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GENERAL ELECTRIC
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STUART J. OSTEN
Midwestern Advertising Manager

MORTON SCHERAGA
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THOMAS A. BYRNES
Director of Field Services and Quality Control

AL JOHNSTON
Circulation Manager

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**TECH DATA**

<table>
<thead>
<tr>
<th>Model</th>
<th>DC Volts</th>
<th>AC Volts</th>
<th>DC Milliamperes</th>
<th>DC Microamperes</th>
<th>DC Amperes</th>
<th>OHMS</th>
<th>MEGOHMS</th>
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<td>0-12-250-500-2500-4600</td>
<td>0-35-1500-6000-15,000</td>
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<td>0-60-600</td>
<td>0-12-120</td>
<td>0-2000-200,000-2500000</td>
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</tr>
</tbody>
</table>

Leather Carrying Case, $4.75.

MODEL 666-HH. This is a pocket-size tester that is a marvel of compactness and provides a complete miniature laboratory for D.C. and A.C. voltage, direct current and resistance analyses. Equally at home in the laboratory, on the work bench or in the field... its versatility has labeled it the tester with a thousand uses... housed in molded case...

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<th>DC Amperes</th>
<th>OHMS</th>
<th>MEGOHMS</th>
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<tr>
<td>666-HH</td>
<td>0-12-50-250-500-1000</td>
<td>0-35-1500-6000-15,000</td>
<td>0-100-1000-10,000</td>
<td>0-60-600</td>
<td>0-1-12-120</td>
<td>0-2000-200,000-2500000</td>
<td></td>
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</table>

Leather Carrying Case, $5.75.

MODEL 625-NA. This is the widest range laboratory-type instrument with long 5½" mirrored scale to reduce parallax. Special film resistors provide greater stability on all ranges. Completely insulated molded case. Built by Triplett over a long period of time, it has thoroughly proved itself in laboratories all over the world.

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<td>0-1-0.1-10-100-1000</td>
<td>0-1-100-1000-10,000</td>
<td>0-1-1000</td>
<td>0-1-100</td>
<td>0-1000-100000-10000000</td>
<td></td>
</tr>
</tbody>
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Six Output on A.C. Volts ranges.

MODEL 2451. Electronic Volt-Ohm-Mil-Ammeter... is easy to use in complicated testing... A must in F.M. and TV work in any sensitive circuit where low-current drain is a factor...

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<th>DC Amperes</th>
<th>OHMS</th>
<th>MEGOHMS</th>
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</thead>
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<td>2451</td>
<td>0-0.5-1-5-10</td>
<td>0-3-15-60-300-1200</td>
<td>0-1-100-1000-10,000</td>
<td>0-1-10-100</td>
<td>0-1-100</td>
<td>0-1000-100000-10000000</td>
<td></td>
</tr>
</tbody>
</table>

TRIPLETT ELECTRICAL INSTRUMENT COMPANY • BLUFFTON, OHIO, U.S.A.

In Canada: Triplett Instruments of Canada, Georgetown, Ontario.
KNOWLEDGE of the operation of the i.f. and limiter sections of the FM receiver is of primary importance to the service technician. It is in these sections that most of the amplification and the selection of the received signal occur. In addition, much of the improvement of FM reception over AM reception results from proper operation of the limiter. Although the pass band width in kilocycles is greater in FM i.f. sections than in AM i.f. sections, the adjustments in alignment are even more critical in the FM receiver.

I.F. Amplifier Requirements

Actually, the relative desired pass band width of the i.f. section of an FM receiver is not very great. It corresponds roughly to the band width of the i.f. section of a high fidelity AM broadcast receiver as shown in Fig. 1. As far as coil and amplifier design are concerned, band width must be considered on a percentage basis. A 200 kc. band width is allowed for FM reception. This band width is about 1.9% of the standard total FM i.f. of 10.7 Mc. This percentage corresponds to about a 9 kc. band width at the AM i.f. of 455 kc. A 9 kc. band width is about what might be expected of a high fidelity AM receiver.

Like the high fidelity AM i.f. section, the FM i.f. section must provide good "skirt" selectivity to prevent interference from adjacent r.f. channels, while simultaneously covering the complete 200 kc. band width. Fig. 2 compares the ideal characteristics and shows the interference possibilities of each type of i.f. section.

The I.F. Signal

To avoid confusion, it is important that we distinguish between the intermediate frequency (which is a fixed value) and the frequency of the i.f. signal (which varies during modulation or frequency changes of the oscillator in the tuner section). Accordingly, we will refer to the standard, fixed intermediate frequency as the i.f. This frequency either follows the RMA standard value of 10.7 Mc. or has a value near it. When
we refer to the beat signal amplified by the i.f. amplifier and produced by mixing of the oscillator and the incoming signals, we will use the term *i.f. signal*.

One of the important differences between AM and FM receivers is the interrelation among the oscillator frequency, the resonant frequency of the i.f. section (which should be the i.f.) and the resonant frequency of the detector section. In AM receivers the i.f. section can be peaked up to a frequency considerably different from the designated i.f. without serious distortion. If the difference is great, the tuning dial can be readjusted and stations are received normally, except that their position on the dial is different and tracking may be impaired.

In FM receivers, however, the discriminator or other detector is very carefully balanced at one particular frequency which should be the i.f. If the i.f. signal center frequency changes, even a relatively small amount, the detector becomes unbalanced and the a.f. output signal is distorted. Thus, if the i.f. section is aligned at, say, 11 Mc. instead of 10.7 Mc., readjustment of the heterodyne oscillator in the tuner to make the i.f. signal 11 Mc. will not produce proper reception because the detector will be out of balance. Further practical alignment attempts to balance the detector at 11 Mc. would change the deviation percentage of the signal and are therefore very bad practice.

Because of the above facts, the practice of tuning in a signal and then trimming up the i.f. circuits for maximum signal, while mildly successful in AM receivers, is a very unwise procedure with FM receivers. The i.f. must be strictly adhered to in alignment.

**I.F. Coupling**

As we pointed out earlier in this article, the pass band requirements of an FM receiver are similar to those of a high fidelity AM receiver with a 455 kc. i.f. Like the AM receiver i.f. section, it is desirable that the i.f. section of the FM receiver have a response that is flat on top and falls off rapidly at the edges. The tendency of the response to have a sharp drop at the sides is known as the
NEW TELEVISION SIGNAL GENERATOR

by John B. Ledbetter

The Hickok 610 is a valuable addition to television servicing equipment.

In most cases, AM and FM receivers can be aligned satisfactorily with only a signal generator and VTVM. Although a scope is of considerable value in checking distortion, i-f and discriminator alignment in FM receivers, it is not an absolutely essential item. In television alignment, however, the situation is quite different. Since the frequency response of video stages in television receivers must be uniform over an extremely wide band of frequencies (6.0 Mc.), a scope must be used, along with a television signal generator, in order to align each stage properly.

A television signal generator differs from the ordinary AM or FM generator in that it must cover all television i-f and r-f frequencies, in addition to the regular FM frequencies. It must also provide sufficient frequency deviation for alignment of wide-band video amplifiers. Some form of frequency markers must be included. These conditions are amply met by the Hickok Model 610 Universal Television Signal Generator.

This versatile instrument covers all television bands and intermediate frequency ranges, and provides frequency markers for checking the response curves and alignment sound traps, video and sound strips, and discriminator circuits. Provisions also are included for insertion of external crystals for alignment of the receiver's local oscillator.

Main features of the Model 610 include: (1) Four FM ranges (0-40 Mc., 35-75 Mc., 75-115 Mc., and 150-230 Mc.) with adjustable sweep width, center frequency and output level. (2) Frequency deviation range of 0-15 Mc. (3) 60-cycle sweep. (4) Oscillating "pip" or absorption "dip" marker range from 20 to 30 Mc. (5) AM frequency range of 20-30 Mc. with variable output. (6) 400-cycle modulating frequency (at 50% modulation). (7) External marker frequency (1 Mc. to 250 Mc.); and (8) External crystal input. The r-f output voltage is continuously variable from 0 to 250 millivolts in multiplier steps of X1, X10, X100, X1,000 and X10,000. A phasing control is incorporated to compensate for possible shifting of the scope trace and retrace patterns. With the above features, pure r-f or amplitude-modulated r-f can be obtained for the alignment of sound traps. Crystal-controlled r-f, modulated or unmodulated, is also available for setting the receiver's local oscillator to any of the 13 standard television channels, or for i-f alignment.

**FM Oscillator**

It is interesting to note the method by which the necessary FM sweep frequency is obtained. A 6J6 twin triode, parallel-connected (V-1) is used as a Colpitts oscillator, and the inductance of its spiral-type tank coil is varied over the desired sweep range by a dynamic drive motor. The rapidly changing position of the dynamic-drive motor shaft produces a corresponding change in frequency of the tank inductance.

