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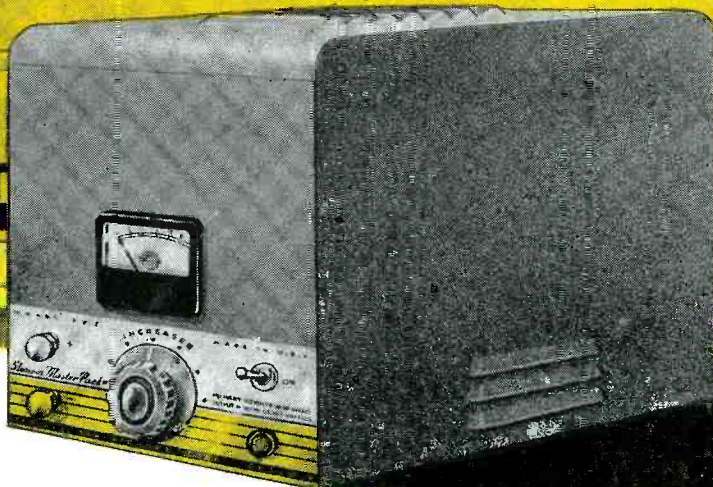
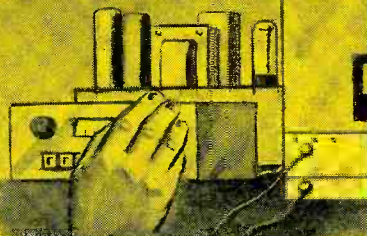
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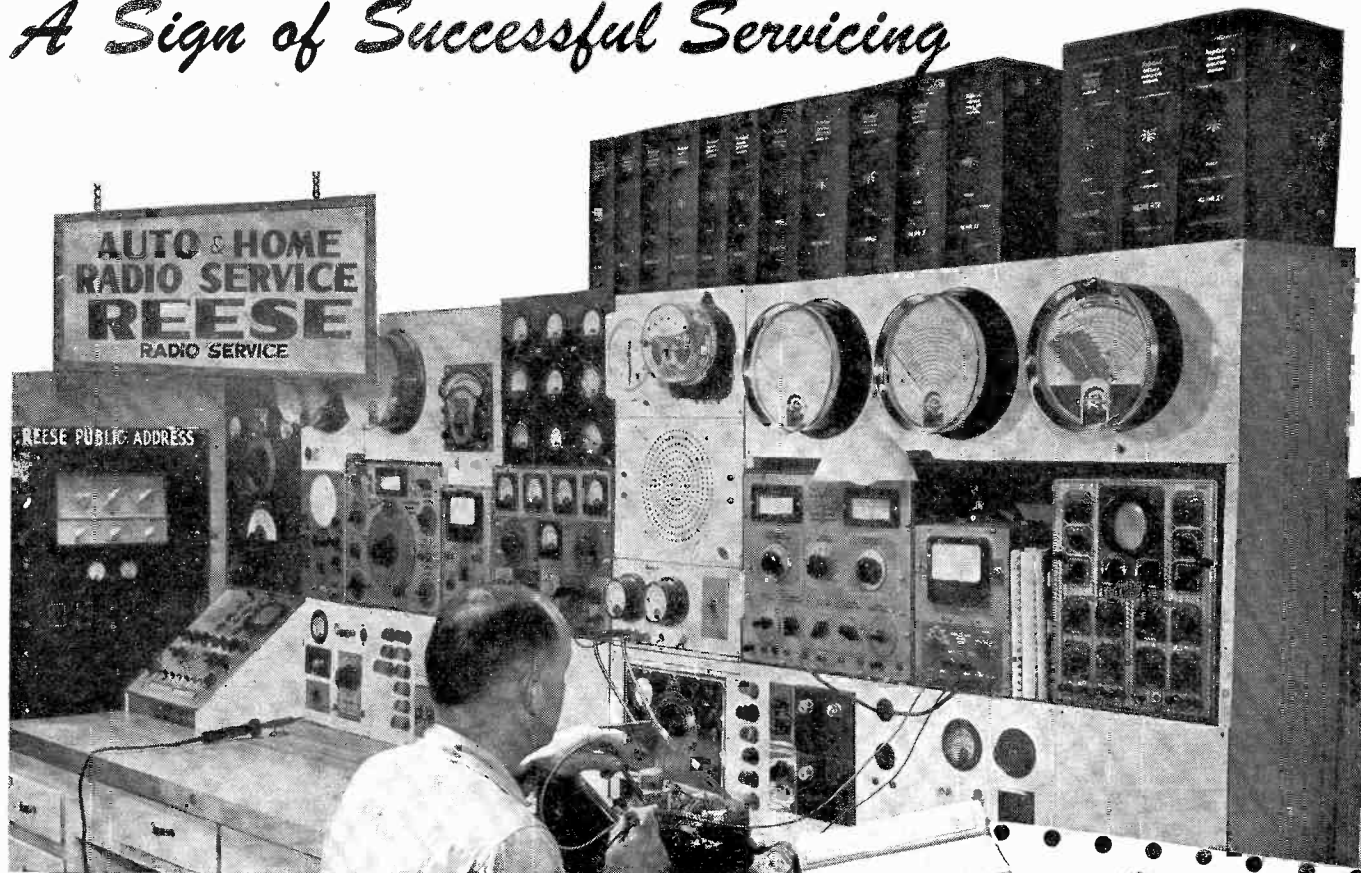
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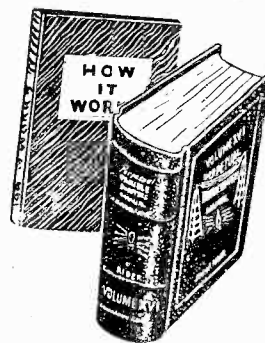
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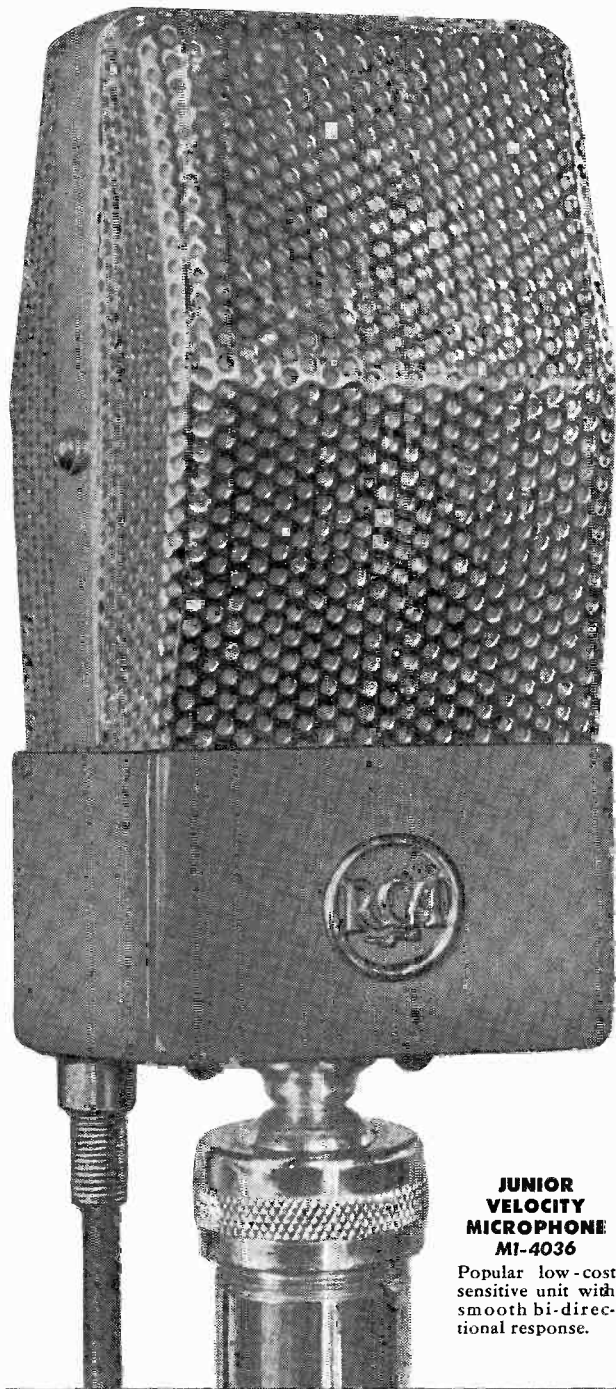
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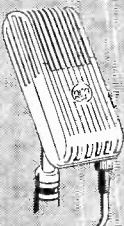
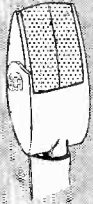
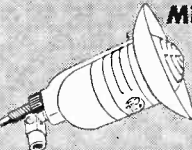

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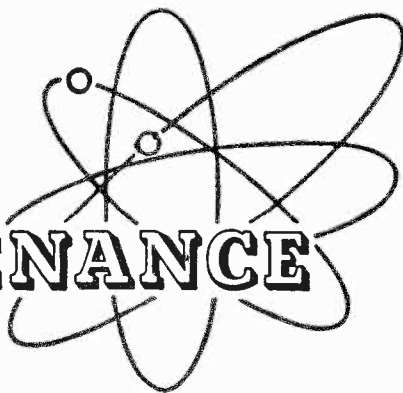
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Volume 3

OCTOBER, 1947

Number 10

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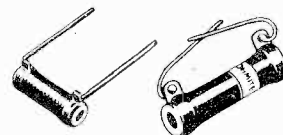
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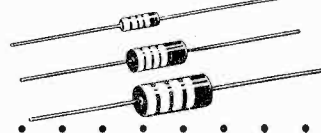
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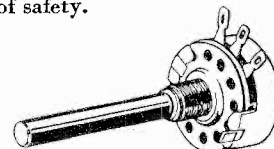
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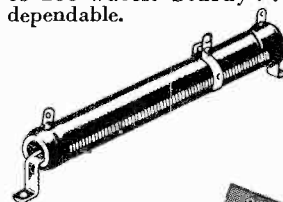
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by John B. Ledbetter



MICROPHONE MAINTENANCE

THE microphone, like other delicate instruments, must be handled with extreme care, and this is especially true in maintenance procedure. It is the purpose of this article to point out some of the more common types of microphone failures and to describe the methods generally used to restore normal operation in the shortest possible time.

It should be primarily understood that no maintenance should be at-

tempted on any type of microphone unless the radio serviceman is thoroughly familiar with both the operation and physical structure of every part of the instrument. It is far better to return the microphone to the manufacturer for repairs than to risk serious damage as a result of a semi-skilled attempt at maintenance and adjustment. The serviceman, however, possessing a fair degree of dexterity, a steady hand and sufficient technical training, can feel

reasonably sure that he will be able to complete *minor* maintenance assignments satisfactorily.

There are several basic rules in microphone maintenance which the serviceman must observe, and it may be well to review some of the most important. First, velocity and dynamic microphones should never be placed on the workbench or in any other position where they may pick up iron filings which are attracted by the powerful magnetic

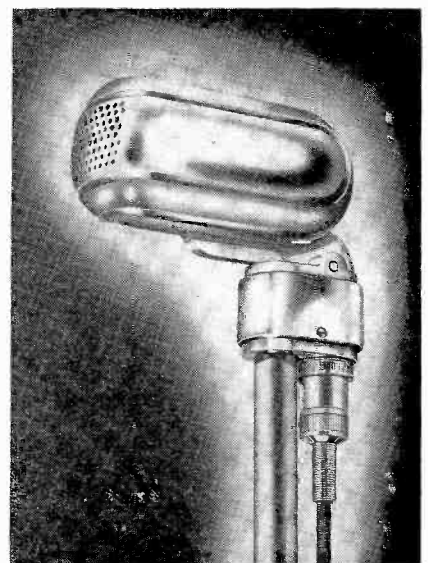
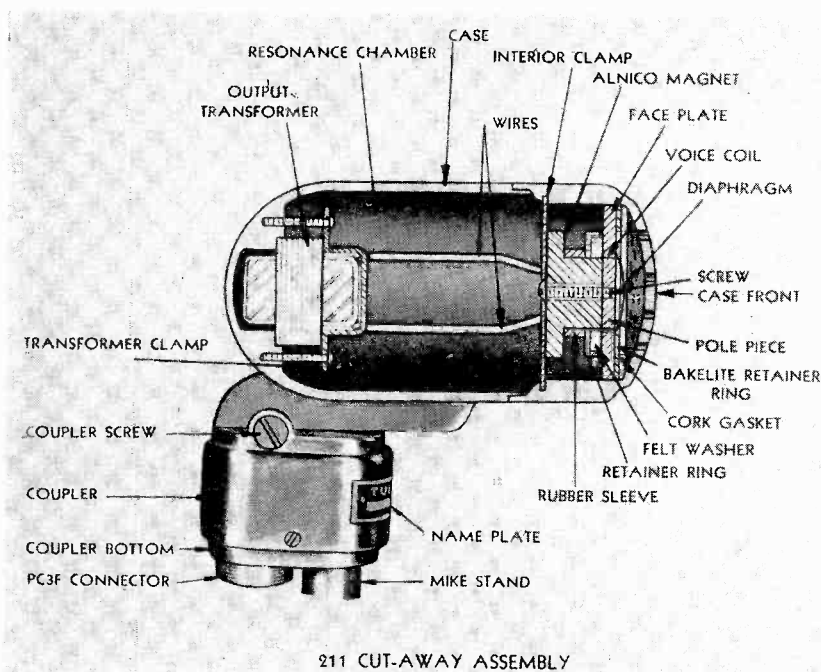


Fig. 1 Internal and external views of a dynamic microphone.

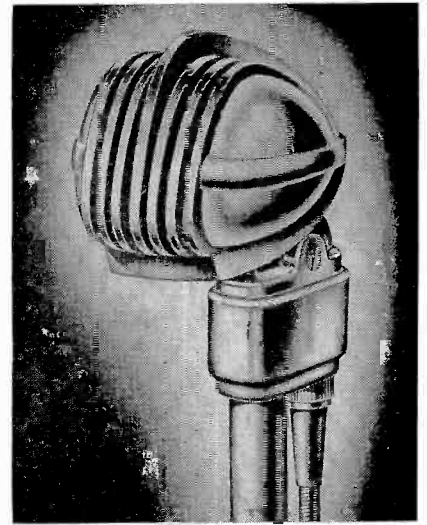
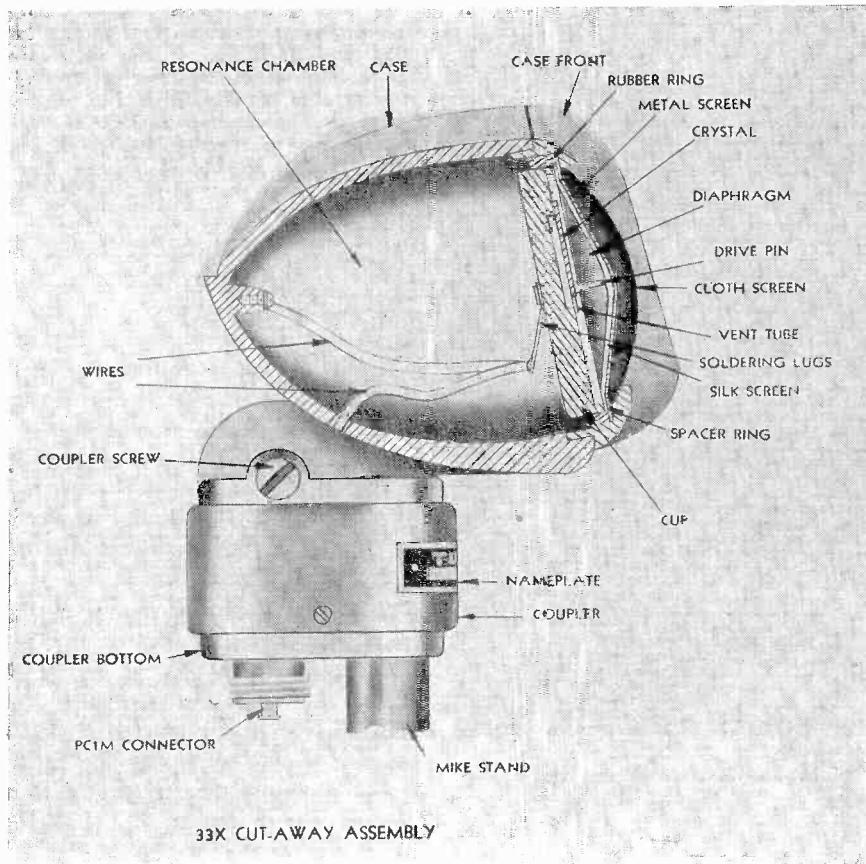


Fig. 2 The crystal type.

field. If enough filings collect on the diaphragm and around the coil and magnet they can seriously impair the operation of the instrument. The microphone should be placed either on a heavy lint-free canvas or duck cloth or on a felt pad, and there should be no iron tools in the vicinity. In disassembling, assembling and adjusting operations, only non-ferrous tools should be used, thus preventing damage to the moving elements due to sudden "sticking" of the tool to the magnet, and to prevent demagnetizing effects.

Second, the velocity type of microphone should always be moved or carried in its normal operating position, that is, with its ribbon in a vertical plane. Carrying the mi-

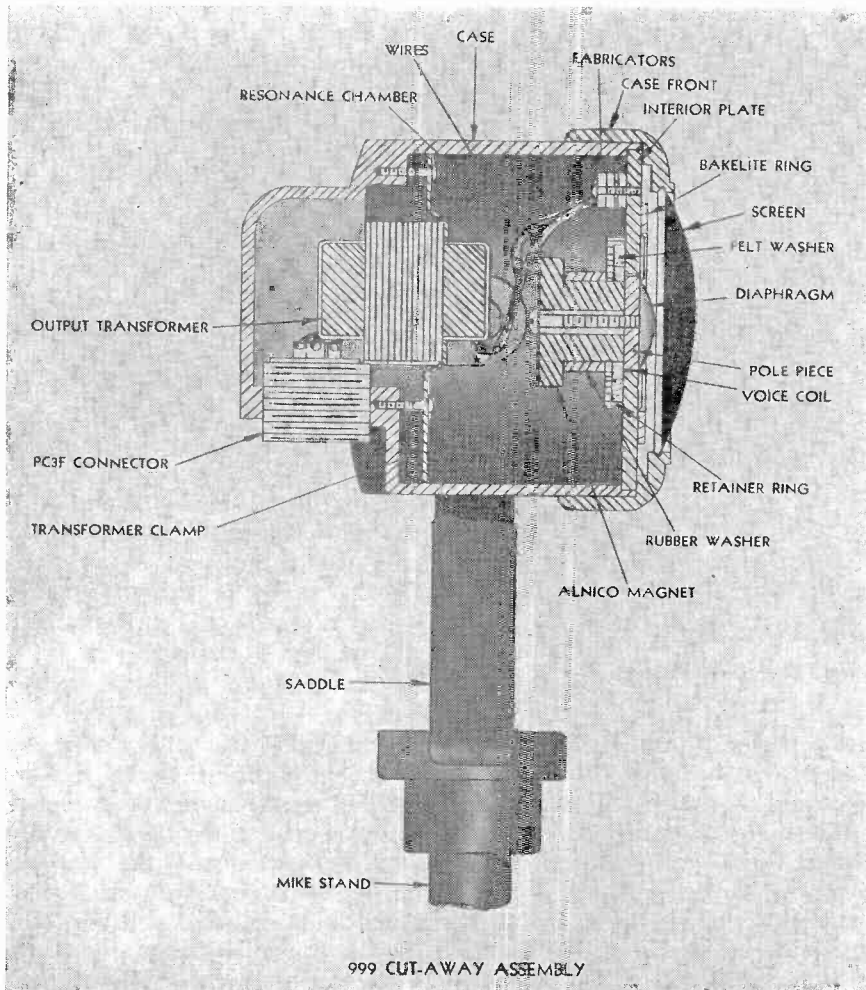


Fig. 3 Another model of the dynamic type.



Fig. 4A Rigid inspection of all returned microphones to determine the cause of failure.

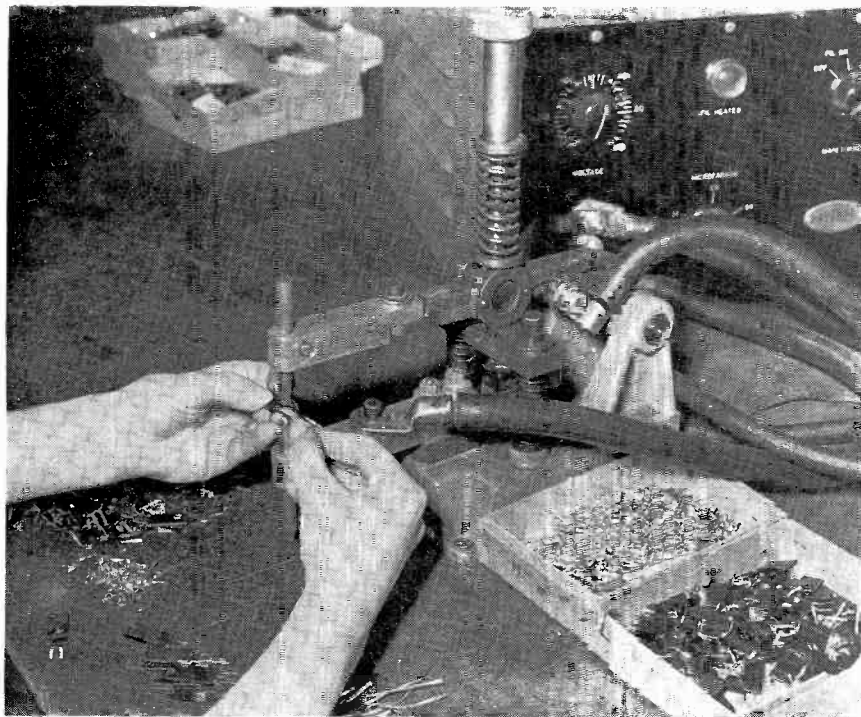


Fig. 4B Process of splicing gold foil crystal leads.

crophone in a horizontal position makes the ribbon stretch or sag. Jarring or rough handling is, of course, to be avoided at all times.

Care should be taken to keep the microphone away from alternating current fields produced by such common sources as conduit lines and power transformers. Serious

demagnetizing effects may be produced as the result of continued exposure to strong AC fields.

The same care should be extended to meters and other instruments which depend on a constant magnetic field for their operation. It should also be remembered that if it becomes necessary to remove

The pictures on these two pages will give you an idea of the care your microphone receives when returned to a reputable manufacturer for repairs. They show operations at the Astatic Corporation's microphone repair department.

the magnet of a velocity microphone, a "keeper" bar must be placed across the poles. It is necessary that the keeper be gradually worked into place as the magnet is being removed, in order to prevent a collapse of the magnetic field. The keeper must remain in position as long as the magnet is disassembled and be gradually removed on reassembling to prevent disruption of the lines of force.

For a practical example in maintenance, let us assume a velocity microphone suddenly or gradually loses its low-frequency response, with the result that reproduction sounds unnatural or tinny. Accompanying this condition is a certain loss of output. On removing the cover, it is found that a considerable portion of the lower part of the ribbon is fastened between the two opposing sides of the magnet. Upon measuring the air gap at both ends of the magnet with calipers or a small rule, it is seen that the bottom of the magnet has been moved inward, narrowing the air gap, and has probably been forced to such a position by jarring or rough handling. The four screws holding the magnet in place are loosened, the bottom section is aligned and checked for clearance, and the entire unit given a field test. Comparative output and quality can be checked against that of a similar microphone known to be in good condition.

The ribbon should be inspected for tiny holes and indentures by holding the unit up to a strong light. Scored or dented surfaces of any concern are apparent without the aid of a microscope.

The windings of a microphone transformer should never be checked for continuity with an ohmmeter. Even the small DC voltage used in most ohmmeters is enough to cause saturation of the windings and thereby impair the low-frequency response of the transformer. Application of a DC voltage to the secondary winding also results in a momentary cutting of the magnetic

lines of force, and the ribbon may be damaged considerably by the sudden impact. All transformer measurements should be made with an inductance bridge.

Fine iron particles may be removed from the diaphragm and between ribbon and magnet by using a small camel's hair brush dampened with carbon tetrachloride. Light gentle motions with the brush will in most cases remove the particles. Inaccessible particles around the coil of a dynamic unit may be dislodged by flushing with carbon tetrachloride. With extreme care, a minute air pressure may be applied around the coil to aid the flushing process. No air pressure, however small, should ever be applied to a ribbon unit.

A loose or sagging ribbon is the cause of excessive "pops" or blasts. These pops are usually produced by actual momentary contact between the ribbon and the magnet. In most ribbon microphones, some provision is made for adjusting ribbon length. Usually the holder to which the top of the ribbon is attached is slotted; variation in ribbon length is possible by loosening the screw and moving the holder upward. Be careful to prevent twisting or stretching of the ribbon—it should be allowed to vibrate freely and made only rigid enough to prevent "popping" or touching the magnet on peaks. Some ribbon ends are "sweated" to the holder with solder. In cases where the extent of ribbon stretching cannot be corrected as described above, the solder may be melted with a hot iron instantaneously applied, the ribbon moved slightly upward and again "sweated." Handling of the ribbon is a very delicate job and if there is any doubt about your ability to correct ribbon distortion, don't attempt the job yourself. *In such instances, the entire unit should be returned to the manufacturer for ribbon replacement and adjustment.*

Excessive hum in a microphone may be due to an ungrounded condition either in the cable or in the microphone itself; and is usually caused by a break in one of the cable leads or in the shield loom, or may be due to dirty or corroded contacts. Hum also can be caused by development of a high-resistance joint or by grounding of one side of a balanced circuit.

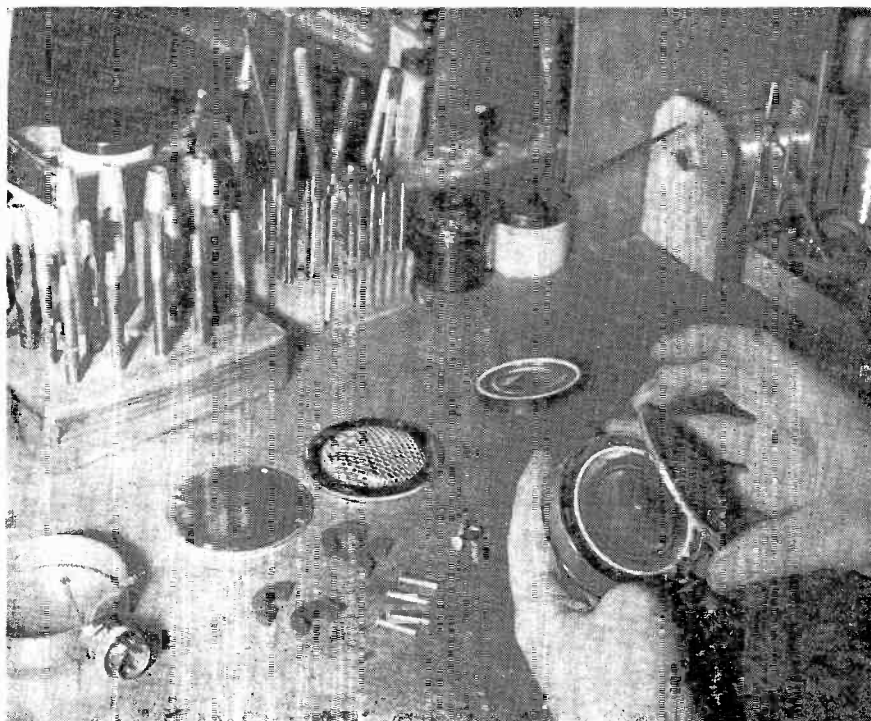


Fig. 4C Reassembling the repaired microphone.

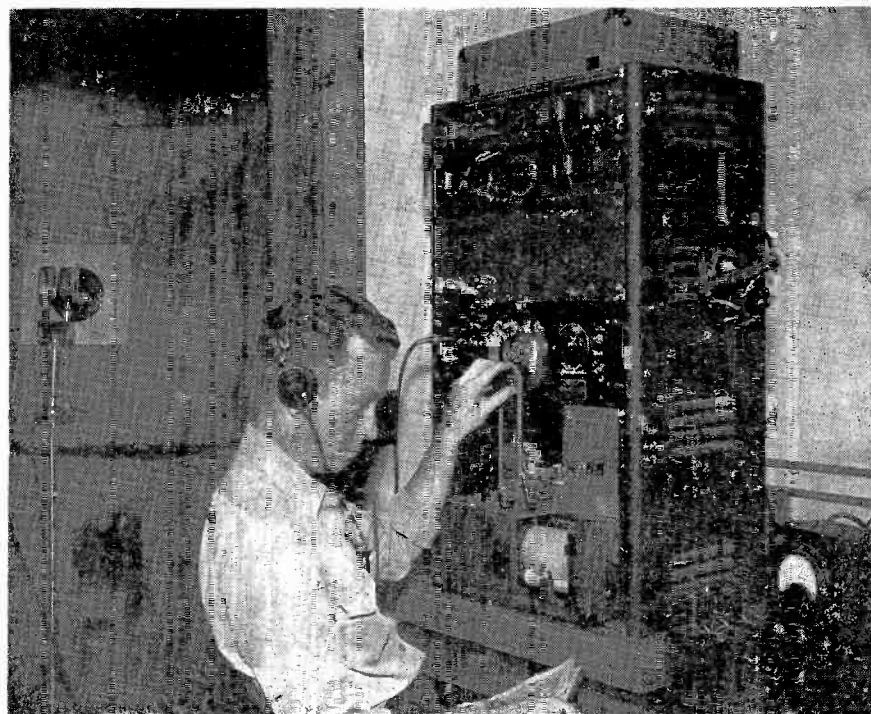


Fig. 4D Calibration of the microphone after the repair job is completed.

