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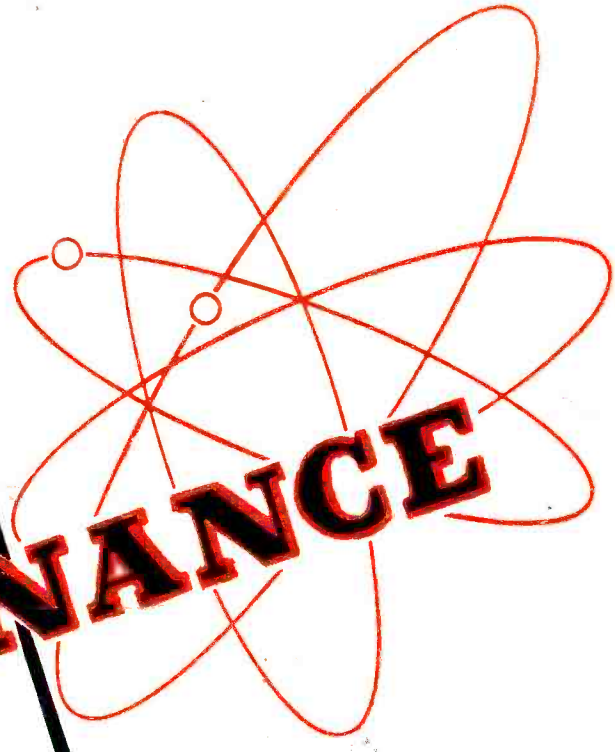

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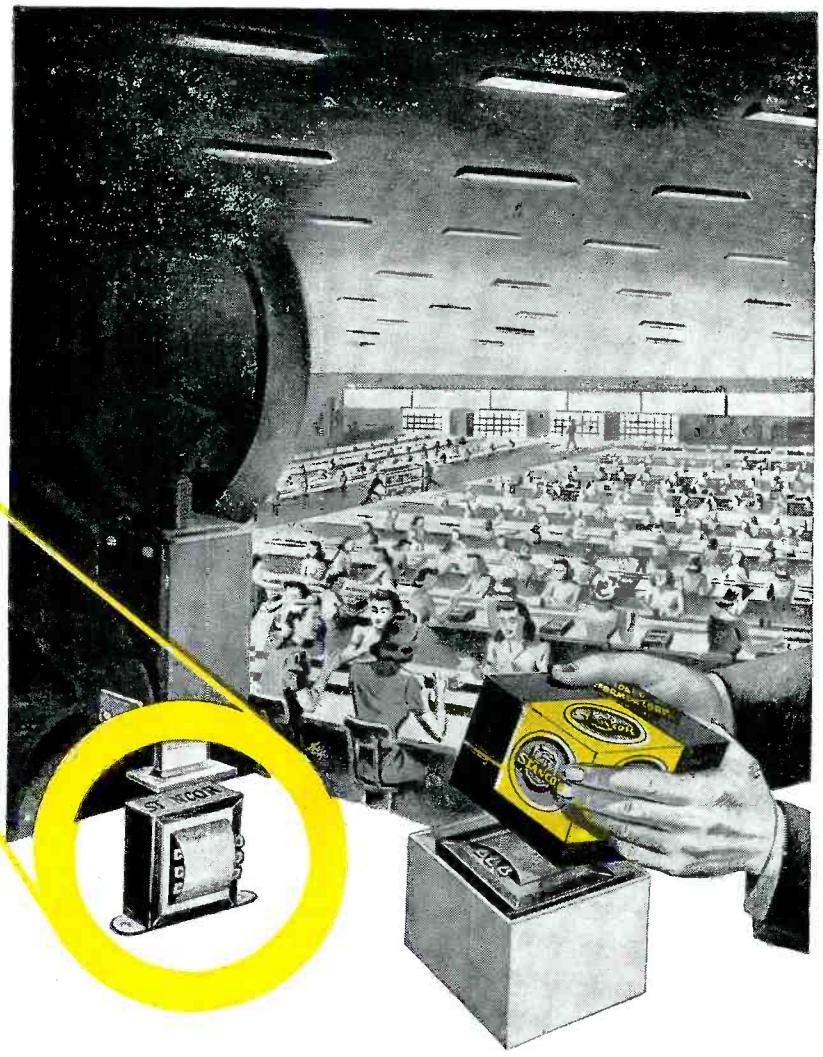

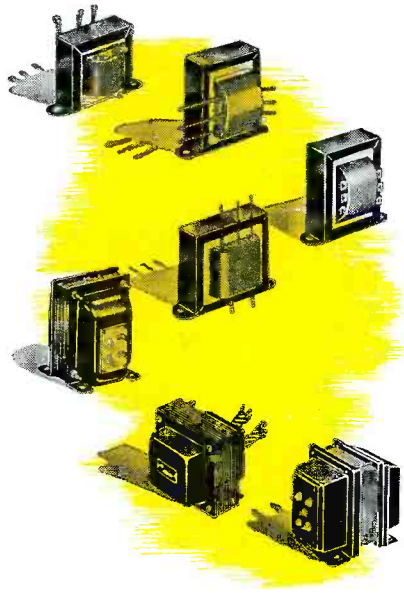

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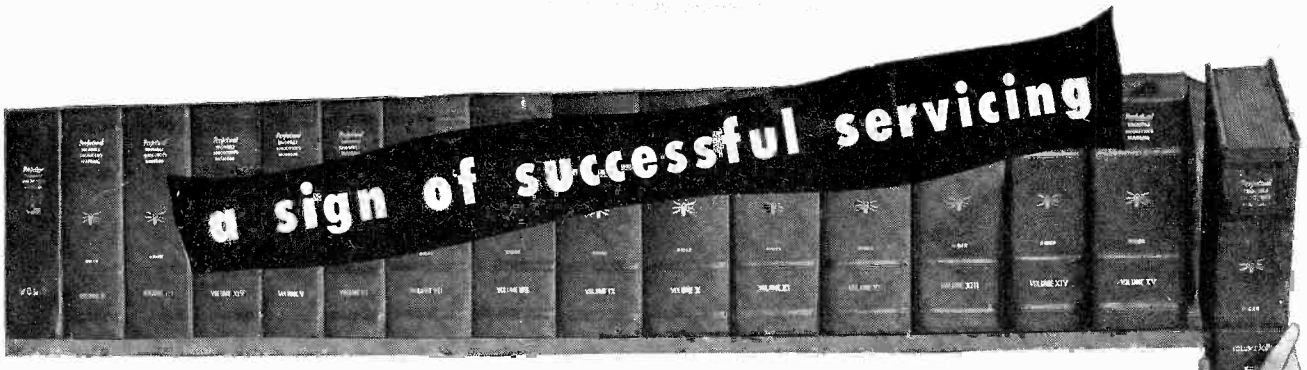

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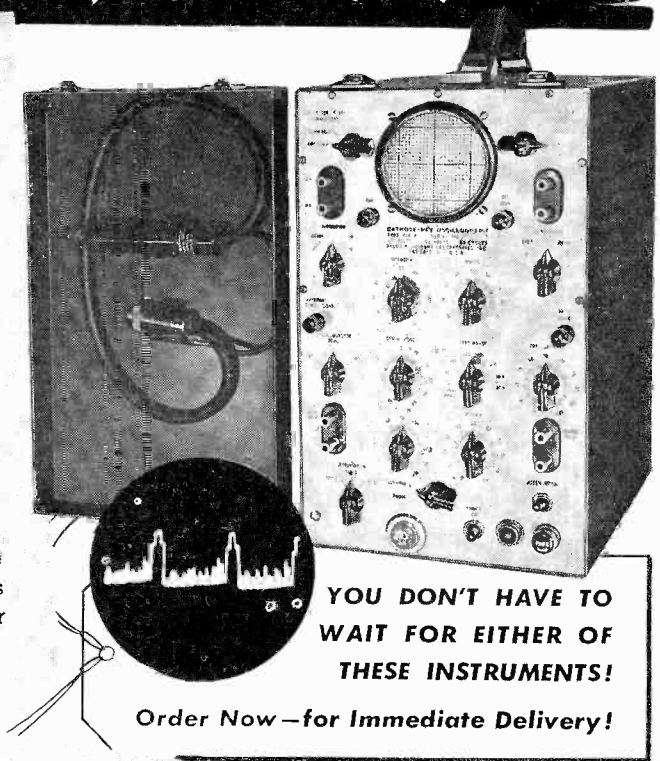

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ELECTRONIC
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Volume 3 DECEMBER 1947 Number 12

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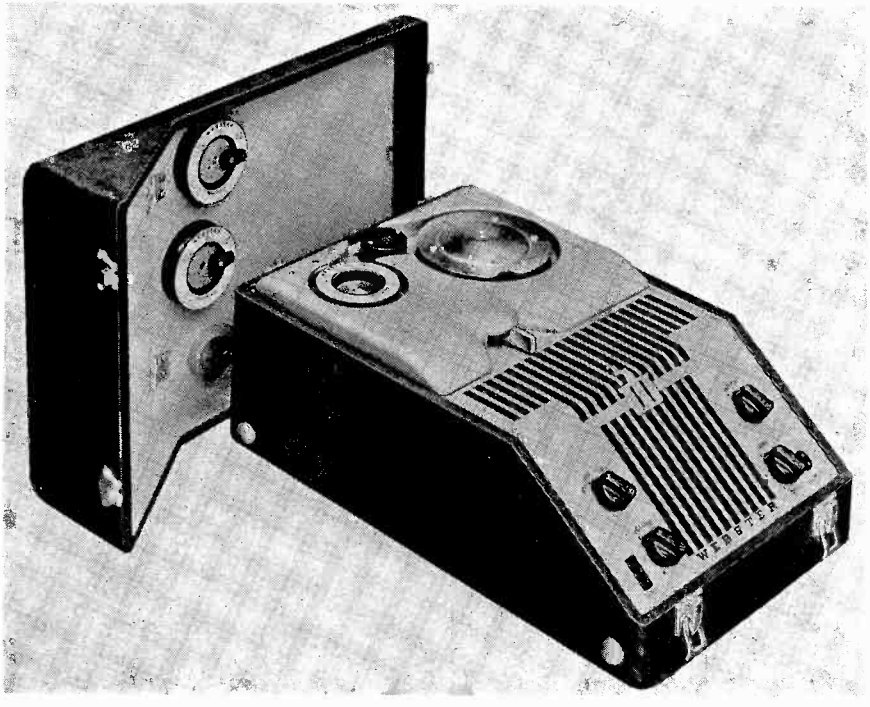
About wire recorders

by
J. Richard Johnson

The average serviceman has a background well adapted to developing new business in this expanding field.

THE idea of recording sound on a magnetic strip is not new; in fact, it is older than the more common disc method. Original patents on a method of wire recording were granted in 1862, whereas Edison's phonograph was not invented until 1876.

If the birth of magnetic recording thus preceded the advent of the disc type, it may be wondered why it was so much longer in reaching its full development. Several important factors are involved in this lag. First, the lack of amplifiers or amplifying devices made it impossible to record at the high levels of intensity required to overcome noise level. Second, a good medium was not available since the type of wire now used is of very good grade and quite fine in diameter, requiring modern drawing methods. During World War II, however, great strides were made in magnetic recording in general and wire recording in particular; and we have now reached the point where several very practical models are available commercially and offer the possibility of profitable maintenance work for the radio service technician.



A new wire recorder model.

Magnetism

Let us consider some of the basic principles and difficulties involved in the operation and servicing of the modern wire recorders. To recognize the actual practical features, it is important to understand the fundamentals which underlie the design of this equipment. These fundamentals are relatively simple. For instance, the simple phenomenon of magnetism forms the complete basis for the whole operation. A magnet is considered in modern

theory to be composed of a large number of molecular elements, each of which forms its own little magnet. Fig. 1 shows two representations of this set-up, including one bar of steel which has not been magnetized, and another which has gone through this process.