The sweep width can be controlled from 0 to 15 Mc. by varying the a-c motor control voltage. This is accomplished by varying the setting of R-22. The main tuning condenser C-3, tunes the oscillator through the 75-115 Mc. range.

**Fixed Oscillator**

In addition to the center frequencies provided by the FM oscillator, a fixed oscillator, employing a 6AK6 Hartley (V-6), is operated at 75 Mc. When this oscillator is in operation, its 75 Mc. output beats against the variable output of the FM oscillator.
By taking the fundamentals, or first harmonics, of each oscillator and utilizing the sum or difference frequencies, full coverage and direct calibration of all television frequencies can be accomplished.

**Crystal-Controlled Oscillator**

A Pierce oscillator, employing \( \frac{1}{2} \) 6SN7 (V-7) can be used to adjust the receiver oscillator to the sound carrier of any local television channel or to provide for crystal marker frequencies. For operation, a crystal of the proper frequency is inserted in the front-panel socket; 400-cycle modulation is provided when desired by a fixed audio oscillator (V-4).

The output of this oscillator is fixed at 50% modulation for use in modulating the variable oscillator while making sound trap adjustments. (It might be noted that crystals are available from the factory for any frequency between 10 Mc. and 215 Mc.).

**Variable Marker Oscillator**

The other half of the 6SN7 (V-7) is employed as a variable Colpitts oscillator tuning the 20 to 30 Mc. marker range. Since standard television i-f and trap frequencies fall within this band, an extremely large and well-calibrated dial is made possible.

The internal marker control may be set either to provide marker “pips” (Fig. 1) or absorption “dips” (Fig. 2) of the response curve traced by the scope. By tuning the variable oscillator dial, the pip can be moved over the response curve until the dial reading represents the exact frequency of the curve at the pip position.

In some cases, the variable oscillator may heterodyne with some undesirable frequency and produce more than one marker on the response curve. This condition may be checked by switching a 1-megohm resistor into the circuit to stop oscillation. The tuned tank circuit will then absorb energy from the sweep generator and put a dip in the response curve at the frequency setting of the variable oscillator.

A 6J6, parallel-connected, (V-2), is used as a mixer for the FM and fixed oscillator outputs. Since the mixer output is fed to a 6AK5 cathode follower (V-3), the sweep originated by the generator is independent of the load on the low-impedance output.

**General Alignment Notes**

Basically, alignment of all receivers follows the same pattern. Complete and detailed information on alignment of individual receivers usually is supplied by the manufacturer and should be followed to the letter. The following notes on general alignment procedure, however, should help in giving a better picture of the various functions of the Hickok 610 Signal Generator.

First, it is absolutely necessary that a good ground be provided. Best results are obtained when a metal bench top is used. Efficiency of the ground system may be checked by touching any piece of equipment or lead wire. If the sweep pattern changes, a better ground should be used.

The recommended order of alignment is: (1) Television I-F Sound Traps, (2) Television Adjacent Channel Traps, (3) Television I-F Amplifiers, (4) Sound I-F Channel, (5) Television Receiver Oscillator, and (6) Television R-F Amplifier.

**Television I-F Sound Traps**

Since the sound and picture frequencies beat against the same oscillator, the sound (4.5 Mc. from the picture) will pass through the video circuits and cause the picture to weave and bob along with variations in audio, unless sound traps are employed. These traps should be adjusted before video i-f alignment, to avoid upsetting the alignment.

**Television Adjacent Channel Traps**

Although adjacent channels must be 75 miles apart, it is possible for sound from one channel to interfere

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To page 34
Here are two units which are an aid in installing television near TV transmitters, where excessive signal strength must be reduced to avoid tearing, distortion and lack of detail in television pictures.

By ALDEN CAPEN

MANY radio service technicians who have worked extensively with television find that sets installed very near to TV transmitters have reception difficulties as bothersome as installations in the “fringe” areas. These installations are so near to the transmitter that signals are too strong for proper control, and the television images are consequently distorted and vague.

Roger Television, Inc., has put two units on the market which do a great deal to help overcome this problem.

By nature, the human eye is a far more analytical instrument than the ear. Consequently, television picture aberrations are far more obvious than their audio counterparts. For example, lack of high frequency response in an audio amplifier or radio receiver is generally overlooked by the customer. In fact, according to many a dealer, the fault is very often demanded. However, the same trouble, lack of high frequency response, shows up in a television set as lack of detail, and is usually cause for returned receivers and profit-wasting service calls.

Foggy reception of one or two stations on a broadcast set, such as may be caused by an overloaded r-f stage, is rarely sufficient cause for calling in a serviceman. The corresponding trouble in television, however, turns up as torn pictures, and is utterly unacceptable to the television set owner.

Similarly, a slight phase-shift in a received signal may be entirely ignored by a radio listener, while the television audience may react strongly to the same trouble showing up as either a ghost or smearing pictures. A barely audible interfering signal becomes a very annoying screen pattern; unnoticed tube noises become snow on the screen; and the slight clicking of a passing vehicle’s ignition will blot out parts of a television image.

Because of the perfection required of a television signal, the entire installation must be arranged to give
"personal" attention to each and every desired station. Thus the need arises for an individualized installation rather than the usual compromise arrangement.

One of the faults very often overlooked by a television installer is characterized by tearing, distortion, mottling and lack of detail, all of which can be due to excessive signal strength.

Signals which are not quite strong enough to cause tearing will often cause vertical bending or distortion. The basic reason is the same as that which causes tearing, being different only in degree.

Together with, or separate from, the tearing and bending, there may be tone distortions which show up as mottled patches and lack of detail. This is due to the distortion of the video portion of the composite signal, which takes place at the same time the synchronization pulse is distorted.

To prevent these effects, among others, the television receiver is equipped with a contrast control, and often with automatic gain control. This circuit, however, is always designed to cut down overall gain by reducing amplification in several stages simultaneously. Therefore, an extremely strong signal may overload the first r-f stage before the contrast or gain control can be of help. The result on the screen may be the puzzling situation of a light, thin picture which is nevertheless splotchy, bending, torn or otherwise distorted.

**Tel-Adjust**

Obviously then, until means are provided in television receivers to reduce signal strength before the first stage is reached, this must be done by the installing serviceman. Preferably, the work should be done without the need to remove or rewire the chassis. This can be accomplished by the use of an external switching and signal equalizing box, installed in the antenna’s transmission line. One commercially available unit of this type, in kit form, is the Tel-Adjust.

Basically, the Tel-Adjust is a low-loss switch in an enameled black steel can with colored aluminum cover, arranged for mounting to the side of the receiver or to the window sill. Provision is made to install fixed attenuation pads consisting of several carbon $\frac{1}{2}$w resistors inside the box. By making use of the switch, a choice of several attenuation values are possible, and each station’s signal may be attenuated by the proper amount, even though the strength may vary greatly.

Several types of fixed pad arrangements will accomplish the same results. For balanced lines, however, such as 300 ohm twinlead, a balanced attenuation network is preferred, such as the “O” and “H” types shown in Fig. 1.

On the other hand, when coaxial transmission line carries the signal from the antenna to the receiver, an unbalanced pad is sufficient, and cheaper to install. Examples are the “T” and “P” types, Fig. 1.

In order to install these equalizing pads, however, two things must be known: (a) How much attenuation is needed; (b) the resistance values which will produce exactly the needed attenuation without upsetting the impedance values of the receiver and transmission line system.

**Tele-Pad**

The only practical method of determining the amount of attenuation needed to prevent overloading, tearing and distortion, is to insert a variable pad box into the transmission line close to the receiver, and to vary it until the trouble is eliminated.

This variable pad box should have a constant impedance equal to that of the transmission line, whatever it may be, and fairly accurate calibration at television frequencies. In addition, low-loss components are desirable, to keep down the insertion loss at “zero” attenuation position. A unit of this type, employing ceramic switches with silver plated components, is the Tele-Pad. Its etched, calibrated dial reads to 30 db attenuation in steps of 3 db.

Experimentally determining the amount of attenuation needed on each overloading station is the first step. The next is to achieve this attenuation without sacrificing impedance matching, which would create standing waves in the line, and therefore ghosts on the picture.

Fortunately, most receivers utilize either 300 ohm or 72 ohm transmission line and receiver input impedances, and the complicated formulas and figuring can be reduced to table form, as in the case of the detailed charts which accompany the Tele-Pad and Tel-Adjust. Some of these values, together with proper circuits, are shown in Fig. 2.

The use of a switch for equalizing purposes permits of another step towards better and clearer pictures—the elimination of ghosting and interference. While some other means of eliminating these faults have been attempted, the basic and reliable approach is via the use of highly directional dipoles with multi-element parasitic arrays. If care is taken to choose a very highly directional beam antenna, most interfering signals can be dodged out completely by slowly orienting the antenna in both vertical and horizontal directions for best signal versus weakest interference.