Typical of the latter is the following case from one of the author's maintenance reports:

Subject: Western Electric 630—A Non-Directional Microphone.

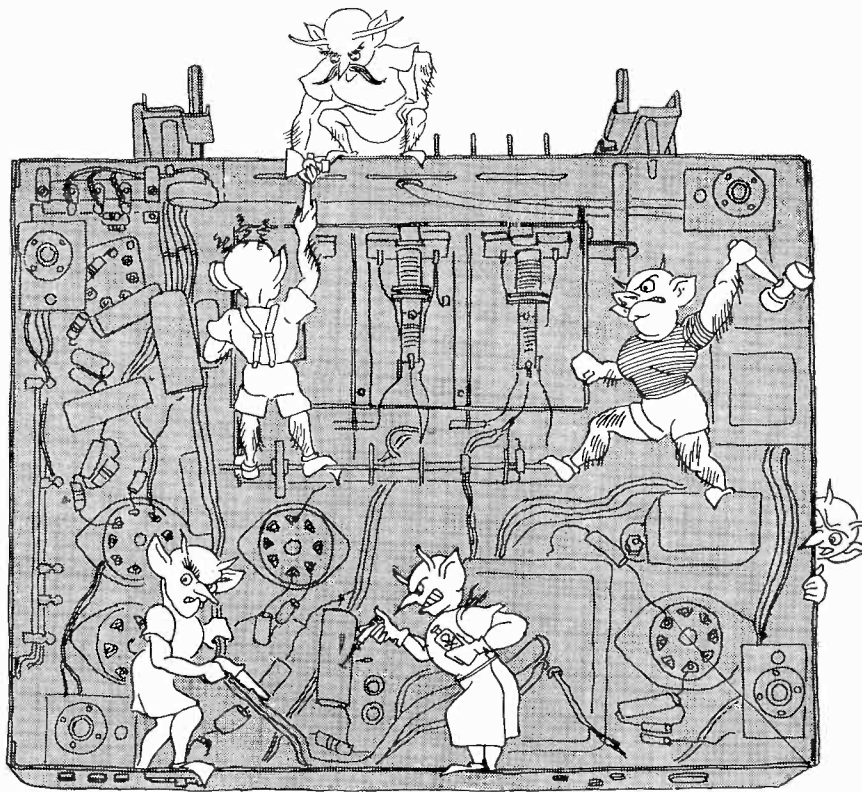
Condition: Excessive hum.

Remarks: On testing, the above

condition was at first steady, then became intermittent.

Disposition: The shell was disassembled by removing the two back screws and the terminal lugs 1 and 2 were inspected.

→ To Page 36



GREMLINS . . .

or intermittents?

by John T. Frye

When you're stuck with one of those tough intermittent jobs you may begin to wonder whether or not these little guys really exist. The author doesn't believe in them and he tells a very convincing story.

HORSES HAVE HORSEFLIES; bubble-dancers have smart alecks who throw pins; and radio servicemen have intermittents.

Truly the intermittent set is the fly in the ointment of radio servicing. It consumes time, lowers profits, arouses a feeling of frustration and exasperation, and deflates the ego. In spite of the hours and hours of time likely to be consumed in finding the trouble, the repair usually consists of a thirty-cent condenser. The bill must consist chiefly of labor charge; and this, coupled with the fact that the customer is convinced to begin with that "there is not much the matter

with the set; the volume just hops up and down," does not make for good customer relations.

It is easy to see, therefore, that any improvement in the speed with which these sets are put through the shop will make a substantial showing in the net income. Realizing this, the author has always had a most lively interest in this particular fault. He has interviewed dozens of old-timer servicemen as to their methods of dealing with such sets, has read every article he could secure on the subject, and has made copious notes on such sets as have passed over his own bench. This article represents the

condensed findings from all three sources.

He realizes, though, that there are as many ways of handling intermittents as there are of handling women; and in both cases, each man is likely to think that his way is the best. The defense of the method outlined here is based on three points: first, it is deliberately designed to avoid the use of expensive special equipment; second, it proceeds step-by-step from the most common to the more rare causes of the intermittent condition; third, it is not "just one man's opinion" but represents the combined judgment of many veteran

servicemen with a total experience of several centuries.

What Is an Intermittent?

If there breathes a serviceman with soul so dead that he does not know what an intermittent is, let us say that for the purposes of this discussion an intermittent is a receiver that suffers abrupt change in the quality of the reception of a signal that is independent of the signal itself or of the wishes of the operator. The quality may vary; the volume may jump up and down within comparatively narrow limits; or the set may go completely dead and then come back to life of its own accord. The chief characteristic of the performance is that it is highly erratic and unpredictable and does not conform to any discoverable pattern.

The place to start on such a set is with its owner. When the set is secured, collect all the information you can about its misbehavior and write the pertinent information on a complaint slip attached to the set.

Symptoms

Does it go entirely dead or merely change volume abruptly? Does it come back of its own accord? If not, what brings it back? Turning it on and off? Flipping the band-change switch? The turning on of some other electrical appliance in the house? Jarring the floor or the set? How long has it been acting this way? Is the condition worse at any particular time of day? How long after it has been turned on does it usually start to "act up"? Does the dial lamp go out when this happens? Does the tone quality change when the volume does?

Every one of these questions is important, and the answers, com-

bined with experience, will enable you to put your finger on the trouble in a matter of minutes—sometimes. It is the "other times" that make servicing intermittents so interesting!

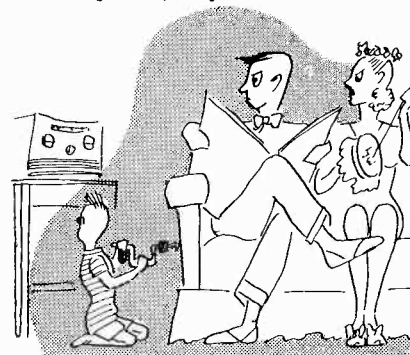
The next thing to do is really something not to do: *Do not jar or disturb the set any more than is absolutely necessary until you have heard it cut out.* That means not removing the tubes or doing anything other than place it gently on a secondary bench, connect necessary leads, and turn it on. Quite often the condition causing the trouble is based on a very nice positioning of parts, and wrestling the tubes around is likely to disturb this set-up just enough so that the set will play perfectly in the shop and then start misbehaving as before when returned to the customer.

Tube Failures

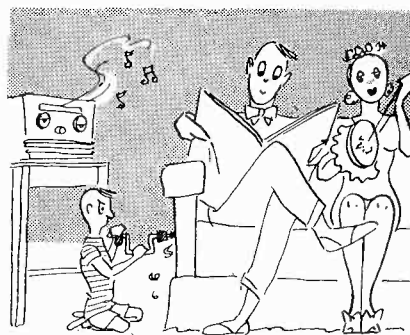
When the set does cut out, note every detail of how it acts, for it is trying to tell you what is wrong. For example, if the volume of an AC-DC set goes down gradually just after the dial lamp goes out or is greatly dimmed, you are in luck. One of the tube filaments is thermostatic. When cold, the broken ends make good contact; but at a certain temperature, expansion breaks this contact, which is again resumed after the filament cools down. Sometimes this cycling occurs with the speed and regularity of a railroad flasher. At other times the contact may be made and broken over long periods of time and with no apparent time schedule.

Personally, I do not like to try to find which tube is at fault with a tube checker. Pulling the tube out of the socket often makes the tube filament refuse to open up. A

Does it go completely dead?



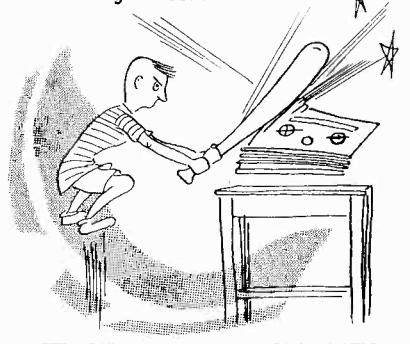
Does it come back by itself?



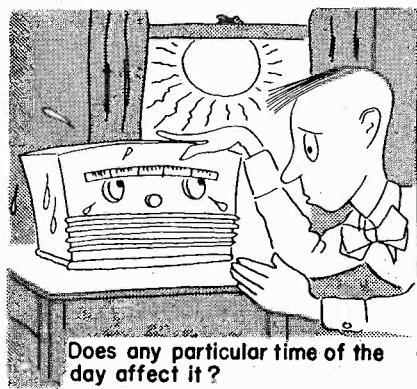
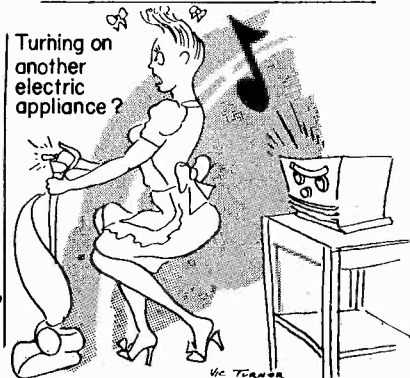
If not, what brings it back?



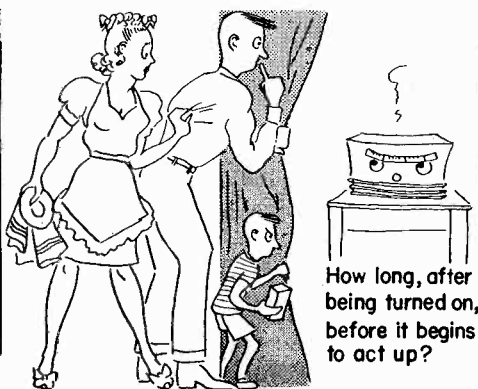
Jarring the set?



Turning on another electric appliance?



Does any particular time of the day affect it?



How long, after being turned on, before it begins to act up?

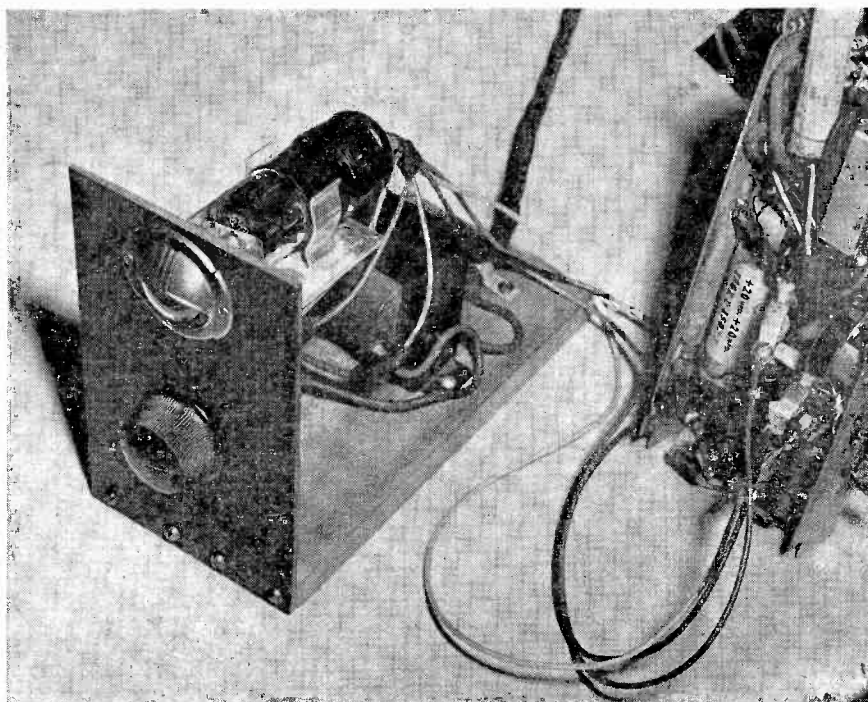


Fig. 1 Those elusive intermittent conditions which cause so much annoyance can often be traced more efficiently by means of the device shown here. It's a simple vacuum tube voltmeter using a tuning eye tube. Its use is described in the text.

voltmeter placed across the filament pins during the time that the filament is open will reveal the full line voltage across these connections. If the intermittent action is of the positive quick-flashing type, you can usually ease each tube out of the socket and substitute a new one for a quick check; but if the condition shows up very rarely, it is best to pull out the chassis and use the voltmeter method.

High voltage tubes are worse in this respect than the ones using lower filament voltages; therefore, it is a good idea to suspect 50L6, 35L6, 35Z5, 12SQ7, 12SK7, and 12SA7 tubes in that order. Any tube, though, can develop this fault, and it is harder to locate in a transformer set wherein the tubes are metal. The clue is the fact that the volume dies out gradually. Tapping tube grids while the set is "out" will usually enable you to spot the offender, for the grid of a dead tube will reveal no "click."

If the volume change is abrupt and none of the above-mentioned symptoms are present, the next thing to suspect is a tube with an internal short or poor connection. This is especially true if the drop in volume is accompanied by a rustling, static-like noise. The test is to strike the tubes gently with a bakelite rod. Gridcap tubes are

struck directly downward on top of the cap; the other tubes are struck first on one side and then on the other. Time after time you will find a 6A8, 6A7, 6K8, 12A8, 75, 6F5, 6Q7, 12Q7, etc., that will cause the radio to change volume abruptly when tapped lightly on the gridcap. The volume change is usually accompanied by a sharp "pop" at the instant of impact. Usually, the trouble seems to lie in a poor connection between the cap and the grid lead; and during the war, I reclaimed dozens of these tubes by removing the cap, scraping the lead to shining brightness, and resoldering and cementing the cap in place. This does not always work, though; and now that the tube shortage is over, the best repair is a new tube.

I do not know why mixers and tubes containing high-gain triodes seem to lead in this kind of trouble, but they do; however, any tube may develop a short, and all of them should be subjected to a light tapping with the rod of bakelite.

Condensers

Servicemen are agreed that condensers are the most common cause for intermittent reception, and my only reason for taking up tubes first is that these could be checked without removing the chassis. Since

condensers perform so many different functions in so many different circuits in a set, the symptoms that a defective condenser will produce are many and diverse. A poor condenser may cause a set intermittently to whistle, lose volume, motor-boat, howl, go completely dead, develop a loud "rustle," or even change stations. This condition may be brought on by a like variety of "stimuli." Jarring the set, heating of the parts, voltage surges caused by snapping the set on and off, flipping the wave-band switch, or switching on and off other electrical apparatus in the house may trigger the change.

I use the gadget pictured and diagrammed in Fig. 1 to tell me whether the difficulty lies ahead or behind the detector. This is simply a 6U5 tuning-eye tube mounted on a panel and having its filament heated with a 6.3 volt transformer. A variable cathode resistor is included for controlling the shadow-angle, and the B Plus, Ground, and AVC-Bus leads are equipped with small battery clips for attaching to the proper points of the set being checked.

The little vacuum-tube voltmeter—it really is one—works equally well on AC-DC or transformer sets. On the former, care must be taken to connect the ground lead of the meter to the set ground—usually the cold side of the line-switch—rather than the chassis. B plus is usually connected to the screen-lead of the output tube. Eight volts of AVC will close the eye with 100 volts on the target; twenty-two volts are required when the target volts are upped to 250.

The three clips are simply connected to their proper points, a good station is tuned in, the cathode resistor is adjusted so that the eye is just closed, and the set is left alone. When the intermittent condition appears, the eye is examined. If it remains the same, the trouble lies behind the detector; if it opens up, the trouble lies in the detector or ahead of it.

The attention can now be turned to the condensers in the indicated section of the receiver. Bad coupling condensers in the audio system are the most common. If the annoying condition can be made to come and go by jarring the set,

twisting the chassis, or wiggling one of the control shafts, the guilty condenser is usually easy to find. Try tapping each one lightly with the bakelite rod, first on one side and then on the other, while the set is playing at low volume. When the bad condenser is found, a very slight movement will cause the volume to change. *Do not* tug the condenser roughly about on its supporting leads. That is the way to make two intermittent conditions grow where only one grew before; and, as Lincoln said about wars, one at a time is enough.

When you find such a condenser, turn the set off, clip a good condenser of like value across the suspected unit, and turn the set back on. Now try the tapping test. If the volume remains steady, gently unclip one end of the bridging condenser and see if the original state of affairs does not again prevail, only to disappear as soon as the good condenser is bridged across. If it does, you are reasonably safe in assuming that a replacement of the condenser will cure the intermittent. Such elaborate precautions are necessary because when you are tapping one condenser, you may be jarring another just enough to make you think that the one you are tapping is the guilty party. If you like, you can use a high resistance variable resistor in series with the bridging condenser to "ease" it in and out of the circuit when the volume is down; but I have found the above method more effective.

If the tuning-eye shows that the trouble is ahead of the detector, try the tapping-test on the condensers there. Screen, cathode, plate, and AVC by-passes should be checked as well as oscillator coupling condensers. In tapping these condensers, it is a good idea to feed a strong, unmodulated signal into the antenna post from the signal generator. This signal should be strong enough nearly to close the tuning eye. Any marked fluctuations in the shadow-angle when a condenser in the RF, IF, or oscillator sections of the set is tapped should be removed.

Opening screen, cathode, and AVC by-pass condensers will usually, but not always, cause the set to oscillate. Sometimes the only

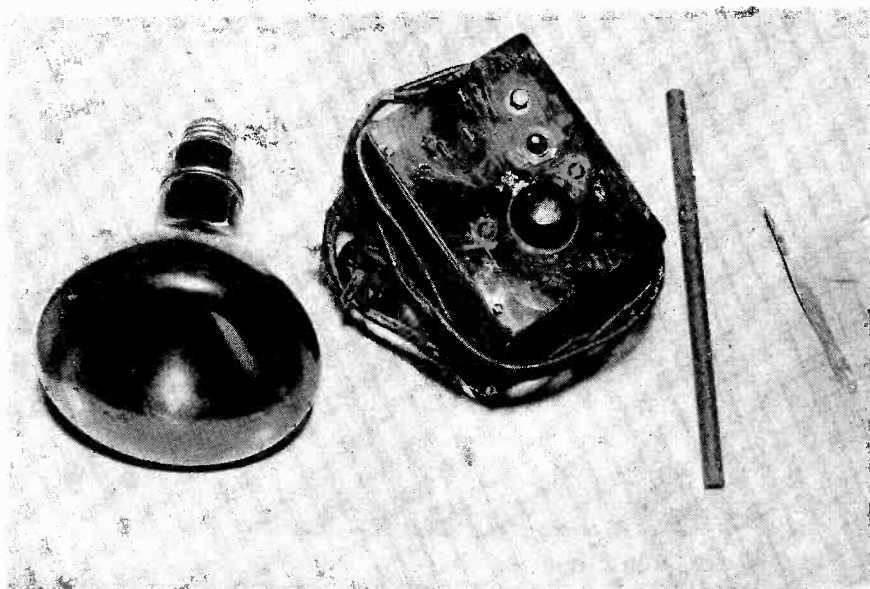


Fig. 2 Showing that expensive and elaborate equipment is not always necessary in finding intermittents, the author explains the use of infra-red lamp for applying localized heat, a voltage regulator, bakelite rod for tapping tubes, and tweezers for moving wires and condensers.

symptom is a marked lowering in the volume of reception. When mica or paper condensers in the oscillator circuit go bad, they usually cause the oscillator to go dead on all—or at least the low-frequency end—of the band. This is usually accompanied by some station-shift on the dial.

Sometimes a filter condenser, especially the fabricated plate type, will cause intermittent action. In this case, no mechanical checks can be made; but the condition may be recognized by a high crackling, popping noise, accompanied by more or less hum. If the filter condenser also serves as a plate-return by-pass, this may be accompanied by oscillation or motor-boating. Bridging the defective unit with a good condenser will usually send a surge through the former that will temporarily cure the condition; but replacement of the entire condenser—not just the opening section—is the only workmanlike repair.

Coils

If the trouble is not tubes nor condensers, coils are the next logical source of trouble to be investigated. The quickest way to check a coil is with an ohmmeter that causes considerable current to flow through the coil. Low ranges on the "ring-shunt" type of ohmmeter fulfill this condition. Any deviation from a normal reading, or especially any fluctuation of the resis-

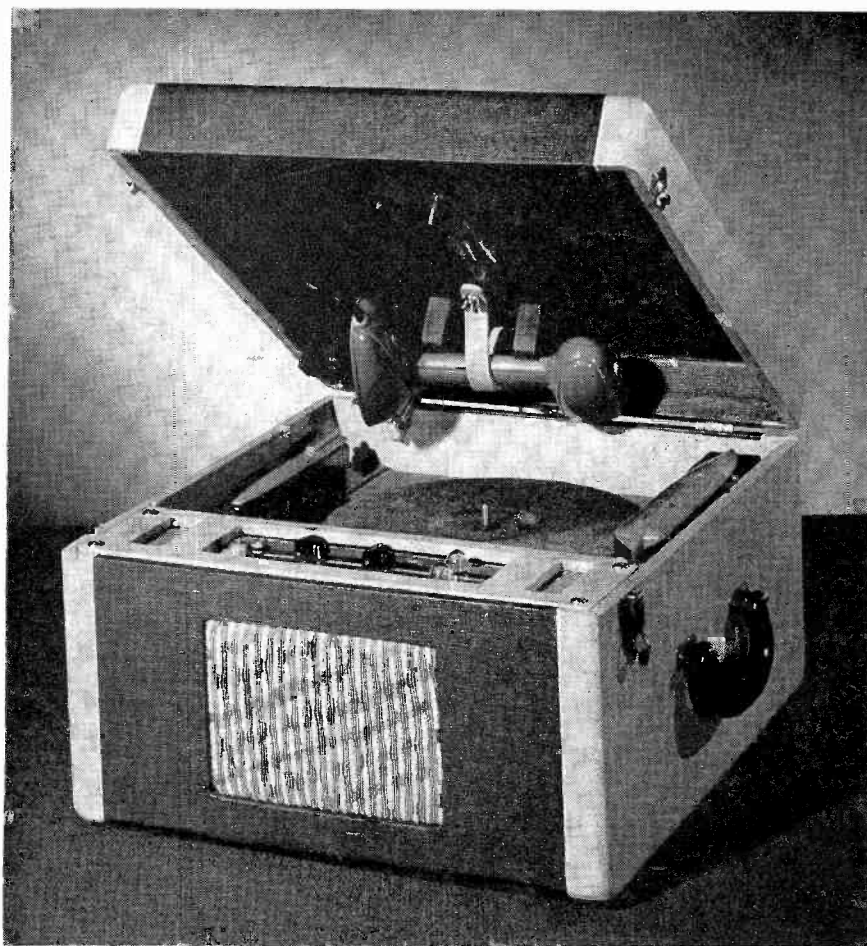
tance reading, should point toward a defective coil. Such coils cause the volume to jump up and down, and this is usually accompanied by a characteristic rustling, squeaking sound similar to that made by sucking the breath through tightly pursed lips. Windings carrying current are the most likely to cause trouble, but the other windings of RF, IF, and output transformers and of oscillator coils should be checked, too.

An opening speaker voice-coil is especially likely to cause an intermittent condition. When this happens, the set goes absolutely dead. Manipulating the cone with the fingers, though, will usually bring it to life spasmodically as the open ends are brought together by the flexing of the paper cone.

If no bad coils can be found, look suspiciously at the resistors, especially the metal-covered type that are riveted to the chassis. Bad connections develop between the resistance element and the lug-type leads. This is usually evidenced by a set that is very noisy and erratic in behavior when first turned on but that settles down when the resistor has had time to heat up and expand. Moving the taps gently with a pair of tweezers and listening for noise and volume-change will reveal if the trouble is there. Other resistors may best be checked with an ohmmeter or with a voltmeter that measures any fluctua-

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If you are prepared to service this type of instrument a profitable new field is awaiting you. Wire and tape types will be discussed in subsequent articles.



HOME RECORDERS

by J. Richard Johnson

FOR many years the practice of the art of recording music and voices was limited to industrial concerns who concentrated on the production of commercial records. But now the recorder is rapidly moving into the home, spurred on by release of the new wire and magnetic tape types, which have aroused a great deal of public interest. While the home record never has pretended to be serious competition for commercial records, it does provide a new and interesting form of home entertainment. The service technician will do well to keep well informed and prepared to handle this sort of work as the number of units in use is increasing rapidly. This article will discuss the disc type; succeeding articles will describe wire, tape, and film types.

A complete recording setup is really a combination of several dif-

ferent sections, each one of which is often regarded as a separate unit by itself. Fig. 1 shows a typical disc recorder arrangement in which all the necessary units for recording and playback are included. A system which is completed in the broad sense should make available the following facilities:

1. Voice or music recording through a local microphone.
2. Recording of radio programs, including voice, music, etc.
3. Ability to "play back" the record through the system, so that reproduction of recorded sounds can be accomplished through a loudspeaker.

Microphones

Of the various types of microphones, probably the most frequently used in this kind of equipment are the carbon and crystal types.

The carbon microphone is the only type which gives an output signal comparable in signal strength with that of the second detector of a superheterodyne receiver. Accordingly, in installations in which the carbon type is used, the same amount of audio gain as that used with the receiver is sufficient. Carbon microphones have two definite disadvantages: 1. poor quality, and 2. most of them are low in impedance and require a microphone transformer.

Crystal microphones, on the other hand, have good fidelity and high impedance so that they can be fed directly into the grid of an audio amplifier. Their output is much lower than the carbon type, however, and more gain is necessary than would ordinarily be used for the receiver audio amplification alone. For example, Fig. 2 shows

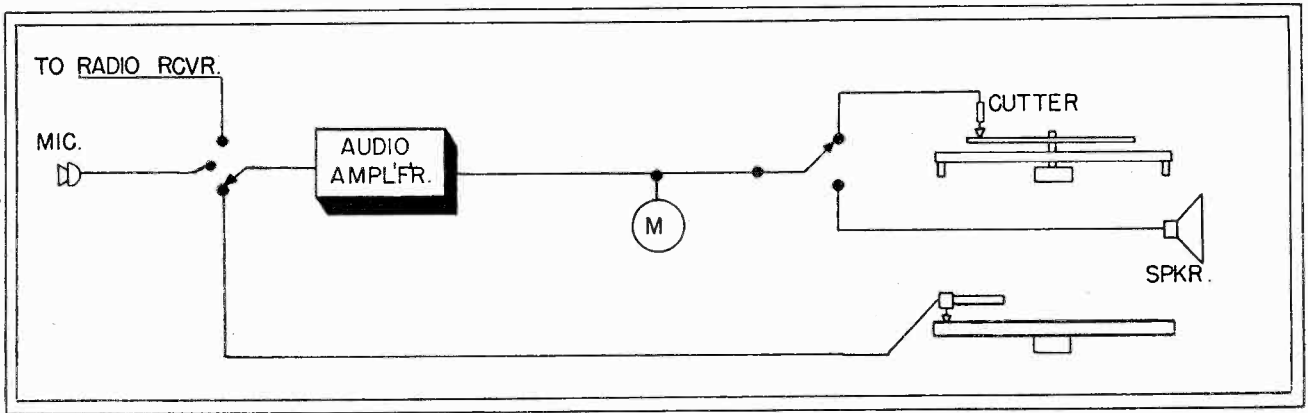


Fig. 1 Block diagram of a complete recording and playback system.

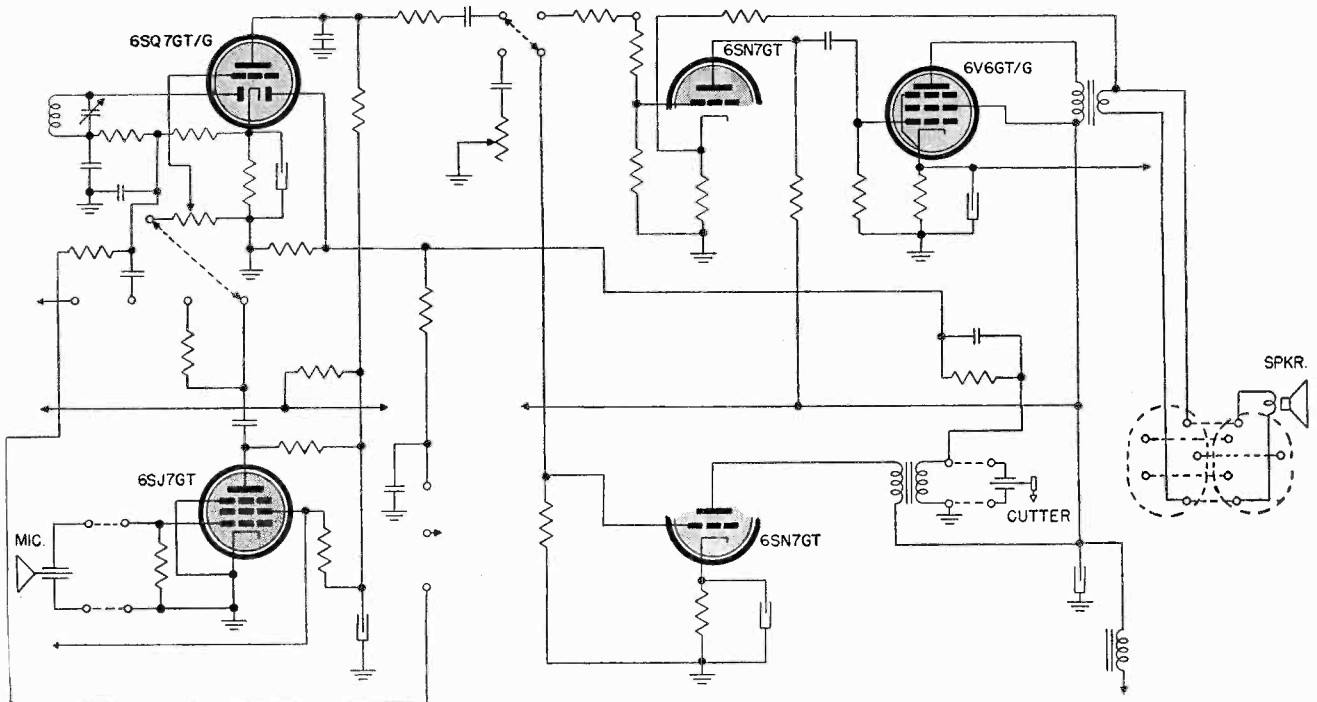


Fig. 2 Audio system of the Recordio 6B10 home recorder.

the audio section of the Recordio model 6B10 recorder in which an extra tube (6SJ7) is used as a pre-amplifier when recording is taking place. A different tube is used for the audio output stage on recording from that used for speaker output. A separate output transformer is also used, because the cutter has a much higher impedance than the speaker and must be matched properly to provide the necessary power at low distortion.