Each of the little elementary magnets is made to line up in the same direction so that the total magnetic effect points toward one pole or the other after the bar has been magnetized. Previous to magnetizing, however, these elements point in various directions so that the total magnetic effect due to their random positions adds up to zero.

If we now extend this idea of the magnet into a long, thin, steel wire, we can have the same effect taking place as shown in Fig. 2. Here, portions of the wire become magnetized in one direction or the other; thus one inch of the wire might be North in one direction and South in the other, whereas the next inch would have the opposite polarity. It can be seen immediately that this arrangement allows the possibility of what is known as "demagnetization." Demagnetization is the leakage of magnetism from one section of the wire into the next. It is thus important that succeeding sections of the wire which are oppositely magnetized be sufficiently spaced so that this leakage is reduced to a minimum.

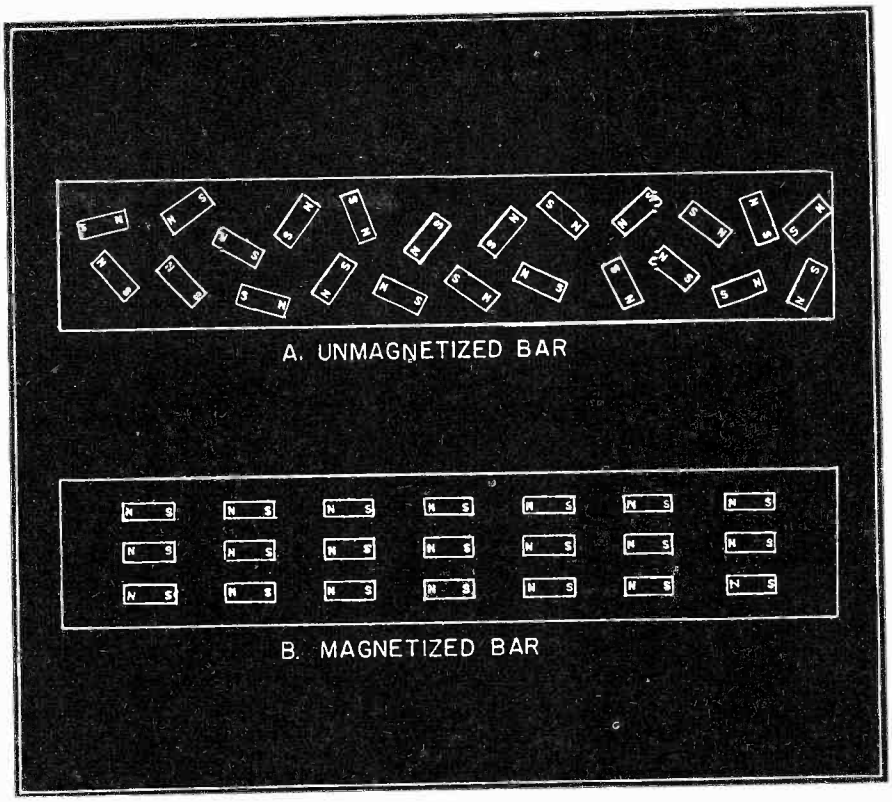


Fig. 1 How the elementary magnets align themselves in a magnetized bar.

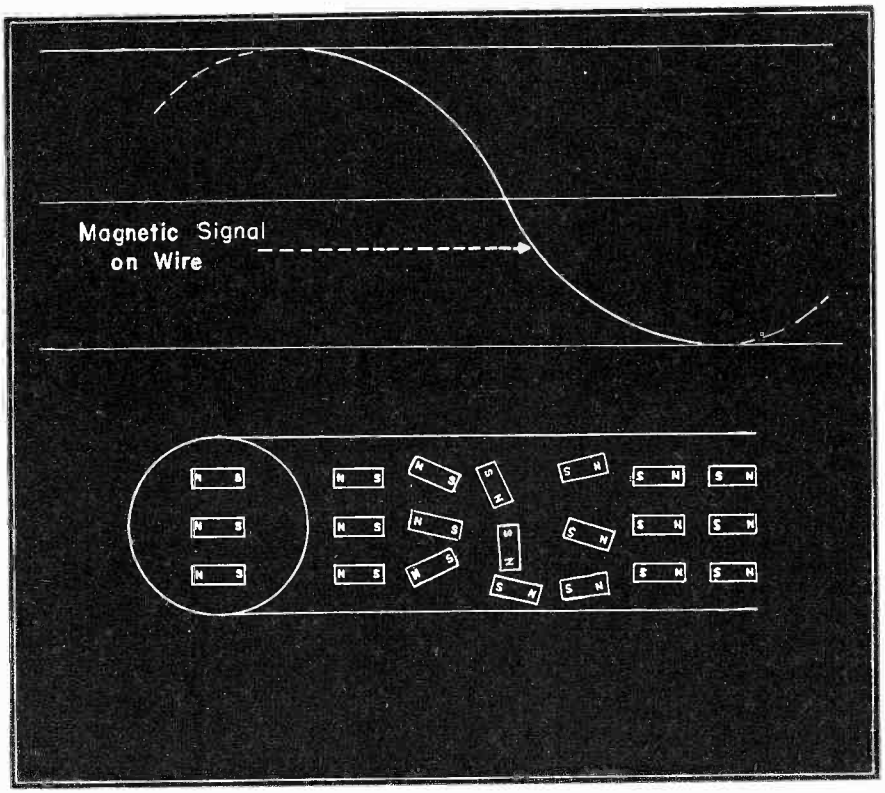


Fig. 2 How a magnetic signal is applied to an iron wire.

Electromagnet

The next fundamental principle of magnetism involved is that of the electromagnet. This device is an artificially created magnet which derives its magnetic force from the fact that it is surrounded by turns of wire carrying an electric current. It is usually constructed of soft iron so that the *retentivity*, which is the ability to hold magnetism, is kept at a low level, allowing the magnetism to disappear almost completely when the current through the coil is interrupted.

Let us now combine an electromagnet and the steel wire that we first discussed into an arrangement similar to that shown in Fig. 3. The electromagnet is formed into a shape such that a narrow gap is provided at one end through which steel wire is pulled. If we now place a varying electric current on the coil of the electromagnet, the variations in this current will result in a varying amount of magnetism in the wire as it passes through the gap. If we now reverse the procedure, removing the source of current on the coil of the magnet and passing the magnetized wire through the gap, a corresponding

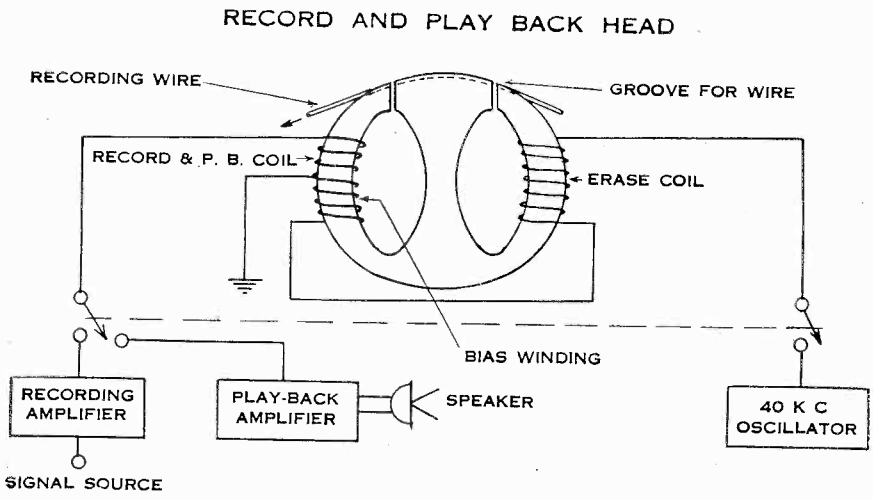


Fig. 3 Diagram of magnetic recording and erasing head.

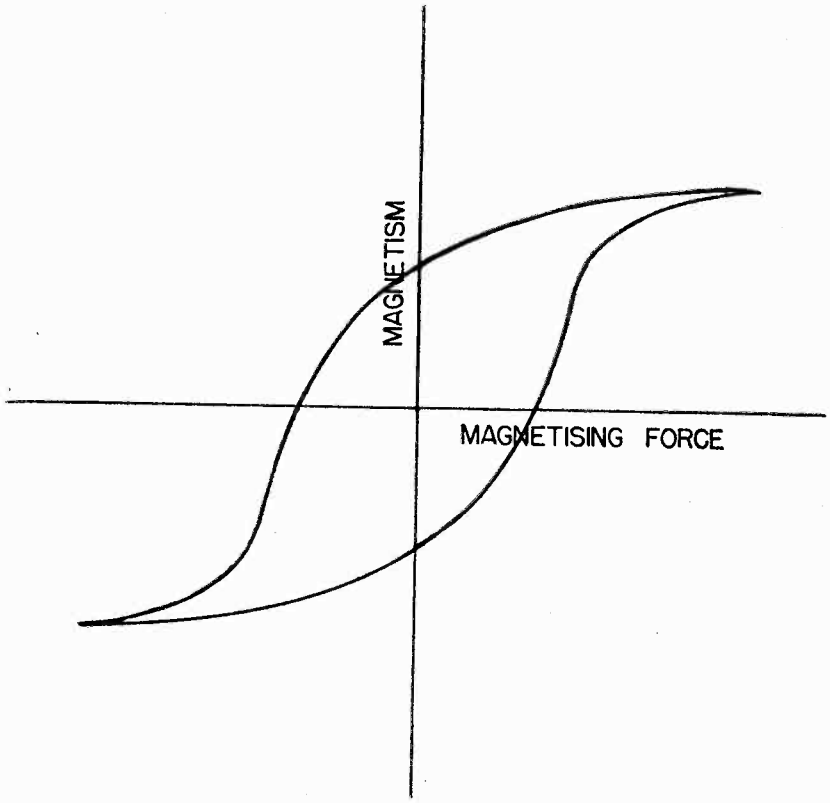


Fig. 4 Magnetization curve of a piece of iron wire.

voltage will appear at the terminals of the coil. This varying current, or voltage in the case of the wire recorder, is the audio signal. It is thus impressed in magnetic form upon the wire, and in many instances the same instrument which did the recording is used for playback.

Development Difficulties

Now let's consider some of the imperfections inherent in the wire recording system and which designers have had to cope with. First, consider Fig. 4, which shows what is known as the *magnetization curve* of a piece of iron. As added magnetizing force from a coil is applied, the resulting magnetization in the iron itself is shown plotted on the graph. Notice that the relation between the two is not linear. In other words, it does not vary as a straight line.

There is also a tendency for demagnetization to take a different path from that during magnetization. This effect is known as *hysteresis*. In trying to produce high fidelity recordings, this is a difficulty because the audio tones will be distorted when played back by this system. To overcome non-linearity and hysteresis effects, we add to our wire recorder what is known as *bias*. This bias raises the operating point on the magnetization curve to the linear portion, thus giving us a better chance for faithful reproduction. A DC bias could be used, but it has been found more advantageous to use an alternating bias to accomplish this purpose. This not only improves linearity, but at the same time improves the signal-to-noise ratio of the system. The frequency of the bias applied is in all cases somewhere in the supersonic region, varying usually from little over the range of audibility to about 100 kc. It is thus necessary to include an oscillator in magnetic recording devices.

The Medium

Another factor important in the quality of reproduction is the suitability of the medium used, which in this case is wire. The wire should have a good magnetization characteristic and the right amount of retentivity to keep the recording at full strength without losing its value. It must also have a low leakage from one section, known as an *element*, of the wire to another, thus reducing the contrast. If the succeeding elements of high and low intensity are spaced far enough apart, this leakage can be reduced on almost any type of wire within reason; but this would have to be accomplished by an increase in the speed so that with a given frequency, succeeding cycles would be properly spaced. It is therefore necessary to compromise on these two factors. It has been found that quite satisfactory results can be obtained with speeds of as low as eight inches per second, although many recorders run at several times this speed. Of course, this factor is also influenced by the frequency of the audio tone being recorded. If the frequency is very high, a much higher speed must be used to space the elements properly.