Obviously, however, the best direction for pointing the beam on one station’s signal must be altogether different for another station. Therefore, if two or more stations have this trouble, it will usually be found worthwhile to install two or more dipole arrays, connected through separate transmission lines, and a Tel-Adjust to the receiver’s input terminal.

---

**FIG. 2**

<table>
<thead>
<tr>
<th>DB Attenuation</th>
<th>300 ohm impedance ‘O’ pad</th>
<th>72 ohm impedance ‘P’ pad</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$R_1$</td>
<td>$R_2$</td>
</tr>
<tr>
<td>6</td>
<td>1000</td>
<td>100</td>
</tr>
<tr>
<td>12</td>
<td>470</td>
<td>300</td>
</tr>
<tr>
<td>18</td>
<td>390</td>
<td>560</td>
</tr>
<tr>
<td>24</td>
<td>330</td>
<td>1000</td>
</tr>
<tr>
<td>30</td>
<td>310</td>
<td>2200</td>
</tr>
</tbody>
</table>

(all ‘$R$’ values are in ohms)
FOR operation at higher frequencies (around 100 megacycles), triode tubes have been devised which possess certain advantages over the multi-element tubes customarily used as mixers or frequency converters.

Dual triodes have the advantage that one tube can serve as both oscillator and mixer with resulting economy of current drain and initial cost. Dual tubes of the 6J6, 7F8 and XX7 types have been specifically designed for optimum performance at higher frequencies, such as encountered in FM and TV receivers.

The triode provides a much lower mixer gain at standard broadcast frequencies than the conventional multi-element tubes. For this reason, many FM-AM combinations use two mixer circuits, a triode for FM and a pentode for AM. However, r.f. and i.f. circuit gains using a triode mixer are greater at broadcast frequencies, and a satisfactory overall result is possible with careful design.

One of the major factors governing the ultimate sensitivity of a radio receiver is the inherent circuit and tube noise in the early portions of the circuit. Obviously, a receiver will not respond to a signal having an intensity less than the noise generated within the set itself. For best results, the inherent noise in the front end of the set should be about 1/3 of the minimum signal to be received. In the design of the triode tubes mentioned, the inherent grid noise has been reduced to a minimum. The loading effect of these triodes on the tuned circuit connected to the grid is small, so that the selectivity and “Q” of the circuit are not badly affected by the tube in this type of mixer circuit.

The oscillator and mixer stages of the recent Montgomery-Ward Model No. 74WG-2705A are shown in the partial schematic diagram, Fig. 1. Due to the fact that the 6J6 tube used has a common cathode, the bottom portion of the oscillator coil is used as a “tickler” to couple the oscillator signal into the mixer section of the tube. Both the oscillator and the mixer grid returns share the path through the lower section of the oscillator coil to the cathode. Good design practice dictates that the portion of the coil devoted to the “tickler” function be made as small as possible. Frequency drift in this circuit with tube warm-up is fairly small. Maximum coupling of the “tickler” coil to the oscillator tank coil is, of course, also achieved in this circuit.

The mixer is biased by means of the 100,000 ohm grid leak, which functions to regulate automatically the conversion gain with changes in the oscillator injection voltage. The oscillator injection voltage is rectified by the mixer grid and develops a d.c. bias proportional to the magnitude of the injection voltage. The oscillator...
COIN-OPERATED RADIOS

by W. I. Fischman

Here is how one radio service outfit has added a profitable sideline to its business.

TAKE a coin operated radio. Put in a quarter and it will play for two hours. In Philadelphia, two men are able to go about their jobs while quarters pile up in three hundred of their coin operated sets all over the surrounding section.

The two men are Robert Klein and Art Lipschutz, and both consider their coin-operated business part-time work. Art, who services these radios, owns and runs "Art's Radio Shop," handling neighborhood radio servicing and specializing in the repairing of auto radios. Bob Kline is a full time salesman and, like Art, handles the route on the side.

Their company had its inception in May 1946, with the purchase of 25 coin-operated sets. The public response was excellent, and two weeks later they invested in 50 more, followed by a purchase of another 50 a few weeks after that. Fifty more sets a couple of months later completed their stock for a year.

At first, the response was amazing. "It can't stay this good . . . it's bound to slump," they thought. It did slump but, to their delight, the slump did not come close to hitting bottom. After the initial novelty had worn off, the financial returns from each location leveled off to a modest but steady sum that shows almost no seasonal variation.

Location

A bit of experimentation was necessary to determine the best locations for sets. They did not work out in the better hotels. Such places provide a cocktail lounge, a night club and other diversions for guests. In second and third rate hotels, however, the quarters really mounted up. In such hotels, entertainment facilities are limited. Tourists cabins also provided an excellent outlet. No single sets (outside of those for test purposes) were installed. Everything was done on a concentrated mass basis . . . a hotel . . . a set of tourist cabins, so that collection could be made swiftly.

When a hotel is sold, on the idea of a coin-operated radio installation (and they are approved by the Hotel Association), a test setup is made. Radios are put in representative locations. If the response is good more sets are added, until the location's saturation point is reached. Art and Bob operate on a three year contract with their locations. This insures expenses and a reasonable profit on an installation. The hotel or tourist cabin gets 25% of the gross take and stands absolutely no expense or trouble. Art and Bob provide the machines, install them, service them, and make regular collection rounds.

The radios are set to play either one or two hours for a quarter, depending on the location. Bob Kline figures that each set is played an absolute minimum of one hour out of each day. This means a minimum gross of 25 cents a day, or $1.75 each week. After the hotel takes its cut, approximately $1.37 remains. The cost of maintenance and collection tunnels this down to a net of about $1.10 each week for each machine.

Servicing

Collections are not much of a problem for, barring breakdowns, the radios can go as long as a month without needing attention. Two days every few weeks are used to make the rounds collecting and servicing. In the car they carry a volt ohmmeter and several sets of spare tubes, which are quicker to use and easier to carry than a tube checker.

A large portion of the service consists of prying match sticks, hair pins and odd bits of paper out of the coin slot. Bad tubes are replaced and minor repairs made on the spot, but sets that need extensive service work are replaced with a spare and the faulty radio brought back to the shop. Out of the 300 sets, only 5 or 6 are brought back to the shop each collection round. Half of these

Besides restaurants, coin-operated radios may be profitably installed in hospitals, beauty parlors (with special earphones), etc.
LIFETIME AUTOMATIC PLUG

A new type Lifetime Automatic Attachment Plug Cap, which requires no stripping or slitting, is being manufactured by the Academy Electrical Products Corp., 4849 Broadway, New York 34, N. Y. The plug is molded of durable Plaskon and comes in a wide variety of modern pastel colors. No screws, soldering or crimping is used to attach the plug. Connection is automatically accomplished by metal points incorporated in swingable blades. These points pierce insulation of individual conductors and make electrical contact. It is very well made, and only seconds are required to assemble it completely.

TV ANTENNAS

Many gains in television reception have been made possible by the tests of the Research Laboratories of the Ward Products Corporation, 1523 East 45th Street, Cleveland 3, Ohio. Under the direction of Jim Finneburgh, Chief Engineer, Ward has developed their new Model TV S-6 stacked array, many times more powerful for TV reception in remote installations and poor signal locations. The strong signal pick-up of the Ward TV S-6 is accomplished by stacking two of their finest antennas, one above the other with correct half-wave spacing. An ingenious method of allowing complete adjustability for orienting, even though bays are stacked, has also been engineered. Pre-assembly of component parts has been designed to save installation time and expense.

MICROGROOVE ARM AND CARTRIDGE

Engineers of The Astatic Corporation, Conneaut, Ohio, worked directly with Columbia technical experts in designing their new FL-33 Pickup and LP-33 Crystal Replacement Cartridge, for use with the new, long playing Microgroove discs produced by Columbia Records, Inc., the pioneer pickup and microphone manufacturers have announced. As a result, the Astatic tone arm and its cartridge are capable of getting the most out of LP records.

They are being manufactured to meet precisely the specifications set forth by the record manufacturer.

An outstanding feature of the Astatic equipment is that the LP-33 Crystal Cartridge, which has a permanent sapphire needle with .001-inch tip radius for microgroove recordings, is readily interchangeable with a companion cartridge, LP-78, for playing conventional 78 rpm records. The cartridges may be changed in seconds, by anyone, because they fit firmly into position in the pickup on the same slip-in principle by which cap and body of some modern fountain pens are joined together.

The FL Filter, an accessory for the pickup that assures perfect performance with high quality speakers, is also being produced by Astatic.

BROADCAST MICROPHONES

Two completely new high fidelity, high output, dynamic Broadcast Microphones are announced by Electro-Voice, Inc., Buchanan, Mich. Developed in cooperation with network and station engineers, the new Models 650 and 645 are designed to meet the exacting requirements of modern high fidelity FM and AM broadcast service. Consistently accurate wide range high fidelity response out to 15 kc, extremely high output level, and rugged shock-resistant construction make them suitable for either studio or remote pickup. Manufactured to close tolerances, under laboratory quality control, every unit is individually calibrated.