The radio which supplies the programs to be recorded may or may not be considered a necessary part of our complete system. Disc recorders which first appeared in the home were usually accessories supplied with large console radios. This more or less tied the recorder up to the radio receiver. Lately, however, there has been a definite tendency away from this associa-

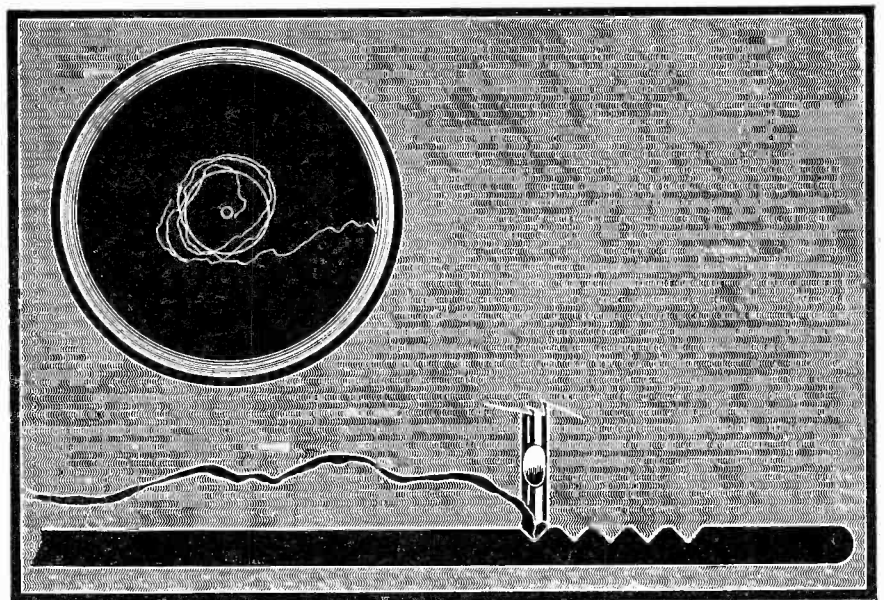


Fig. 3 How cutting is done in a lateral recording unit. The needle swings from side to side in accordance with the audio signal and cuts out the chip which moves toward the center of the record if adjustments are correct.

of each part, including commercial examples, is presented in this article.

Cutting Action

Before going into a description of the actual parts of a disc recorder, let's consider some of the details of the cutting action. Generally, there are two main kinds of cuts for disc recorders, first the *lateral* type and second, the "hill and dale" or *vertical* cut. The vertical method is seldom used for home type recorders, so we shall confine our discussion to the lateral type. The cutting head element drives the stylus back and forth horizontally in a motion similar to that of a pendulum. The higher the frequency of the audio tone being recorded, the faster the motion of the stylus. The *amount* of motion side to side and, of course, is greatest at the highest levels. Fig. 3 shows how a greatly magnified record groove might look if cut by the lateral method. In cutting the record, the piece that is removed takes a long thin hair-like form and is called the "chip." A little practice enables one to determine, from the thickness and appearance of this chip, whether a good record is being made.

Types of Heads

Two main types of cutting heads are used in home recorders, crystal and magnetic. The fact that the crystal type is simpler, lighter, and less expensive accounts for its use in many units. The crystal unit has a very high impedance, however, and unless the amplifier used has a good deal of spare power available, a special output transformer winding is necessary. The service technician should remember that special matching circuits are often used in the cutter circuit and take that into account when making repairs and replacements.

Arm Drive

The heart of any disc recorder system is the cutting head and its drive mechanism. Most home types use the arm type of drive and have both cutting head arm and pickup arm mounted on the same unit. In Fig. 4 are several examples of this arrangement showing application with and without record changer,

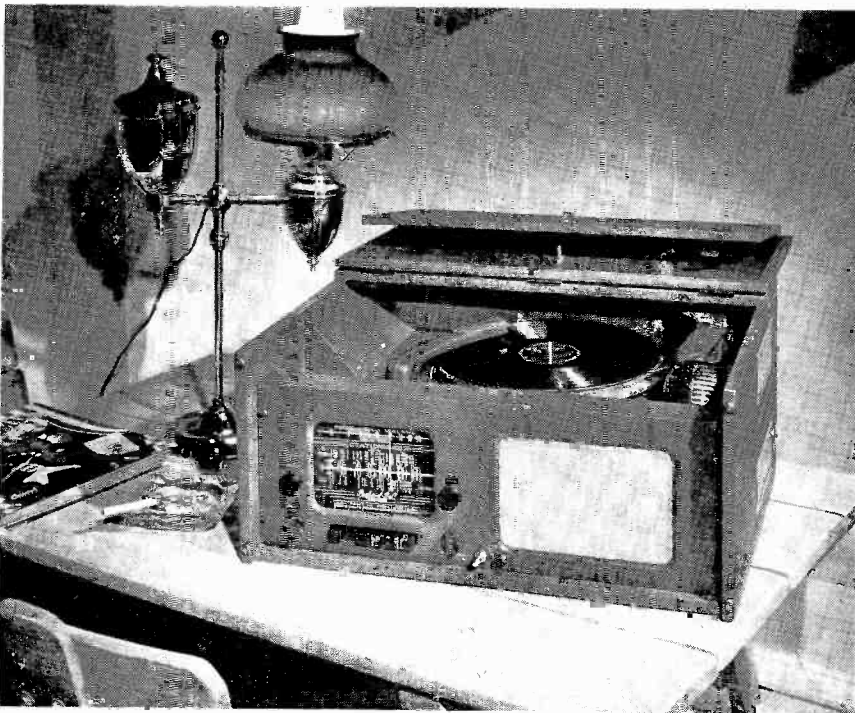
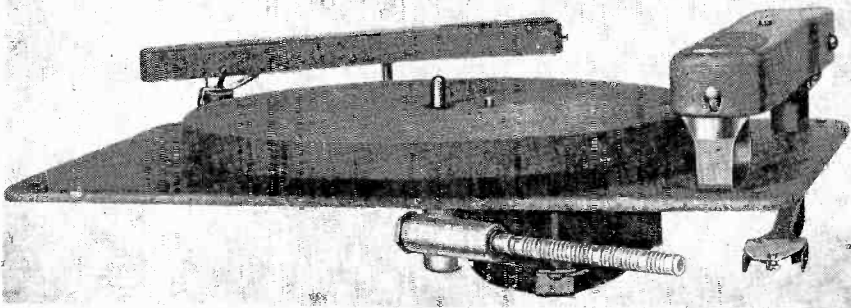
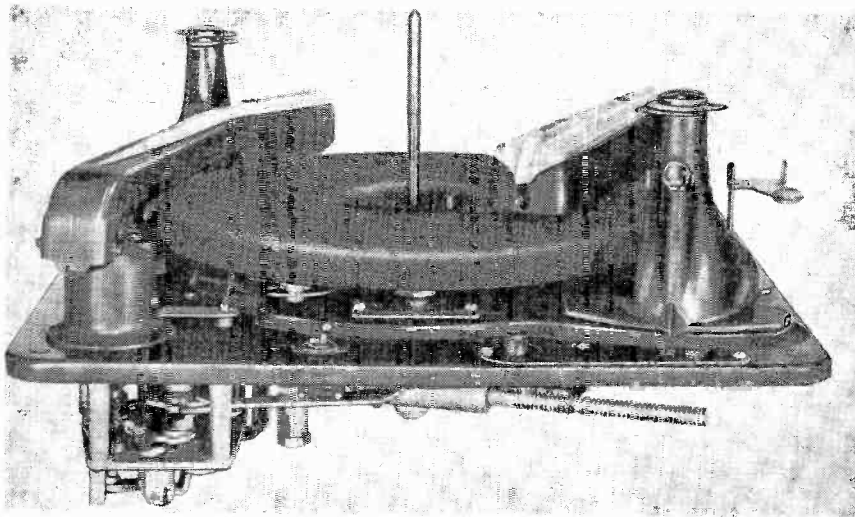


Fig. 4 The most popular home recorders are those which have the cutting head and playback pickup on the same chassis. Here are several examples of this type.

tion, and many present-day recorders are entirely separate units which supply only turntable, cutting head, and amplifier. In some cases units labeled "recorder" include only cutting head and drive mechanism.

Even though the serviceman is likely to run across only complete systems, it is important that he be familiar with each separate part to facilitate his trouble shooting. For this reason, a step by step analysis

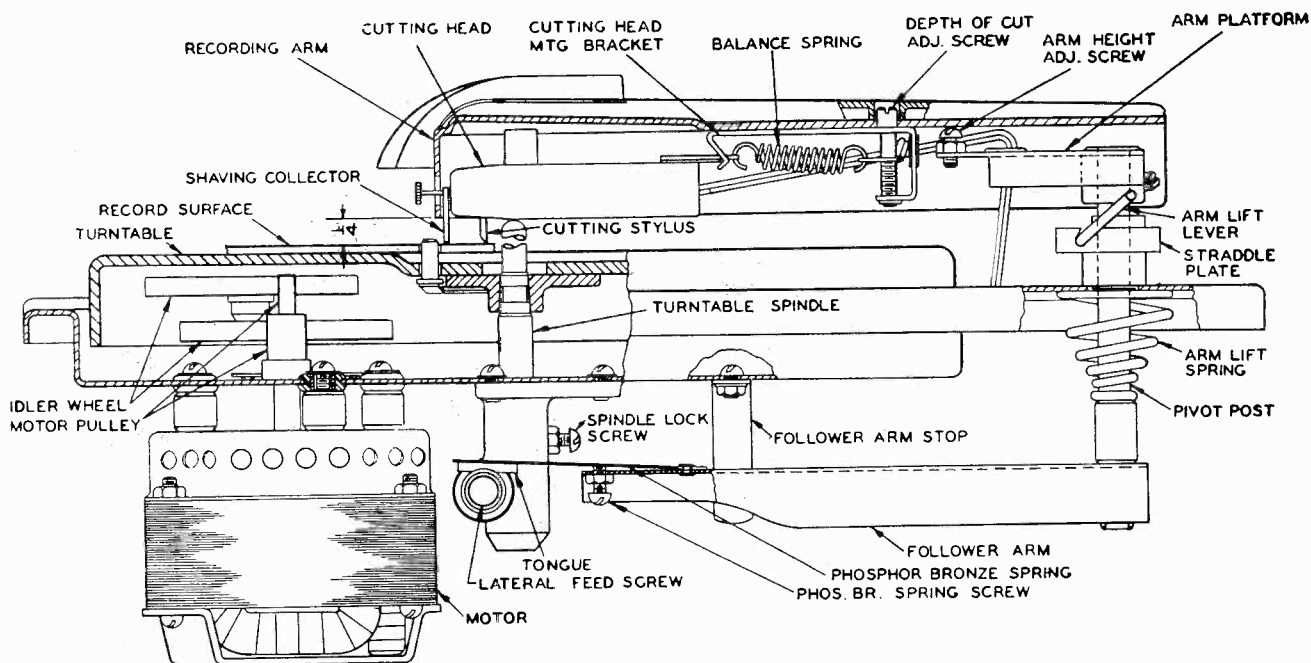


Fig. 5 Diagram of the General Industries Model GI-R90 turntable assembly showing the working parts and various adjustments discussed in the text.

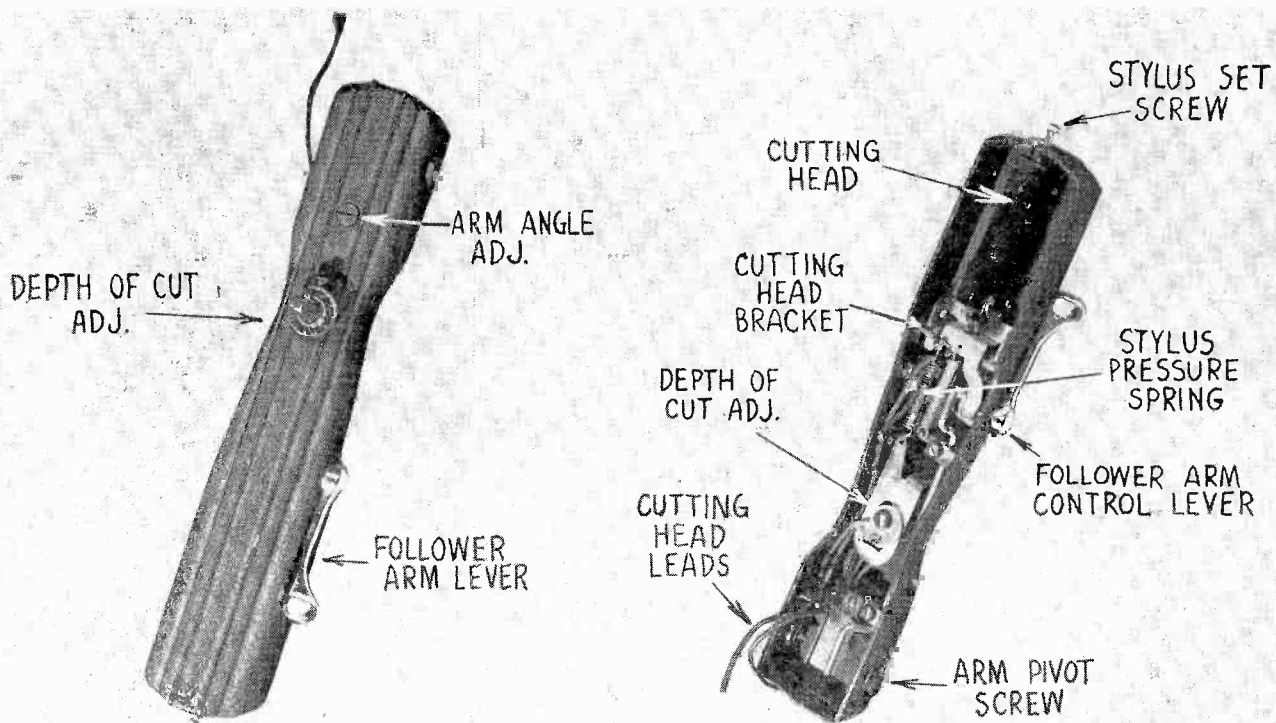


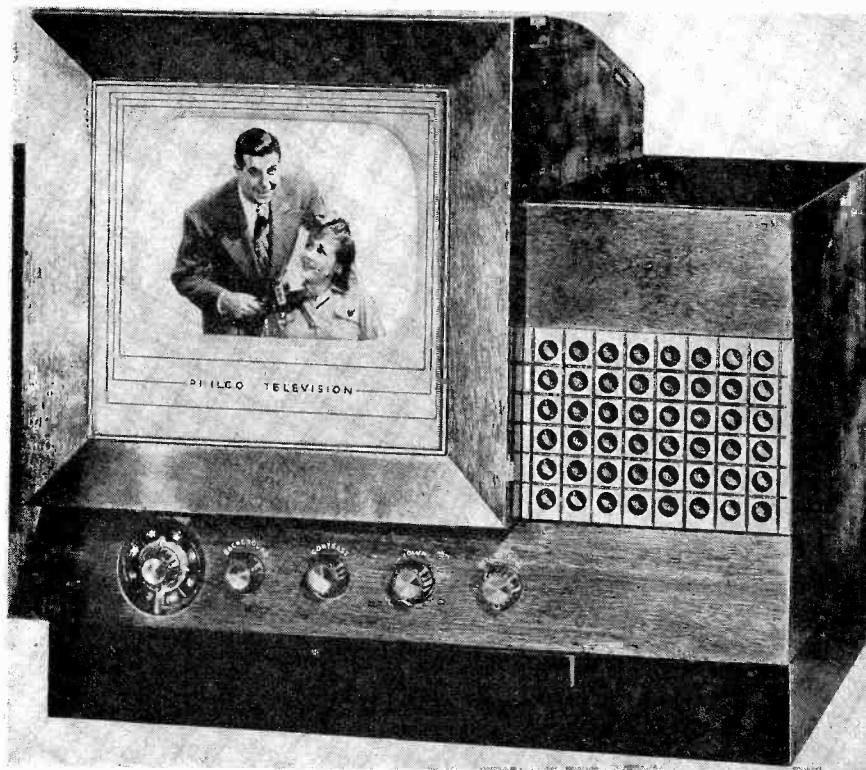
Fig. 6 Two views of a typical recording arm mechanism used in a Seeburg record changer and recorder combination. Left: top view shows depth of cut adjustment and follower arm locking lever. Right: Bottom view showing various parts and adjustments.

and one installed in a complete portable type recording apparatus. Fig. 4 illustrates the most common method of moving the arm across the record as recording progresses. A lever, called the "follower arm," connected to the recording arm but located under the chassis, has two pieces of metal, the bottom edges of which fit into the grooves in the worm gear shown in Fig. 4. This

worm (lead screw) is geared to the turntable drive shaft. As it turns, the motion of the teeth of the worm moves the recording arm across the record at the proper speed to space the grooves the necessary distance from each other. In some instruments, a piece of leather engages the worm instead of the two pieces of metal. Commercial records have approximately 90 grooves per inch.

On home records, the number is much higher, averaging somewhere near 120. The grooves are not as deep as those of a commercial record, and the playing time is greater. For instance, a 10-inch home recording (78 rpm) plays for 4¼ minutes if the surface is completely used. Standard commercial 10-inch

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RF TUNING SYSTEMS

..... TELEVISION RECEIVERS

by
Morton Scheraga
 Allen B. DuMont Labs.

Broad band operation and high frequency channels have been important factors in the new tuners discussed in this article.

THE growth of television from its prewar status of only a few operating stations to the relatively large number in operation in 1946 made it necessary for the Federal Communications Commission to assign additional channels in the frequency spectrum to this new medium. Prior to that time seven television bands had been assigned in the frequency region between 44 and 108 mc. Only in the New York area were there as many as three stations operating. Consequently, prewar sets were designed with radio frequency systems capable of tuning to three of the 5 channels then in use. A few designs had provisions for reception of only one channel. (There were no stations

operating on channels 6 and 7 before the war.)

More Channels

To accommodate the more than one hundred applications for television stations throughout the country, the FCC assigned six additional channels, and at the same time changed the frequency allocations of the previously assigned stations in order to make room for the new Frequency Modulation band between 88 and 108 mc. With this new channel make-up, no more than seven stations are permitted in any one area, and no two channels are adjacent to each other. The latter ruling was made to prevent interference between channels caused by

oscillator drift in the receiver. Table I lists the frequency bands; also shown are the video and audio carrier frequencies.

Faced with the problem of extending the range of the RF tuning system in order to cover any seven out of a possible thirteen channels, manufacturers embarked along several lines of development and came up with tuning systems which differ radically from those in earlier models. In most new receivers it is possible to tune for any one of thirteen channels, so that if the owner moves to another area, he need not have the RF tuner realigned. Some manufacturers, on the other hand, have designed their tuners with seven or eight channels.

Should the set be moved to an area where stations operate on different frequencies, the receiver has to be returned to the service shop where new coils must be substituted in the tuner.

High Frequency Problems

The extension of the television channels into the high frequencies between 174 and 216 megacycles immediately sets up new complexities in circuit design and at the same time demands even greater refinement in techniques used by the serviceman. At these high frequencies, ordinary methods of switching tuning coils are inadequate, for slight changes in the inductance of the switch contact will throw out the RF bandpass alignment or oscillator adjustment by several megacycles. Lead lengths must be kept extremely short, and their location as well as parts are critically set. Even replacement of tubes may require a complete realignment of the tuner.

Systems Used

Three basic RF tuning system designs have thus far been introduced in the new sets. One method is exemplified by the tuner used in all RCA models where provision is made to select any one of thirteen channels by rotating a switch. This switch arrangement moves a shorting bar up and down a balanced transmission line. The second type of tuner is that employed in the Philco receivers. In the Philco tuner, a separate set of coils is used for each channel, but only eight channels are provided for at any one time. A notable feature of this tuner is the turret type of switching arrangement which keeps lead lengths to a minimum. Finally, there is the "Inputuner" system used in the DuMont receivers. This tuner is continuously tuneable from 44 to 216 mc and, therefore, covers the FM band as well as the television channels.

RCA Type

In the RCA RF tuner, three 6J6 double triode tubes are used in the radio frequency amplifier, oscillator, and converter circuits. Refer to Fig. 1. The RF amplifier is push-pull operated and fed from a 300 ohm ribbon transmission line through an untuned input circuit.

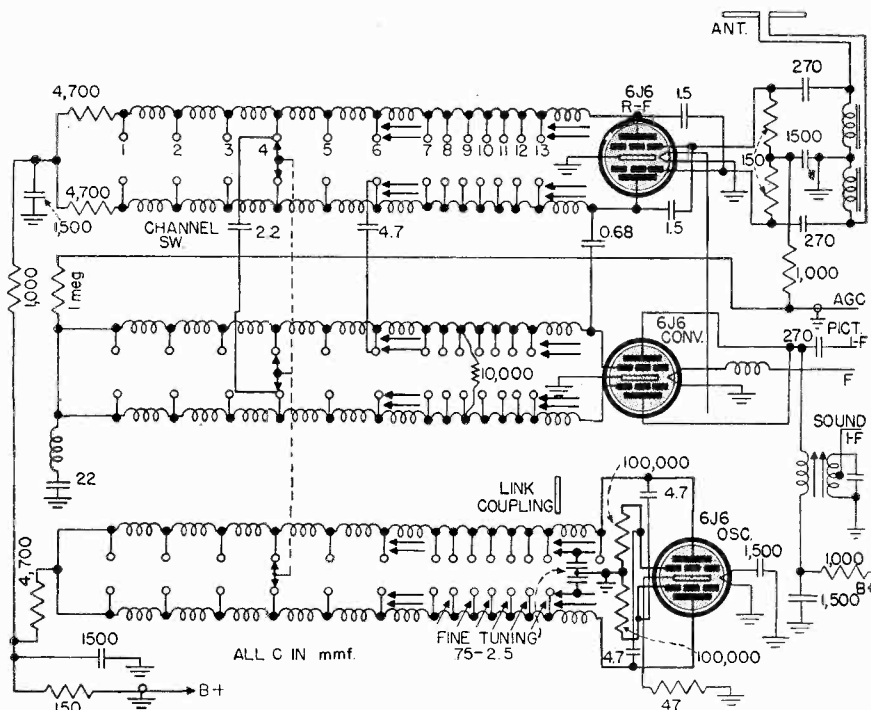


Fig. 1 The RF tuner used in all RCA television receiver models. From top to bottom are the RF amplifier, converter, and local oscillator circuits which tune to all 13 television channels.

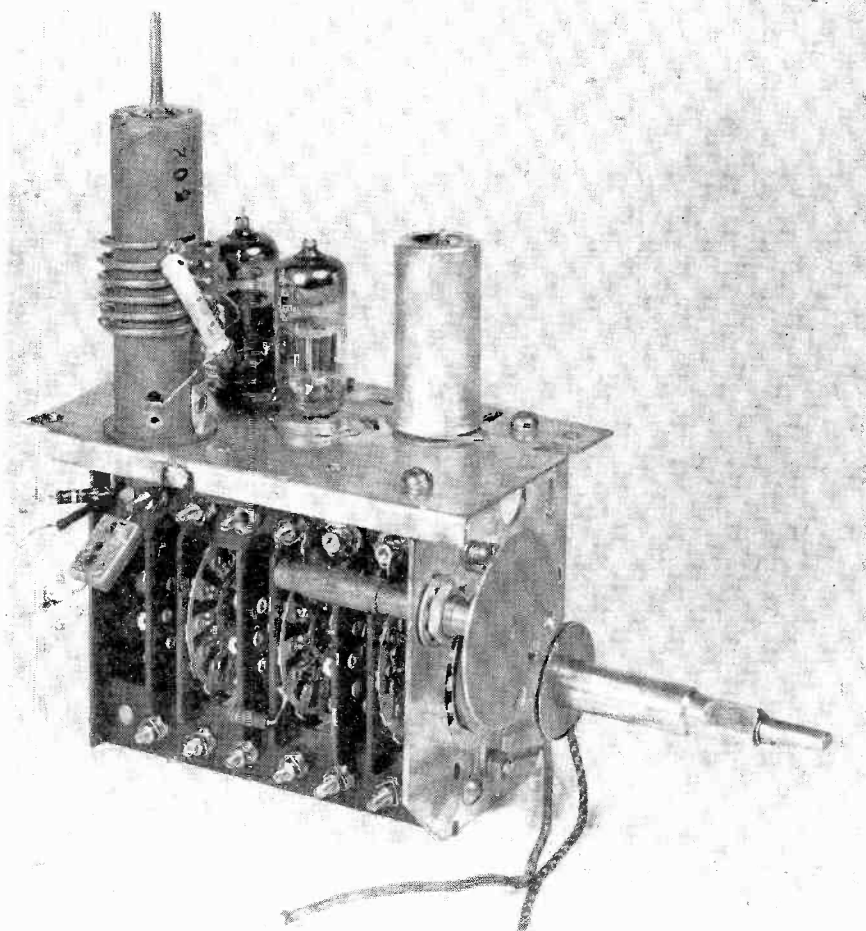


Fig. 2 Assembly of the RCA RF tuner.

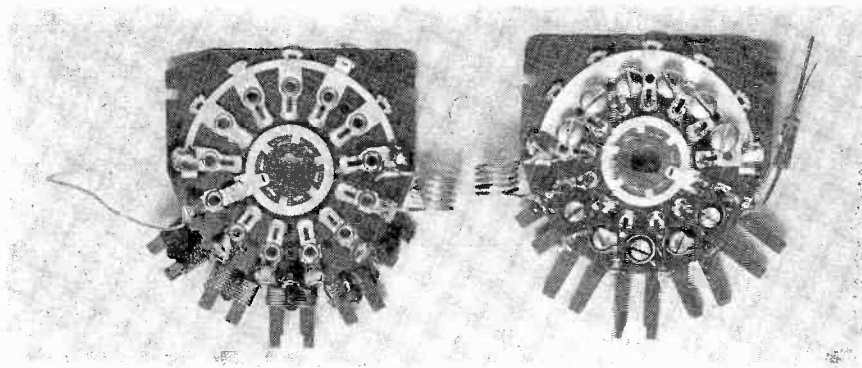


Fig. 3 Switch wafers used in RCA tuner, showing mounting of coils and straps.

TABLE I
Frequency Allocation of Television Channels

Channel No.	Band Width (mc)	Video-Carrier Frequency (mc)	Audio Carrier Frequency (mc)
1	44-50	45.25	49.75
2	54-60	55.25	59.75
3	60-66	61.25	65.75
4	66-72	67.25	71.75
5	76-82	77.25	81.75
6	82-88	83.25	87.75
Frequency Modulation Band-88-108 mc			
7	174-180	175.25	179.75
8	180-186	181.25	185.75
9	186-192	187.25	191.75
10	192-198	193.25	197.75
11	198-204	199.25	203.75
12	204-210	205.25	209.75
13	210-216	211.25	215.75

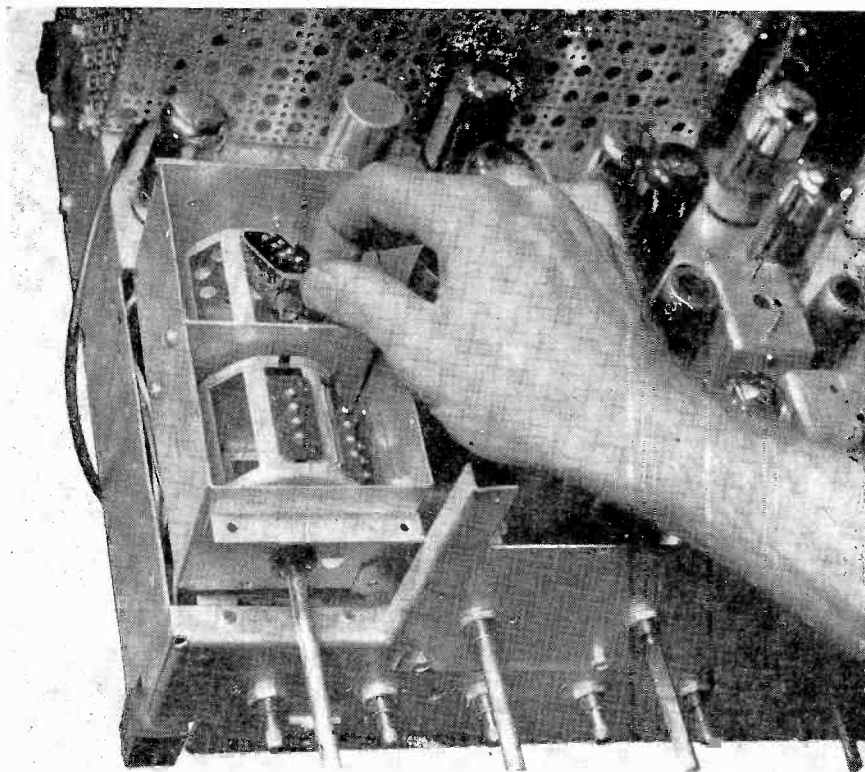


Fig. 4 How different coils may be inserted in the Philco Turret-Tuner.