Magnetic difficulties are also encountered with wire, mostly due to the difficulty of coiling and uncoiling the fine material without tang-

ling effects and twisting. In order to accomplish this, wire recorders are designed with both driver and follower spools synchronized to keep the turns constant. Fig. 5 shows the effect of various amounts of twisting upon the output of a wire recorder. Fig. 6 shows frequency response curves of three types of wire recording units.

This brings us to the general consideration of the frequency response of the system. As has been pointed out before, the spacing of the elements on the wire is a function of frequency and no matter how carefully we design the unit, there is always bound to be a drop off of efficiency at the higher frequencies. This is no great difficulty, however, since it can be largely overcome by the proper use of equalization in the amplifier.

Equalization consists of making the amplifier response greater to high frequencies and low frequencies than the response through the middle range. This equalizes for the drop-off in the response of the recorder and playback system at high and low frequencies. How the two response curves combine is shown in Fig. 7.

It is usually found advantageous to use not more than 3 db of pre-equalization at 3 kc, 9 db at 5 kc, and 15 db at 7 kc. One other type of trouble which occasionally arises is what is known as *cross talk* or *signal transfer*. This is the result of the proximity of several turns when the wire is spooled, resulting in transfer of magnetic force from one turn to the other. The severity of this factor can be greatly reduced, and generally is, in commercial models by perfection of the medium or wire. Some of the factors which are involved in this are (1) the retentivity and coercivity of the medium; (2) the shape of the magnetization curve, especially in the low region; and (3) permeability of the medium. Perfection of the composition of the wire in most cases also prevents another difficulty which was experienced by early designers of wire recorders. This factor is what is known as *modulation noise* and results from the non-uniformity in the magnetic properties of the medium. Modulation noise, however, is not always a result of medium variations, but may result from imperfections in the mechanical driving system which cause the turns in the wire to vary as it passes through the recording head. These latter causes, however, are fortunately very rare in the average commercially available wire recorder.

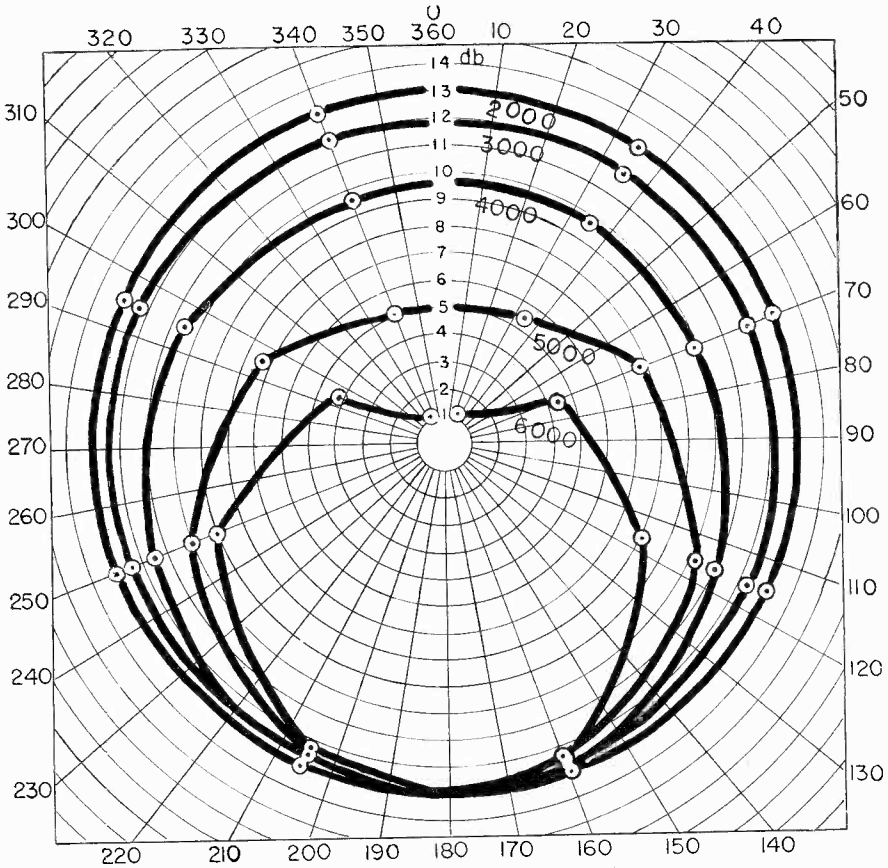


Fig. 5 Effect of wire twisting on frequency response. Figures on the outside are degrees of twist. Each curve represents an audio frequency and is labeled in cycles per second.

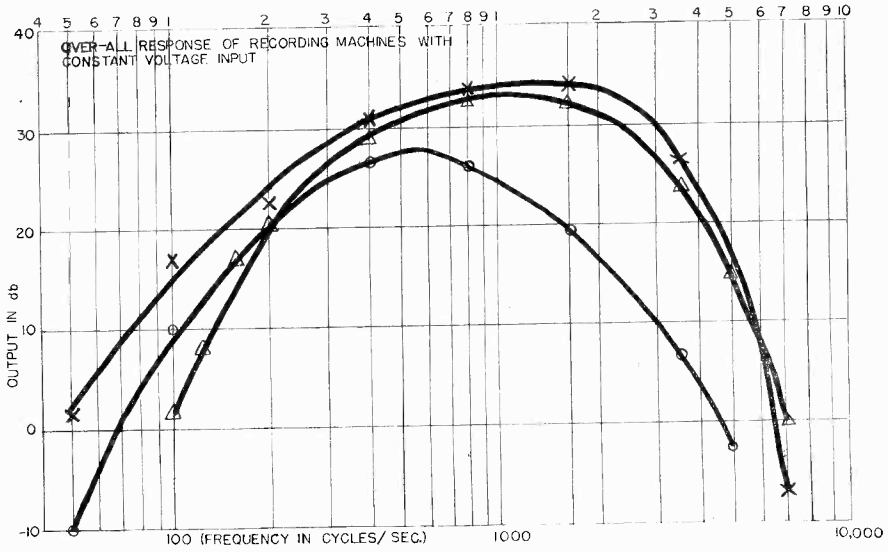


Fig. 6 Typical response curves of wire recorders.

We will now consider some typical examples of wire recorder units now available on the market and point out the particular features which are important in servicing work. To summarize the basic requirements for good operation, we will list the following: (1) The speed must be proper and must be uniform. (2) The speed must be

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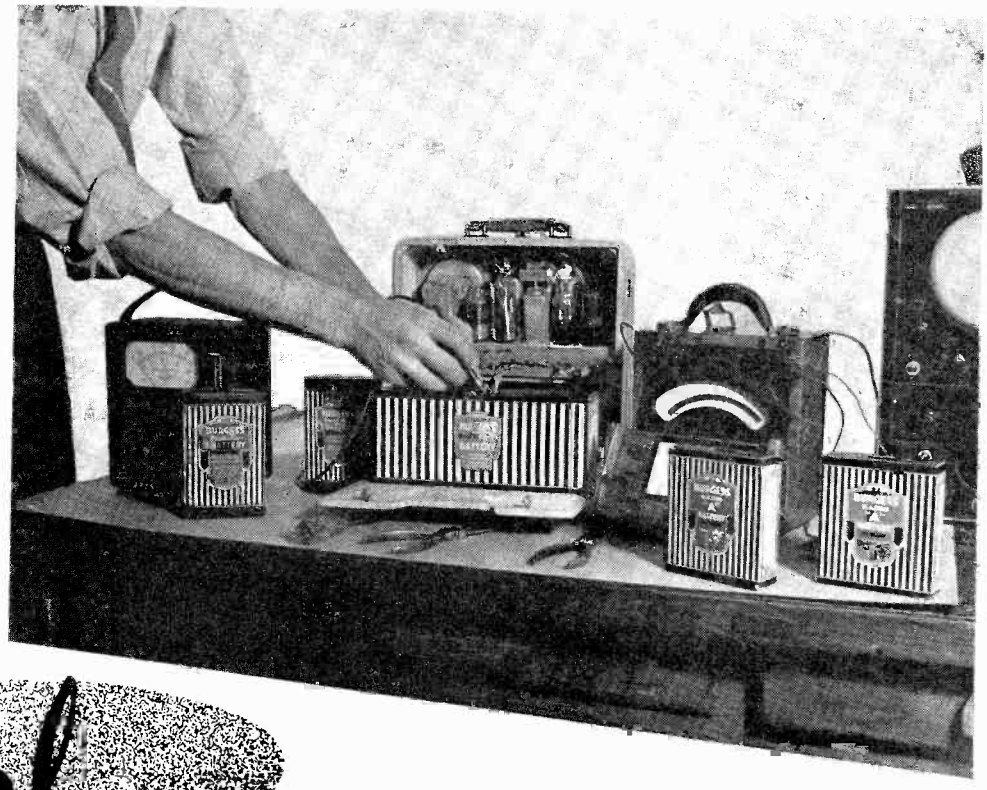

Rural Radio Servicing

by Jack Darr

Three-way portables and pocket radios make knowledge of rural battery powered receivers useful in city or country.

BATTERY powered receivers represent an important percentage of present day service work. City and suburban dwellers are again using many of these sets in the form of portables and three-way models. In many farm communities, however, the battery set has been predominant from the beginning of radio broadcasting. In any event, rural or urban, the battery set is here to stay for a long time, and familiarity with its special problems is a "must" for the efficient radio service technician.

Let's classify the battery type receivers most frequently encountered. They fall into the following general classes:

1. The "straight" battery receiver. This is the kind which uses A, B and sometimes C batteries.

2. The 6-volt household type of receiver. This class makes use of a vibrator pack and usually contains 2-volt tubes connected in series groups of three tubes per group.

3. The AC-DC battery pack receivers. These are the sets which use a high filament voltage tube as rectifier; the other tubes are battery types and get filament voltage from the plate supply or the cathode of the power tube when on AC operation.

Battery set design is almost standardized, due to the need for economical operation. Tube lineups and functions for the 2-volt and 1.4-volt sets are summarized in Table I. A typical battery set arrangement is shown in Fig. 1.