VOLT-OHM-MILLIAMMETER

The Simpson Model 221 is something entirely new in test instruments. It is actually the equivalent of 25 individual instruments. Designed as a high sensitivity a.c.-d.c. volt-ohm-milliammeter and equipped with rotating dials, it is ideal for television, radio, and industrial testing. Patented by Simpson Electric Co., the Roto-Ranger principle eliminates the confusion of numerous scales and multiplying factors common to ordinary multi-range testers. Its operation is simple—as the selector switch is moved to the range desired, the proper scale for that range is brought into place behind the meter window. There are no cramped calibrations; each scale is large and full-sized, as it would be for a separate instrument. The case of the Model 221 is finest wood construction, leatherette covered. Finish of the panel is brilliantly gleaming black anodized aluminum, combining attractiveness with extreme durability.
The Little Volume Control with BIG Advantages

The small size of the Mallory Midgetrol lets you service portables, auto radios and small AC-DC receivers which require 15/16" controls.

The unique shaft design of the Mallory Midgetrol saves installation time with all types of knobs.

Electrical characteristics let you use the Mallory Midgetrol to replace 1 1/8" as well as 15/16" controls. Stocks are further reduced because no special shafts are needed.

The Mallory Midgetrol is quietest by actual tests—and tests prove it stays quiet, too. In addition, it has nine big features that are all new.

- NEW SIZE
- NEW DESIGN
- NEW SHAFT
- NEW EXTENSION
- NEW SWITCH
- NEW ELEMENT
- NEW TWO-POINT SUSPENSION
- NEW CONTACT
- NEW TERMINAL

It's the NEW Standard in Carbon Controls. See your Mallory Distributor.
Psychoologists tell us that every now and then it does you good to take your hair down and get rid of some of your pet peeves by talking about them. Working on this theory, I am confident that I am speaking for the whole service fraternity when I say plaintively that I wish customers wouldn’t... Call me on the telephone and give me a ten-minute case history of their set without allowing me to squeeze in a single question, and then blandly inquire: “Now what would you say is the matter with it?”

Invariably comment, “I am sure there is not much the matter with the set. It was playing perfectly alright before it started to smoke and smell so funny. It’s probably just some little thing that you can find in a minute.”

Continue to cling grimly to the idea that a radio has one single solitary condenser in it, and that after this has been replaced, there should be no further condenser trouble for at least ten years.

Cling just as fondly to the theory that “loose wires” cause most of the trouble in radio receivers and be darkly suspicious that, when a serviceman says that the trouble was a defective oscillator coupling condenser, he is just trying to use big words to cover up the fact that all that was wrong was one of these “loose wires” that are so common to the customer and so rare to the serviceman.

Let Cousin Willie, “who had something to do with radio in the war,” give the set an expert going over before it is brought to the shop. “Of course, if he had the necessary tools, he could have fixed it; but he said to tell you that he is certain that one of the oscillator wave-guides is out of alignment.”

Allow small children to play with the complicated record changer mechanism over which I have sweated blood adjusting to the utmost of perfection and then complain because the job does not “hold up.”

Feel that it is my fault if one of the other four tubes in their a-c—d-c receiver goes out a short time after I have replaced, say, the 35L6.

Bring me radios in which mice have been nesting.

Bring me radios in which cockroaches are nesting.

Leave me stuck with radios that I have declared not worth fixing for month after month, insisting each time I call that “we will be by for that this week. John wants to make an end table out of the cabinet, and we are going to let Junior play with the insides.”

Give me a big song and dance about how necessary it was that a particular set be got out in a rush, and then, after I had worked overtime to get it out, not show up for it for two or three weeks.

Insist that since I did a good job on their radios, I should also work on their vacuum sweepers, electric mixers, heating pads, electric clocks, hair curlers, etc.; and feel half mad because I try to explain that I am not equipped for that kind of service.

Expect my service charges to be in proportion to the original cost of the receiver; i.e., expect that a filter condenser installed in an a-c—d-c set cost about one-tenth of what the same job would cost on a console combination.

Try to get me to say how much it will cost to fix a set before I have even seen the receiver.

Bring in a set that I had worked on a year or so before, and remark: “That set never worked right after you fixed it the other time, but we never got around to bringing it back, to page 47.
MADE TO SELL YOU
AND YOUR SERVICE

3 NEW SYLVANIA AIDS!

Here's the new Sylvania Service Kit now available to service dealers—a prestige-building and practical addition to your service business!

Made of laminated plywood covered with brown plastic fabric with the appearance of fine leather, this kit has a tube capacity of over 75 tubes. The interior measures only 18" x 11¾" x 3¼". The tool section in the lid is designed to hold the most commonly used tools for on-call service. Ask your Sylvania Distributor for this wonderful new, low-priced Service Kit. Get that added professional touch that means so much.

only $9.95

And here's the new Sylvania illuminated shadow box sign that's ready for hanging in your window, on your wall, or on any strategic flat surface in your window. Two eyes in the top of the sign are for hooks or chains.

The big, bright red letters "Radio Service" tell your message in no uncertain terms to every passerby. The sign's face is glass; the background translucent yellow. The red letters are outlined in black, while the bottom half of the sign is black with yellow lettering. The brown metal case is chrome trimmed. Size: 18¼" long, 8¼" high, 3¼" deep. Seven-foot cord provided.

only $4.50

At Sylvania Distributors everywhere! Sylvania Electric Products Inc., Advertising Department, Emporium, Pa.
a new family joins the sangamo tribe...

New Dependability, New Long-Life Performance

Meet Sangamo Electrolytics, the newest family to become linked with the Sangamo Tribe. Introducing, from left to right on the opposite page, are illustrations of the "Chieftain", "Tomahawk", "Warrior", "Apache", and "Mohican". These newcomers now join the established tribe of Sangamo Micas, Silver Buttons, Papers, and Plastic Tubulars. Their heritage of dependability and long-life performance stems from being built in a factory which was constructed especially and exclusively for the manufacture of contamination-free electrolytics. Their performance will meet and exceed the most stringent requirements of electronic applications. Yet, these new, high-quality capacitors are competitive in every respect from a standpoint of design, construction, and price.

Your own trial-use will convince you that new standards of dependability and longevity have been built into Sangamo Electrolytics. Order from the new Sangamo Electrolytic Capacitor Catalog No. 825B, which is yours for the asking, and without obligation.
ELECTRONICALLY SPEAKING

One of the most dynamic of the organizations of skilled radio technicians that have been formed by radio servicemen, is the Radio and Television Service Engineers Association, Inc., of Anderson, Ind. Anticipating the advent of at least one telecasting station in central Indiana in the not too distant future, this association has been conducting its own television service training program with excellent results.

W. D. Renner and W. W. Hensler, of Howard W. Sams & Co., Inc., recently spoke at an Anderson association meeting on the subject of television installation and signal distortion. Basing his talk on data developed in the extensive Photofact program of television receiver installation and servicing analysis, Bill Renner pointed out that successful reception of a usable signal at points as far as 150 miles from the telecasting antenna may bring about a modification of the previously considered requisite of line-of-sight limitations for satisfactory television receiver installations.

A four-year program of TV expansion into over eighty cities has been announced by CBS. At present, the CBS TV network includes New York, Boston, Philadelphia, Baltimore and Washington. Before the end of this year, CBS plans to extend its services to the Toledo, Detroit, Cleveland, Atlanta and Los Angeles areas. Twenty-five more stations are contemplated for 1949, thirty-six more for 1950, and nineteen during 1951.


→ to page 28
You're a responsible citizen. You do good work. But how are the people in your neighborhood, the radio owners that pass your store every day going to know it unless you tell 'em and make it stick!

The RAYTHEON BONDED DEALER PROGRAM makes it stick! It provides you with an iron-clad 90-day BONDED guarantee on labor and parts that is backed by the hundred million dollar assets of the Western National Indemnity Company. Raytheon pays for your bond. It doesn't cost you a cent!

YOUR RAYTHEON DISTRIBUTOR HAS A BOND FOR YOU

Ask him about the Raytheon Bonded Dealer Program and how you can use it to build steady, profitable volume.

Act now — while there is still an opportunity for you to become a Raytheon Bonded Electronic Technician.

RAYTHEON MANUFACTURING COMPANY

RADIO RECEIVING TUBE DIVISION
NEWTON, MASSACHUSETTS. CHICAGO, ILLINOIS. LOS ANGELES, CALIFORNIA

RADIO RECEIVING TUBES • SUBMINIATURE TUBES • SPECIAL PURPOSE TUBES • MICROWAVE TUBES
Presenting
DURANITE
the
SUPERIOR
CAPACITOR

Immune to Moisture
Penetration

Unaffected by
Temperatures of
250°F.

Several sizes —
11/32" to 21/32"
dia. 1 1/4" to 2"
long.

• An entirely new tubular capacitor—featuring Aerolene, the
new impregnant; new processing methods; new DURANITE casing.