The plate circuits are connected to pairs of series inductances which are terminated at the far ends. These series inductances are effectively a one-quarter wave section of a balanced transmission line. Tuning is accomplished by rotating the station selector switch, which connects a shorting bar to opposite switch points located at thirteen points along the line. This shorting bar inserts additional series inductance between the RF tube plates and changes the resonance of the transmission line in the following sequence: In the channel 13 position the minimum inductance is required for the highest frequency, and the line is terminated across the RF amplifier plate coils L-25 and L-26. These are variable inductances. As the shorting bar is moved to channels 12 through 7, additional metal strap inductances are successively inserted in series. The large frequency change from channel 7 to 6 (174 to 88 mc) is handled by the adjustable series coils L-11 and L-12. Finally, there are a series of figure-eight coils which are located between the contacts of channels 6 to 1. In this manner, incremental inductances or length of line are added to the initial channel 13 inductance as the switch rotates from 13 to 1. The switch is operated in continuous rotation and has no stop.

Tuning of the local oscillator is similar to the RF amplifier tuning. The oscillator stage uses another 6J6 push-pull circuit with tuned plate lines, terminated by another shorting bar which is ganged to the RF amplifier bar. Fine tuning of the oscillator is provided by the trimmer capacitor C-15, which is connected between the oscillator plates.

The same system is used for the converter. Again a 6J6 is push-pull connected, with the tuned transmission lines in the grid circuits. The converter circuits are physically located on the RF tuner assembly between the oscillator, and the RF amplifier to provide coupling of the amplified RF signal and oscillator to the converter. Link coupling is also used to obtain uniform oscillator injection voltage to the converter over the complete tuning range. The location of the components in these stages is shown in the complete RF tuner assembly of

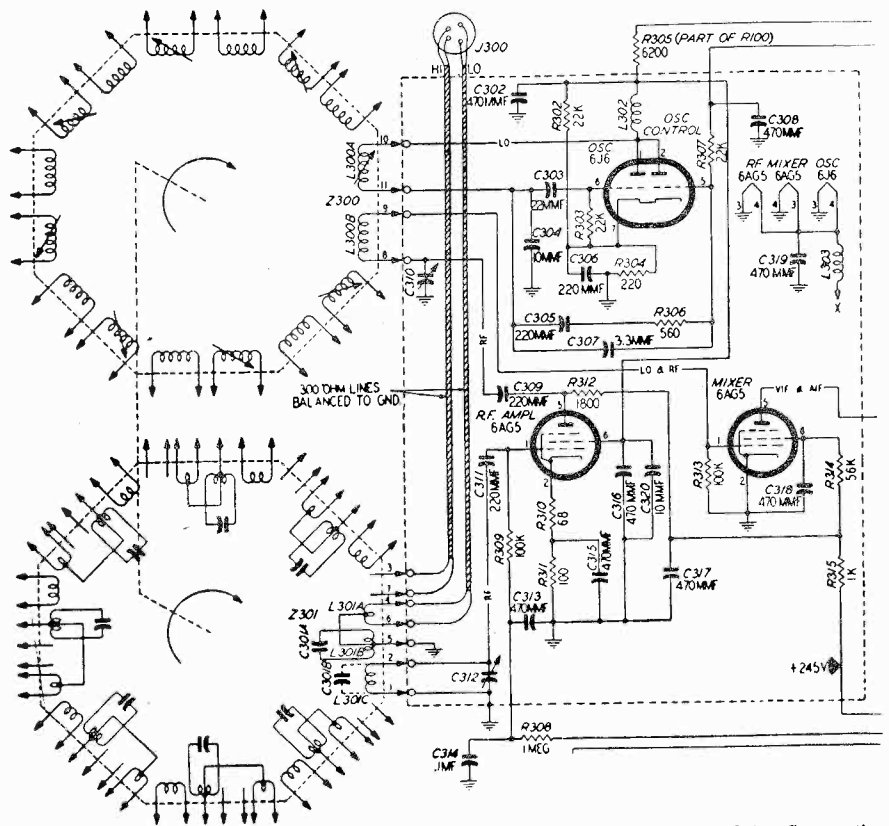
Fig. 2. The main shaft is rotated for channel selection, while a concentric shaft is connected to the trimmer capacitor for fine tuning. Fig. 3 shows the type of switch wafers used in the tuner assembly.

Philco Type

Philco has incorporated several interesting features into its "Precision Channel Selector" which includes automatic frequency control of the oscillator, preventing any frequency drift of the IF signal, and automatic volume control of picture and sound which overcomes the fading of high-frequency signals. The Philco tuner is an eight-position turret-tuner with snap-in coils for the designated channels for the television broadcasting area in which the receiver is to be used. The antenna coil and the RF amplifier coil for each channel are built as an assembly, as are the mixer coil and the local-oscillator coil, so that two assemblies comprise a set of coils for any one television broadcast channel. The turret is octagonal in shape (See Fig. 4) and each set of coils is mounted on a different face of the octagonal drum. The front section of the drum carries the mixer and oscillator coils while the rear turret holds the RF amplifier and antenna coils. Any eight of thirteen sets of coils can be snapped into the turrets without soldering or wiring.

The advantage of the turret-tuner is that the leads connecting the coils to the RF amplifier, oscillator, and converter stages remain short and unchanged. All the coils are mounted on the turret drum and each set is moved into position as required. Good contact between switch points is provided for on the Philco tuner by spring supporting of the contact points.

Since the Philco tuner can receive stations on both the low and high television bands, provision has been made for the installation of two antennas, one for stations operating in the frequency range between 44 and 88 mc, and the other antenna for those on frequencies between 174 and 216 mc. Both antennas are connected to the input terminals, but only one is in operation at a time, depending upon the position of the turret. This is accomplished by arranging the coils on the turret, so that the RF and



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Fig. 5 Schematic diagram of RF section of Philco Model 48-1000.

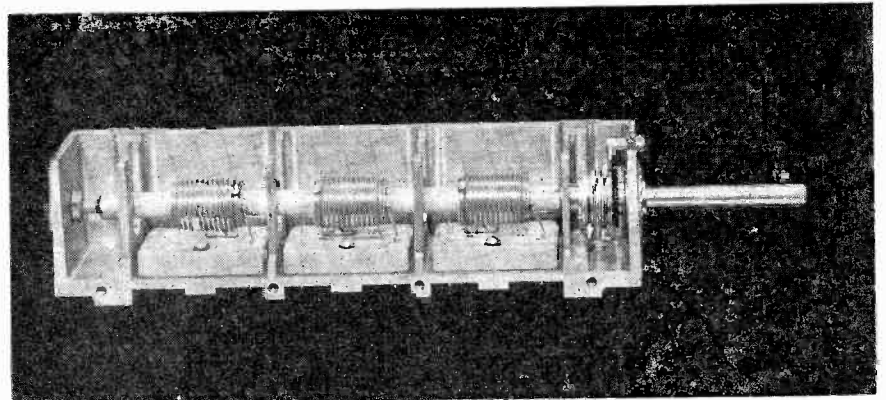


Fig. 6 The "Inductuner," a unit developed by P. R. Mallory & Co., and used in the DuMont "Inputuner" tuning system. It provides an extremely wide tuning range from approximately 44 to 216 mc. The three variable coils provide for RF stage, mixer stage and oscillator stage tuning.

antenna coils of the low band channels occupy the contact positions 1, 2, 4, 5, and 6, (See Fig. 5), while the high band coils are connected to contacts 1, 2, 3, 5, and 7.

When correct antenna, antenna coils, RF coil, local oscillator coil, and mixer coil have been connected into the circuit by setting the channel selector knob, the signal from the antenna is transferred to the RF amplifier circuit which uses a

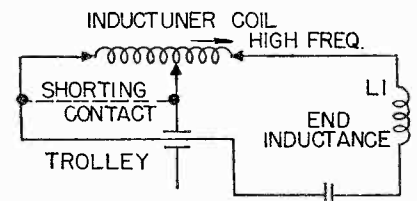


Fig. 7 The basic "Inputuner" circuit.

→ To Following Page

RF Tuning Systems

→ From Previous Page

6AG5 tube. The amplified RF signal is resistance coupled to the converter where it is heterodyned with the output of the local oscillator, which is inductively coupled to the grid circuit of the converter. Stability of the oscillator is assured by the incorporation of an automatic frequency control circuit in which a control signal from the FM discriminator circuit raises or lowers the frequency of the local oscillator to maintain a constant intermediate frequency. When the FM intermediate frequency is centered about the correct frequency, the DC voltage at the center point of the discriminator output will be zero. If the center frequency drifts above or below the correct value, the output voltage will be a positive or negative DC potential, respectively. It is this DC voltage which is fed back to the oscillator control tube. Since the correct oscillator frequency is obtained when there is zero voltage at the center of the discriminator output, the oscillator coils can be aligned in the following manner: with a television sound signal being received, adjust the oscillator coil slug to obtain a reading of zero voltage on a vacuum tube voltmeter connected across the discriminator. When the oscillator is correctly adjusted, maximum sound will be obtained. Make this adjustment for each position of the turret turner.

DuMont Inputuner

Differing quite radically from either the RCA or Philco type of tuning systems is the DuMont "Inputuner," which tunes continuously from 44 to 216 mc without a break covering all 13 television channels as well as FM amateur and aviation channels. The heart of the "Inputuner" is a three section variable inductance invented by Paul Ware developed by P. R. Mallory & Company, and known as the "Inductuner." As shown in Fig. 6, the "Inductuner" consists of three coils mounted on a ceramic shaft, and at the left end of the shaft an accumulation stop

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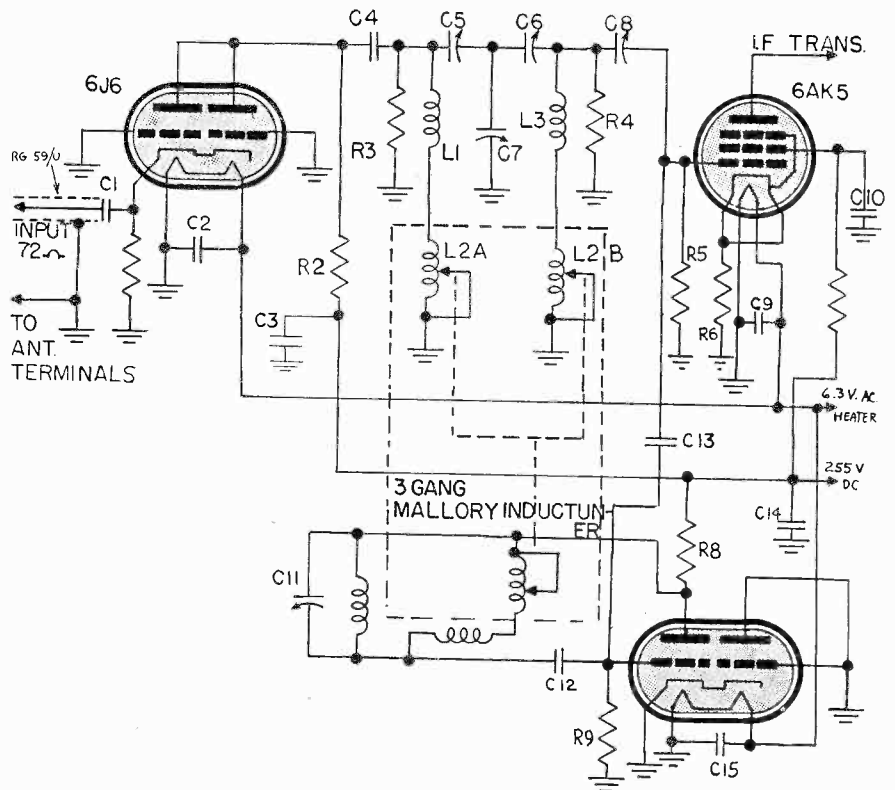


Fig. 8 RF Section of a DuMont receiver showing how the "Inputuner" is used.

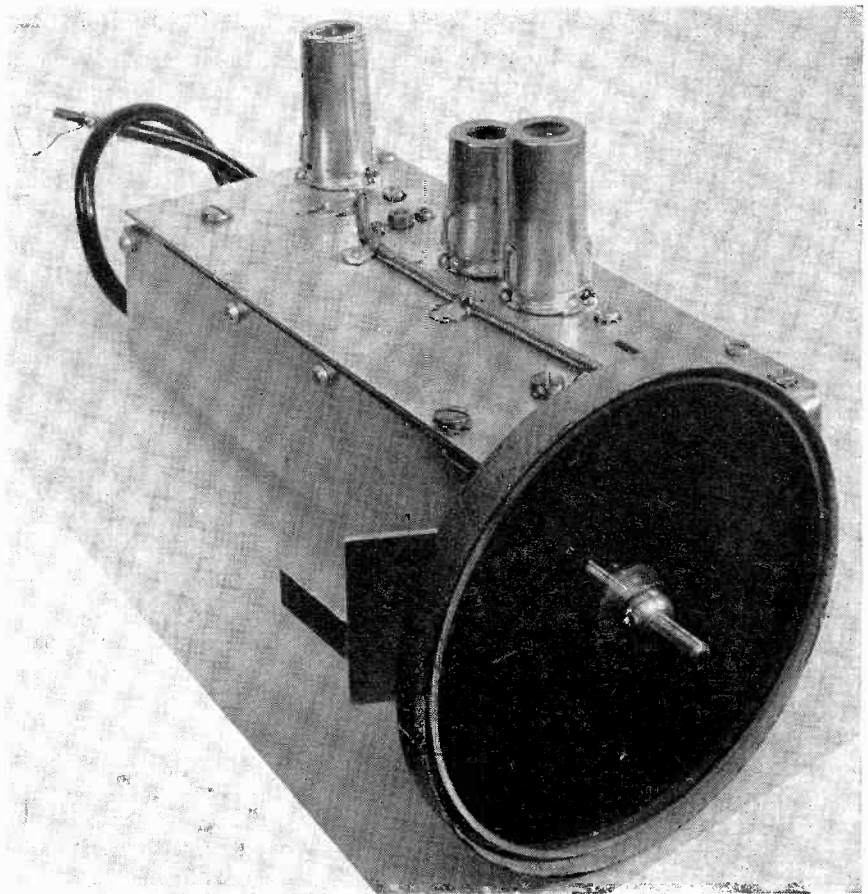
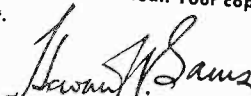
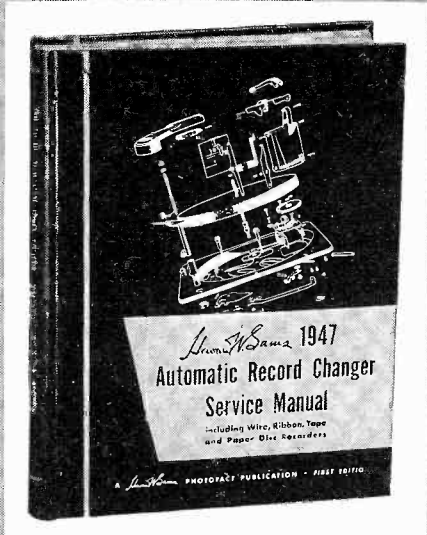


Fig. 9 Complete "Inputuner" assembly for continuous 44-216 mc coverage, showing manual drive dial. Assembly is preadjusted and precalibrated and requires no further adjustment after installation.

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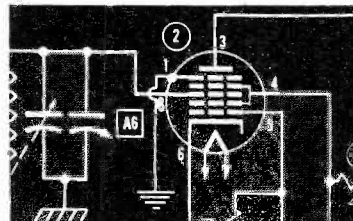
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RF Tuning

Systems

→ From Page 22

to prevent damaging the device if turned too far in either direction. Each coil is tunable continuously for 10 turns which varies the inductance over approximately 0.02 to 1.0 microhenry. A trolley contact moves along each coil, dividing it into a used and unused part. The contact is shorted to the low frequency end of the coil so that the unused section is resonant at a very high frequency.

Fig. 7 is the basic "Inputuner" circuit, comprising a variable coil, a fixed coil and a fixed capacitance in series. Instead of using a small part of the variable coil to reach the high frequency end of the television band, the variable coil is run out to the limit, and the separate end inductance L1 is used. The entire "Inputuner" circuit employs three tubes, an antenna coupling tube, a mixer, and an oscillator. See Fig. 8. The signal from the antenna is injected into the cathode of a 6J6 double triode that has both sections connected in parallel. Cathode input is a convenient and efficient means of coupling a fixed line impedance to a wide tuning ratio, wide band-pass circuit. Two sections of the "Inductuner" are used to tune the plate circuit of the input tube while the third section tunes the oscillator to correct frequency. The output of the oscillator and the tuned plate circuit are capacitively coupled to the grid of the 6AK5 mixer tube.

The adjustment of the "Inputuner" circuit is relatively simple in contrast with the multiple adjustments required with band switching arrangements where as many as thirteen individual channels have to be aligned. In the "Inputuner" circuit, the entire bandpass circuit from 44 to 216 mc is aligned by adjusting only capacitors C5, C6, and the end inductances L1 and L2. The oscillator is tracked to the dial calibration by means of two adjustments, capacitor C11 and end inductance L4.

Tuning Dials

For rapid selection of the desired station, DuMont has developed two types of tuning dials. Fig. 9 shows

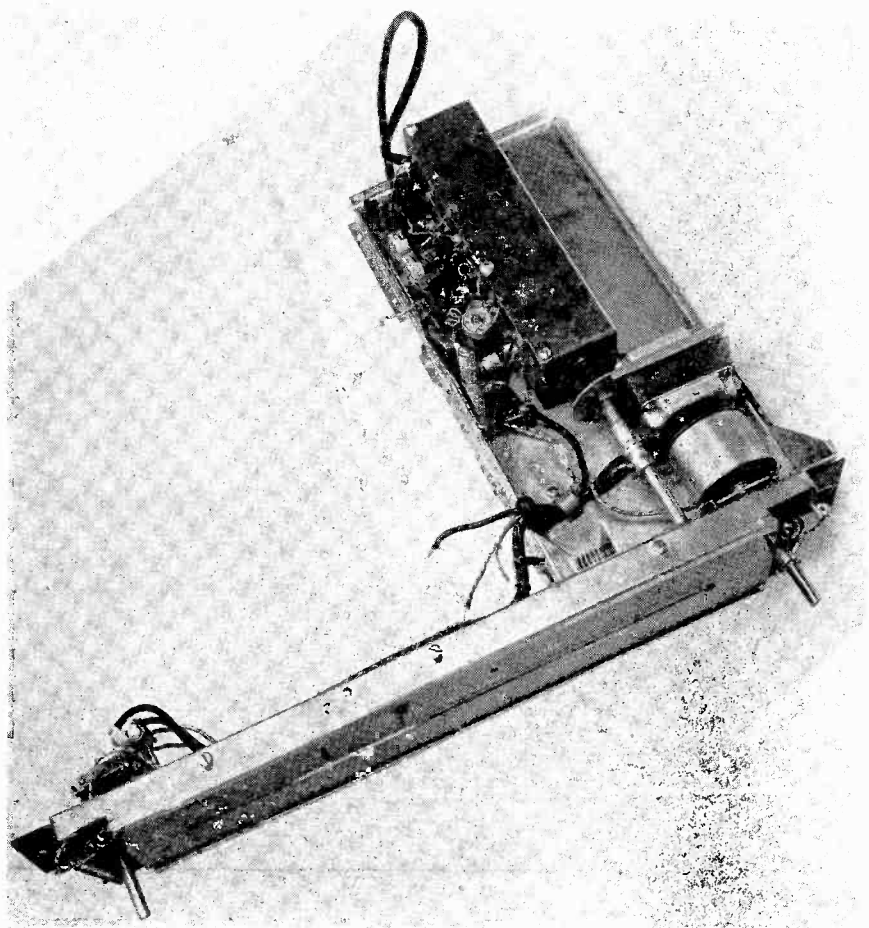


Fig. 10 This assembly contains the same electrical circuits as the unit in Fig. 9, but in place of the manual tuning handle knob and dial is a motor drive mechanism for mechanical tuning. The cover is removed to show location of "Inductuner," components, motor drive and clutch.

the complete "Inputuner" assembly with the manually operated dial. This dial has two lucite disks mounted one behind the other. Approximately 15 inches of scale length is obtained on each disk, providing ample bandspread for the wide tuning range. One disk makes ten turns to cover the entire range of the tuner, while the other is geared for vernier action and moves through less than one turn. On the deluxe models, motor drive is provided to rotate the tuner to the desired station. This dial mechanism is shown in Fig. 10.

The three tuning systems described above are examples of the basic types which are being incorporated in the new receivers. Because of the complexity of these tuners, most manufacturers have built them as completely independent units which are separately aligned and then attached to the main chassis. Manufacturers have thus far discouraged the serviceman from aligning the tuner units. If

any trouble is encountered in the tuner, they recommend that it be removed from the chassis and returned to the factory where adequate test equipment and skilled personnel are available to realign it. In the RCA and DuMont tuners, for example, careful pruning of coils is required to obtain the correct pass bands and overall tracking of the oscillator. At present, these manufacturers have adopted a service policy of having the serviceman return the defective tuners. With the Philco type of tuner, however, where each channel has individual coils, it is possible for the serviceman to align the tuner if he possesses sufficient test equipment. Methods for aligning such a tuner were described in the article "The RF Section" in the December 1946 issue of RADIO MAINTENANCE. In this article, there are also described methods by which the serviceman can quickly locate a faulty tuner so that he need not spend undue time in troubleshooting. ✓✓✓

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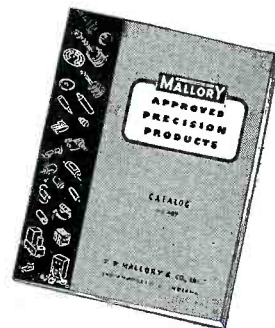
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Home Recorders

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records never run more than a little over three minutes. The grooves in the home recording are necessarily made more shallow since they are placed closer together.

Fig. 5 shows a diagram of a General Industries Model GI-R90 turntable assembly. The cutter is suspended inside the arm by means of a spring and pivot assembly. The tension provided by this spring is adjustable by means of the "depth of cut" screw projecting from the top of the arm. To provide for needle replacement, the set screw is made to project through the end of the arm. A slot is provided at this point so that the cutter may move up and down on uneven records. The arm is supported by means of the arm platform which turns on the pivot post. At the bottom end of this pivot post is connected the follower arm which has a spring and tongue bearing on the lead screw, or worm. As previously described, this lead screw turns during operation and moves the recording arm across the face of the record. Many recording arms also include a "chip collector" which keeps the chip from fouling the cutter, thus spoiling the record.

Overhead Drive

The more commercial types of recorders use the overhead drive, two examples of which are illustrated in Fig. 7. In this type, the cutter is mounted on a carriage which derives its lateral motion from the lead screw. The lead screw is above the turntable and can apply its force directly to the cutter instead of through a comparatively long arm. Recorders using this type of drive are usually more elaborate than the arm type and have many additional adjustments. Due to their solid construction, and the smaller tolerances used, more exacting work can be produced by their use.

In the recorder illustrated in Fig. 7A, two overrun clutches are provided to prevent a record from being spoiled by jamming. One of

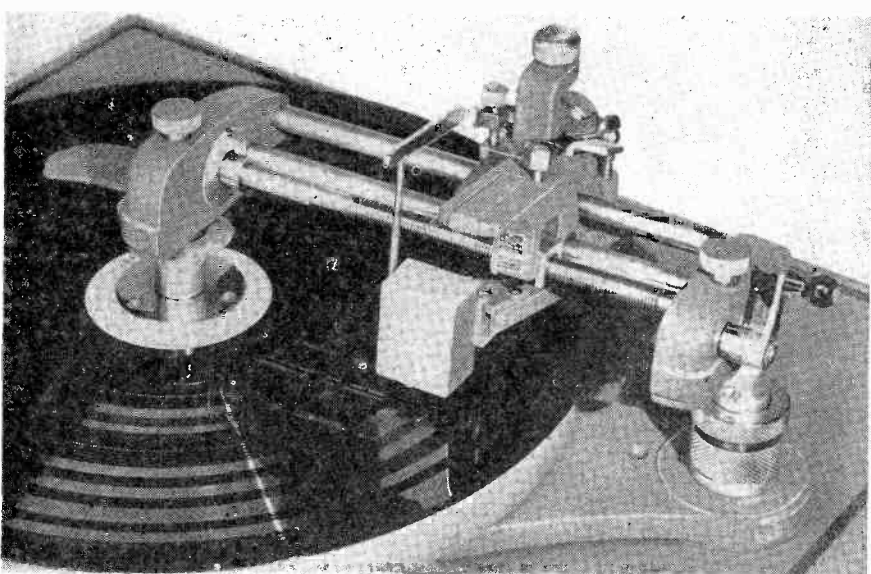
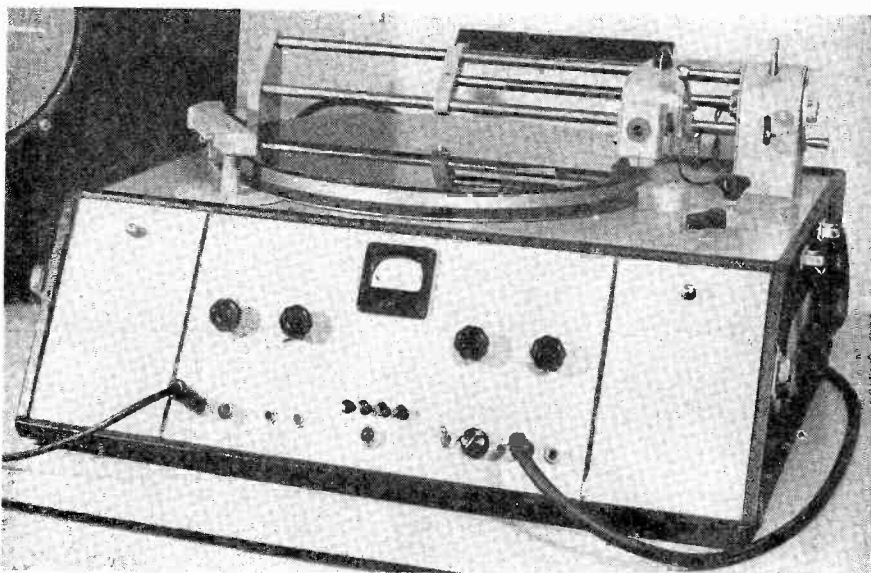


Fig. 7 The overhead drive type of recorder is a more specialized piece of equipment and is therefore not very often found in the home type of unit. Two examples of this type are shown.

these is built into the lead screw and prevents damage due to cutting too near the center or edge of the record blank. The other clutch is in the crank mechanism which is used to adjust the position of the cutter. This second clutch prevents jamming of the crank from spoiling the record. The mechanism is so designed that adjustments can be made on depth of cut, pitch (grooves per inch by changing lead screw), and needle pressure.

Troubles encountered in connection with disc recorders may arise from:

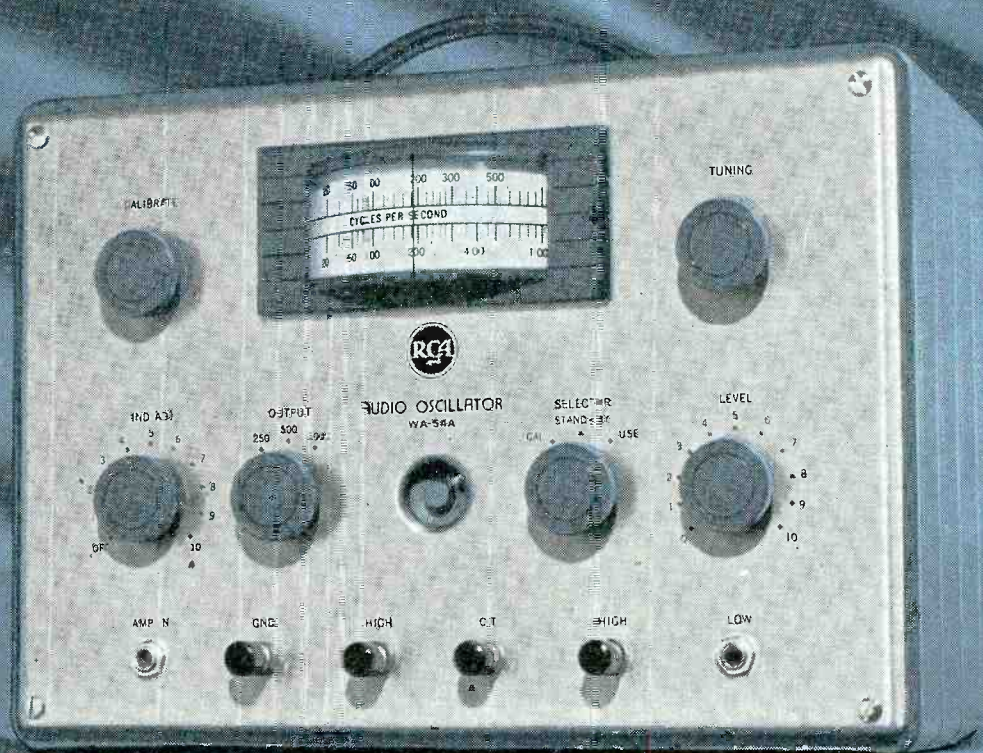
1. Improper adjustment and operation
2. Wrong types of accessories (needles, blanks, etc.)
3. Defect in the mechanism

Probably the greatest number of service calls in connection with recorders involve difficulties in technique of operation. This is to be expected because many people apparently do not realize that although the art of recording has moved into the home, it still requires a good deal of attention to details to produce good records. The serviceman should be well grounded in the important requirements in order that he may satisfy those customers who have no other difficulty than the need of instruction.