Test Equipment and Methods

A good electronic volt-ohmeter, signal generator and a condenser-tester will service any of these sets, although a signal tracer is also useful. The writer has on his bench a 1.4-volt and a 90-volt battery connected to a socket on a cable which feeds through a hole in the panel. There is enough spare cable to reach any part of the bench. This arrangement is very convenient when serv-

TABLE I

Function	2-volt, 4-volt	1.4-volt
Mixer-oscillator	1A6, 1C6, 1C7G, 1D7G	1A7, 1B7, 1R5
RF, IF amp.	32, 34, 1D5, 1E5	1N5, 1P5, 1L4, 1T4, 1U4
2nd Det.—1st AF	1H6, 1F7, 30-diode, 30 triode	1H5, 1S5
Power output	33, 950, 1F5, 1G5	1A5, 1C5, 1Q5, 3Q5

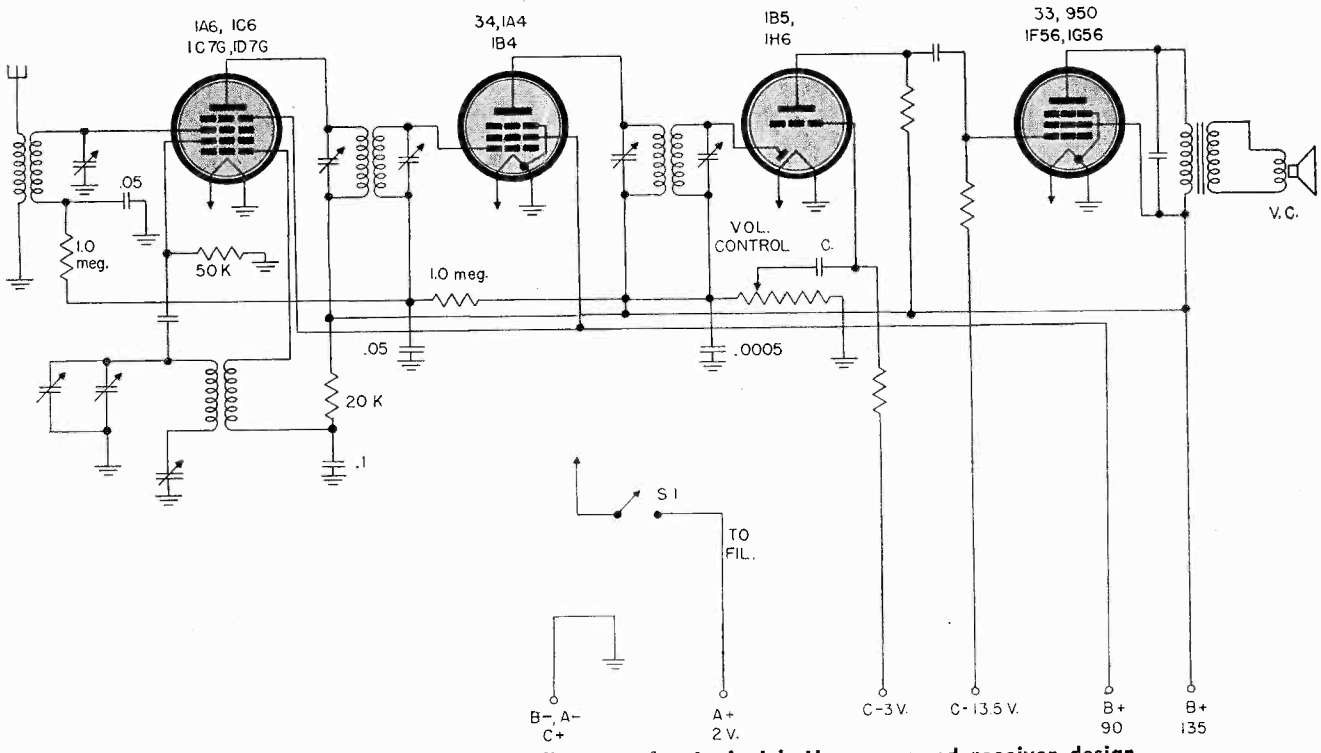

Fig. 1 A simplified schematic diagram of a typical battery powered receiver design.

icing sets with short battery cables. A milliammeter (0-20) is connected in the B-minus lead for checking leaky filters, plate current drain, etc. The battery itself includes six No. 6 dry cells for the A supply, and two 90-volt "B" sections from old packs, in parallel. Filament supply for 2-volt, 4-volt, and 6-volt sets may be obtained by bringing a lead from each cell of your bench car-radio battery to give 2, 4 or 6 volts. "B" supply for older sets requiring up to 135 volts may be had from a power pack made from the power section of an old AC receiver, with appropriate bleeders. A test speaker arranged to give impedances of 8000 ohms, 25,000 ohms, or the voice coil alone will match almost all sets. A good outside antenna and a good ground are essential for testing on the air. Equipment and layout suitable for battery set servicing are shown in Fig. 2 and 4.

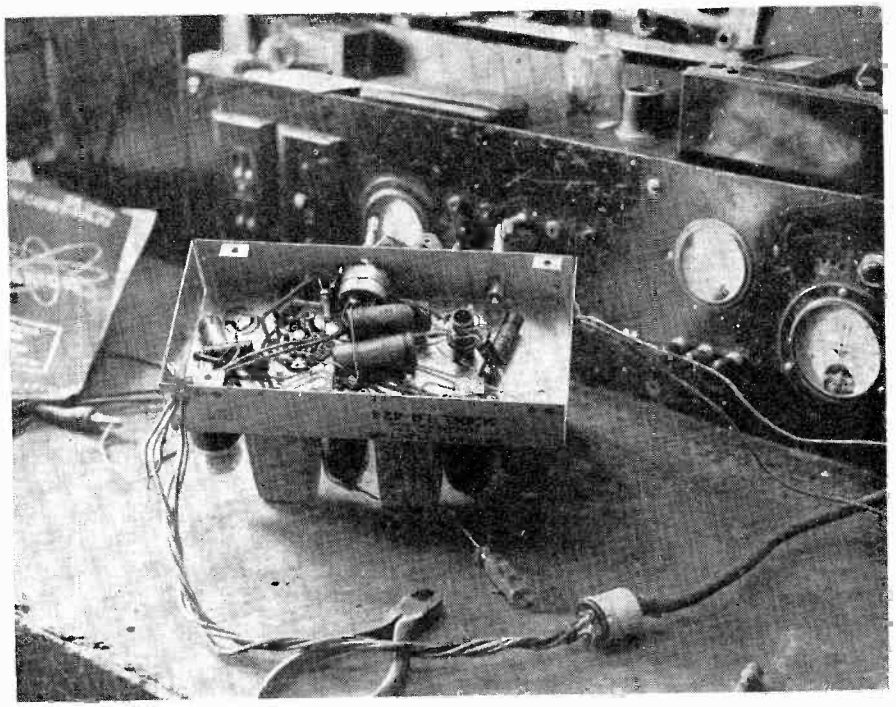

Fig. 2 A representative four tube 1.4 volt battery set of the kind discussed in the text. Note the milliammeter at the right reading plate drain. The author's extension battery-cable and plug are also shown.

Servicing Methods

Battery receiver servicing methods are conventional, with the advantage of not having to hunt hum in the power supply! If you are using the customer's battery, be sure it is up to rated voltage. Minimum usable voltage for the "A" section, which is critical, is around 1.1 volts. All battery voltage measurements must be taken under full load. Types of batteries used in standard receivers are illustrated in Fig. 3. It is a good idea to develop a routine for testing battery sets. I have obtained good results with the following procedure:

1. Test all tubes.

2. Check the battery cable and plugs for loose or bare wires and for proper connection to be sure the "A" wires are not on the "B" battery, etc. Never leave a bare spot on any battery wire as a short can burn out a full set of tubes in a split second.

3. Hook it up and turn it on. Be sure the antenna and ground connections are good. A poor ground

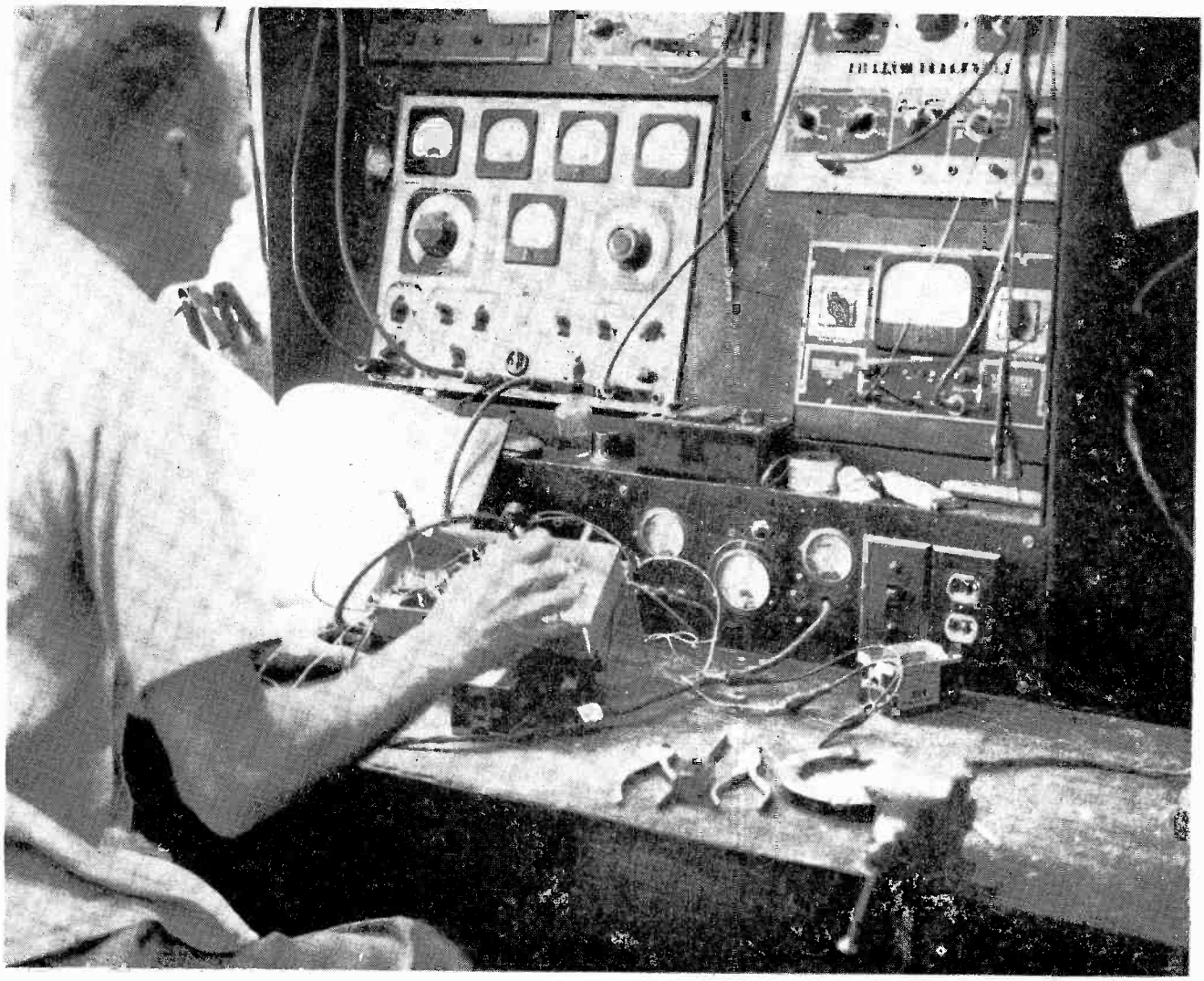

Fig. 4 The author working on a battery-powered receiver.

will result in loss of sensitivity and oscillation at the low end of the dial in some sets.

Sensitivity and selectivity on some of the lower priced sets can be improved by removing the loop and substituting a good antenna coil. This must be carefully matched and tuned. Check the performance of the set on your test stations. A station between 550 and 600 kc will provide an excellent check of oscillator performance. Failure of oscillator may result from several causes: a week tube, low filament voltage, a bad coil, a defective padder condenser, the oscillator grid leak changed in value, or (watch for this one!) a shorted "gimmick." A gimmick is two wires on top of the gang condenser, from stator to stator, twisted together. Moisture in a braid-covered wire here will ruin things. Check the oscillator grid leak. This resistor should be approximately 200,000 ohms for a 1A7 or a 1B7; 50,000 ohms for a 1C7, 1D7, 1A6, or a 1C6; and 100,000 ohms for a 1R5. Check the developed voltage across this resistor for a measure of the oscillator performance. DC voltage, which must be measured with a VTVM, should be about 15 volts at the low frequency end of the dial. Signal voltage with a signal tracer should be 25-30 volts.

Antenna and RF coils are standard. Some sets, such as 1942 Philco and earlier Zeniths, are critical. Factory replacements are recommended for these.

IF Section

The IF section in battery receivers is not much different from that found in the AC variety. Occasionally an extra IF stage using resistance coupling is inserted. Several standard approaches, well known generally, work very well with the battery type. A signal from a signal generator is fed into the receiver and output indication may be obtained with:

1. A VTVM connected from AVC to ground.
2. A signal tracer hooked to the diode second detector plate. (If the tracer is the tuned type, it must be adjusted to the intermediate frequency.)
3. Output meter connected to the last AF stage.