Such is DURANITE—the toughest tubular yet offered for use in
stay-put assemblies. Therefore don’t confuse DURANITES with
conventional molded tubulars. DURANITES are different.

Drop, bang, scratch—no damage to the permanent, non-varying,
rock-hard DURANITE casing. Unaffected by high temperatures—
nothing to melt or burn. Thoroughly moistureproof. No shelf
deterioration. Pigtailed won’t pull out. And so on.

Order DURANITES from your Aerovox jobber. Popular capacities:
200 to 1600 v. D.C.W. Try them. You’ll be amazed!

To avoid delay when writing to the manufac-
turer give issue and page number

Antenna Manual—This book presents in a single volume a com-
prehensive compilation of antenna, transmission line, and propagation
data of vital interest to those associ-
ated with the practical aspects of
radio broadcasting and communication.

Its author, Woodrow Smith,
has placed his emphasis on this test
on engineering approximations and
physical reasoning, rather than com-
plex mathematical treatment. It is
306 pages long, and illustrated where
necessary by photographs, sketches,
and graphs.

The book examines radio waves,
transmission lines, basic antenna
theory, low and medium frequency
antenna systems, high frequency an-
tenna systems, VHF and UHF an-
tenna systems, receiving antenna con-
siderations, coupling, measuring
equipment and techniques, and an-
tennas for navigational guides. This
discussion embraces television an-
tennas.

This book is published and dis-
tributed by Editors and Engineers,
Ltd., 1300 Kenwood Road, Santa
Barbara, California.

Sylvania Campaign Literature—
Sylvania Electric Products Inc., has
put out a brochure describing the ad-
vertising material available to Syl-
vania radio service dealers in con-
nection with its advertising campaign
for the remainder of 1948. This
available material, planned to fit in
with other aspects of Sylvania’s
nationwide advertising, consists of
special postal cards, four-color win-
dow displays, full-color window
streamers, one and two column new-
paper ad mats and eight and twelve
inch decals for window, door and
truck.

Public Address Manual—The first
industry-wide Public Address Man-

Model 266
Vacuum Tube Voltmeter
for TV, FM, AM

RANGES: Volts: (A.C.) 0.5, 5, 50, 100, 250, 500, 1000, 2500
Milliamperes: (D.C.) 0.1, 5, 10, 50, 100, 250, 500
Amperes: (D.C.) 0.1-10
Ohms: 0.1 ohms to 10 megohms
Size: 8 1/2" x 9 1/2" x 8", Dealer’s Net Price, complete with Operator's Manual $94.50

Model 266 is a vacuum tube voltmeter designed for TV, FM, AM applications. It offers various ranges for accurate voltage, milliamperes, and amperes measurements. The voltmeter can measure from 0.5 volts to 2500 volts, milliamperes from 0.1 to 500 milliamperes, and amperes from 0.1 to 10 amperes. The resistance range is from 0.1 ohms to 10 megohms. The compact size of 8 1/2" x 9 1/2" x 8" makes it convenient for use in various settings.

Model 330 RCP
Mutual Conductance Tube Tester
for TV, FM, AM

The Simpson Model 330 RCP is a mutual conductance tube tester designed for TV, FM, AM applications. It measures tubes in terms of percentage of rated dynamic mutual conductance, providing a direct indication of tube performance with reference to the manufacturer's standard microhms rating. The tester shows tubes as good, fair, weak, or definitely bad. After a tube test, one button returns all switches to the normal position ready for the next test. The size of the tester is 15 1/2" x 9 1/2" x 6 1/8", and the dealer's net price, complete with operator's manual, is $132.50.

Model 415-A Signal Generator for FM and AM

This model incorporates a built-in sweep circuit for modern FM servicing. It incorporates frequency-modulated signal with a sweep of 1 megacycle, more than adequate for all FM alignment. It can be internally modulated at either 60 cycles or 400 cycles, or modulated from an external source. A 120 cycle saw-tooth voltage is available as scope synchronization or as actual scope sweep. AM bands cover complete frequency range from 75 KC to 130 MC. The noise level is 20.5 db. For 105-130 volts, 50-60 cycle. The dealer's net price, complete with operator's manual, is $145.00.

The Simpson Model 330 tests tubes in terms of percentage of rated dynamic mutual conductance, a direct indication of tube performance with reference to the manufacturer's standard microhms rating. It shows tubes as good, fair, weak, or definitely bad. When you have finished a tube test, one button returns all switches to the normal position ready for the next test. The size of the tester is 15 1/2" x 9 1/2" x 6 1/8", and the dealer's net price, complete with operator's manual, is $132.50.

Model 415-A Signal Generator is designed for FM and AM applications. It incorporates a built-in sweep circuit for modern FM servicing. It frequency-modulated signal with a sweep of 1 megacycle, more than adequate for all FM alignment. Internally modulated at either 60 cycles or 400 cycles, or modulated from an external source. A 120 cycle saw-tooth voltage is available as scope synchronization or as actual scope sweep. AM bands cover complete frequency range from 75 KC to 130 MC. The noise level is 20.5 db. For 105-130 volts, 50-60 cycle. The dealer's net price, complete with operator's manual, is $145.00.

On Model 266 Vacuum Tube Voltmeter, note their distinguishing Simpson features: the 1 volt range. For full scale deflection, necessary in low R.F. voltage measurements; the zero center switch provides for discriminator circuit alignment; a feature which embraces all D.C. voltage ranges. D.C. volt input resistance ranges from 50 megohms to 200 megohms. A.C. volt input impedance at 60 cycles is 40 megohms. The low input capacitance of the probe (approximately 4 microfarads) insures the accuracy essential for the high frequencies encountered in servicing FM and television receivers.
G. E. PHOTO
PREPARE FOR A BETTER JOB WITH
100% PRACTICAL
"ON-THE-JOB" TRAINING

A Sensational
Announcement to
the Top "1/3" in
Servicing...

After 2 Years of Preparation
CREI Introduces Its New
Home Study Course in

TELEVISION
AND FM
SERVICING

VIDEO SWEEP GENERATOR
This new course was prepared by CREI at
the request of several large manufacturers,
distributors and dealers who said, "We must
have more servicemen trained to handle the
approximately 800,000 television sets and
4,000,000 FM sets to be produced this year
alone! CREI knows exactly what you need
and every effort has been made to keep this
course practical and to the point. If you are
now in service work you will be able to
thoroughly understand and apply each lesson.
It has been reviewed and checked by quali-
fied service experts who know what you
must know to get ahead in this booming field.

Start your training now and you start ap-
plying your new-found knowledge imme-
diately. Every lesson in this course can be
helpful in your daily work. As you progress
in your training you will find yourself
equipped to handle complicated Television
and FM work that only a few months ago
looked "impossible". The time to start is now.
It costs you nothing but a few minutes
time to read the interesting facts and the
complete lesson-by-lesson outline. So prac-
tical, so simple to understand.

GET ALL THE FREE FACTS
NOW — FILL OUT AND
MAIL COUPON

Capitol Radio Engineering Institute
16th & Park Rd., N.W., Dept. RT-10
Washington 10, D. C.
Please send me complete details of your new
home study course in Television and FM
Servicing. I am attaching a brief resume of
my experience, education and present position.
Name
Street
City, Zone State

ANTENNA GUY RINGS
Rust-Proof—Light Weight—
Cast Aluminum
Center Hole Sizes: 1" Each 55c
1 1/2" Postpaid
Other Sizes 1 1/4" Cash
Made to Order 1 1/2" with order
Hill Manufacturing Co.,
Box 573, Laureldale, Penna.
**THE EDITOR-JUDGES COMMENT**

"Judging the contest is fun, and I’m learning something from it ... am impressed with both quantity and quality of the entries ... contributors took genuine interest in a challenge to their American ingenuity ... hard to make a choice ... it is evident that servicemen have found it necessary to devise for themselves special tools ... no designer sitting off at a distance can possibly anticipate their needs so well ... basis of a fine exhibit ... would like to print ... will result in valuable additions to serviceman’s tool kit."

**FIRST PRIZE WINNERS**

**May**
Harry L. Smith, Long Island City, N.Y., was picked by the judges as the lucky winner of the DuMont Type 274 Five-Inch Oscillograph.

**June**
To lucky Gerard P. Diaz, Parkville, Missouri, went the RCP Model 665-A "Billionaire" vtv and Model 705-A Signal Generator.

Heartiest congratulations to them both, as well as to the other winners.

---

**AN INVITATION TO YOU**

Come on in, servicemen! The contest’s fun—and easy, too. Many prizes left. Only one thing to worry about—time’s a-wasting. Pick up an entry blank today at your Hytron jobber’s. Or drop us a penny postal. The easy-to-follow entry blank will help you do the rest. Just describe briefly your proposal for a simple, economical shop tool like the Hytron Tube Tapper or Miniature Pin Straighteners. Enter in any or all monthly contests. Mail to Hytron Contest Editor. Then make room on your bench for one of those deluxe first prizes.