First, good records cannot be made unless the proper types of styli and record blanks are used.

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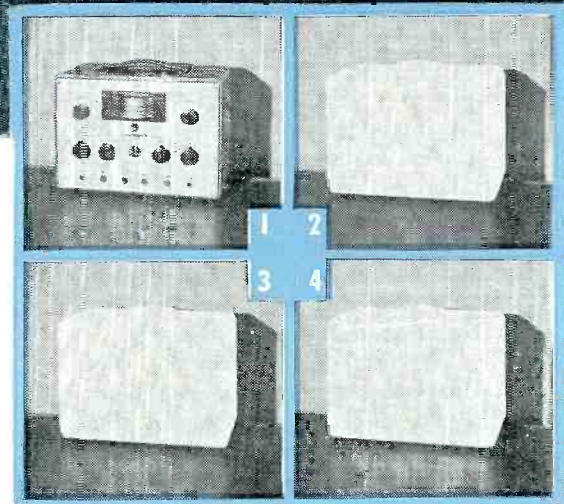
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Home Recorders

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Stylus Types

Types of styli (cutting needles) are shown in Fig. 8. The long shank and short shank types are not always interchangeable and recorders designed for one will usually not function properly when the other is used. Another variable is the shape of the cutting face which may be straight or curved. The lowest priced type is the plain steel stylus. The steel is hardened, and the point is ground into the shape of a V. Stellite and precious stones are used as cutting points on the more expensive kinds. Plain steel needles are only useful for about 30 minutes of recording or from five to ten records. Some of the more expensive needles, such as the sapphire type are good for as long as ten hours. These figures are for average conditions and will vary considerably according to the kind of blanks used, and how well adjustments are made.

The points of styli are usually made very sharp. It is, therefore, very important that the cutting unit never be allowed to rest or scrape on any hard surfaces such as the turntable or metal chassis. A flat is provided on the shanks of most types of styli. This is for the purpose of positioning the cutting edge most favorably. As in the case of many kinds of playback needles, the shank is turned so that the set screw tightens against this flat, thus tightening the stylus in the right position. It should be noted, however, that even when this flat is used, slight variations in positioning may occur. Such minor maladjustment of stylus position can be identified because the thread (chip) tends to throw or move toward the outside of the record instead of toward the center, which is the proper direction. In this case, the set screw should be loosened a little, the shank turned slightly and a recheck made on the operation. Another difficulty which may arise is loosening of the stylus in the cutting head. Most manufacturers recommend that the set screw

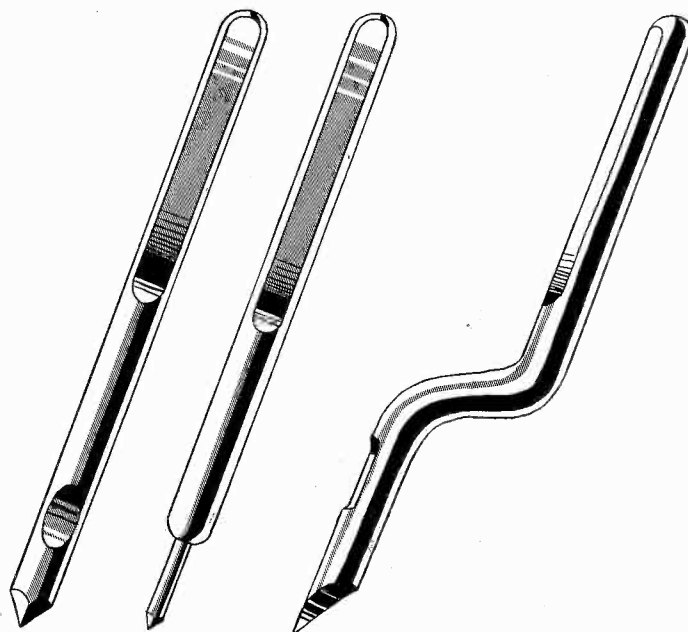


Fig. 8 Some of the types of styli used in home recorders.

be given a little tightening turn each time a recording is made.

Recording discs or blanks are available in a wide range of types and quality. They are usually classified according to the base or foundation material. The main types are paper, steel, aluminum, and glass. Although it is often possible to get excellent results with the other types, the highest quality and most dependable are the glass base blanks. The paper base type is the least expensive, lightest, and can be easily sent through the mail, although its playback life is relatively short. Glass blanks, being harder and lasting longer, are most easily broken and, since they don't wear so much themselves, produce the most wear on the stylus. It also requires more stylus pressure when cutting a glass blank than that required for paper or metal types. In this connection, it should be recognized that the "depth of cut" adjustment only does what its name indicates when the same kind of blanks are used. What is really adjusted here is the pressure of the stylus on the blank, and for the hard glass blanks the depth of cut adjustment must be advanced considerably over the position used for softer types.

Now let us consider the operating adjustments which are necessary for good results. Some of the places in which troubles may arise are as follows:

1. Depth of cut adjustment

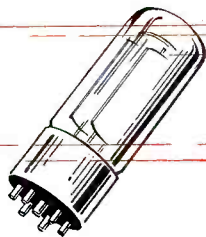
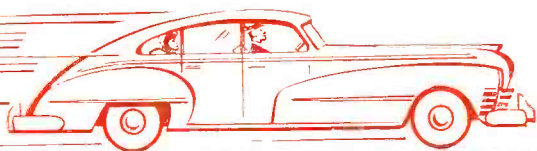
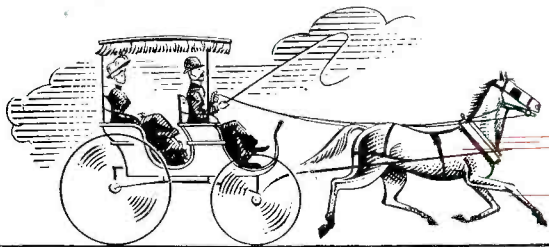
2. Pivot post adjustment
3. Volume level adjustment
4. Tone control adjustment

1. *Depth of cut adjustment.* In making this adjustment, either of the two extremes of too deep or too light a cut should be avoided. Too deep a cut causes the stylus to penetrate the soft recording surface of the record and bear upon the base material, and at the same time cause the grooves to run into each other. On the other hand, if the cut is too light the playback needle will not stay in the groove. A little practice enables the user to recognize by the thickness of the chip (thread) whether the cut is of the proper depth. The adjustment is usually made by means of a knurled metal knob (see Fig. 6) or a screw projecting from the top of the arm.

2. *Pivot post adjustment.* This adjustment raises or lowers the horizontal angle of the arm. In some models variation can be accomplished by means of a screw projecting from the top of the arm casing. (See Fig. 6.) In other models the adjustment is inside the casing, and the arm must be lifted toward a vertical position to provide access. This screw should be set properly before the depth of cut adjustment is made, since it will affect stylus pressure.

3. *Volume level.* The audio level used is very important. Too much audio causes the lateral swing of

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The Organizations

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.

A REPORT received from the Southern Tier Chapter of The Radio Servicemen of America, Inc., reads as follows:

"Our Chapter consists of 30 members. We meet only once a month during the summer months, therefore, I have not had much to report.

"We are to have a basket picnic Sunday, July 20, with our families.

"We are getting spots on one of our local broadcast stations — WNBF. A new local station, WKOP, has promised to do the same for us. We are planning a newspaper group ad to tie in with the radio spots.

"Our August 5th meeting will be honored by Mr. James H. Canning, of Sylvania Electric Products, Inc., who will speak on the oscilloscope and its use in servicing FM receivers. We have invited the Catskill group of servicemen to this meeting.

"We have tentative dates with other speakers for September, October, and November.

"We are interested in available 16mm sound films relating to the technical side of radio. Can anyone give us any information as to where we can get such films, etc.?"

Earl L. Pittsley

Vernon H. Preston, Secretary of the Long Beach Radio Technicians Association, Inc., forwards the following interesting information:

"The Radio Technicians Association is a non profit organization run by radio servicemen in and around

FLASH!

Word has been received as we go to press that there will be a statewide convention of Pennsylvania Radio Servicemen's Organizations in Philadelphia in January. Organizations everywhere will be invited to attend. We expect to have more complete information in the next issue.

Long Beach, California. At present, the association has about sixty active members.

"The regular meetings are held on the second and fourth Wednesdays of each month. They start at seven and are over at ten. These meetings are preselected by our

program committee. It is headed by Mr. Howard Coy.

"We have outstanding speakers from the laboratories of RCA, Packard, Bell, Motorola, and other leading companies.

"Movies at some meetings help to make the meetings interesting and fast moving. Once every three months a door prize of some radio testing equipment is made. The amount is about \$30.00.

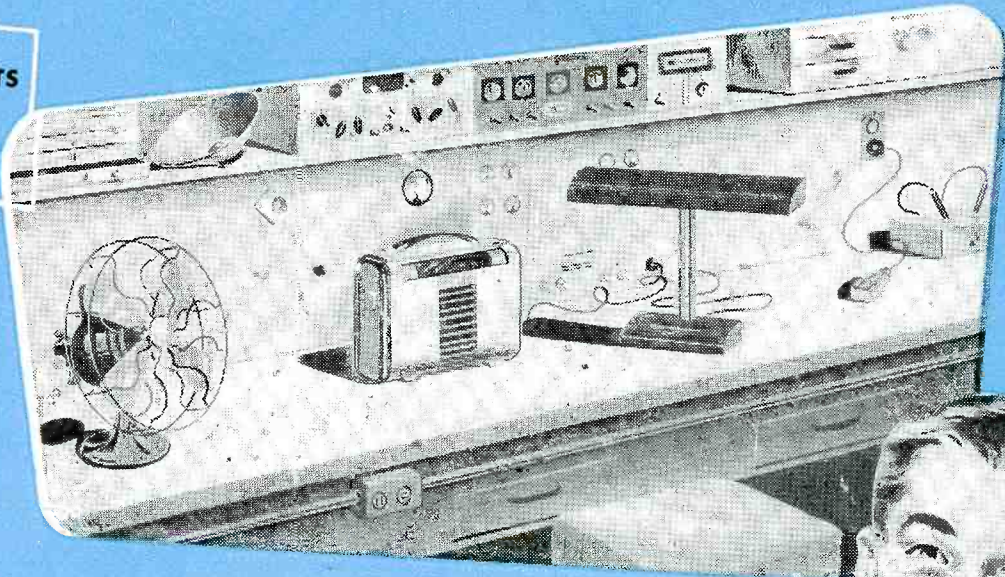
"The election of officers is held at the end of the year, at which time a vote would be taken. The following meeting would be the installation of new officers.

"A certificate is available to the members after passing an examination which is made up by the officers of the current year. Enclosed

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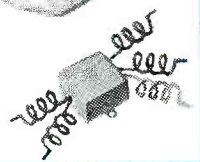
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Start The Capacitor coming my way at once — FREE.

Please send copy of Catalog No. 195A.

Name.....

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City..... Zone..... State.....

I am a serviceman amateur experimenter

Other classification.....

CIRCUIT ANALYSIS

FROM TIME to time, as we analyze receiver characteristics which are new and different, we shall find certain variations which represent a *trend* rather than an exclusive feature of the set we are using as an example. Often we shall point out several other sets which have incorporated similar arrangements.

Our first receiver for this month is an example in point. It is the General Electric Model 303. The converter section of this set is shown in Fig. 1. Notice that the main tuning dial does not tune the oscillator coil itself (L1) but rather varies the inductance L2 which is connected in parallel with L1. This variation is accomplished by means of a slug tuning arrangement, which

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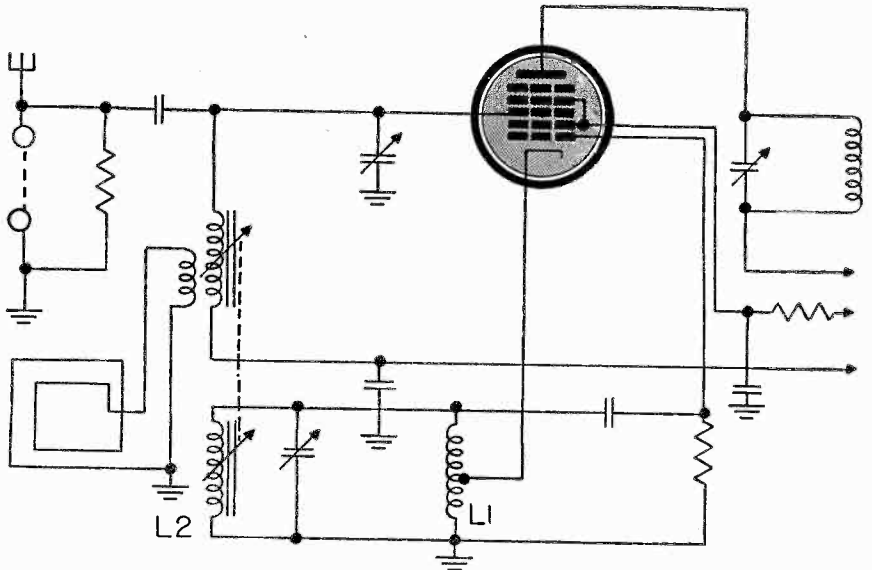
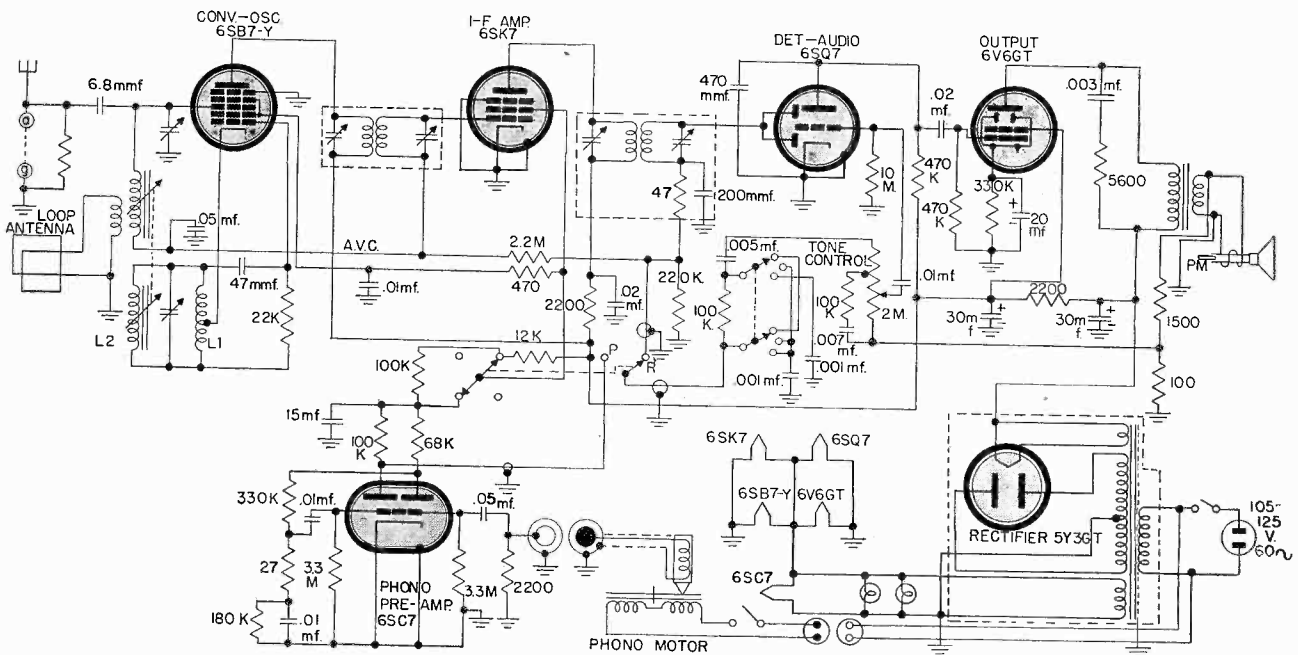


Fig. 1 Converter section of the General Electric Model 303. Notice the variable inductance in parallel with the oscillator coil.



General Electric Model 303

**HERE ARE SIMPSON'S
PROFIT-MAKERS FOR
SERVICEMEN...**

"BASIC 3"

The serviceman who tries to "get along" with cheaply-made, run-of-the-mill test instruments is taking an outside chance on success. The business of radio servicing must be *built* from the bottom up on an endless succession of perfect jobs. Knowing what the trouble is, in a receiver, and knowing when that trouble is eliminated *can be no better than the test instruments that reveal them.*

The "Basic 3" Simpson instruments shown here are an extremely profitable investment for any serviceman. He needs all three and, in their price range, he cannot buy better anywhere else. In fact, in their price range they are unequalled. They will do more than many instruments selling for substantially more. These are facts easily demonstrable to any serviceman who will take the time to check up. And it is worth the time in the *cold cash of profits* to discover how Simpson engineering skill and uncompromising quality construction produce the *staying accuracy* for which Simpson instruments are famous.

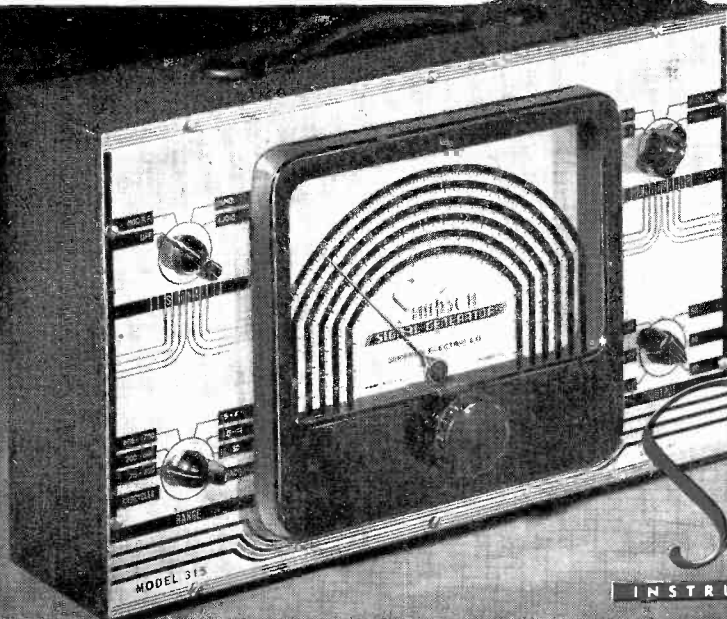
MODEL 315 SIGNAL GENERATOR. Designed down to the most minute detail for highest accuracy, greatest stability, minimum leakage, and good wave form **\$67.35**

MODEL 305 RC TUBE TESTER. Tests all tubes. Provides for filament voltages from .5 volts to and including 120 volts. Spare sockets for future tube developments **\$59.50**

MODEL 260 HIGH SENSITIVITY SET TESTER. 20,000 ohms per volt, D.C. Voltage ranges to 5,000 volts A.C. and D.C. Resistance ranges to 20 megohms. Current ranges to 500 milliamperes, also 10 amperes D.C. **\$38.95**

In New Roll Top Safety Case **\$43.75**

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Simpson
INSTRUMENTS THAT STAY ACCURATE

Circuit Analysis

→ From Page 32

gangs this circuit with the mixer grid circuit.

Consider some other examples which show that other manufacturers are using this circuit. Fig. 2 shows the converter section of the Studebaker (Philco) Model S-4627. L1 is the oscillator coil, and is connected as you would normally connect a Hartley. But it is the tuning of L2 which varies the oscillator frequency. Fig. 3 is a schematic of the converter section of the Audar Model PR-6A. Here again it is a separate parallel coil which does the main tuning. Notice in addition that although in Fig. 1 (G.E. 303) the auxiliary tuning inductance is placed across the whole oscillator coil, in the case of Fig. 2 and 3 only part of it is shunted. This means that in these latter cases the change in the tuning inductance must be relatively larger because of its smaller effect on the total parallel inductance.

The next receiver for discussion is the Airline Model 64WG-2010B. This is an AC operated phono-radio combination superheterodyne. Note that resistance coupling is used between the first and second stages. R1 (2200 ohms) is the plate load resistor and is coupled to the 6SF7 grid through coupling condenser C1 (47 uuf). The grid is connected through R2 to the AVC line from which it obtains its bias. The 6SF7 tube contains a pentode and a diode which act as last IF stage and detector, respectively.

A further interesting feature of this receiver is the tone control. Fig. 4 illustrates this part of the circuit. Two simultaneous effects which aid each other are produced. The first is that produced on the voltage being coupled into the grid of the 6V6 audio output tube. Point A is shunted to ground through C2 and the upper part of the control R3. The closer the arm moves to point B the less resistance will there be in series with C2. Motion of the arm toward the upper end of the pot "lowers" the tone by discriminating against high frequencies.

The other effect has to do with the volume control, R4. This is the

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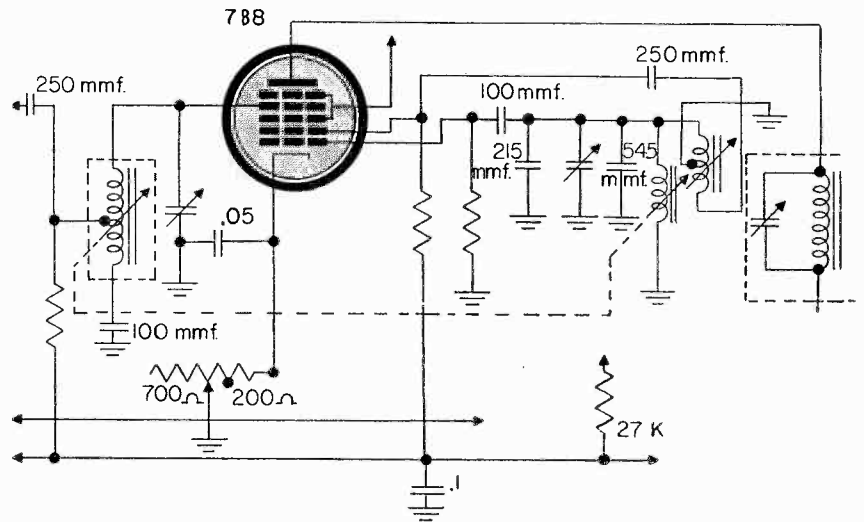


Fig. 2 Another set which uses a tuned shunt inductance. The converter section of the Studebaker (Philco) Model S-4627.

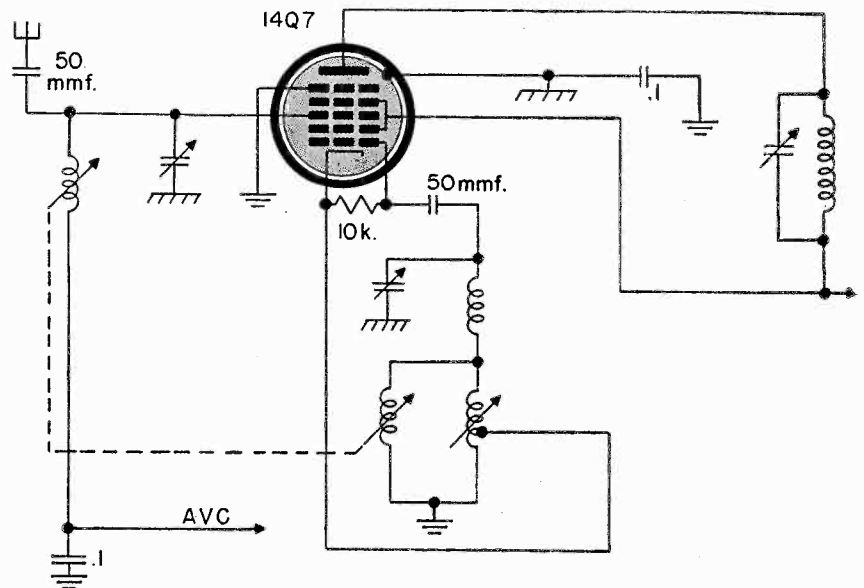


Fig. 3 Third example of the shunt inductance idea—the Audar Model PR-6A.

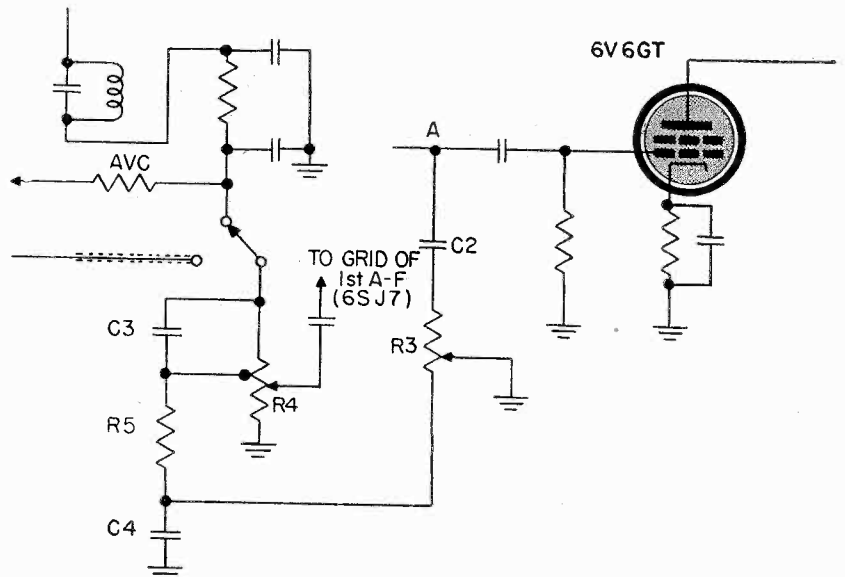
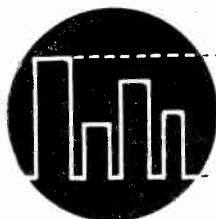
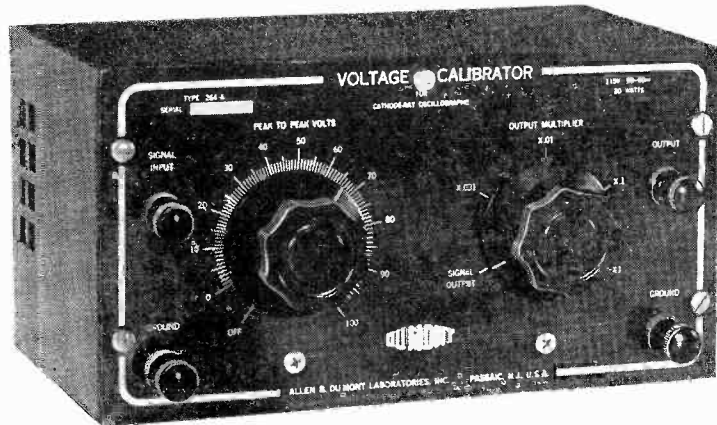


Fig. 4 Tone control circuit.

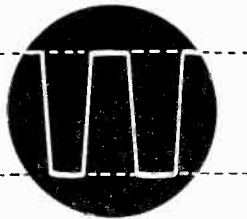
A New Du Mont instrument for peak-to-peak voltage measurements! Measures any waveform! Can be used with any oscillograph!

DU MONT TYPE 264-A Voltage Calibrator

PLACE IT RIGHT ON TOP OF YOUR OSCILLOGRAPH!



Example: Typical complex signal; peak-to-peak voltages unknown.



Adjust amplitude of this calibrating signal to match desired peaks of unknown signal. Read voltage from dial settings of calibrator.

- HIGHLIGHTS...**
- Independent of line-voltage variations.
 - Direct-reading.
 - Convenient to use.
 - Low-priced.
 - Small and compact.
 - Overall accuracy of $\pm 5\%$. Better than requirements of most electronic circuit tolerances.

- SPECIFICATIONS...**
- RANGE:** 0-0.1; 0-1.0; 0-10; 0-100 volts.
 - ACCURACY:** $\pm 5\%$ of full scale on each range, with variations in line voltage as great as $\pm 10\%$.
 - INPUT IMPEDANCE:** 20 uuf (signal connected through calibrator).
 - FUSE:** $\frac{1}{2}$ amp.; 115 volts, 50-60 cps., 20 watts.
 - SIZE:** $4\frac{1}{2}$ " x 8" x $5\frac{3}{4}$ ".
 - WEIGHT:** 5 lbs.