One of the most important factors contributing to instability in the IF section is a defective decoupling condenser. In AC receivers, the filter condensers in the power supply provide a decoupling effect to prevent oscillation. In battery types, even though filtering is not necessary, a good sized condenser is necessary to prevent feedback effects when the batteries act as a common impedance.

Now consider some of the most frequent troubles originating in the IF section:

1. *Oscillation and "birdies" at the low end of the dial.* This is an indication that the IF is tuned

to a broadcast frequency instead of the correct intermediate frequency. This often results from attempts of the layman to do home "alignment."

2. *The IF section breaking into oscillation when the trimmers are peaked.* This ordinarily is caused by a defective decoupling or filter condenser as described above. The condenser is usually a dry electrolytic having a value from 4 to 12 uf at 100 - 150 volts. It is connected either from B-plus or from B-minus to ground. Usually this is the only screen or plate return bypass in the whole set so an open unit or one with a high power factor (over forty per cent) will cause oscillation. Check for the presence of signal at the IF or audio frequencies across this condenser. Any signal voltage indicates a defective unit. High power factor condensers will have to be disconnected to give a correct check. Replacing the defective unit with a good condenser will quickly reveal this trouble. Always realign the IFs after replacing filter condensers as the change in the B-plus return impedance will change alignment considerably.

3. *Low volume due to high resistance windings in the IF transformers.* Check for this trouble with an ohmmeter. A good winding in a 450 kc section should measure from 10 to 20 ohms.

4. *Shorted multiple trimmers.* Some later sets use a multiple trimmer gadget which incorporates the IF trimmers and the two small IF filter condensers in one unit. These develop shorts and stop the signal although no effect is found with ohmmeter, due to 47,000 ohm filter resistor. Disconnect and check each part if the signal comes up to the last IF plate and quits!

Troubles in the 1H5 second detector-first AF stage are usually open plate resistors, leaky coupling condensers, both in and out of the stage. Plate voltage should measure 40-50 volts with a VTVM, through a half megohm load resistor.

Power Stage

Leaky coupling condensers into the power stage will cause loss of bias, sever distortion and high battery drain. Bias voltage should be checked at the output grid every time a set is serviced. Even a difference of one volt will give trouble. Most 1.4 volt sets use a self-bias circuit (see Fig. 5) with a resistor isolating the B-minus ground by the voltage needed; 4.5 volts is correct for a 1A5, 1Q5, or 3Q5; 7.5 volts for a 1C5. A short in the high voltage will burn out this resistor, which is usually ¼ watt, as it will shunt it directly across the 90 volt battery. Visual evidence of overheating will warrant replacement of the resistor. Check the bias voltage at the resistor, then at the grid, across the decoupling resistor. A difference in reading indicates a leaky coupling condenser. Check ouput transformers with an ohmmeter. The DC resistance of the primary should be around 400-600 ohms. Readings up to 2000 ohms indicate a high resistance joint. In this case, replace the transformer. Be sure to match the load impedance of the transformer replacement to the tube in use—8000 ohms for 1C5, 1Q5, 3Q5; 25,000 ohms for a 1A5. Watch the position of the leads as coupling between plate

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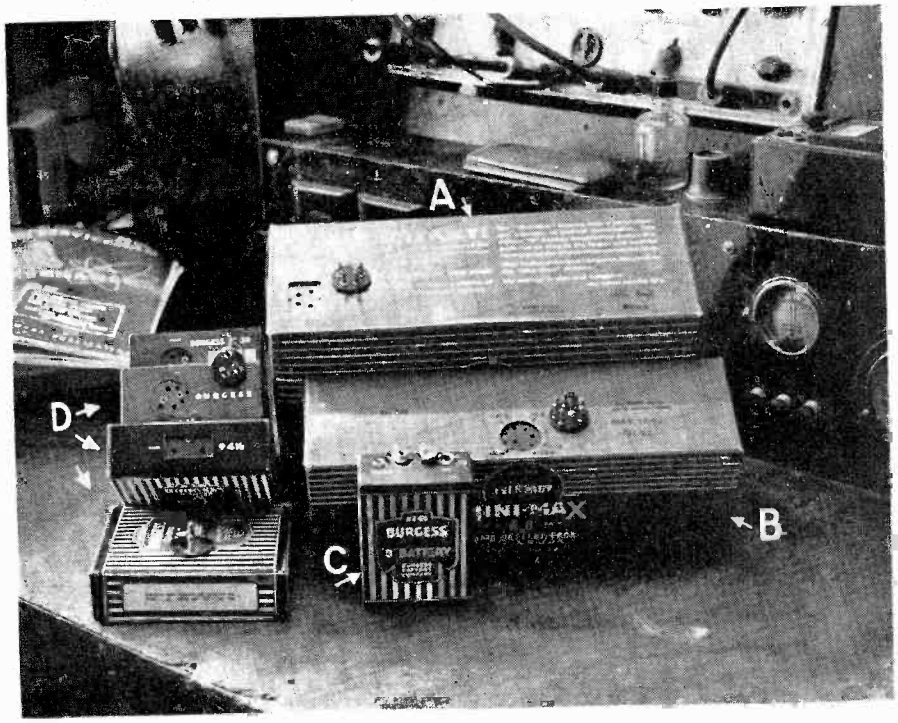


Fig. 3 Types of batteries frequently found in rural and portable receivers. A—Large pack, 1.4-90 volt pack for home battery sets. B-7.5-90 pack for portables. C-67.5 volt B battery for mini-portables. D—45 and 4.5 volt battery set for portables. Plugs used with each are shown lying on respective batteries.

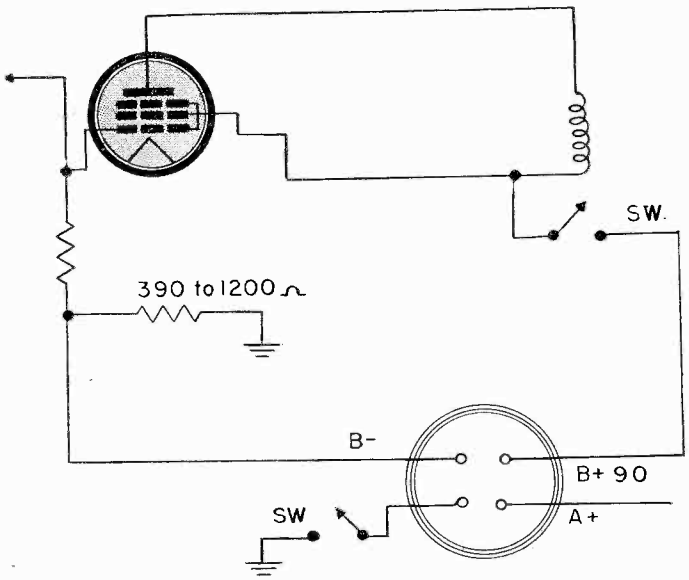
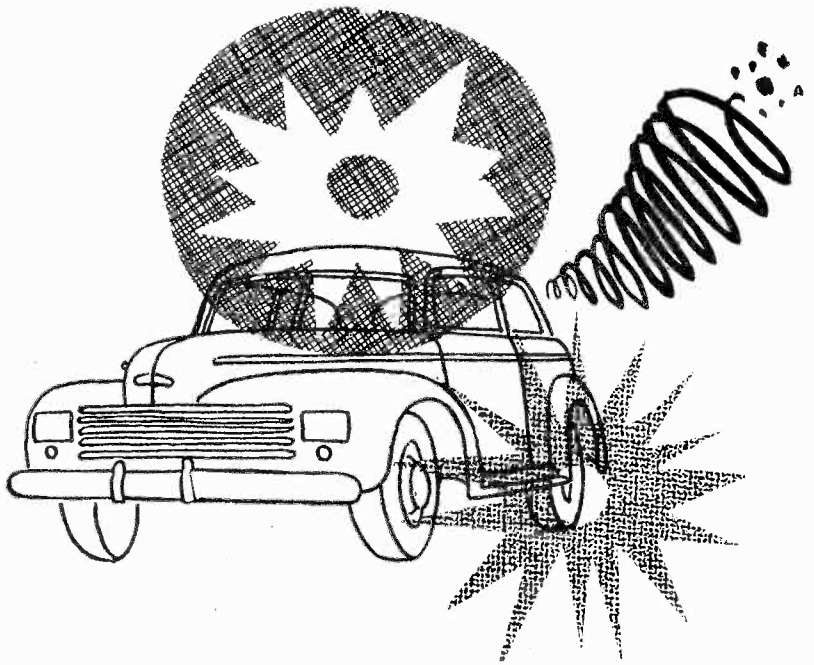


Fig. 5 Self-bias circuit used on nearly all 1.4 volt sets.



Auto Radio Noise Elimination

by Don Blair

The right adjustment here and there often makes a profitable job and a happy customer.

EVEN if you don't like it, the automobile radio receiver is here to stay. The radio service technician is going to continue to encounter plenty of the mobile type, and the noisy ones are popping up every day.

The little gremlins who live underneath automobile hoods thus have caused and will continue to cause a lot of headaches among the members of the radio service fraternity. They are the demons who cause noise in auto radios. However, like most other bogies, they

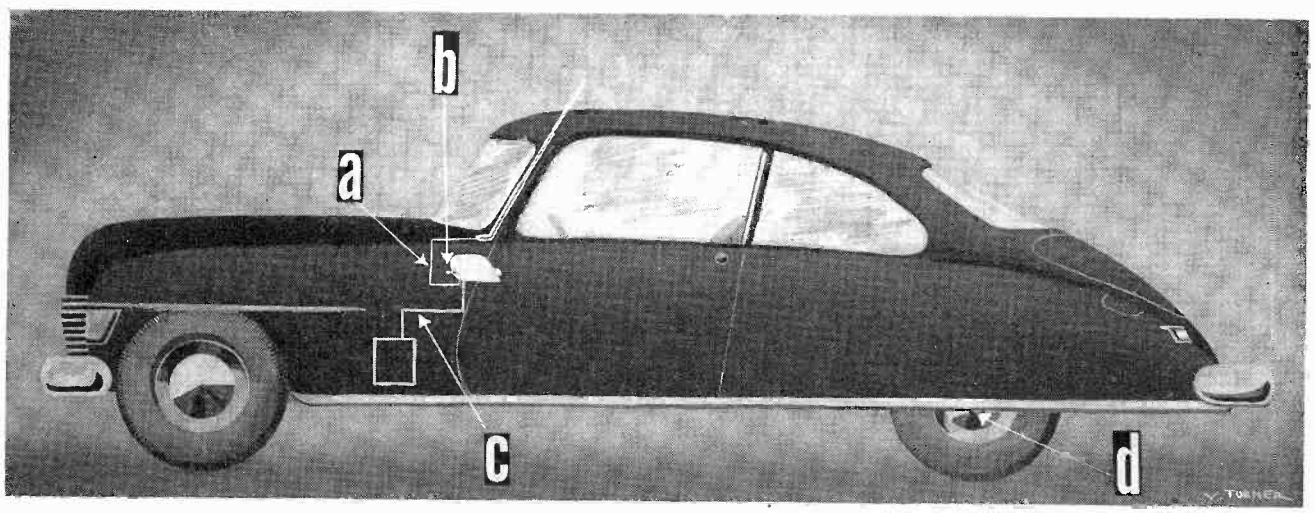


Fig. 1 Some of the critical points in eliminating noise: a—antenna lead in; b—point where the receiver is grounded to the car chassis; c—battery wire; d—wheels. Under seat heater hose also can cause trouble