---

**SPECIALISTS IN RADIO RECEIVING TUBES SINCE 1921.**

**HYTRON**

**RADIO AND ELECTRONICS CORP.**

**MAIN OFFICE: SALEM, MASSACHUSETTS**

**RADIO MAINTENANCE • OCTOBER 1948**
Electronic Speaking

-- From page 22

The JFD Manufacturing Co., Inc., Brooklyn, N.Y., is part of its service to television installation technicians, announces the formation of the JFD TV-FM Antenna Installation Department. The department will offer free advice to all servicemen in the analysis and solution of their TV-FM antenna installation and reception problems. This is the first department of its kind supported by an antenna manufacturer for the sole benefit of its customers. The new service is an outcome of the JFD TV-FM Antenna Installation Forums, which are now being conducted in television centers all over America. All servicemen interested in taking advantage of this new facility should address their inquiries to the JFD TV-FM Antenna Installation Service Department, c/o The JFD Manufacturing Co., Inc., 4110 Fort Hamilton Parkway, Brooklyn 19, N.Y.

Westinghouse Radio Stations, Inc., a subsidiary of the Westinghouse Electric Corporation, has filed a petition with the FCC which, if approved, would grant authorization for the first commercial stratovision station to bring television broadcasting to about 6,000,000 people who under present allocations will not receive protected service. The petition requests allocation of channel 8 for an air-born television station to operate about a point 30 miles of Pittsburgh and to provide service in an area with a radius of approximately 200 miles, an area 35 times that normally covered by ground television stations.

Transvision Inc. is planning a nationwide service of TV clinics for servicemen. Meetings will be held in TV centers across the country, under the sponsorship of Transvision Inc. and your local jobber. They will be conducted by Transvision engineers. Watch your jobber for further details.

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TRANVISION


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- Weighs only 3 ozs., yet can do the job of a 200 watt iron.
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- Bakelite handle, cord covering, for comfortable cool grip.

PRICE: including transformer and Tip-Head "A", $13.95

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OCTOBER 1948 • RADIO MAINTENANCE
NO CHARGE FOR THESE AUTOMATIC SALESemen!

They have sold thousands upon thousands of

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This colorful display will help you get your share of the high-profit radio battery replacement business... estimated this year at many millions of dollars.

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This eye-catching window streamer measures 25 x 10 1/2 inches, printed in 3 brilliant colors. Especially designed for high visibility. It will attract and invite customers into your store. NOTE! We show the WINCHESTER-OLIN Window Streamer. A similar BOND-OLIN Window Salesman is also available.

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Mail me at once—no charge—Counter Display and Window Streamer. BOND-OLIN or WINCHESTER-OLIN. (Check brand desired.)

NAME

STREET & NUMBER

CITY ZONE STATE
With several notable improvements over its predecessor, the Du Mont Type 274, this new Du Mont Type 274-A is an even finer instrument for the job of radio and television servicing.

An improved vertical deflection amplifier offers a sensitivity of better than 0.2 rms volt/in., and a range (within 30%) of 20 cps to 100 kc in frequency response.

As a result, in your servicing of both radio and television receivers, you can now look at more parts of more circuits with still greater accuracy and therefore better results.

For example, you can see lower level signals and you can handle more parts of the detector and i-f circuits. You can now minimize "hum" troubles more easily, and you can do a better job on sync circuits as well as on other circuits of television receivers.

In fact, with the new Type 274-A, you can't miss doing an all-around, hang-up, more satisfactory and therefore more profitable job. And remember, the new Type 274-A still has the big, 5-inch tube!

Cat. No. 1420-A with 5BP1-A .......... $136.50
Cat. No. 1422-A with 5BP11-A ....... $139.25

Trade Literature
From page 24

The Manual will contain 2024 pages covering the products of 147 manufacturers and the years of equipment production embraced by the manual is from 1938 to date—a span of 10 years. The general makeup of the Rider P-A Manual is like the other manuals produced by this publisher. This number of manufacturers is 12 more than was originally announced in advertisements. The publisher went all out in his efforts to give the public address servicing industry the greatest amount of information so that p-a servicing can be carried out at a profit. The price of the manual, which is loose-leaf and bound in the sturdy blue Rider binders, is $18.00. It may be obtained from John F. Rider, Publisher, Inc., 404 Fourth Ave., New York 16, N. Y. Accom-
Lightest
Most Efficient
Crystal Pickup
Cartridge
Ever Conceived!

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SALES AND SERVICE EASY!

Enables you to service most replacements immediately—helps you sell more replacement jobs to old and new customers—cuts overhead and inventory—increases turnover and profit! Contains 6 cartridges, 4 needles, mounting plates, literature, replacement chart and full instructions. Available in KIT "A" (Osmium) or KIT "B" (Sapphire).

NEW MODEL L-14
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New Microgroove Torque Drive Crystal Cartridge now available—at same price. Model L-14 has smooth, peak-free, wide range response to 12,000 c.p.s. No filter necessary. Replaceable Osmium-tip or Sapphire-tip needle.

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Now available for REGULAR or MICROGROOVE records. Uses Model 503 Matching Transfilter.

BETTER COUPLING OF RECORD GROOVE TO CRYSTAL

Exclusive Electro-Voice development now brings amazing improvement in record playing . . . outmoded existing crystal pickup cartridges . . . opens up vast new replacement opportunities. Fully tested and proved . . . the new Series 12 TORQUE DRIVE provides a more rugged cartridge for everyday use in home phonographs, booth demonstrators, and coin-operated machines. Assures finer reproduction, less surface noise, less needle talk, less record wear, longer record life, more needle plays!

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Comes in low, medium and high voltage outputs to provide universal replacement. Speeds servicing, steps up your profit. Installation is simple. Each cartridge is furnished with replaceable Osmium-tip or Sapphire-tip long-life whisker needle. It is available individually or in kits.

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Export: 13 East 40th St., New York 16, U.S.A.
Cables: Arlob
Webster-Chicago WIRE RECORDER

is a top quality, precision unit designed for installation in radio console or for use in semi-portable applications with radio or high fidelity amplifier. Model 78 provides all combinations...recording from radio or microphone; playback through headphones, radio or external amplifier, with simple push-button control of electrical circuits. A sensitive meter provides accurate recording level indication and the wire transport mechanism is positive acting and foolproof.

Easy to install... Model 78 is easy to install, and makes an ideal combination. Contained in an attractive metal case which mounts as a complete unit, Model 78 is furnished complete with microphone, one spool of wire and all necessary plugs, cords and instructions for neat installation.

The radio-listening public is demanding auxiliary equipment for more complete enjoyment of their radio programs, record music and home entertainment.

DEMONSTRATE and install Webster-Chicago Model 78 Wire Recorder.

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Power, fidelity and a price that will amaze you for a speaker of this exceptionally high quality—it’s the G-E 1201.

It's a wide range speaker with the frequency response stretched out at both ends of the curve to give intense realism, smooth, full lows and "high fidelity." A curvilinear cone is employed to provide this extended frequency response. Alnico 5, 141/2 ounces of it, gives high sensitivity and smooth response.

The moving parts in the speaker assembly are ruggedly designed to take high power without damage to the speaker in any way.

Note: Frequency response 50—13,000 cycles.

For complete information on this outstanding speaker write: General Electric Company, Electronics Park, Syracuse, New York.
Provides Vast New Sales Fields For Dealers and Servicemen

The long-playing micro-groove records have opened a vast new sales field for Servicemen and Dealers. Hundreds of thousands of record enthusiasts are ready to buy the new records, but they must have a new pickup to play them. This is your big opportunity to "adapt" their present sets with the Shure "900MG." It is a tremendous market—an immediate, anxious, impatient market. Here are opportunities, sales, PROFITS! Think of the hundreds of phonograph users in your immediate area. You will render an outstanding service by using a Shure "900MG." It is unsurpassed for the most brilliant reproduction of music you have ever heard.

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SHURE BROTHERS, INC.
Microphones and Acoustic Devices
255 W. HURON ST., CHICAGO 10, ILL. • CABLE ADDRESS: SHUREMICRO

Television Signal Generator

From page 11

with the video of an adjacent higher-channel station. FM sound on Channel 5, for example, may interfere with video reception on Channel 6. Some receivers employ adjacent channel traps. These should also be adjusted before video alignment.

Television I-F Amplifiers

With the signal generator set at the correct television i-f frequency and adjusted for the proper sweep width, alignment should start with the i-f stage preceding the detector, working back to the r-f section. Since video i-f amplifiers must pass a band of frequencies 6 Mc. wide, the importance of proper adjustment cannot be overemphasized. (To visualize the tremendous response of video amplifiers, stop a moment and consider that the entire broadcast band can be put into just one television channel 6 times!)