The Du Mont Type 264-A Voltage Calibrator is designed to measure the peak-to-peak voltage of any signal being viewed on a cathode-ray oscillograph. Small, low-priced, convenient, it may be used with any commercial cathode-ray oscillograph. The output is essentially a square wave the amplitude of which is continuously variable from 0 to 100

volts. By merely throwing the selector switch, either the unknown signal or any of four ranges of calibrating voltage may be applied to the input of the oscillograph. There is no need for switching leads between signal and calibrating voltage. Unlike a voltmeter, measurements may be made of any part of a complex, composite waveform with Type 264-A.

Descriptive bulletin sent on request.

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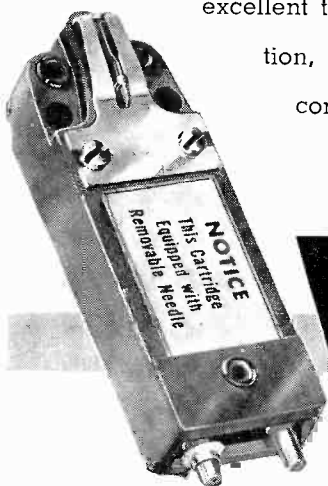
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 ALLEN B. DUMONT LABORATORIES, INC., PASSAIC, NEW JERSEY • CABLE ADDRESS: ALBEEDU, PASSAIC, N. J., U. S. A.



IN MAKING Astatic tone arm cartridge replacements in home record players, many leading service men are experiencing excellent results with Astatic's new Model "QT."

Engineered with a matched, replaceable Needle of unique design and operation, this new Crystal pick-up cartridge is a service man's dream come true . . . relatively inexpensive, simple to mount and connect . . . and greatly advanced in its quality and beauty of tone reproduction.

Astatic's Model "QT" Crystal Cartridge is available with guarded sapphire or precious metal tipped Needles. For quiet, faithful reproduction, freedom from needle talk, relatively high output, excellent tone range, and positive record protection, the "QT" Cartridge warrants earnest consideration. See your Radio and Electronic Parts Jobber or write for literature.



Microphone Maintenance

→ From Page 9

These lugs are rather long, and terminal 2 was found to have been short-circuited to the inside of the housing. These lugs were cut short and the leads resoldered. The diaphragm and magnet were inspected for possible filing pick-up, the acoustic-resistance tube checked for possible clogging, and the unit reassembled. Subsequent tests proved operation to be satisfactory.

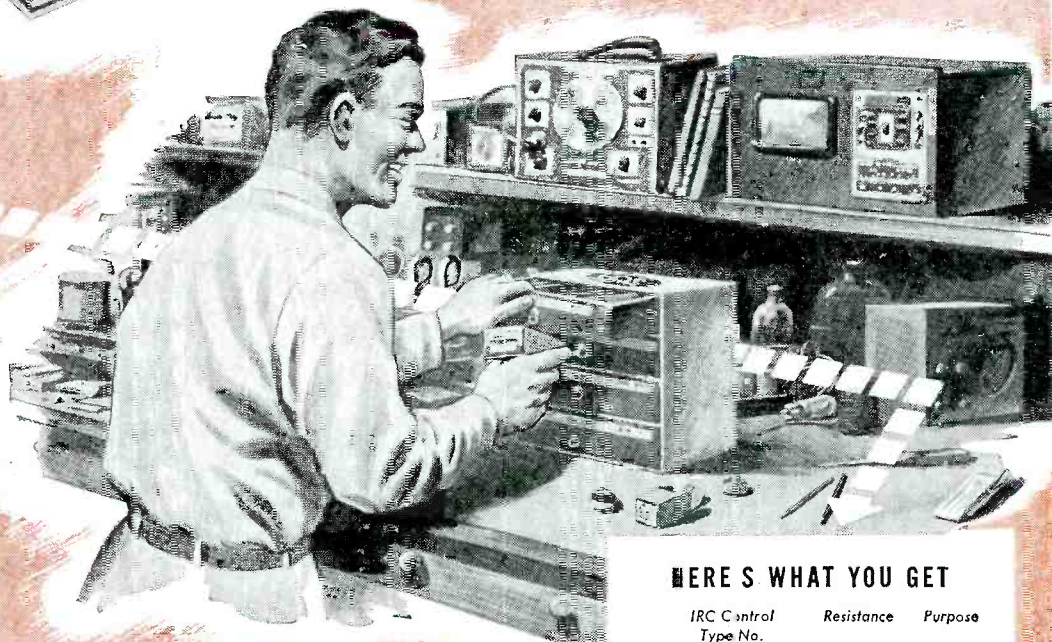
An ungrounded or open condition in the cable itself may be determined by inspection or by checking each lead and the shield with an ohmmeter (*but only after the cable has been disconnected from the microphone, since, as has been mentioned before, a DC voltage applied to the microphone transformer can cause serious damage to the ribbon and to the low-frequency response of the transformer*). An intermittent condition may be checked by connecting the faulty cable between a microphone and amplifier and twisting the cable at various points. In the majority of cases, the break will be found near one of the ends of the cable since the strain at these points is greatest. A good procedure in salvaging a faulty microphone cable is to "cut back" a length of about six inches from each end of the cable where practically all breaks are found.

Microphones of the cardioid type may be treated as two separate units in routine maintenance. A microphone such as the Western Electric 639-A may require occasional attention to the directive pattern switch contacts which may develop noise or an intermittent condition due to loss of tension or collection of dirt on the contact points. Although the switch may be disassembled rather easily by uncrimping four small blade-edged fingers, this should be done only when it becomes necessary to increase contact pressure of the blades themselves since the fingers have a tend-

→ To Page 38



This New IRC JUNIOR Control Cabinet Belongs on Your Bench



Here's one selection of 9 "hot-number" controls, switches and shafts you'll use every day! The new IRC Junior Control Cabinet contains 9 of the most-used 1/2, 1 and 2 meg. type D controls with the added adaptability of the tap-in shaft feature—plus 4 switches and 4 special shafts.

This inexpensive assortment of popular controls will save you time and money, and reduce your need for exact replacements. Factory-packed in a handsome four drawer cabinet of sturdy cardboard. Cabinet attractively finished in blue, yellow and silver with twelve individually identified compartments. Order the new inexpensive JUNIOR Control Cabinet from your IRC Distributor today. International Resistance Company, 401 N. Broad Street, Philadelphia 8, Pennsylvania. In Canada: International Resistance Company, Ltd., Toronto, Licensee.

HERE'S WHAT YOU GET

IRC Control Type No.	Resistance	Purpose
5 D13-33	500,000 ohms	A
1 D13-133X	500,000 ohms	B
1 D13-137	1.0 meg.	A
1 D13-137X	1.0 meg.	B
1 D13-139	2.0 meg.	A

Purpose: A-Tone or Audio Circuit control; B-Tapped for tone compensation.

SWITCHES

3 #41	S.P.S.T.
1 #42	D.P.S.T.

SHAFTS

1 Type "A" double-flatted tap-in shaft is included with each control—plus:

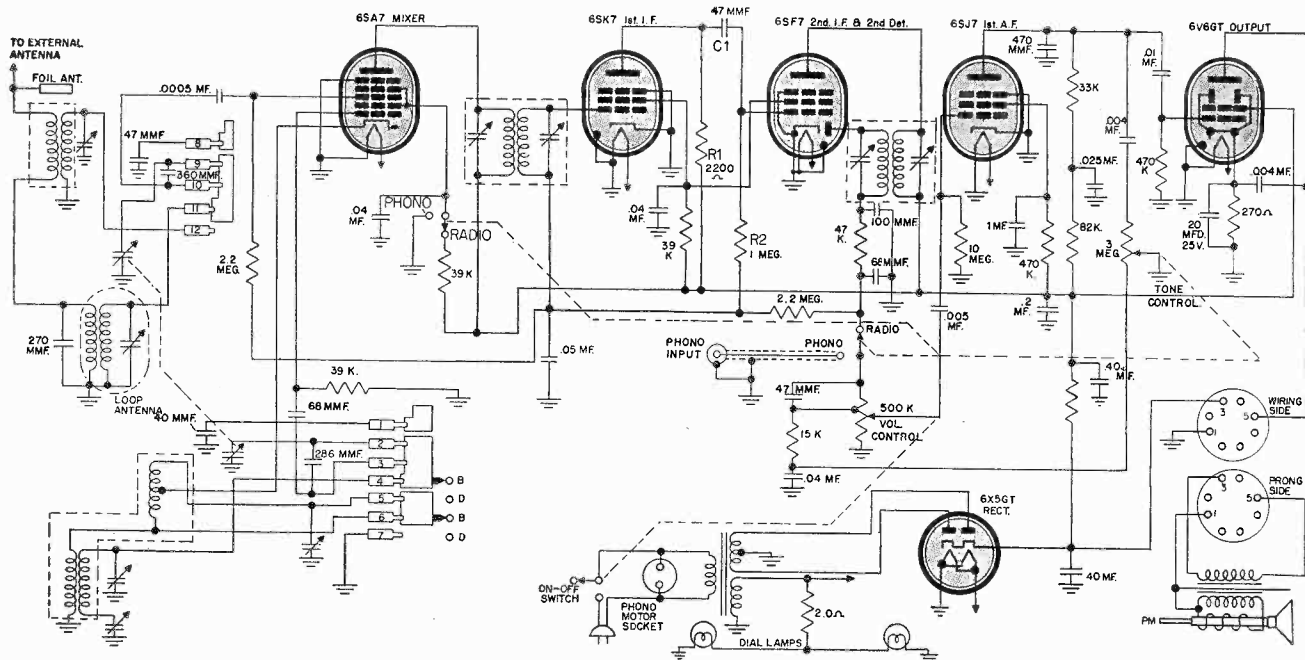
3 Type "E" with universal knurl for special type push on knobs.

1 Type "H" with universal groove for many Delco, RCA, Sears-Roebuck and Westinghouse models.

Cabinet furnished at no extra cost.

INTERNATIONAL RESISTANCE COMPANY
Wherever the Circuit says 





Airline Model 64WG-2010B

Circuit Analysis

→ From Page 34

tapped variety of potentiometer. Condenser C3 is placed between the tap and the high end of the control, to equalize for tendency toward excessive highs at full volume. Between this tap and ground the series circuit of R5 and C4 provides another compensating circuit. At high frequencies, the reactance of C4 is low and the series circuit shunts the lower part of the volume control with a low impedance. On the other hand, to low frequencies the shunting impedance is high and no effect is produced. The net effect, therefore, is a "bass boost." Because of the tap at D which runs to the low end of tone control, the amount of this effect is controlled. Moving the tone control arm down reduces the bass boost by shunting C4, as previously described; moving it upward decreases highs by the shunting effect of C2. ✓ ✓ ✓

Microphone Maintenance

→ From Page 36

ency to break off after several such operations. The contact points may be cleaned without disassembling the switch by saturating with either carbon tetrachloride, or a solution of half alcohol and half ether, while rotating the blades. Air pressure may be used to remove dirt or loosened particles. The contact points should then be lubricated by applying a very small amount of a fine grade of clock oil or Daven oil, picked up on the point of a pin or small wire and applied directly to the contacts. Too much of any lubricant picks up dirt and other foreign particles.

An attempt to repair or adjust the ribbon in a cardioid type of microphone is not advisable since ribbon adjustment is very critical. A small error in alignment could produce a rather large amount of frequency discrimination.

Maintenance of the various types of crystal microphones is usually limited to the cable and plug connections since the crystal itself is a sealed unit requiring no maintenance during its useful life. When the crystal elements have deactivated to a point where output and quality have decreased to a degree

warranting replacement, the crystal unit is simply removed and a new one installed. Most microphone companies have complete facilities for quick replacement of a cartridge if you return the microphone to the manufacturer. Unit life can be greatly increased by observing the following precautions:

(1) Keep the microphone away from extreme heat and dampness and out of direct sunlight as much as possible. Sunlight especially accelerates the process of cell deterioration, particularly in units composed of crystal salts (Rochelle).

(2) Exercise reasonable care in handling.

(3) Avoid excessive shock and vibration. The use of microphone stands incorporating sponge rubber lining or similar shock-absorbent features aids in reducing direct shock effects. These last two precautions apply to all types of microphones—not to the crystal type alone.

Again it should be pointed out that the maintenance and repair of microphones constitute tedious and delicate operations and should be attempted only by competent and experienced personnel. ✓ ✓ ✓



SEE PAGE 3

Don't Miss
the Test Equipment
Symposium
in the November
RADIO MAINTENANCE

SPRAGUE TRADING POST

SWAP—BUY OR SELL

FOR SALE—Sam's Photofact folders, 1 to 19 inclusive, 1 to 10 in binder, \$30; Bider's manual 6, \$11, 7, \$14; complete set Supreme diagrams \$6 and 6v ATR battery eliminator 6 amp. \$15. City Radio Service, DeRidder, La.

WANTED—Four WE 215 vts A tubes; signal generator and tube tester, C. Morales, 278 E. 37th st., Brooklyn, N. Y.

FOR SALE—Electronics magazine June, 1937 to present; Communications, Jan. 1937 through 1946; Life first issue through 1946; all complete in perfect condition, \$100 plus freight, Philip Ross, 230 Wadsworth Ave., New York 33, N. Y.

FOR SALE—National NC 44 receiver, tubes, meters, parts, mikes and tools. Send for list, Thomas J. Tucci, 5228 Penway Ave., Philadelphia 24, Pa.

WANTED—Hickok RFO-4 or RFO-5 oscilloscope, Roy M. Beyer, 1927 N. Madison, Saginaw, Mich.

FOR SALE—Simpson 260 voltohmmilliammeter, perfect condition, \$25, Ralph Goode, 2 Maryland Ave., Delmar, Del.

FOR SALE—822R, \$43; Telrad 18A, \$19; Millen 90800, \$23; T11M77, \$32; T-3, \$3; kw final 2-304, \$45; Bias Supply 350v 250ma regulated, \$14; antenna coupler, \$11; 160m & 80m VFO, \$15; 700v 500ma, 100v bias, \$25; Kw 2700v bridge plate supply, \$45; Speech 4-2A3 Class A, \$30. I. D. Goldman, Kline Road, B.D. 1, Ithaca, N. Y.

FOR SALE OR TRADE—1946 Sprayberry radio training course with answers \$20 or will trade for new radio tubes or what have you? Wade H. Müller, Eastaboga, Ala.

WANTED—SX-28A or 110V, 60 cycle military prototype. Must be in perfect condition and have been well cared for. State full details and final price in first letter. William D. Green, Route 1, Box 5, Chester, Pa.

FOR SALE OR TRADE—Captured Jap communications receiver with 6v dynamotor. Want technical manuals for BC-40-430 transmitter. All letters answered. Jack Jones, Box 809, Custer, S. Dak.

FOR SALE—60' Windcharger vert. radiator new \$50; 1000 watt, a-c, 60c, 110v, alternator, 6v excitation, \$35; 38' Premax vertical antenna, \$15. Want Meissner 3.5, 5 amp, 28v selenium 1-w. rectifier. All letters answered, Joe Walker, 1912 W. 7th st., Coffeyville, Kans.

FOR SALE OR TRADE—Rider's manuals 3, 4, and 5 \$3.50 ea. postpaid. Want BC-342 or 312. H. B. Steedly, Jr., P. O. Box 283, Bamberg, S. Carolina.

FOR SALE—New cathode ray tube, RCA, 5BP1, 5", will sell for \$15. W. R. Dorsett, Route 6, Macon, Ga.

FOR SALE OR TRADE—Million CT tube tester and instructions good condition and 1935 Chevrolet Radio in good working condition. R. W. Brandstatter, 416 N. High St., Bantoul, Ill.

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... Priced for the Service Market



NEW De Luxe SPRAGUE TO-3 TEL-OHMIKE

This new de luxe Tel-Ohmike is the ideal instrument for capacitance and resistance checking or analyzing. Smaller—easier to use than previous models. Checks capacitors and resistors **WITHOUT REMOVING THEM FROM THE CIRCUIT**. Has high-grade built-in D.C. volt-milliammeter.

Although designed and priced for servicemen, Tel-Ohmike is used in hundreds of laboratories where its accuracy and usefulness have been proved in the most exacting applications. It's a real *professional* instrument—for servicemen who take real pride in their work.

See it today at your Sprague jobber's store. Write for copy of free Tel-Ohmike Bulletin M-414.

WANTED—Thordarson T19P88 plate transformer; also several 866 fl. transformers, misc. meters and other parts for Kw final. Can also use two 822 or 203Z tubes and 3 National TML-100 DA condensers. Eddie Howell, 501 W. Harden St., Graham, N. C.

WILL TRADE—U.S. School of Music saxophone course in good condition, slight if used. Want test equipment, Rider's manuals, or what have you? L. Moore, 1645 Stuart St., Berkeley 3, Calif.

FOR SALE—NRI Power pack, 6v d-c to 400v d-c, \$15 or trade for test tester; converter 6-c or 12v to 110v a-c \$16. Also for sale National Radio Institute course \$45. Travis Heard, 933 Wodell St., Athens, Ga.

FOR SALE OR TRADE—75 assorted radio receiving tubes (Cost \$62) will sell \$50; four volume course in practical mathematics \$3; course in practical radio and electronics \$5.—tubes new, books in perfect condition. Need good signal generator or tube checker or what have you? M. K. Breck, P. O. Box 737, Osborn, Ohio.

WANTED—Rider's manuals 3 to 10, used but in good condition; Hardware Radio and Appliance—1442 Fifth Ave., New York 35, N. Y.

WILL TRADE—Air Pal Stewart-Warner radio — needs little repairing. Wants 11C5, 11C6, 1D8GT tubes, Nick Bowisk, 11 Clifton St., E. Lynn, Mass.

FOR SALE—Gardiner deluxe code machine with eleven double tapes, perfect condition \$20. W. E. Larwood, 5716 Myrtle ave., Kansas City 4, Mo.

SELL OR TRADE—ATR inverter d-c to a-c 110v, 350 watts, int. 250 watts continuous; practically new, \$20 or any Rider's manuals 1 to 14 in good condition. Novello Radio 40 Cobden St., Boston 19, Mass.

FOR SALE—Stanley portable electric hand drill operates on 110v a-c or d-c current and takes up to 3/4" drills. Used very little, \$23. Dave's Radio, 1316 42nd st., Brooklyn 19, N. Y.

FOR SALE—Supreme scope 2" tube, with tubes, model 531, \$20. Solar condenser analyzer CA, \$20; Precision multi-meter 842, \$20; all ready to operate. F. C. Hoffman, Ry, Appleton, Wis.

FOR SALE—Meissner analyst, like new, has been used few times, complete with cables and instruction book, \$100. Joseph Jordan, R.F.D. #1, Elmhurst, Ill.

WANTED—Circuit diagram of Signal Corps wireless sets No. 19, Mark II also 2 EF50 Padder oscillator tubes for same. Geddes Radio Repairs, 2853 Myrtle Ave., Schenectady, N. Y.

FOR SALE—\$115 worth of tubes, resistance line cords, power transformers and chokes. Stancor transformers, P-6005 and P-6003; tubes, 12SQ7, 6SQ7, 6C6, 12A6, 6BR, 5V4, 5U4, 45, 70L7, 3D6/1299; 6U7, 6C8, 56, etc. \$50. Buster Henderson, 111 Bartow St., Cartersville, Ga.

FOR SALE—Service bench and test panel completely wired; also Hickok signal generator 18 and 6v power pack for auto radio service. Write for details. Sid's Radio Service, 49 Christie Ave., Clifton, N. J.

WANTED—Used car radios, any condition. Describe and state price. The Simplex Shop, Salina, Kans.

FOR SALE—Two 813's brand new \$4.60 ea.; Meissner, 3 tube a-c-d-c receiver with short wave and broadcast coils and magnetic speaker \$12. J. L. Gaston, 120 Ocean View Ave., Brooklyn 24, N. Y.

SELL OR TRADE—Hickok T-53 dynamic mutual conductance tube tester in good condition, \$29.50 or will trade for electronic equipment. Particularly want car radio or communications equipment. H. W. Ballew, Department of Physics, Texas Tech, Lubbock, Texas.

FOR SALE—Superior CA-10 signal tracer, A-1 condition, \$10. O. H. Williamson, Cooper, Texas.

FOR SALE—Rider's manuals 1 to 15; Meissner Analyst; Clough-Brengle volt-ohmmillimeter; R.C.P. tube tester and TCA scope #151. Will sacrifice. B & S Electronics, 158 Main St., Indian Orchard, Mass.

WILL TRADE—32v inverter 110v, 100 ma output. Filtered for radio use. Want BC-454, 8-6 m-c receiver and b.c. 948-r receiver; must be new. Russel Neterra, Evansville, Minn.

FOR SALE—RCA TT5 television receiver, A-1 condition, \$100. Jack's Radio Service, 295 Wainwright St., Newark 8, N. J.

SELL OR TRADE—Hallierafter Sky-Chief and National NC-44 short wave receivers; Webster three stage power amplifier; National Radio Course, manuals and books. Want Super-Pro, Fredson signal generator and Coax Speaker. Glenn Watt, Chanute, Kans.

FOR SALE—Triumph Oscilloscope, perfect condition, never used. 3" tube, built in wobulator and all the other features of other scopes. \$60. Radio Communication Service, 4475 Myrtle St., San Diego 5, Calif.

FOR SALE—500 tubes—All new in sealed cartons, write for list. H. C. Miles, 204 Sherman Ave., New York 34, N. Y.

WANTED—Used Ultra high frequency receivers, any make, tuning 2 or 5 or 10 meters. Write model, make and price with tubes. Joseph Moyer, 556 Vineyard St., Bethlehem, Pa.

SELL OR TRADE—40 miniature tubes; hundreds of others; also circuit for army Morse Talkie and other circuits, \$1 ea. What do you need? Stoner Radio 506 E. Pierson Rd., Flint 5, Mich.

FOR SALE—Abbott DK-3 transceiver for 2 meters complete with tubes and fresh batteries \$25; also Knight 2 meter transceiver with 115v 60 cycle power supply, \$25. L. Colby, 122 Main St., Owego, Tioga Co., N. Y.

WANTED—Volume control for American-Bosch radio 28 or 38 m.c. Charles Roruth, 661 Gutman ave., Baltimore, Md.

FOR SALE—Simpson 305 tube tester in perfect condition \$38. H. C. Miles, 204 Sherman Ave., New York 34, N. Y.

FOR SALE—2 amplifiers, 50 watts, with tubes. F.O.B. Ed Monahan, Shawomet, B. I.

FOR SALE—Rider's manuals 1 to 6 \$45 and Gernsback manuals 1, 2 & 3, \$10.50. C. R. Ciesicki, 4010 E. 153 St., Cleveland 5, Ohio.

WANTED—Thordarson T11M78 transformer. Will trade or sell Stancor A-3834. Charles M. Conley, Box 261, Clearfield, Utah.

FOR SALE—Mark II tank set transceiver 40 watts fone/cw—2-8-meas—230 240 megs complete. Want 100 to 300 watt, all band phone/cw rig. Send details, 1019-36th St., Anacortes, Washington.

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The Sprague Trading Post is a free advertising service for the benefit of our radio friends. Providing only that it fits in with the spirit of this service, we'll gladly run your own ad in the first available issue of one of the six radio magazines in which this feature appears. Write CAREFULLY or print. Hold it to 40 words or less. Confine it to

radio subjects. Make sure your meaning is clear. No commercial advertising or the offering of merchandise to the highest bidder is acceptable. Sprague, of course, assumes no responsibility in connection with merchandise bought or sold through these columns or for the resulting transactions.

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SERIES 10-20

Combination, Master Lever operated, Tube PERFORMANCE Tester, Battery Tester and 34 range, PUSH-BUTTON operated, AC-DC Circuit Tester.

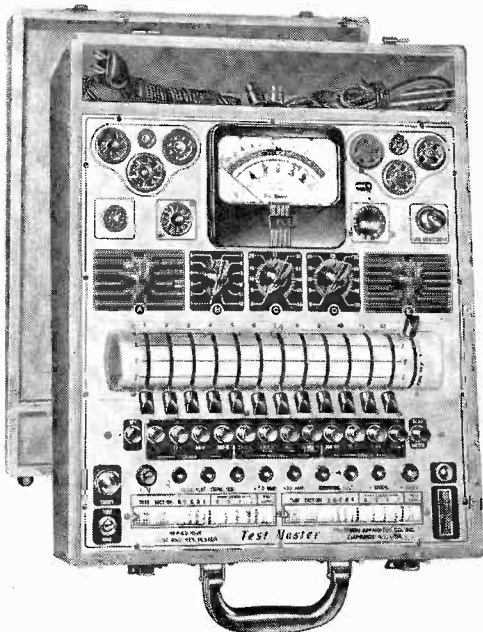
* An amplifying tube tested for just one selected characteristic does not necessarily reveal its overall performance capabilities. Electronic tube circuits look for more than just Mutual Conductance or other single factor. In the Precision MASTER Electronamic Tube Test Circuit, the tube under test is subjected to appropriately phased individual element potentials and is electro-dynamically swept over a complete Path of Operation, on a sinusoidal time base, encompassing a wide range of plate family characteristic curves. This complete Path of Operation is automatically integrated by the indicating meter in the direct and non-confusing terms of Replace-Weak-Good.

*REG. PEND. U. S. PATENT OFFICE

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* Affords highest practical order of obsolescence insurance thru use of the Precision 12 station Master Lever Element Selector System.



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- ★ Six A.C., Six D.C. and Six Output Voltage Ranges:
0-6-12-60-300-1200-3000 volts
- ★ Four Self-Contained Resistance Ranges: 0-1000-100,000 ohms; 0-1-10 megohms (No A.C. power required)
- ★ Six D.C. Current Ranges:
0-600 microamperes
0-6-60-300-1200 MA. and 0-12 amperes.
- ★ Six Decibel Ranges from -20 to +64 DB.
- ★ All standard functions available at only two polarized tip jacks.
- ★ Automatic interlocking push-button range selection.
- ★ 1% wirewound and matched metalized resistors.
- ★ Large easy reading 400 microampere, 4 5/8" meter.
- ★ All ranges self-contained, without any additional panel controls.
- ★ All circuits insulated from power line.


MODEL 10-20-P; in sloping portable hard-wood case with tool compartment and hinged, removable cover. Size 13 3/4" x 17 1/4" x 6 3/4".....\$109.10

MODEL 10-20-C; in modern, chrome trimmed, counter cabinet; fine dull black ripple finish on heavy gauge steel. Size 17" x 17 1/8" x 7 1/2".....\$111.10

MODEL 10-20-PM; mounted onto 17 1/2" x 19" steel panel with rear enclosing dust cover. For standard rack mount. \$109.10

All models include test leads and ohmmeter batteries.

Ask to see the "Precision" Master Electronamic Test Instruments now on display at all leading radio parts and equipment distributors, or write directly for the new Precision 1948 catalog fully describing the Precision Electronamic tube performance testing circuit.



PRECISION
TEST EQUIPMENT

Standard of Accuracy

PRECISION

APPARATUS COMPANY INC.

92-27 HORACE HARDING BOULEVARD
ELMHURST 5, NEW YORK

Export Division: 458 BROADWAY, NEW YORK CITY, U. S. A. • Cables: MORHANEX



by John T. Frye

I HEARD the other day about a charlatan who had been discovered using a most imposing medical aid. It consisted of a complicated and wonderful array of tubes, lights, coils, relays, and dials surrounding a ground-glass screen. The patient was seated in a chair near this machine, and wires were attached to various portions of his anatomy. A connection was made in the vicinity of nearly every major organ of the body. Then the switch was thrown, the lights flashed, the relays chattered, the meter hands quivered, and finally, in glowing red letters on the ground glass screen, appeared the exact name of the patient's illness. Perhaps the word was *measles*; or it might be *sciatica*.

Unfortunately, this marvelous medical diagnostic device turned out to be a hoax, and doctors will have to keep right on using their schooling, experience, and keenly trained powers of observation for making their diagnoses.

I am afraid that some of us radio servicemen are trying to persuade ourselves that we shall soon have a machine that will do for us what the inventor of the "diagnosing machine" promised to do for doctors. Certainly, we are encouraged in this belief by the rapid development of servicing equipment.

When I started working on radios—we did not start calling it servicing until later—a voltmeter, a continuity meter, and a soldering iron were just about all the tools you needed to tackle any set. A few of us fancier fellows, of course, had to have a special neutralizing kit and a special socket for leaving the filament of a '26 tube dead while we neutralized it; but this was really an affectation. An

old '26 with a filament prong cut off was just as good if not better.

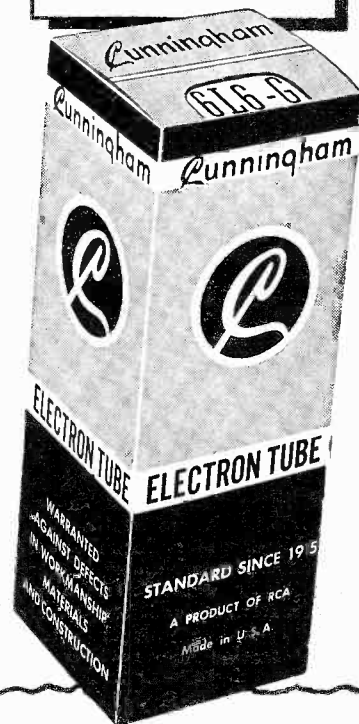
The eye, the nose, and the ear were your most essential testing instruments. You had no trouble spotting a bad tube, for, unlike the alleged case of the Indians, the only *bad* tube was a dead one; and in those days a good '01A lighted up like a Christmas tree. Bad filter condensers were easy to locate, too. They revealed their presence by a nice cherry color on the rectifier plates, by a pungent, expensive odor in the vicinity of the power supply, and a little pyramid of melted tar on the baseboard beneath it.