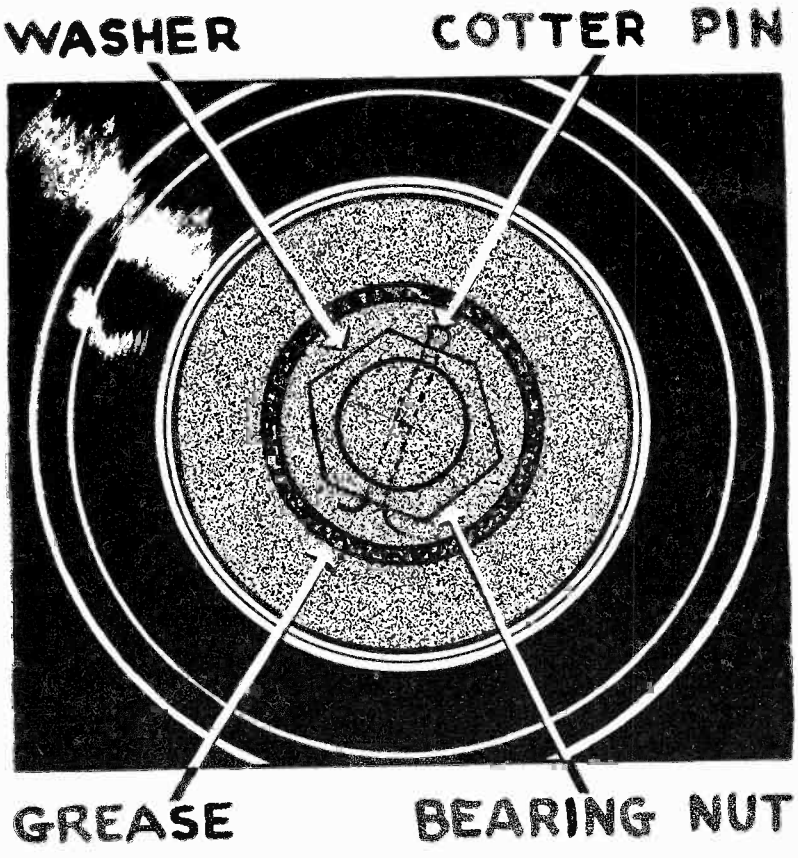


Fig. 2 Cross section of wheel hub, showing how static can build up.

cannot long survive when exposed to the light—we propose to expose 'em!

Battery Wire Noise

The first step in logically tracing auto radio noise is to disconnect the antenna. The second step is to start the motor, try it at varying speeds, and note the noise levels.

With a good installation, and with the receiver audio and tone controls turned high, there should be no ignition noise with the engine turning at constant speed. A little hash as the motor is accelerating or decelerating is to be expected and tolerated.

Now, remember that any noise in the radio must be sneaking in through the back door, on the battery wire, since the antenna is entirely disconnected. This noise must be gotten rid of before we can proceed further.

Here the generator bypass, the distributor supressor or bypassing condenser, and other factory recommended filters get in their good work. Noise must be reduced to the absolute minimum without an antenna if a good finished job is expected.

If the recommended filters are in place, and ignition noise persists, try experimental lead dressing under the dash while motor and radio are running—with the aerial still disconnected. It is often surprising what a little regrouping of jumbled wiring will accomplish.

A sometimes baffling source of noise can be brought inside the car on the water cooling system; where underseat heaters are supplied through lengths of rubber hose. Usually these must be shielded.

Common Ground Point

In this connection, dealing with VHF circuits has taught the effectiveness of establishing a common ground for each RF circuit or stage. This idea can be used in routing auto noise to oblivion.

Consider the steel box of the radio as the point of zero RF or noise potential. Add as large a part of the car as possible to this zero point by making doubly sure the radio is thoroughly grounded to the bulkhead, or to the dash if mounted thereon.

Use lockwashers!

If good sharp washers are at hand, pull the mounting bolts up snug; then with a punch and a hammer, drive the washer one-sixteenth turn in the direction of rotation. This will gouge each tooth of the lockwasher into the bulkhead metal, and through the paint, which a simple tightening of the nut may not accomplish.

This makes a neater job, with less effort than scraping or sanding the paint around the mounting holes.

Finally, tighten the mounting nuts.

Assuming that our installation is satisfactory up to this point, with the radio free from noise, we can plug in the antenna lead.

Antenna Noise Pickup

Once in a long time, just often enough to make it interesting, we get no noise through the aerial, and our job is done. But very much more often, noise comes through when the antenna connection is made, and we must trace it and short it out.

Noise can get onto the aerial, onto the lead-in, or onto an unshielded connection between antenna and lead-in.

To prove lead-in pickup—ground the antenna rod to the car body.

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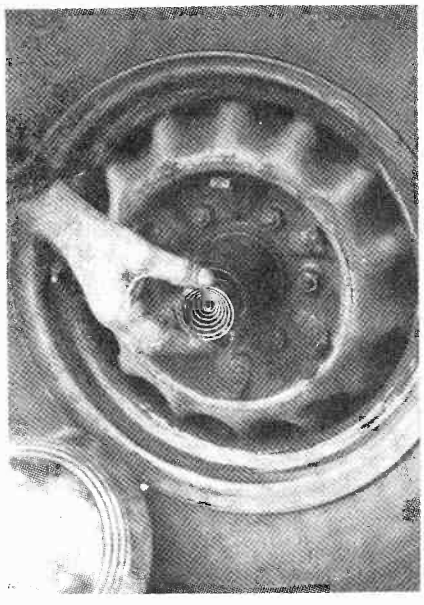


Fig. 3 Installing the wheel static eliminator.

Alignment Methods

by Irving Dlugatch

The service technician is confronted with a bewildering variety of circuits these days. A handy reference table to standard procedures is often a useful jog to the memory.

CIRCUITS that require alignment have multiplied rapidly since the birth of radio communications. The technician must be thoroughly familiar with all of them in order to restore a customer's receiver to its original efficiency. However, where so great a variety of adjustments may be met, it is increasingly difficult to remember the necessary details. The chart that follows is intended to provide the serviceman with a quick guide to standard methods of alignment thus obviating the need for time-wasting research.

Nothing in this chart is intended to take the place of information that can be obtained from the manufacturers. The correct way to align any receiver is the method used by the factory that produced it. Where such data are not available, generalized standard methods as herein outlined will suffice.

The following rules should be followed for best results:

1. Always use the weakest signal from your signal source which will produce output from the receiver.

2. Use appropriate insulated alignment tools to avoid hand capacity effects.

3. Do not connect the signal generator across a tuned circuit being aligned.

4. Do not connect the signal generator across an inductance which is directly in the magnetic or electric field of a circuit being aligned.

5. Always repeat the alignment at least once.

Chart of Standard Alignment Methods

Circuit	1st Step	Sig. Gen. Connect.*	Sig. Gen. Freq.	Meter Type	Meter Conn.	Adjust	Remarks
Neutrodyne	Open filaments or B+ to stage	Grid of previous stage or antenna post	Modulated RF any freq. in receiver range	AC Output	Plate of audio power ampl.	Neutralizing condenser for min. output	
TRF	(a) Dial set at 1400 kc (b) Dial set at 600 kc	Same Same	Modulated 1400 kc Modulated 600 kc	Same Same	Same Same	Trimmers for max. peak Slotted sections of tuning cond. for max. peak	Use of dummy antenna advised ***
AM Superheterodyne Selective IF	Short osc. tuning cond. Ground antenna post Stop AVC	Grid of previous or 1st detector stage	Modulated IF	Same	Same	IF trimmers for max. peak	

Chart of Standard Alignment Methods

Circuit	1st Step	Sig. Gen. Connect.*	Sig. Gen. Freq.	Meter Type	Meter Conn.	Adjust	Remarks
Fidelity IF	Same	Same	Modulated IF plus or minus 5 kc	Same	Same	**(a) Peak 1st IF to 5 kc below IF (b) Peak 2nd IF to 5 kc above IF	
Broadcast Oscillator and Antenna	(a) Remove osc. cond. short Remove ant. term. ground Dial set at 1400 kc	Ant. post or place hot lead near antenna loop	Modulated 1400 kc	Same	Same	Osc. trimmer then ant. trimmer for max. peak	
	(b) Dial set at 600 kc	Same	Modulated 600 kc	Same	Same	Osc. padder or slotted section for max. peak Slotted section of ant. cond. for max. peak	Rock tuning condenser for best peak
Short Wave Oscillator and Antenna	Dial at 16 mc or near high freq. end of each band	Same	Modulated 16 mc	Same	Same	Osc. trimmer then antenna trimmer for max. peak	Trimmers will be at minimum capacity. Peak is 2nd one as trimmer is opened.
IF Trap		Antenna post	Modulated IF	Same	Same	Trap for minimum output	
AFC		Grid of last IF	Unmodul. IF	DC VTVM	Across bottom diode resistor of discriminator	Discriminator trimmers for max. peak	Should be no change in control tube plate current as AFC is switched on and off****
FM Superheterodyne Ratio Detector		Same	Same	Same	Diode load resistor	Same	Identified by large condenser across single load resistor
Travis Discriminator		(a) Same	Unmodul. IF plus $\frac{1}{2}$ bandwidth	Same	Diode #1 load	Secondary #1 trimmer for max. peak	Identified by two separately tuned secondary windings
		(b) Same	Unmodul. IF minus $\frac{1}{2}$ bandwidth	Same	Diode #2 load resistor	Secondary #2 trimmer for max. peak	
		(c) Same	Unmodul. IF	Same	Across both load resistors	Primary trimmer for min. peak	
Foster-Seeley Discriminator		Same	Same	Same	Across one diode load resistor	Both trimmers for max. peak	

Chart of Standard Alignment Methods

Circuit	1st Step	Sig. Gen. Connect.*	Sig. Gen. Freq.	Meter Type	Meter Conn.	Adjust	Remarks
Summerhays Discriminator	Procedure the same as Foster-Seeley. Differs only in that one diode is reversed.						
IF	Procedure the same as for AM except that output meter will be a DC VTVM and it will be connected across grid leak of last limiter stage. With the ratio detector, the meter will be connected across the diode load resistor. Unmodulated signal used.						
Oscillator and Antenna	Same						
Television Video IF	Short osc. tuning cond.	Grid of prev. stage or 1st det.	Sweep generator with marker. IF frequency old-12.75 mc new-26.4 mc	Oscilloscope	2nd vid. det. load resistor	Trimmers for correct response curve‡‡	Freq. given are usual values
Audio IF		Grid of previous stage	Sweep gen. with marker. Center frequency old- 8.25 mc new-21.9 mc	Same	2nd det. (audio) load resistor	Same‡‡*	For slope detection, center freq. will be the low end of bandwidth
Traps		Conv. Grid	Trap freq. unmodul.	Same	Video 2nd det. load resistor	For min. output	
Discriminator	See FM Superheterodyne						
Oscillator and Antenna	Procedure same as for AM receiver for coarse adjustment. Final alignment best done with receiver connected to antenna with test pattern being received						
AFC (Automatic sync)	Discriminator slug adjusted to point where observation of raster shows instability then turned in slightly to lower frequency.						

NOTES:

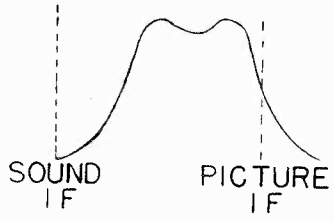
* A series condenser should be used whenever possible with the hot lead of the signal generator.

** This assumes "staggered" method of obtaining broad IF band. Some receivers use over-coupling and resistor loading and in these, all stages should be aligned exactly on the IF.

*** Since the alignment will be affected by the antenna used, it is well to attempt to duplicate factory methods. A standard dummy antenna consists of a 200 uuf condenser between the signal generator and a parallel circuit using a 20 mh coil shunted by a 400 uuf condenser in series with a 400 ohm resistor. The output of this connects to the antenna post of the receiver.

