $1.75 while they last.

**LYELL HARDWARE**
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---

**Cunningham Electron Tubes**
A product of RADIO CORPORATION OF AMERICA
Harrison, N. J.
Our first announcements of the availability of back numbers of RADIO MAINTENANCE brought a response much greater than we anticipated. As a result we are continuing to comply with the demand of radio servicemen for these back issues. We don’t know how long we may be able to fill orders for the earlier issues as the supply is dwindling fast, and some are already sold out. Only those listed are now available, so if you are anxious to get them, send in your request as soon as possible.
Radio repairs alone bring you bread-and-butter business. But you can have that and a rich "cake" too.

Thousands of successful servicemen have already discovered how C-D Quietones step up their profits over and above their normal business. And it's easy as pie!

Here's a popular, proven method: Simply hook up an old-fashioned brush-type fan, or any noise-making modern appliance, right on your sales counter. Plug in the customer's own set — cut the C-D Quietone in and out — and then and there your demonstration will "wrap up" an extra, profitable sale. Sound easy? It is — and you'll multiply your profits with every customer who steps into your shop.

Servicing is a BIG Job!

FM is a big thing now, and Television is getting bigger every day. People are getting bigger and more complex radio sets, and the radio serviceman is encountering more responsibilities, more varied tasks, and developing a bigger business. An expanding service business needs an efficient jobber who knows what servicing problems are, who can provide fast delivery, whose prices are the lowest in the top quality field, whose product lines are the best. We can help you grow by giving you better service—faster response to your mail orders. Stop in and see us or give us a call today. Say you saw this ad in Radio Maintenance and find how well we can serve you!