We used signal tracing in a direct form. Starting at the back end of the receiver, we yanked out tubes and listened for clicks as the plate current was interrupted. When we heard no click, we stopped and found out why. Open audio transformer windings, dead tubes, weak batteries, and poor connections accounted for ninety per cent of the troubles.

I need not tell you the picture is radically different today. Receivers are immensely more complicated; and the serviceman needs, and has, much finer equipment with which to ferret out difficulties. He has a service oscillator that will give him an exact duplicate of a transmitted signal of any intensity and on any frequency he may choose. What is more, he can have it with or without modulation; and the modulation can be either of the frequency or amplitude type. Signal tracers permit him to follow the signal step by step from the antenna coil. Vacuum-tube voltmeters allow him to measure the stage gain of every circuit unit. An oscil-

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BUILT FOR SERVICE



Technical Tips

Spotting Weak Converter Tubes

- Low cathode emission affects both oscillator and mixer functions of a frequency converter. It reduces the oscillator voltage which, in turn, lowers the conversion transconductance; it also tends to reduce mixer gain. The net result is a marked drop in tube output.

A more serious difficulty is that the oscillator may cease to function because of low emission. When this happens, no signal can reach the i-f stage and the receiver goes dead.

Either or both results are usually sufficiently marked to cast first suspicion on the converter tube. The easiest and speediest check is to replace this tube with one known to be good. You can always count on a Cunningham.

For more service—TURN THE PAGE →

Cunningham
Electron Tubes

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

BUILD BIGGER PROFITS

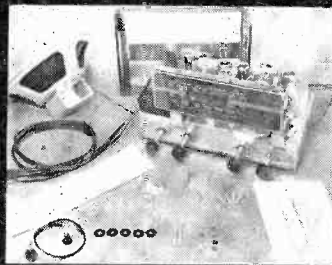
with
ESPEY
CUSTOM
BUILT CHASSIS

YES! These ESPEY custom-built radio receiver chassis are really designed to make bigger profits for YOU—the Serviceman and Serviceman-Dealer! They are ruggedly constructed of only the finest materials, and are electronically designed to give your customers maximum reception-pleasure over the years ahead, thereby assuring your reputation as "knowing your stuff!"

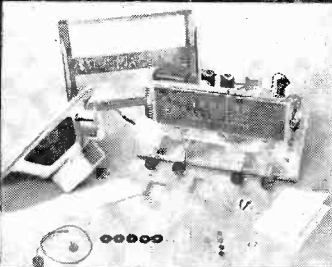
Engineered to meet all requirements for an excellent receiver chassis to be installed in your customer's cabinets, these ESPEY models are priced far within the competitive range. With three models to select from, your replacement worries are over. May we suggest that you contact your regular jobber, and examine these sets at your leisure? We feel certain that you will be just as enthusiastic about them as we are!

(In the event that your jobber does not have these chassis as yet, write us for full details! "Radios for Everyone . . . Everywhere.")

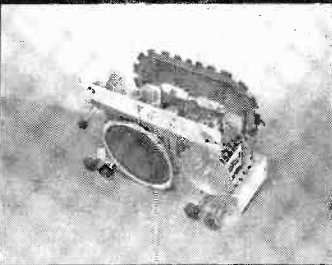
ESPEY MFG. CO., INC.
528 EAST 72ND ST., N.Y. 21, N.Y.



MODEL 7-B: 11 tube Superhet AM-FM. For 105 125V AC. Automatic and full range volume controls. 10" Alnico V speaker, wired for phono. AM-FM antennas supplied. RMA listed. Supplied complete, ready to install and operate.



MODEL RR-14: 8 tube Superhet. For 105/125V AC. Automatic and full range volume controls. 10" speaker. Covers Broadcast and 2 short wave bands. Wired for phono. Built-in loop. All climates.



MODEL 97A: 6 tube Superhet. 105 125V AC/DC. 6" speaker. Automatic and full range volume controls. Broadcast and shortwave. Wired for phono. Built-in loop. Tone control. RMA listed. Complete and ready to install.

reveal the seat of the trouble in glowing letters on a ground glass screen. No, it does not seem too far fetched, but I am afraid it is

If you will think about it a minute, you will see that all of our modern servicing aids are merely *evidence collecting devices*. Each acts to tell the operator something about the way a signal performs in a particular part of the radio circuit. Some do this in a broad and general sense; others focus the investigation on a very small portion of a single circuit; but all of the devices merely deliver sought after information in an impersonal, non-interpretive manner. Human intelligence is necessary to know where and how to apply these instruments and to interpret their findings. They themselves are products of human intelligence and are intended to aid, not supplant, the human mind.

It requires more *basic* knowledge of radio theory to employ a fine piece of radio servicing equipment than it does to use a simple servicing aid. Almost anyone can understand the theory of an ohmmeter and soon learn to use one intelligently; but a great deal more is demanded of the operator of an oscilloscope if he is to comprehend everything he sees on the screen. That is why we may as well give up the hope that advances in the design of radio servicing equipment will make unnecessary the mastery of radio theory. On the contrary, we must know more theory in order to understand the functioning and the use of the instruments themselves!

Please do not think that I am arguing that the quality of the serviceman is indicated by the number and complexity of the instruments over his bench. Certainly I do not mean that. The veteran can employ his vast store of knowledge as a substitute for many costly and complicated instruments; but the corollary of this is not true; that is, the serviceman who is weak in radio theory cannot buy instruments that will take the place of the knowledge he lacks.

I dislike hammering on this theme, but I feel that it is so important that I want to say once more: the best radio serviceman is

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**WANTED SERVICE MEN ALSO
SERVICE ORGANIZATIONS**

for television sets in all television cities from New York to Los Angeles. Experienced. Apply in writing describing experience in full.

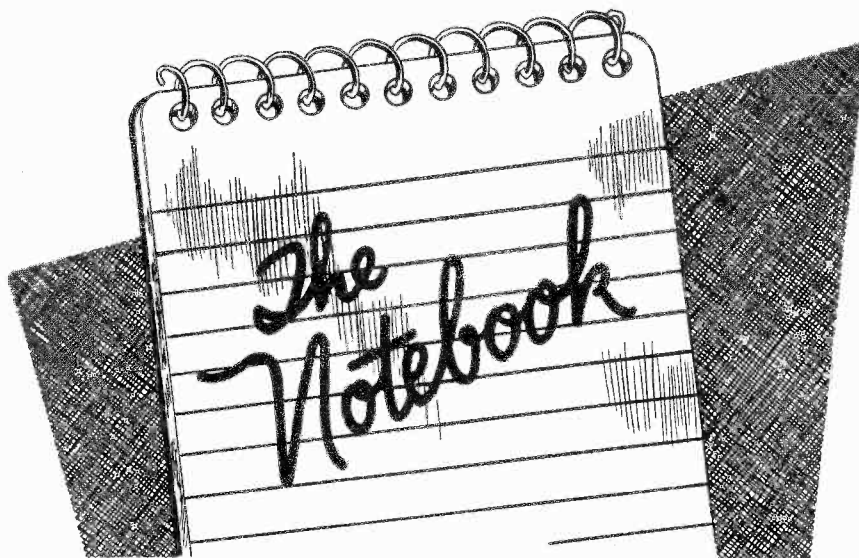
**UNITED STATES TELEVISION
MFG. CORP.**
3 West 61st Street,
New York 23, N. Y.

**Over the
Bench**

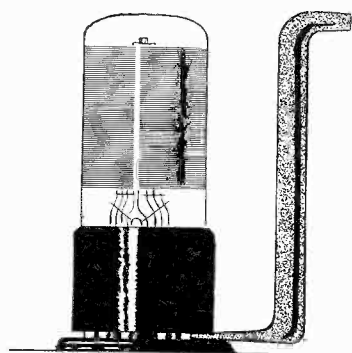
→ From Page 41

loscope permits him actually to "see" the signal.

In view of all this, it does not seem so far fetched to envision the day when a machine will be available that can be attached to the output of an ailing receiver and will



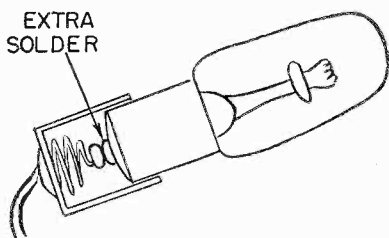
Each month the reader sending in the best suggestion receives a crisp ten dollar bill. For all others published, RADIO MAINTENANCE will pay five dollars. Let's hear from you.



Tube Remover

For removing loctal tubes from cramped positions such as in many auto radios, a small offset screwdriver is useful. Just insert the end of the screwdriver under the tube base, and the tube can then be easily pried out.

Ira P. Colby
Radio Service
Springfield, Vermont

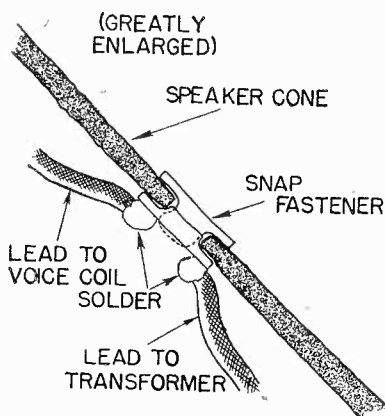


Pilot Bulbs

The problem of a noisy receiver caused by those loose bayonet type pilot bulbs can be solved by adding

more solder to the lump used for the "hot" connection.

Harry N. Johnson
Roxbury 19, Mass.



Voice Coil Leads

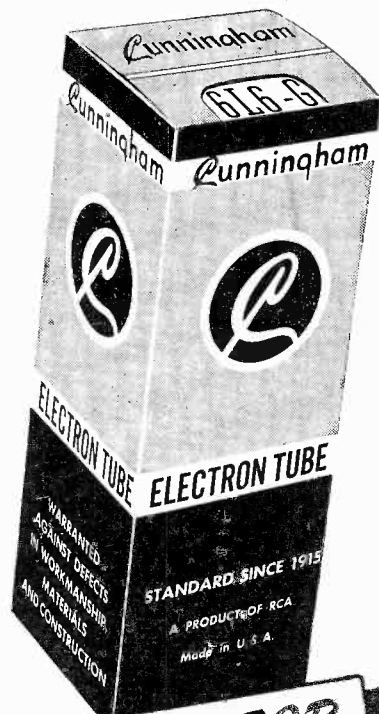
When one of those short voice coil leads breaks away from a speaker cone, an ordinary snap fastener can be used for support. Take the fastener apart, make a small hole in the cone where the voice coil leads join, and snap the fastener back together on the cone. The wires can then be soldered to the fastener.

Joseph J. Connolly
Rosedale, Long Island,
N. Y.

Cable Shielding

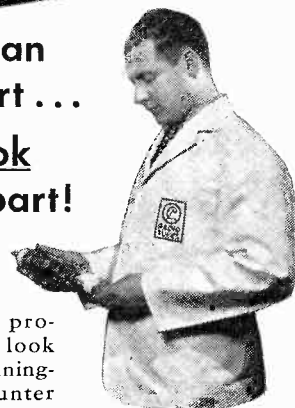
When hum is produced by loose weave shielding on microphone

→ To Page 44



BUILT FOR SERVICE

Be an expert ...
look
the part!



There's a professional look about Cunningham's counter jackets and service coats that commands respect and won't go unnoticed by your customers.

Both styles have the famous "big C" monogram on the upper pocket. And you can have your firm name included across the back of each coat and your employees' nicknames stitched above the monograms.

These are quality coats, built for service — just like Cunningham tubes. ORDER YOURS TODAY FROM YOUR CUNNINGHAM DISTRIBUTOR.

For more sales — TURN THE PAGE →

Cunningham
Electron Tubes

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

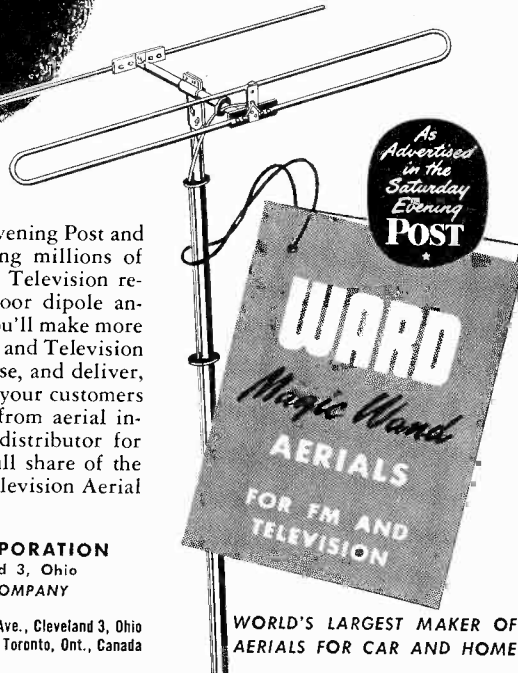
WARD boosts your SALES

This campaign, in the Saturday Evening Post and leading newspapers, is convincing millions of present and prospective FM and Television receiver owners that a good outdoor dipole antenna is a necessity. As a result you'll make more money selling "Magic Wand" FM and Television Aerials . . . and be able to promise, and deliver, finest reception no matter where your customers live. You'll make added profits from aerial installations, too. See your Ward distributor for details on how to assure your full share of the benefits of this major FM and Television Aerial campaign, or write:

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

with All-out
Consumer Advertising on
Magic Wand
FM AND
TELEVISION AERIALS



Over the Bench

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the one who has the best mastery of radio theory.

It is superior understanding that places him above his fellows. He is never happy as long as there is something about a new circuit that is not crystal-clear to him. A fuzzy, half-comprehended idea of how the circuit works is intolerable. He has to know—not because of the extra dollars he can make through the knowledge, not so that he can flaunt this knowledge, but simply for the sake of knowing.

Such a one has no worries nor fears about the future filled with undreamed-of and complicated electronic inventions. He knows that he will be able to take them in his stride, for his prize servicing instrument, his *firm grasp of radio theory*, knows no obsolescence!

The Notebook

→ From Page 43

cords, it can be eliminated by slip-

ping $\frac{3}{8}$ inch wide braided loom over the entire length of the cable and soldering to the connector casings at each end. It is not necessary to remove intermediate connectors as the loom balloons sufficiently to pass any fitting up to 1 inch in diameter.

Ross Schaefer
New York 33, N. Y.

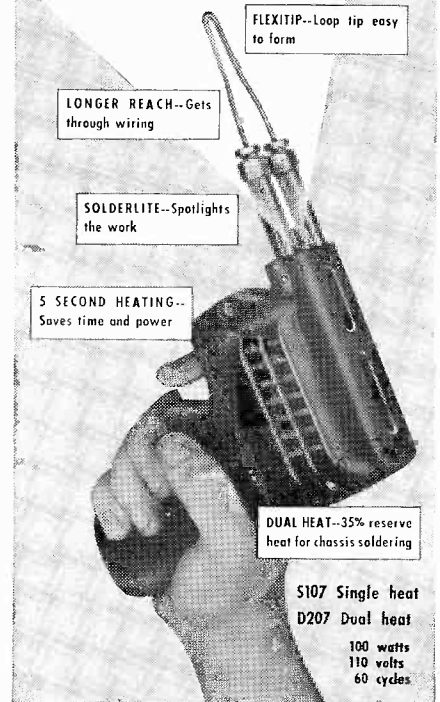
Finding Wire Breaks

Here is an idea for a device useful for hunting for "under-insulation" breaks in line cords, coils, etc. Take two snap connectors from a #647 Mini-Max battery and solder one to the bolster of a pocket knife as shown. Solder the other one to one end of a piece of wire, the other end of which has a phone tip on it to plug into an ohmmeter. This wire is "snapped" onto the knife and the other lead from the ohmmeter is clipped onto the wire in which it is suspected there is a

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FOR FASTER SOLDERING
2 NEW WELLER
SOLDERING GUNS
with

Solderlite



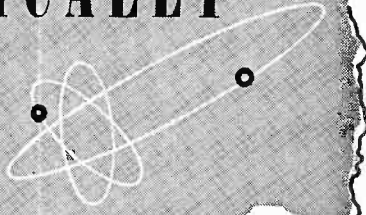
The new Weller Soldering Guns with Solderlite plus the fast 5 second heating help make service work more profitable for radio, television and appliance service men, electrical maintenance men, electric motor rewinding and repair shops, automotive electrical service. A useful and time-saving tool for laboratory workers, experimenters, hobbyists, telephone installation and maintenance men. See your radio parts distributor or write for bulletin direct.

812 Packer St., Easton, Pa.

**WELLER
MANUFACTURING CO.**

In Canada: Atlas Radio Corp., Ltd., 560 King St., N. W., Toronto, Ont.
Export Dept.: 25 Warren St., New York 7, N. Y.

ELECTRONICALLY SPEAKING



THE progress being made with high fidelity reception was recently demonstrated by RCA in their exhibition hall in Radio City. The demonstration consisted of alternately playing two pianos. One of the pianos was on the stage in the theater, and the other was in a specially constructed broadcasting studio located in a remote part of the building. The latter piano in the studio was heard through a radio set placed on the stage alongside the other piano. The audience was challenged to distinguish between the music coming from the local and remote instruments. The radio reproduction of the music was apparently so lifelike that members of the audience were unable to detect the difference. It was pointed out that modern improvements in broadcasting studios as well as in receiver design helped to make such high fidelity possible. The importance of acoustics at both transmitting and receiving ends was emphasized.

The VT (proximity) fuse, which was used extensively during the war, is used by General Electric's Research Laboratory in Schenectady to regulate the movement of laboratory personnel in and out of a corridor. As a person walks along a corridor on the third floor of one of the laboratory buildings, his motion is detected by a microwave transmitting-receiving unit, which operates red and green lights visible to persons leaving offices and workshops along both sides of the passageway. This system is useful in warning one, by means of a red light, that he must be careful to avoid barging into another person, especially when delicate instruments are being handled.

The RMA reports that more television receivers were produced in June 1947 alone than in the entire year 1946, and FM-AM receiver production for the first six months of this year was two and a half times that for the same period last year. Altogether, over eight million radio and television receivers were produced between January and June 1947.

A LOUDSPEAKER SYSTEM, having a million times the intensity of the ordinary voice, was developed during the war for broadcasting to the ground from an airplane at 10,000-foot altitudes. Known as "Polly," this 2000-watt sound system was used successfully by the U. S. Navy in the Pacific area to persuade Japanese troops on by-passed islands to surrender, according to Harold Burris-Meyer of the Stevens Institute of Technology, Hoboken, N. J., who spoke on the General Electric Science Forum here. During the war, the system was assigned to a project in the physics section of the National Defense Research Committee, which developed such a group of weapons.

In the "Polly" system, said Mr. Burris-Meyer in the WGY and WGFM broadcast, "There are two speakers, each consisting of 36 speaker units. They create a sound-intensity level in excess of 130 decibels at a point 30 feet in front of the loudspeakers. This is somewhat over a million times the intensity of my voice coming from your loudspeaker."

Clearing up the by-passed islands and organizing occupied territory were tasks in which Polly played an important role, he explained. "Polly first announced to many by-

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BUILT FOR SERVICE



Cartoon Displays!



● Here are two more of the famous Stein cartoons that "sell with a smile" and draw attention wherever they're displayed. Each cartoon is in *full color* with an easel back for easy setup anywhere in your shop.

Put 'em in your window and watch people stop! Put 'em on counters, shelves or cash registers and watch your business grow! **GET THE SET OF FOUR TODAY FROM YOUR CUNNINGHAM DISTRIBUTOR.**

For expert guidance—TURN THE PAGE →

Cunningham

Electron Tubes

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

"LET'S GET ACQUAINTED"

ELECTROLYTIC CAPACITORS

See your local Jobber! He has an interesting offer for you relative to our "Get-Acquainted" plan!

Illinois Condensers are recognized for their superior performance. They stand up in all climates and under the most varying conditions, because, fine workmanship, plus the purest of raw materials, goes into their manufacture.

Illinois Condensers will not let you down. Your reputation is our reputation when you use Illinois. Since we both take pride in our work—

Let's Get Acquainted

A copy of our latest catalogue is yours for the asking. We invite your inquiries.

ILLINOIS CONDENSER CO.
1616 NORTH THROOP STREET • CHICAGO 22, ILL.

Home Recorders

→ From Page 28

the stylus to be so great that the walls between the grooves are broken down. This will cause the playback needle to jump grooves or frequently sound like the "broken record" routine. If too low a level is used, the playback pickup will not have enough output, and the signal to noise ratio will be unfavorable. Most recording outfits have an indicator which allows the operator to gage the audio level and keep it proper. This indicator usually takes the form of a neon bulb or a db meter. Manufacturer's recommendations as to audio level should be closely followed. If there is definite doubt as to the proper audio voltage which can be safely applied to the recording head, catalogs which list the head itself will often state the RMS rated audio voltage allowable. Normally, the recording unit as a whole will not need the maximum value of audio voltage at which the head is rated and, in fact, will jump the grooves at this value. It is important to remember that application of any high DC voltages will ruin almost any cutting head, and one should be extremely careful when handling the cutting head leads. The best policy is to leave the power off during such handling.

4. *Tone Control adjustment.* The most favorable position of the tone control is usually a matter of taste. However, if the user is not familiar with tone effects, he may feel that his records "don't sound right" simply because this adjustment is not properly made. The serviceman can use his previous experience in broadcast receiver tone controls to good advantage in this connection.

So far, we have considered troubles which might arise in connection with styli, blanks, and operating techniques. An additional factor is mechanical failure or maladjustment. Some of the most frequent mechanical troubles are due to:

1. *Improper engagement of worm drive.* On the arm type, the lever (follower arm) under the chassis should firmly engage the feed screw. This condition can be checked for

by putting the control lever in the cutting position or in some types simply lowering the pickup arm over the turntable. The arm should then be gently pushed to the right and the left. There should be no play; if there is, the worm drive is not engaging properly. If the engagement is so loose that slippage occurs or so tight that motor speed becomes uneven, adjustment should be made on the follower arm spring screw. It will also be found that too loose an adjustment of this screw will produce uneven groove spacing.

2. *Recording arm mounting out of adjustment.* Most arms are positioned at the pivot end by a U shaped link, and the follower arm post. Failure of the arm always to return to the same height may be due to improperly adjusted or broken spring or the follower arm binding in the pivot post bushing. This binding may also result in trouble in raising the arm from the horizontal position. The proper remedy is application of petroleum jelly to the follower arm post. The lubricant should be worked in by alternately raising and lowering the recording arm.

3. *Uneven speed.* This is ordinarily due to something wrong in the drive mechanism. Sometimes the idler wheel wears excessively and loses friction. Dirt or dust in the idler or motor bearings or foreign matter on the inside surface of the turntable can also cause poor speed regulation. These troubles are more likely to show up in recorders than in phonograph record players because of the heavier load applied when records are being cut. The result of poor speed regulation is distortion due to raising and lowering of pitch in tones reproduced. The resulting sound is similar to that produced when someone is slowing down a record player turntable.

Lubrication

Like other types of machinery, recorders have moving parts which need oiling. It has already been pointed out that petroleum jelly is recommended by manufacturers for the pivot post bushing. Motor and idler bearings should occasionally be lubricated with a few drops SAE #10 pure mineral oil to insure proper operation. ✓ ✓ ✓



E.M.C. Model 101-B
VOLOMETER*
(trade name)

ONLY \$20.95

(illustrated)

In Portable case—\$24.95

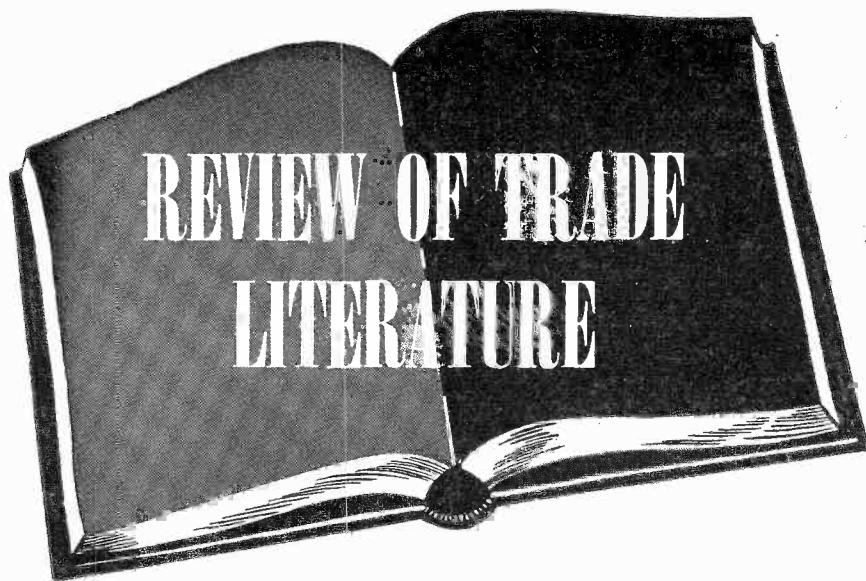
5 DC and 4 AC voltage ranges, 3 current ranges.

Resistances from 1/20 ohm to 20 megohms in 4 ranges.

AC volts 25 cycles to 1 megacycle. Multiplier resistors accurate to 1%. 4 1/2" meter.

WRITE for full information about this and other models.

ELECTRONIC MEASUREMENTS CORP.
114 Liberty St., New York 6, N. Y.



To avoid delay when writing to the manufacturer give issue and page number

A NEW 40-page booklet entitled "How To Pass FCC License Examinations" has been issued by the Cleveland Institute of Radio Electronics. This booklet gives extensive information about the requirements for obtaining FCC commercial operators' licenses and proper procedures for obtaining these licenses. Included are: list of requirements, extracts from various government pamphlets, extracts from the amended Communications Act of 1934, extracts from "Rules Governing Commercial Radio Operators," information about examining offices, list of FCC publications, and suggestions about methods of study for the examinations. A copy of this booklet can be obtained free of charge by writing to the Cleveland Institute of Radio Electronics, Terminal Tower, Cleveland 13, Ohio.

Data about the history and characteristics of ceramic capacitors are included in a booklet entitled "Why Ceramic Capacitors" issued by Centralab. Historical facts and reasons for the increasing popularity of the ceramic dielectric type of condenser are included. Can be obtained without charge from Centralab Division of Globe-Union, Inc., Milwaukee, Wisconsin.

A 23-page catalog entitled, "Testing Equipment and Panel Meters," issued by the Supreme Instruments

Corporation, includes descriptions of the Supreme line of test equipment, including tube testers, AF and RF oscillators, signal tracers, oscilloscopes and multimeters. A photograph of each type of instrument is shown. This publication is designated Catalog No. 447 and can be obtained by writing to Supreme Instrument Corporation, Greenwood, Mississippi.

Howard W. Sams & Co., Inc., publishers of Photofact, have prepared three new service information folders which are available without charge to all radio servicemen. The first of these is a complete Cumulative Index to more than 1,000 postwar radio receivers, combinations, record changers, recorders, and sound amplifiers. The index is arranged alphabetically and by model number indicating the proper Photofact folder to use for complete service information on any of the models listed. The second folder describes five good, simple ways to file Photofact folders including the new "30 second" method. These data on filing are also applicable to other servicing material in loose-leaf or folder form. The third folder offered by the Sams Company is a specimen Photofact folder covering a popular radio phonograph combination. All three of these servicing aids are available without charge to radio serv-

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JOHN RIDER SAYS . . .

**Put a roof
over your business**

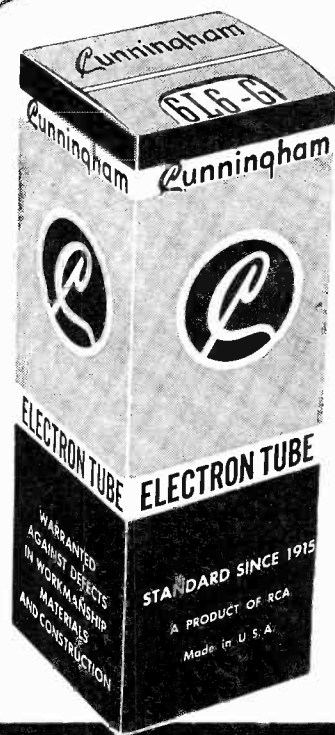


It's tempting fate to run a business without the protection of insurance against property damage and bodily injury. Accidents will happen—and a heavy claim, or a series of minor claims, are often sufficient to wreck an enterprise that has taken years to establish.

Radio servicing is not without its hazards. One of your workers may sustain injury while erecting an antenna—or may drop a pair of pliers through a skylight. In any event, the responsibility is yours. That's why it is important to give your business the coverage that insurance affords.

Suitable and adequate insurance relieves you of the financial responsibility of settling claims. Its cost is low in relation to the protection it provides and the confidence it generates in the minds of employees and customers alike.

Built for Service



**Cunningham
Electron Tubes**

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



Dial Belt Kit
Cable Kit

Hardware Laboratory—Cement

G-C SERVICEMEN'S DIAL BELT KITS

The best belts for all sets. Easy to install. Supplied in kits of various sizes with steel box. No. G-25—Kit of 25 belts—List \$6.70.