**** AFC alignment is done only after all other alignment has been completed.

‡‡



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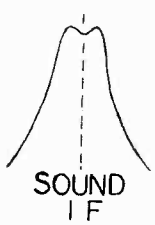

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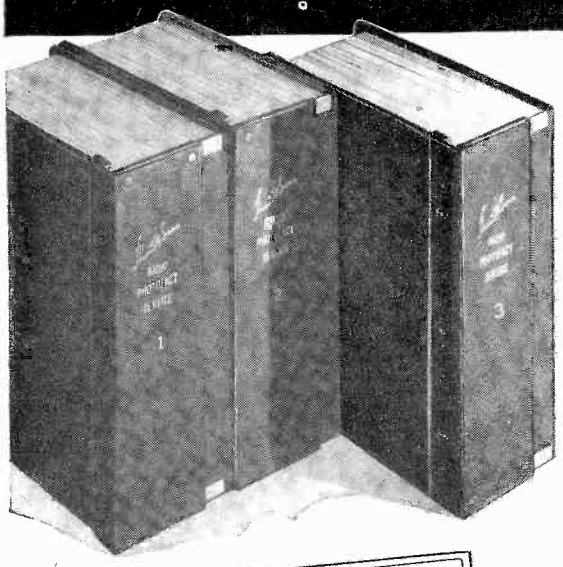

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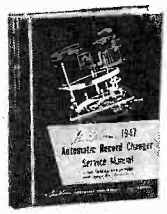

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the Organizations

Reports from all over United States and Canada are making it clear that the Radio Service Technician is finding membership in an organization of great benefit. Radio Maintenance has kept you informed by starting this column many months ago, and we have watched group activity grow. If you are an organization member, let's hear from you about your group activities.

WE'RE waiting for more complete news about the Radio Clinic for servicemen to be held in Philadelphia, January 11, 12, and 13. As mentioned before in this column, radio service technicians from far and near will be invited and the **Philadelphia Radio Servicemen's Association** will hold a convention and dinner. We know that committees are hard at work, and in the January issue we expect to have full details.

"The Associated Radio Technicians of British Columbia held their annual convention in the Stanley Park Pavilion on September 24th with an attendance of about 150. The convention opened at 9 AM with most of the jobbers showing a wide range of test equipment and parts in their displays.

"The technical discussions opened with a very interesting description on the 'Theory and Operation of Fluorescent Lighting' by Al Hurley. Dr. Frank Noakes described some of the electronic devices used in industry today, such as the latest methods and equipment used to locate breaks in power lines from the distribution point—much more efficiently than a physical examination of the line could do. Another electronic device tests the quality of concrete and metals by measuring the speed of shock waves through its mass. A third instrument tests the strain applied to a metal article or structure at any desired point. Dr. Noakes expressed his belief that the possibilities for employment of electronic engineers now in training are limited only by their ability to apply their knowledge in industry.

"After lunch, Jack Davies of C.G.E. demonstrated their new reluctance phono pickup, followed by Nick Foster, instructor at Edison Vocational School, Seattle, who spoke on the latest developments in FM and television. As FM servicing could be put to almost immediate application (FM transmitter is being installed in Vancouver) Mr. Foster went into great detail of circuits used by manufacturers in the United States and Canada and also discussed FM detection and antenna requirements. Speaking about transmitting problems, Mr. Foster stated that live talent should be used as much as possible. Disc jockeys are out if FM reception is to come up to the high quality entertainment most people are told to expect.

"After dinner, a very successful day was concluded with an excellent floor show."

S. Beyer, Publicity

New organizations are still joining our column. **The Radio Research Club of Portland,** Oregon, makes its debut with the following report.

The Radio Research Club meets every Thursday at twelve noon in the Multnomah Hotel. The meeting room is always announced on the lobby bulletin board. We spend half an hour for lunch, and an additional hour is spent on radio problems — business, technical, or

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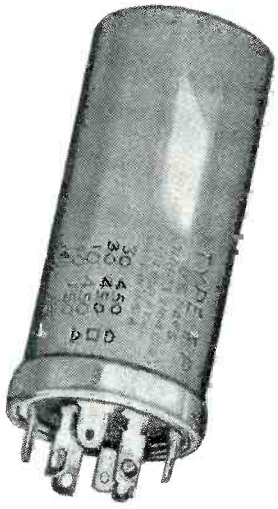
This photo illustrates one of the interesting media being used to tell the public about the advantages of radio service organizations. The Associated Radio Service Dealers of Columbus, Ohio, recently had seven of these reflector-type illuminated billboards erected. A "prorating" system shares the cost among the members.

What's The Indian Rope Trick Got To Do With MALLORY CAPACITORS?



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Rural Radio Servicing

→ From Page 11

leads and volume control will cause audio howl.

The later types of 1.4 volt tubes are all GT types with a metal collar connected to pin No. 1. This connection on the socket is used as a tie-point on some older sets for B-plus, AVC, etc. Check this factor when replacing G with GT tubes. This connection should have all extra wires removed and the lug connected to ground.

Switches

Switches should be checked, especially in intermittents. Most sets use a DPST switch, breaking the A-plus and B-plus leads. Occasionally, a DPST type will be found breaking A-minus and the ground end of the bias resistor. In emergencies, an SPST switch may be used to break A-minus and ground the end of a bias resistor. Check the contact resistance; even one ohm is enough to impair performance. So called "battery-saver" switches will be found in some sets which switch a 0.5 to 0.75 ohm resistor into the A circuit, and an extra resistor into the bias. If there is no perceptible difference in the battery drain, as is frequently the case, I suggest jumping the switch and leaving the resistors out of the circuit.

AC-DC Types

Now we come to those sets beloved of all radiomen, the AC-DC battery type. The major difference in these jobs is a series filament string, energized from a bleeder resistor in the high voltage, or from the cathode of the output tube. Some sets use a complicated switching arrangement, changing the filaments from parallel on battery position to series on AC-DC position. In most cases, they are left in series, switching the B-plus and the filament string from the "A" battery to the resistor (see Fig. 6). These resistors run around 2000 ohms, center-tapped for a large (20 - 40 uf) filter condenser. Some sets use a 3Q5 for battery operation and the pentode section of a 70L7, 117L7, etc., for AC-DC. The 3Q5 filament is usually left out when the set is on AC-DC, and the rest of the tubes are heated from the cathode current of the pentode section of the 70L7, etc. A bewildering assortment of shunt resistors, bypass condensers, etc., will be found in some sets. These are necessary to carry plate currents of preceding tubes around the other filaments. The 1H5 second detector is usually the last tube in the string, nearest to ground or common, to minimize hum potential between its filament and ground. The power tube, 3Q5, 1A5, etc., is usually the first. Filament voltage may be checked across the whole string by connecting a voltmeter to the load end of the resistor and common, and turning the set on. The voltage will rise slowly enough to enable you to turn it off if it goes above the correct amount. Overloads of more than one volt should be remedied to avoid short tube life. Filament voltage should also be checked across each tube as a weak tube will sometimes assume more than its share of voltage. Open input filter condensers will cause low filament voltage as well as low plate voltages as most rectifiers used in these sets are of the half-wave type. Hum is sometimes due to open or low filament filter condensers, though this is rare. Watch for substitution of a tube with incorrect filament current rating—1C5 for 1A5, etc., as the wrong drain will cause upsetting of the voltages on all the other tubes. Be sure to check the oscillator filament voltage as this can cause stoppage or weakness of oscillation.

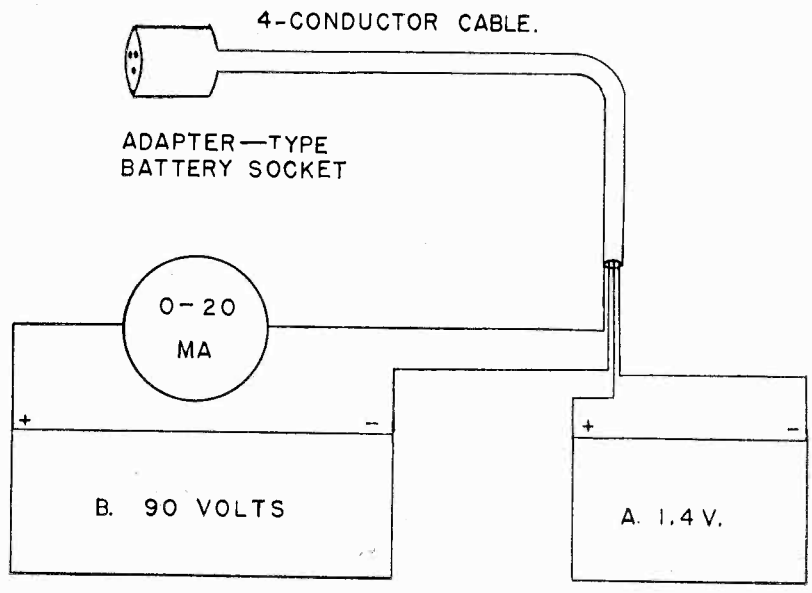

Fig. 6 Typical schematic of cathode-energized filament string. The on-off switch is not shown.

TABLE II

Original	Use	1.4 v. Type	Changes
1C7G, 1D7G	Osc. mixer	1A7, 1B7, 1R5	Change osc. grid leak to 200,000 ohms. Insert 8000 to 15,000 ohm screen filter, bypass with .05.
1D5G, 1E5G	RF, IF amp.	1N5, 1P5	Remove all screen dropping resistors, hook to 90 v.
1H6G, (1H4 diode, 1H4 triode)	2nd det. 1st AF	1H5	Plate load .5 meg., Grid resistor 10-15 meg.
1F5G, 1G5G	Pentode power output	1A5, 1C5, 1Q5, 3Q5	Install proper bias resistor; check output transformer for proper load impedance.
1H4 driving 1J6, 1E7	p-p output Class B	1G4 into 1G6	1G4 bias 6 volts. Bias cells may be used. 1G6 identical with 1J6.

Filament Conversion

There is still a market for conversion jobs in some places where there remain a large number of 2-volt and 4.5-volt sets. Types using octal based tubes are easily changed

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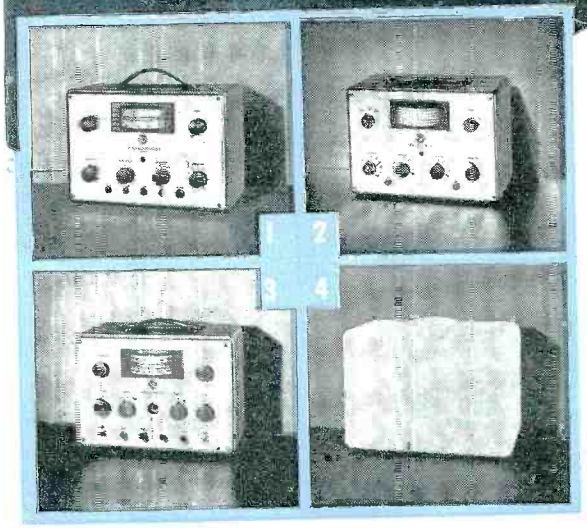

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About Wire Recorders

→ From Page 7

the same as that used for recording. (3) The tension in the wire must not vary. (4) The manner in which the wire is wound upon the spool must be regular and uniform so as to avoid snarling. (5) Provision must be made for rewinding the wire after recording is finished.

In Fig. 8 is shown a top view of the Silvertone Wire Recorder Unit. Notice that part of the mechanical system used for spooling the wire is also the turntable for the record player. The wire speed and sizes of the parts have been chosen so that 78 r.p.m. can be used with this turntable in both recording and record playing operations. Parts shown in the photograph are (a) the turntable, which also acts as a spool for the wire; (b) the supply spool; (c) the cutting head; (d) the automatic switch mentioned above; (e) the magnetic selector control; and (f) the phonograph pickup arm.