Exact alignment procedure depends, of course, on whether over-coupled or stagger-tuned i-f transformers are employed. The manufacturer's service data should be consulted before proceeding with specific alignment.

In stagger-tuned amplifiers, each i-f transformer is tuned to a different frequency. The marker is successively set to the correct frequencies and alignment carried out as indicated in the manufacturer's alignment notes.

Oscillator adjustment in receivers having no automatic frequency control (AFC) should be made with the "fine tuning" adjustment turned to its center position. R-F adjustments are mainly "trimmed up" adjustments, and are made with the generator connected to the antenna, with the deviation set at 10 Mc.

Sweep-Shooting Procedure

The ideal method for sweep shooting or comparison-checking the video, audio and associated circuits, is to obtain first a television receiver in good operating condition and feed calibrated signal voltages into various stages.
Are you Building a Business ... or Burning your Bridges?

Would you patronize a dentist who filled your teeth with plaster of Paris?
Would you trust your children's lives to a doctor who prescribed cut-rate pills?

Your business, too, is built on customer confidence! And your reputation is too valuable to risk with inferior or unknown products. The cost of the parts you use in the average repair job is insignificant compared with your investment in your reputation.

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JOBBER DISTRIBUTING ORGANIZATION FOR PRODUCTS OF SPRAGUE ELECTRIC CO.
Coin-Operated Radios

→ From page 15

have foreign matter jammed into them so firmly that on-the-spot removal is impractical. Incidentally, despite explicit instructions on each radio, the quarter slot is often jammed with two dimes and a nickel.

Of the remaining radios, volume and tuning controls suffer the most, along with celluloid windows and dial pointers. Occasionally, a speaker will be damaged due to liquid being poured on the set, or a condenser will give up the ghost; but the coin-operated radios are sturdily constructed with rugged circuits. Most of the set is tamper proof and so the repair ratio is very low. Only one or two sets a month need service because of electronic failure. Little equipment is needed for service in the shop. Art Lipschutz has found that a signal generator and his regular kit are sufficient.

In cases where a set is inoperative, the management is instructed to refund the money and tag the radio out of service. Unless in an urgent location, the servicing usually waits until the next collection round when the faulty set is repaired on the spot or replaced with a spare. The effect of so many units spread out over a large area means that although one set may be out of service for a few days, the decrease in income is negligible.

Installation

Installation is simple. The back of the radio is screwed to the wall. Depending on the surface, toggle bolts, wood screws or lag bolts are used. The rest of the radio looks to the back. The job can be handled by one man in 15 minutes, but is a little awkward, and two men can do the work easier and in only five minutes. Radios are always located near an outlet and the cords neatly tucked to the baseboard running to the receptacle.

When Bob Kline and Art Lipschutz started their route, they thought stolen sets would be a major problem. So did the insurance companies, who were reluctant to write out a policy. The radios were so firmly anchored to the wall, however, that very few of them were stolen. As a matter of fact, it’s been almost a year since an attempt was made and they’re thinking of giving up the hard fought-for insurance as an unnecessary waste of money.

Altogether, this radio service outfit has found that coin-operated radios can be a very profitable sideline. If you are prepared to give this sideline a certain amount of your time and attention, you too may find that it will pay. Investigate its possibilities for your area.

Tele-Pad and Tel-Adjust

→ From page 13

While the methods discussed above are more expensive to use than the usual compromise procedure, it happens that in the final analysis they are the only ways for delivering to the customer perfect reception on all channels. It has been the writer’s experience that of late this concrete fact is becoming more and more recognized by thoughtful service men.

Notice to Service Organizations!

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Radio Servicemen enrolled in service trade organizations may subscribe to RADIO MAINTENANCE at a special Group Plan price, WRITE US FOR PRICES. Here’s how it’s done:

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DOUBLES THE UTILITY OF ANY SCOPE

$19.50
NOTHING ELSE TO BUY

Heathkit AUDIO GENERATOR KIT
HEATHKIT SINE AND SQUARE WAVE
etc. Supplies excellent sine wave 20 cycles
amplifiers, television response, distortion,
to 20,000 cycles and in addition supplies
cycle power transformer, 5 tubes, detailed
precision calibrating resistors, 110 V 60
brated dial, beautiful 2 color panel, 1%
low distortion, less than 1%, large cali-

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Every shop needs a good signal generator.
The Heathkit fulfills every servicing need.
mental fundamentals from 150 Kc. to
30 megacycles with strong harmonics
over 100 megacycles covering the new
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range . 1 ohm to 1000 megohms. Complete

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Reduces service time and greatly in-
increases profits of any service shop. Uses
crystal diode to follow signal from
-徒步 to antenna to speaker. Locates faults
incrementally, internal amplifier available
for speaker testing and internal speaker
available for amplifier testing. Connection
for VTVM on panel allows visual
tracing and gain measurements. Also
tests RF and crystal diodes, PA systems,
etc. Frequency range to 200
Mc. Complete ready to assemble, 110V
60 cycle transformer operated. Supplied
with 3 tubes, diode probe, 2 color
panel, all parts, fast easy to assemble,
detailed blueprints and instructions.
Smalls portable 9" x 6" x 4¼", Wt. 6 lbs.

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A condenser checker anyone can afford
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cales with test voltage up to 500 volts.
No need for tables or multipliers. Reads
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The NEW 1948 HEATHKIT 5 INCH
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New improved model of the famous
Heathkit Oscilloscope. Building an
oscilloscope is the finest training for
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quality of instruments selling for
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supplies 1000V negative and 350 volt positive. Sweep generator 13 cycles to 30 M. cycles. Has vertical and
horizontal amplifiers. Oil filled parts, goodness for long
life. Complete blueprints and instructions included.

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NOTHING ELSE TO BUY

The Heath Company
... BENTON HARBOR 10, MICHIGAN
**Triode Frequency Converter Circuits**

From page 14

Injection voltage can be readily measured by measuring the developed d.c. at the mixer grid with an electronic voltmeter, isolated with a one megohm resistor in series with the probe.

![Diagram](attachment:image.png)

Fig. 3. Mixer-Oscillator stages of Philco Model 46-1226.

---

**Astatic FL-33 Pickup**

For Columbia Microgroove Records

- Here is no mere version of what a pickup for use with Columbia Microgroove Records should be—but the actual playing arm designed to meet the precise requirements of Columbia's new recordings. This new Astatic Pickup is manufactured to meet the specifications by Columbia, to insure maximum quality performance of the Columbia LP Microgroove Record. Available, then, in the Astatic FL-33 Pickup and LP-33 Crystal Replacement Cartridge, is the ultimate of Microgroove companion equipment... alone capable of getting the most out of LP Records.

**Also available** is the LP-78 Cartridge that fits the FL Arm, but having a .003" radius needle for playing 78 RPM Records.

**FL Filter:** For best performance with high quality speakers. Controls pickup response—Eliminates high frequency peak.

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**Features of Astatic's FL-33 Pickup**

1. Five-Gram Needle Pressure;
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4. Frequency Range 30 to 10,000 c.p.s.;
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6. LP-33 Cartridge, with replaceable, permanent sapphire needle.
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Each circuit properly classified and clearly labeled for instant reference! Every basic operating unit in the entire field of electronics for the convenience of everyone in radio—150 circuits completely illustrated—ALL in this one section!

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How to use test equipment and make every kind of measurement in radio. This section alone is worth the price of the entire book.

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The planning, selection of equipment and the assembling and combining of various components in complete PA installations. Every type of unit used is described and analyzed in detail.

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This section is the only complete description of disc recording found in any radio manual on the market. Here all phases of recording are covered—both home and commercial.

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Here in these two sections are found all data and information useful to anyone in radio and electronics.

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98% of all equipment built in radio & electronics is covered here in a section presenting the typical circuit with parts lists and descriptions of each type. This is by far the most useful collection of circuits ever presented.

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**CATHODE RAY OSCILLOGRAPH**

For Television

This 5" Oscillograph is SEVEN to TWENTY times more sensitive, for stage by stage alignment. Features: Phasing control with HICKOK exclusive sinusoidal sweep. 
* Extra high gain vertical amplifiers— .03 V per inch. 
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When you have a public address job use SP8K, SP12M, SP12P. Utah Speakers are quality built and severely tested. They are completely dust proofed and have pot covers. Write for catalog today!

**TRIODE FREQUENCY CONVERTER CIRCUITS**

→ From page 38

A unique feature of this circuit is the part played by the small inductance, L5, in series with the mixer plate. This inductance is combination with the 51 mmf condenser across the primary of the first i.f. transformer, forms a series resonant circuit which effectively short circuits the plate at the resonant frequency. The values are chosen to resonate near the middle of the FM band, say, at 98 megacycles. The "Q" of the coil is intentionally poor so that the circuit tunes broadly and "traps" or shorts out any frequency between 88 and 108 megacycles appearing on the mixer plate, where only the i.f. frequency is desired. This gimmick also materially increases the mixer grid resistance, so that the loading of the grid on the input tuned circuit becomes negligible. A high "Q" tuned circuit is therefore possible, which greatly improves the image rejection and r.f. selectivity.