G-C HARDWARE LABORATORY

40 jars of over 2100 essential electronic hardware items, screws, nuts, lugs, parts, etc. All items you need. No. 6604—List \$24.00

G-C RADIO SERVICE CEMENT

Best cement for speaker and radio work. Suitable for cementing replacement cones. Flexible, vibration proof, water proof and fast drying. Will cement most anything. No. 30-2—2 oz. bottle with brush—List 50c



G-C DIAL CABLE KIT #1

Contains four 25 ft. spools of popular dial cables with assortment of eyelets and clamps. No. 77-SK—List \$4.76

Sold By All Jobbers
Write For Our Catalog

GENERAL CEMENT Mfg. Co., Rockford, Ill., U. S. A.
Manufacturers of over 3,000 products
Sales offices in principal cities

RADIO SERVICEMEN!
Stop NOISY VOLUME CONTROLS WITHOUT REMOVAL FROM CHASSIS

Use . .

QUIETROLE

Quietrole is a highly effective cleaner and lubricant now widely used and highly recommended by servicemen. Quietrole restores over 75% of noisy controls to normal where dirt and grime are the cause of this condition, and Quietrole prolongs the life of all controls.

A small charge to the customer by servicemen assures you of additional profit from a satisfied customer. A 2 oz. bottle @ \$1.75 contains enough Quietrole for 50 applications.

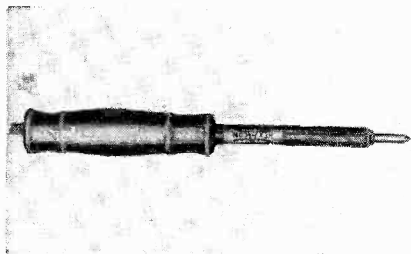
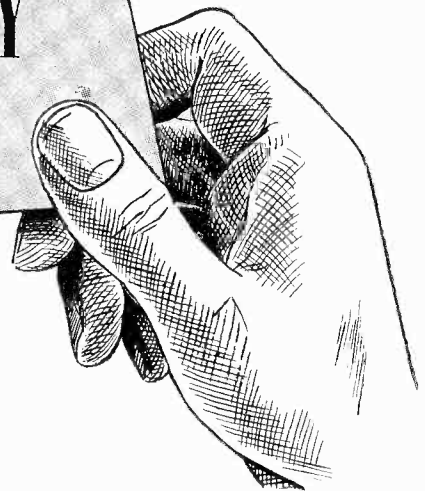
If your distributor cannot supply you, order direct and include the name of your nearest distributor.

Distributors' inquiries invited. **\$1.75**

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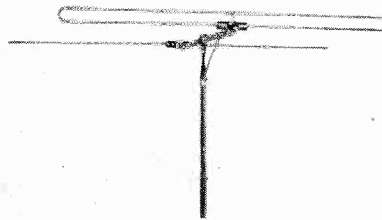


SOLDERING IRON

Hexacon Electric Company announces a new electric soldering iron. This iron can be furnished with 1/8 inch or 1/4 inch diameter tip and in 40, 50, or 60 watts. It is very light in weight, reducing operator fatigue, and is suitable for intricate, close-quarter work.

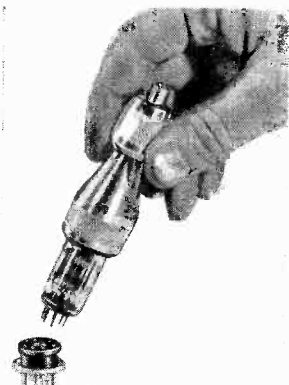
Works on regular 110 or 220 volt line circuit, DC or AC current. Heating elements are of nickel-chromium resistance wire, insulated with mica and are easily replaceable. Removable tips are hard drawn copper and each iron is furnished with a stand.

For further information write to Hexacon Electric Company, 250 W. Clay Avenue, Roselle Park, N. J.



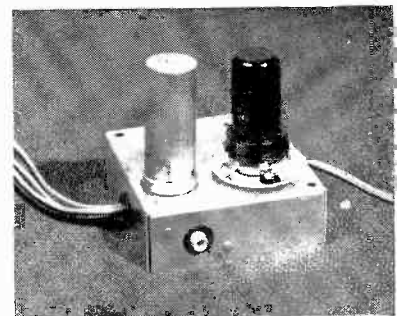
FOLDED DIPOLE

Illustration shows the new Ward folded dipole FM antenna assembled with reflector kit for use in the 88-106 mc band. For complete information about this and the Ward straight dipole, which also is available with or without the reflector kit, write Ward Products Company, 1523 East 45 St., Cleveland 3, Ohio. Both types are available for use in the 44-88 mc television range.



TUBE PULLER

Built for use with miniature tubes such as 6AG5, 50B5, etc., the Amo Miniature Tube Puller enables easy removing and replacing of the tubes in "hard-to-get-at" places with a minimum of effort. A tube is extracted by pressing the Amo down on it and lifting. Replacement in the socket is accomplished by pushing the tube into place, then pressing release button. Further information can be had by writing Salescrafters, Inc., 510 N. Dearborn St., Chicago 10, Ill.



PREAMPLIFIER

A phono preamplifier for use with the General Electric variable reluctance pickup recording head is made available by the Specialty Division of the company's Electronics Department. Utilizing a dual triode,

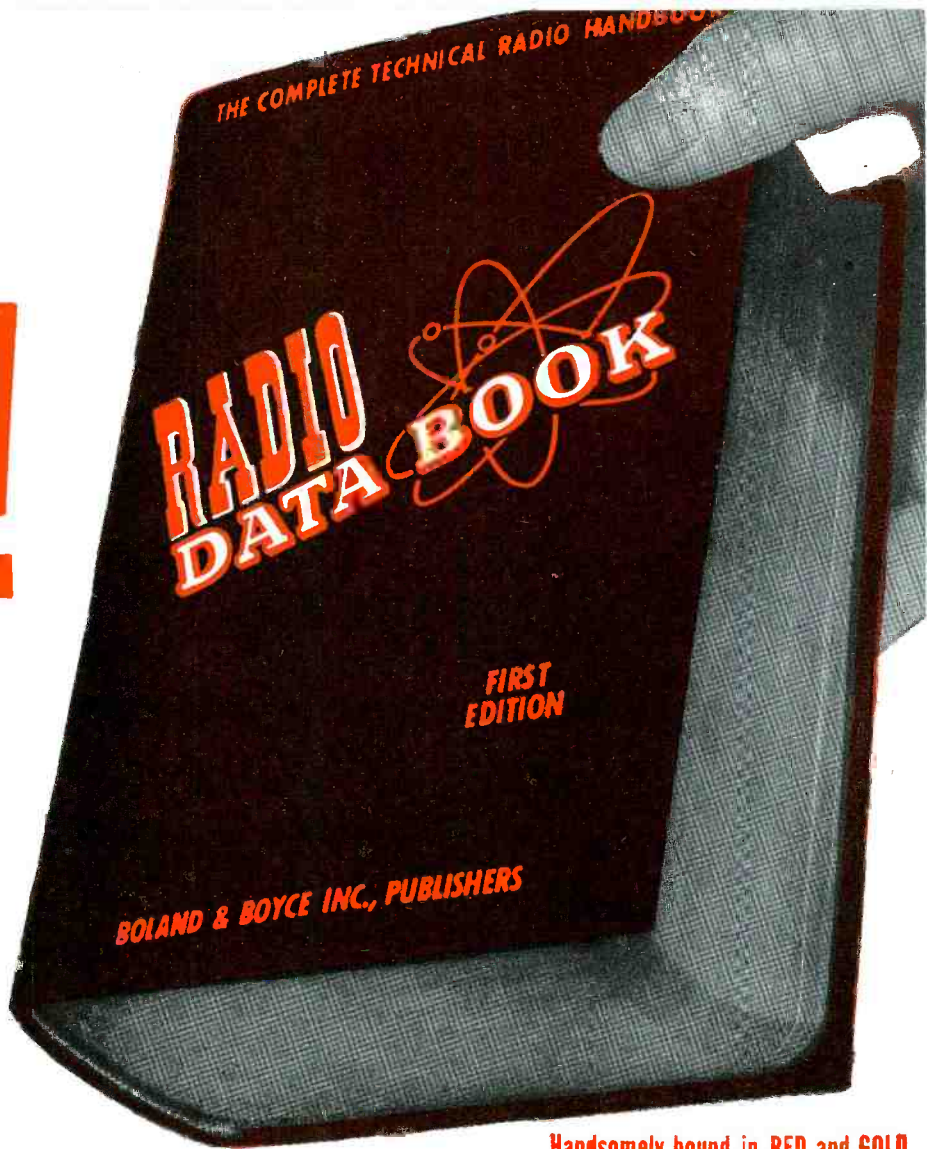
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tions are given of dynamotors, converters, genemotors and the "Mag-motor." Photographs, voltage and current ratings and physical construction of each unit are given in this bulletin. To obtain a copy, write to Carter Motor Company, 2644 North Maplewood Ave., Chicago, Ill.

The Talk-A-Phone Company has just released a new descriptive sheet UL-1 and a twelve-page catalog describing their intercommunication systems. Well illustrated with photographs and line drawings, the catalog gives mechanical and electrical descriptions as well as layout diagrams showing how various systems operate. Systems using up to 100 stations are described. A copy is available without charge by writing Talk-A-Phone Company, 1512 South Pulaski Road, Chicago 23, Ill.

about the subject. Practice problems are included in all sections of the book and a list of answers to these is also provided.

Electronically Speaking

→ From Page 45

passed units that the war was over and gave directions for surrender," he said. "In this task, Polly saved a great deal of time and eliminated the possible necessity of a considerable amount of fighting. Enemy military personnel were told to report to a specific beach, where Naval craft would meet them. Polly also aided in mobilizing the natives on various islands to search for missing aircraft."

Trade Lit

→ From Page 47

icemen. They can be obtained by writing direct to Howard W. Sams & Co., Inc., Indianapolis, Indiana.

The Carter Motor Company has announced the release of the new sales bulletin No. 447-J. Descrip-

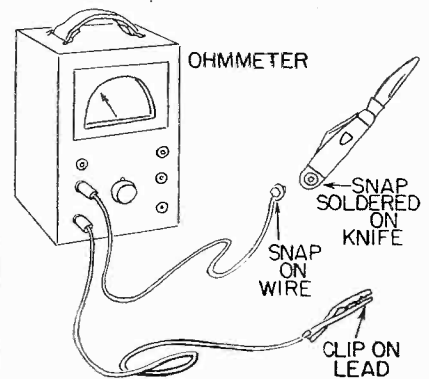
BOOKS

Mathematics for Radio Engineers, by Leonard Mautner, published by the Pitman Publishing Corp., 327 pages, price \$5.00.

An excellent mathematics handbook for the practicing engineer in his daily work. This book will also be found very helpful to the student who wishes to learn more

The Notebook

→ From Page 44



break. The break can then be detected by prodding the wire with the point of the knife.

Edgar M. Carnes
South Zanesville, Ohio

TELEVISION

In Simple Assembly Form

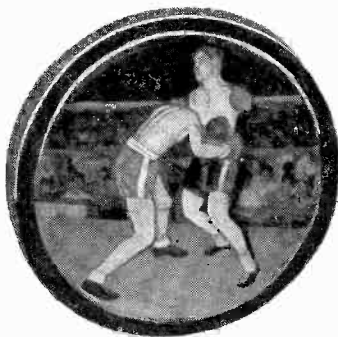
This is not a Kit but an assembly—aligned and tested, ready to use when delivered by following simple instructions.

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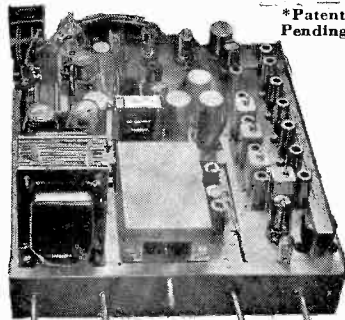
It is so flexible that any number of channels from 1 to 13 can be used. This allows a start with the channels now in use 2-4-5-7-9-11-13 and then install the others as desired for a slight extra cost.

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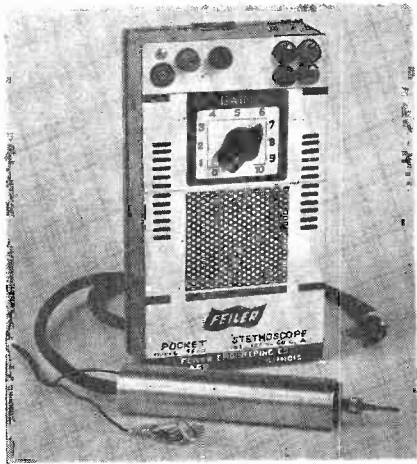
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the device matches the pickup's impedance to an amplifier input circuit as well as furnishing the necessary preamplification and tone compensation.

SIGNAL TRACER

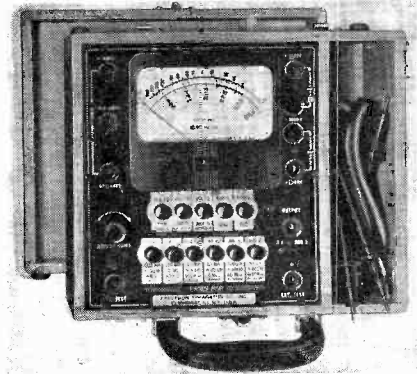
The new model TS-5 "Pocket Stethoscope" is comparable in performance to bench type models TS-2 and TS-3 and features

lightness and small physical size. The unit contains its own PM dynamic speaker with provisions also made for headphone operation. An RF vacuum tube voltmeter may be made of the instrument by plugging any standard Volt-Ohm-Milliammeter into a jack provided for the purpose. The instrument operates on 115 volts AC. An illustrated folder describing further details of operation will be mailed upon request to Feiler Engineering Co., 422 South Dearborn St., Chicago 5, Ill.



MULTIMETER

The Precision Multi-Master Series 858 test set has 54 AC and DC ranges. Eleven push-buttons are provided to select any of these ranges, and the sensitivity is 20,000 ohms



per volt. Resistances as high as 60 megohms and voltages as high as 6000 volts can be measured. There is also provision for insulation testing up to 600 megohms. For further details write to Precision Apparatus Co., Inc., 92-97 Horace Harding Blvd., Elmhurst, L. I., New York.

Gremlins—or Intermittents

→ From Page 13

tion in the voltages controlled by these resistors.

And now let us take up some miscellaneous considerations in connection with intermittents:

Line Voltage

If the intermittent condition shows up only at certain times of

Masco News

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SOUND SYSTEMS and Accessories

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

the day, it is probably a function of line-voltage. A voltage regulator is a great help to check such conditions. The tapped-secondary type can be had quite reasonably in the low current rating needed. Three-way portables are notorious for being intermittent on AC. A weak rectifier or mixer tube or a bad input filter condenser will cause the oscillator to drop out when the line-voltage goes down. Unless these sets can be made to operate down to 100 volts, they are not satisfactory.

Another annoying intermittent is the one that mashes up at certain

→ To Page 54

S.S.S.

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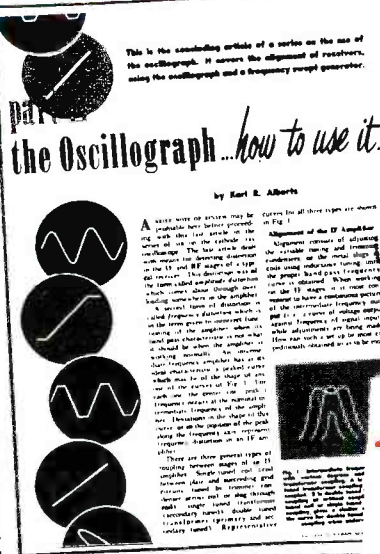
Testing Ali. & Aligning TELEVISION RECEIVERS
 by Milton Scheraga

Adjusting the television receiver... A recent reader has written me... The author explains the steps for testing and aligning television receivers, covering topics like picture control, sound, and color.

Part 1 of the Oscillograph... how to use it.

The Oscillograph... How to use it
 by Karl E. Alberts

A recent reader has written me... This is the concluding article of a series on the use of the oscillograph and a frequency sweep generator. The author provides detailed instructions on how to use an oscilloscope for troubleshooting and testing electronic circuits.



servicing FM receivers

2nd FM Stations Are Now On The Air!
 Two Million FM Sets Will Be Produced In 1957!

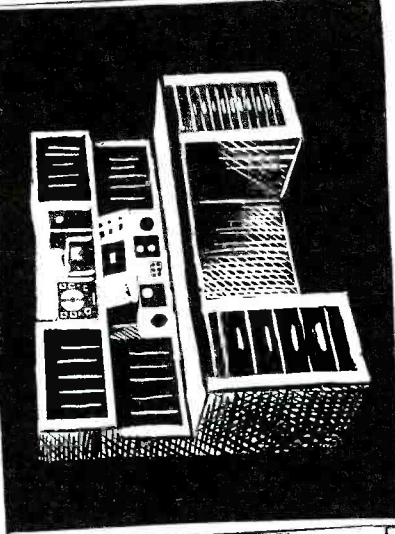
This is the best of several articles designed to acquaint the serviceman with the latest information concerning FM receivers which are now rolling off the production line.

16

ISSUES OF FOR ONLY



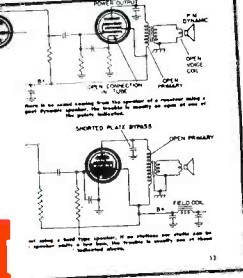
icuing by EAR
 Troubleshooting by aural analysis



Modern Bench Construction

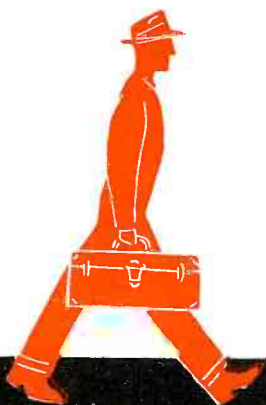
by JOSTER J. MOORE

Modern bench construction... The author discusses the design and construction of a modern electronic test bench, including component selection and layout considerations.



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OCTOBER AND NOVEMBER

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PRESENTS**

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**OVER THE
BENCH**

**REVIEW OF FIELD
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**RADIO
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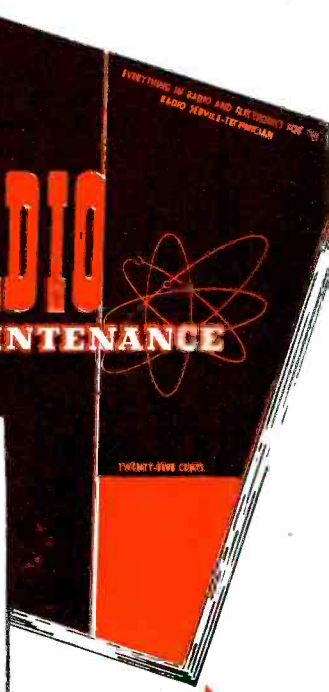
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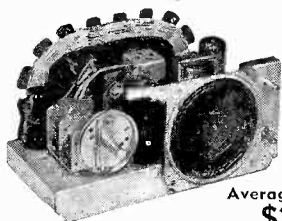
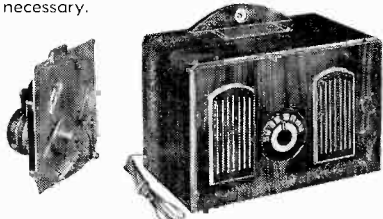


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Gremlins—or Intermittents

→ From Page 51

times of the day in the home location. Often it plays perfectly in the shop. The trouble lies in a tube afflicted with secondary-emission. At a certain critical line voltage, the plate current of the tube—usually an output—starts to creep and keeps right on going up to the point of plate-current saturation. Below this critical line voltage, the operation is perfectly normal. Raising the line voltage to 125 volts for a few minutes should reveal this state of affairs.

Heating

If the set cuts out only after it has been on for some time, heating is probably the factor that is causing it. Quite often such a set will not cut out unless it is in the close confines of the cabinet, which makes it very hard to service. In that case, an infra-red lamp is very fine for focussing the heat where you want it while the set is on the bench. A coil, condenser, or transformer that is sensitive to heat will quickly show its hand in the rays from one of these "health" lamps; but do not leave the lamp focussed at short range on the set for considerable length of time, or you will have the wax dripping out of the condensers. That thing is hot!

A bad volume control can cause an intermittent condition if the slider makes a poor connection with the resistance element, but this is so obvious that the customer usually points it out to you himself.

In conclusion, let me point out that most intermittents are due to bad condensers, bad tubes, bad connections, bad coils, bad resistors. They can usually be located by tapping, pounding or twisting the chassis, moving wires with a pair of tweezers, or checking resistances. The cutting-out can occasionally be hurried by varying the line voltage or by applying localized heat.

The use of an out-board tuning-eye is of great aid in roughly segregating the source of the trouble. Keen observation will soon show that every cause of intermittent ac-

tion has its own peculiar identifying symptoms, and this acquired knowledge is the very best tool for working on such cases.

Unfortunately, there is no sovereign, magic formula for locating the trouble in all intermittents, for the causes for this condition are so many and varied that the technique for cracking them must be highly flexible. A sound grounding in the possible causes for intermittent action, with special stress being placed upon the most common causes, is the best aid the inexperienced serviceman can have in tackling such sets. That is what this article has tried to give you. ▽ ▽ ▽

The Organizations

→ From Page 30

is a sample. (See illustration—Ed.)

"New members must be approved by the board before they can become an approved member. After four months they can take an examination and become a certified technician. A membership card is given and on it are the words 'Certified Technician' 'Approved' or 'Associate.' A card is also given to the apprentice."

Verne H. Preston, Secretary

The July issue of the **Associated Radio Service Dealer News**, (Columbus, Ohio), shows this group to be very active both technically and socially. Very significant is the amount of space devoted to the problems of FM service work, showing that the members are keeping themselves well informed on modern developments. For instance, the fellows were excited about the appearance of the "Pilotuner," which is an "FM tuning unit in a cabinet, 5 tubes plus selenium rectifier, AC operated 3 gang condenser and RF stages and lists at only \$29.95." A new 8000 watt FM station at Newark, Ohio, was reported being received in Columbus, although sometimes with considerable fading.

In the social events column, members of the group were preparing for the ARSD picnic, which was held on August 3. Congratulations to J. P. Graham, able editor of

"ARSD News," on his interesting newspaper and we hope that RADIO MAINTENANCE can continue to be worthy of nice things he says about us in this publication.

From the **Associated Radio Technician of British Columbia:**

"The regular meeting of the Associated Radio Technicians of British Columbia was held July 21 with President Al Johns presiding.

"After the routine business of the meeting, the various chairmen of committees were asked to report. Bunny Cosman said all was in readiness for the annual picnic to be held at Bowen Island August 10.

"The possibility of sharing an office with the Vancouver Electrical Assn., was discussed briefly before being tabled pending more information.

"Wilf Munton reported the dates for the annual convention were definitely set for September 24 and 25 in the Stanley Park Pavilion. Most of the Radio and Electrical jobbers have offered full co-operation by participating in this excellent opportunity to demonstrate what they have to offer to the trade. With many new lines now available, many dealers may not be fully familiar with these goods.

"From the oral preview given by the convention chairman, Wilf Munton, it certainly should be a *must* for every technician, dealer, and salesman to attend one, if not both days of the convention. During the daytime, many technical talks and discussions are scheduled, while entertainment will be provided during the evenings for those who wish to spend a few leisure hours in the company of new, and renewed friends in the delightful setting of the pavilion under the majestic firs in Stanley Park.

"A large number of visitors are expected from all over British Columbia as well as from points across the border as far as Seattle, Washington to make this convention a model for others and a credit to British Columbia, a province well known as the 'Gateway to the Pacific' and in the fore-front of progress and leadership.

"The dates are — September 24 and 25 at the Pavilion in Vancouver's Stanley Park."

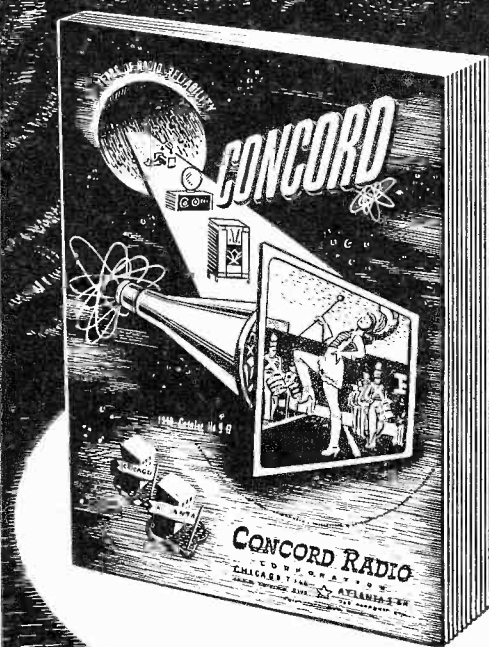
Sam Beyer, Publicity

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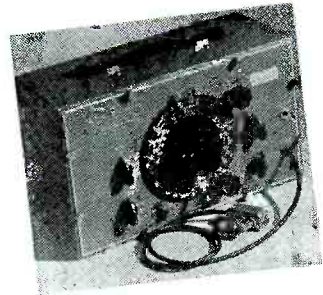
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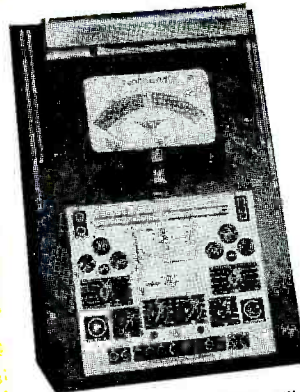
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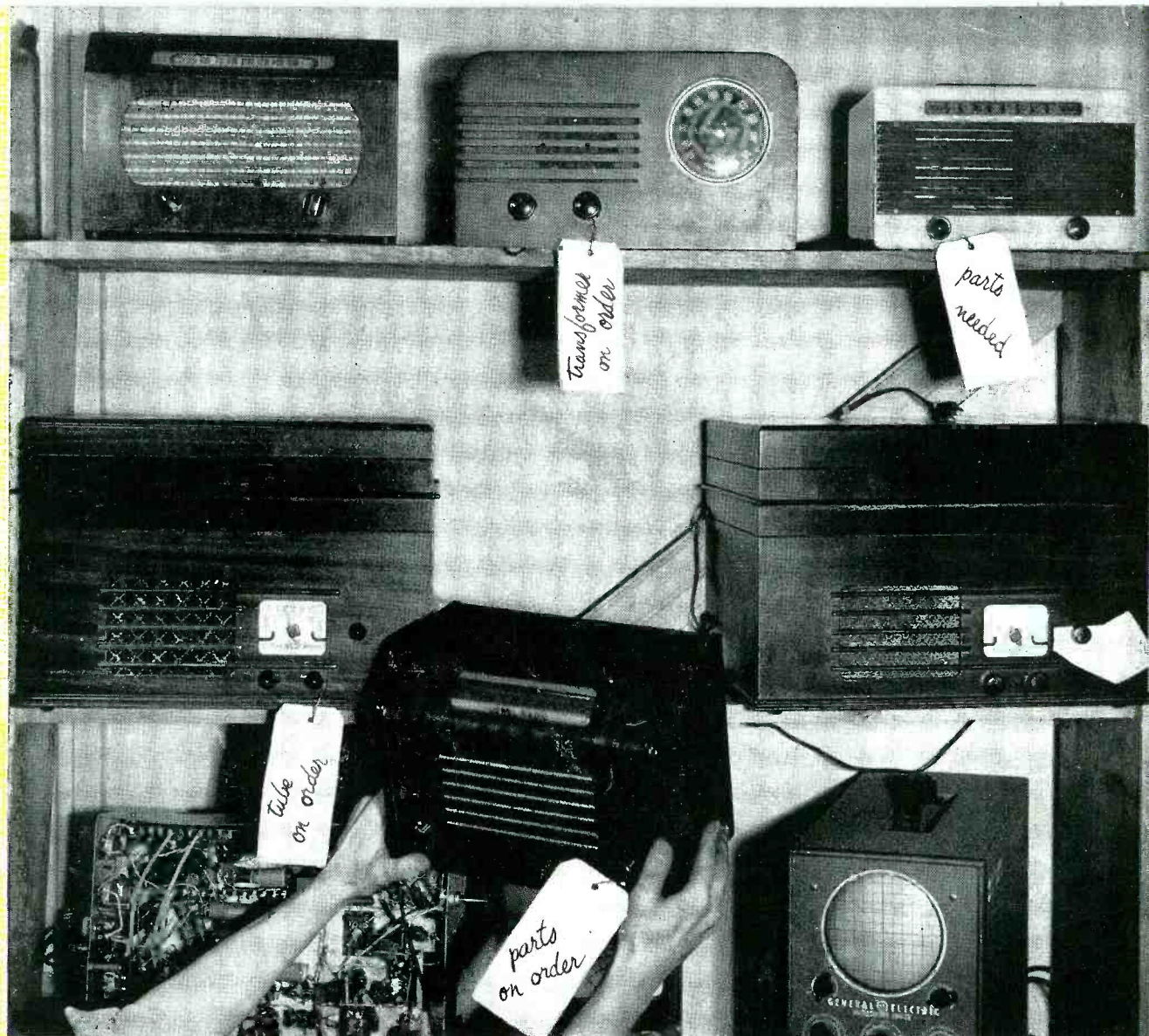
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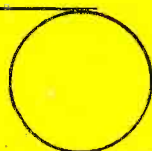
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