The inductance, L5, could have a detrimental effect however, since in combination with the plate-to-cathode capacity of the tube, it would form a parallel resonant circuit at a frequency of several hundred megacycles. This could make the tube oscillate at a high frequency and cause unstable and erratic operation of the set. To prevent this, the 47 mmf shunt capacitor provided from the mixer plate to cathode. This adds enough shunt capacity to prevent parallel resonance at any frequency higher than the band.

Due to the relatively low plate impedance of the triode mixer, the typical i.f. transformer used is limited in effect, so that the mixer gain is less than that of a pentode mixer. However, the decreased grid loading enables a much higher gain in the preceding r.f. stage than is possible with other tubes, so that the overall gain from antenna to mixer plate is approximately the same. The overall selectivity is also about the same. If high "Q" r.f. circuits are used, the triode has the advantage of much improved image rejection.

The tuning of the signal circuit in the triode mixer grid causes a shift
Triode Frequency Converter Circuits

→ From page 40

in oscillator frequency of 20 or 30 kc, but this is fairly small compared to the i-f frequency, and causes no particular difficulty.

In Philco Models 46-427, Fig. 2, and 46-1226, Fig. 3, the circuit is much the same except that a.v.c. is applied to the mixer grid. A small amount of delay is inherent in the a.v.c. due to the regulating action of the grid leak bias. This is somewhat overcome by the fixed bias provided by the resistor in the cathode lead. Degeneration in the cathode is prevented in the 46-427 model by bypassing the cathode resistor with 0.05 mf. It is reduced in the 46-1226 model by a 100,000 ohm bleeder resistor from the high voltage supply. The application of a.v.c. results in a slight shift in oscillator frequency, but in a well designed set the shift is kept within reasonable limits. The plate resistance of a triode mixer rises with a.v.c. voltage, which somewhat narrows the band-pass of the first i.f. transformer. This effect is not desirable in an FM set, where overall fidelity is a requisite.

Repairing a set which uses a triode mixer will be no particular trouble for the radio serviceman who clearly understands the reason for each part in the circuit. A good thing to bear in mind when servicing any modern radio is that the manufacturer is extremely cost conscious, and will not put extra parts in the set without very good reasons. The triode mixer can be treated the same as any other amplifier at high frequencies. Shields which may be in the set are especially important on triode tube sockets because of the grid-plate capacities which might cause regeneration. Never change the point at which a ground wire is connected to the chassis or other grounded structure. Lead lengths must be short, and care should be exercised in dressing the leads in the manner recommended by the manufacturer. The inductance of a short straight length of wire, even though not formed into a coil, becomes extremely important at frequencies approaching 100 megacycles.

Cunningham tubes assay high in esteem in Montana—because Cunninghams measure high in quality and performance. They’re built to give long life and trouble-free service. When new tubes are called for, replace with Cunninghams, and you won’t have to go prospecting for new customers.

See your
Cunningham Distributor
George Steele & Co.
Butte
F.M. I.F. Amplifiers

-- From page 9

To obtain the necessary flat top response with good skirt selectivity, several coupling methods have been used by different receiver manufacturers. One method is to make each of the coupling circuits have a different resonant frequency. The resonance curves of all these circuits combine to form the desired overall response curve as shown in Fig. 3. When such an i.f. section is aligned, each tuned circuit must be aligned separately with an AM signal generator, and only the final overall response check can be made by the visual alignment (sweep generator) method.

Another method is illustrated in Fig. 4. In this case the individual response of each stage is designed to be somewhat broader than the desired overall response. Each circuit is then aligned on the designated i.f. of the receiver. The combined effect of the three stages illustrated is to sharpen the response to the desired value for the whole amplifier. In this case, individual AM alignment is not necessary and the circuits can be adjusted conveniently while viewing a sweep pattern on an oscilloscope.

In a few receivers other arrangements are employed. In some cases, loading resistors are used to broaden the response of some stages, while other stages are more selective. The two different responses in the same amplifier combine to give the desired overall response characteristics.

I.F. Coils

Outwardly, FM i.f. coils greatly resemble AM i.f. coils, except that many of the FM variety are smaller. The internal construction of FM i.f. coils is quite different in appearance because the FM i.f. is so much higher than the AM i.f. Instead of the large, universal (pi-) wound coils found in 455 kc. i.f. coils, the 10.7 Me. variety consist of only a few turns, in a solenoidal form. The coil form is usually any size from ½ to ¾ in. in diameter and has an adjustable slug mounted inside.

Sometimes the coils (primary and secondary) are wound on the same form. In this case there may be an adjustable slug for each coil, with the adjusting screws for these slugs projecting from the top and bottom of the can respectively. In other mod-
No discussion of FM coils is complete without mention of the combination i.f. transformer used in this type of receiver. Fig 5 shows a schematic diagram of a typical combination circuit. As can be seen in this figure, two interconnected transformers are employed. These transformers are sometimes included in the same shield can; at other times in a separate shield can. The low frequency (AM, 455 kc.) primary tuned circuit (L1-C1) is connected in series with the high frequency primary tuned circuit L3-C3. The secondary tuned circuits are similarly connected.

To signals of the 455 kc. i.f., L3 offers such a low impedance that the bottom end of L1-C1 is effectively grounded. To signals of the 10.7 Mc. i.f., the impedance (reactance) of C1 is so low that the top of L3-C3 is effectively connected to the plate of the tube. Similar conditions exist in the secondary circuit.

With this arrangement, no switching is ever necessary in the i.f. amplifier section. When the tuner section of the receiver is switched from AM to FM, the i.f. section automatically adjusts itself to the proper i.f. It is important that the serviceman remember that this arrangement is frequently used. It means that trouble in the i.f. section coils may make the receiver inoperative on both AM and FM. For instance, a short-circuit from some part of the low frequency primary winding to ground would interfere with the operation on FM or AM.

In spite of the fact that several new detectors for FM reception accomplish their own limiting, a large number of receivers now in use include a limiter and a discriminator. The limiter is necessary because the discriminator with which it is used is sensitive to AM signals or disturbances as well as to the desired FM signal. Because the FM signal and the resulting i.f. signal has been purposely modulated only in frequency, the amplitude of the wave can be distorted in any desired manner without interfering with the frequency modulation we wish to preserve.

The limiter circuit reduces the amplitude of the i.f. signal sufficiently to remove amplitude variations of the signal without interfering with the

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frequency modulation, as shown in Fig. 6. This action is obtained by use of an extra i.f. stage so adjusted that signals of even moderate strength cause the tube to reach plate saturation. The grid of the limiter is allowed to go positive on signal peaks and draw current. A series bias resistor in the grid circuit maintains the same level for strong signals than for weak signals.

Tubes chosen for the limiter stage are preferably the sharp cut-off pentode variety. The 6S7 is a popular type. A detailed description of the operation of limiters was given in a previous article in Radio Maintenance.

The ideal limiter section is the cascade type. Two single-ended limiter stages are connected so that the output of one stage is coupled to the input of the next. In this way, any severe amplitude variations which managed to get through the first limiter stage are limited in the second. Another advantage of the cascade type is the fact that two different grid circuit time constants can be used.

The time constants are the products of the resistance and the capacitance used for bias in each stage. They determine how quickly each stage will respond to an amplitude variation of a certain rapidity. A small time constant (smaller resistor and/or smaller condenser) operates better on fast variations, while the larger values are better for slow changes like fading effects. With the cascade limiter, one stage can have a high time constant and the other a low time constant, thus providing good limiting action for either fast or slow amplitude variation.

Possible Troubles

Many of the troubles which the serviceman will encounter in FM i.f. sections are similar to those he has experienced in AM receivers. In fact, most of the FM receivers you will be called upon to service, will be combination types. They will contain both 455 kc. and 10.7 Mc. i.f. transformers, or combinations of the two as described above. Probably less cases of B plus shorts and open windings will be experienced. The high frequency coils are smaller and usually wound with a larger size of wire.

More likely trouble in FM i.f. sections is instability (tendency toward oscillation). This can arise from any number of causes. Improper alignment or defective shielding are two causes. Lead length is very important; usually the shorter the better as far as leads are concerned, although the serviceman is safest in maintaining the original wiring layout as closely as possible.

By-passing in the i.f. circuits is very important and it is strongly advised that replacements of by-pass condensers be exact whenever possible. Be especially careful of paper condensers, which have unsatisfactory characteristics at high frequencies due to the inductance resulting from their tubular shape and construction.

The next articles about FM receivers will discuss the various types of detector circuits, including the latest lock-in oscillator and superregenerative types.
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Ask me to cobble up a set "just so we can sell it."

Come carrying in just the chassis of a set without either the special loop antenna or the field-coil dynamic speaker.

There! That makes me feel much better. Could you add anything to the list? 

Over the Bench

From page 18

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