In Fig 9, the bottom view of the unit, is shown the motor and drive mechanism, which consists of a pulley driven by the motor; which pulley in turn drives the turntable. A very important part of any wire recorder is the recording head. A diagrammatic representation of the one used in this unit is given in Fig. 3. Notice that this instrument contains two coils: one is the recording and play-back coil, and the other is the erase coil. As can be seen in the diagram, the erase coil is connected through a switch to a 40 kc oscillator. The 40 kc oscillator is the source of bias voltage described earlier in the article, and is also used to erase previous recorded material on the wire so that it will be ready to take a new record. At the top of the main magnet is shown the position of the groove for the wire. Notice that it passes through two gaps: one is the recording gap, and the other is the erase gap. These gaps are quite small, on the order of one or two thousandths of an inch so that high magnetic concentrations can be built up and only a small portion

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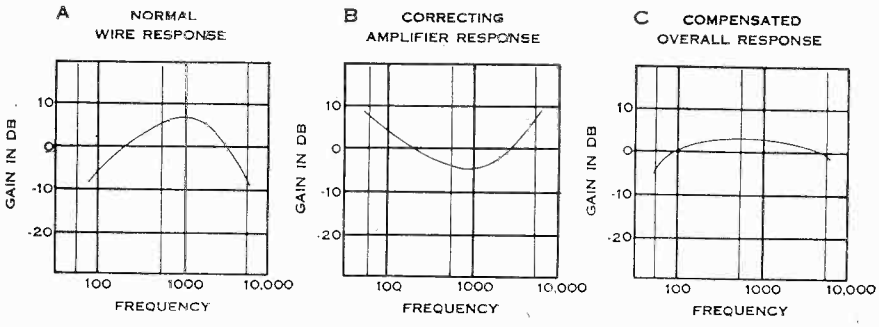

Fig. 7 How response is improved by equalization in the amplifier.

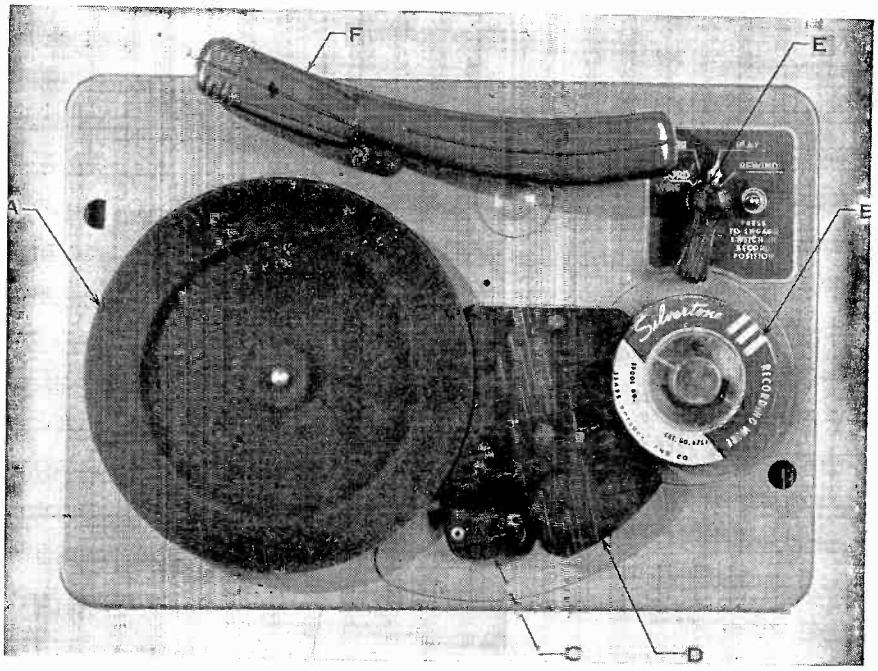

Fig. 8 Top view of the Silvertone wire recorder unit.

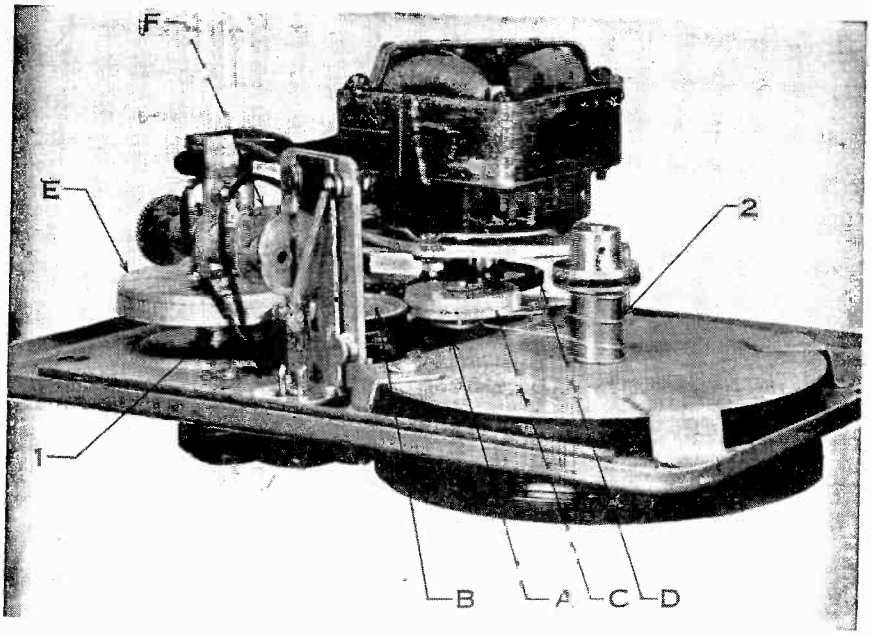

Fig. 9 Bottom view of the Silvertone unit.

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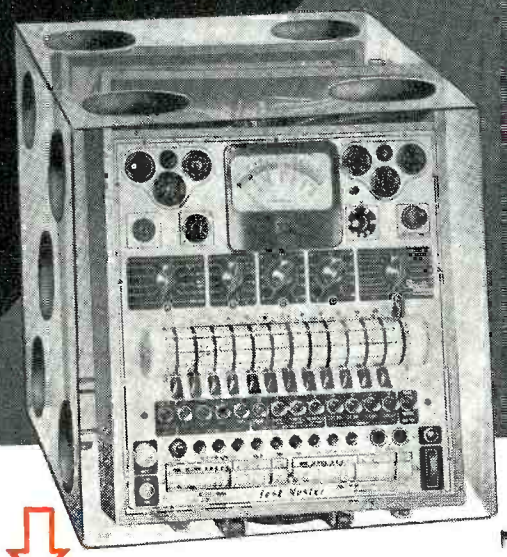

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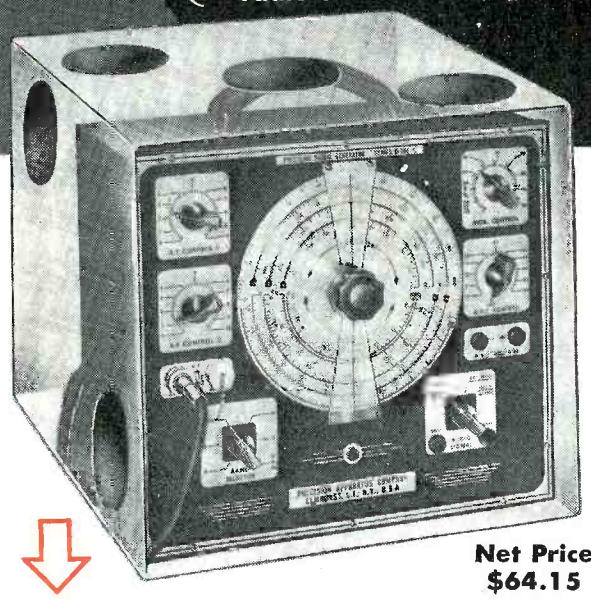

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Rural Radio Servicing

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over, and most 2-volt octals have corresponding 1.4-volt types. Converting older sets using 4-, 5- and 6-pin bases is not recommended as expense of changing sockets would be prohibitive. Table II shows a list of interchangeable tube-types.

When converting 4.5 volt sets, the filament circuit must be rewired to form a parallel circuit. Self-bias is used, with the power tube grid the only one to receive any voltage. Be sure that the AVC network has an actual ground return. The old battery cable is sometimes usable as only four good wires are needed. New four-conductor cable is not expensive, however, and will "dress-up" the job a lot. The standard RMA battery socket for 1.4-90 volts is shown in Fig. 7. When cutting cable, allow enough so that the battery may be placed on the floor under a table. Thirty inches outside the cabinet is enough. Extreme care is necessary in realigning, and a careful check of the completed job is well worth while.

Servicing 2-Volt Sets

The only difference here is in the battery requirements. Check your battery cables carefully. These are generally color-coded. Silvertone's color code is: Blue and Yellow, A-plus; Black and Yellow, A-minus; Red, B-plus; and Black, B-minus. This code is used on their 1.4-volt sets, also. It pays to note coding on all makes of battery sets as manufacturers generally use the same code from year to year. Silvertone's 4-volt sets use 2-volt tubes in pairs, and a 4.5-volt dry battery, or 4-volt wet storage battbattery. Be sure the set is actually

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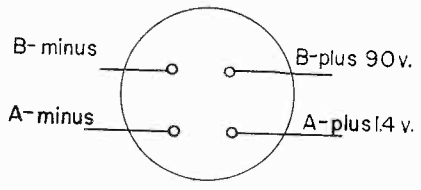

Fig. 7 RMA standard 1.4-90 volt battery socket viewed from prong side.

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a 4-volt type before hooking the "A" battery up. On these sets, if the oscillator is weak or dead, check on the filament voltage. The oscillator filament is usually connected in series with that of the power tube. A weak power tube will cause the oscillator filament voltage to be low.

General hints on connecting battery sets: Be sure set is turned *off* before making any connections; always check tubes before making any battery connections; then if tubes are blown, you know who blew them! This is mentioned because of the frequency with which battery sets come in with all tubes burned out, due to misconnection by the owner or others. Quick-check; pull out a couple of tubes and look at the filament tension spring (the "hook"). If the filament is open, the hook will be up against the top of the glass. These are definitely dead and you have saved testing them. Always connect "A" battery leads first. This gets them out of the way and insures against accidental contact with "B" batteries. Be very careful when testing voltages. An accidental slip of a test-lead will blow a whole set of tubes. (Voice of Experience again!)

Portables, large and "pee-wee"

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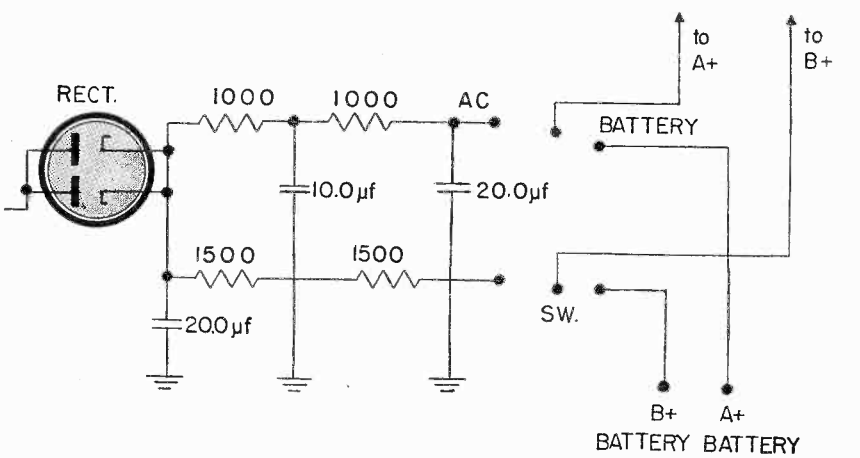

Fig. 8 Bench-testing battery hookup for 1.4 volt sets. Milliammeter in panel.

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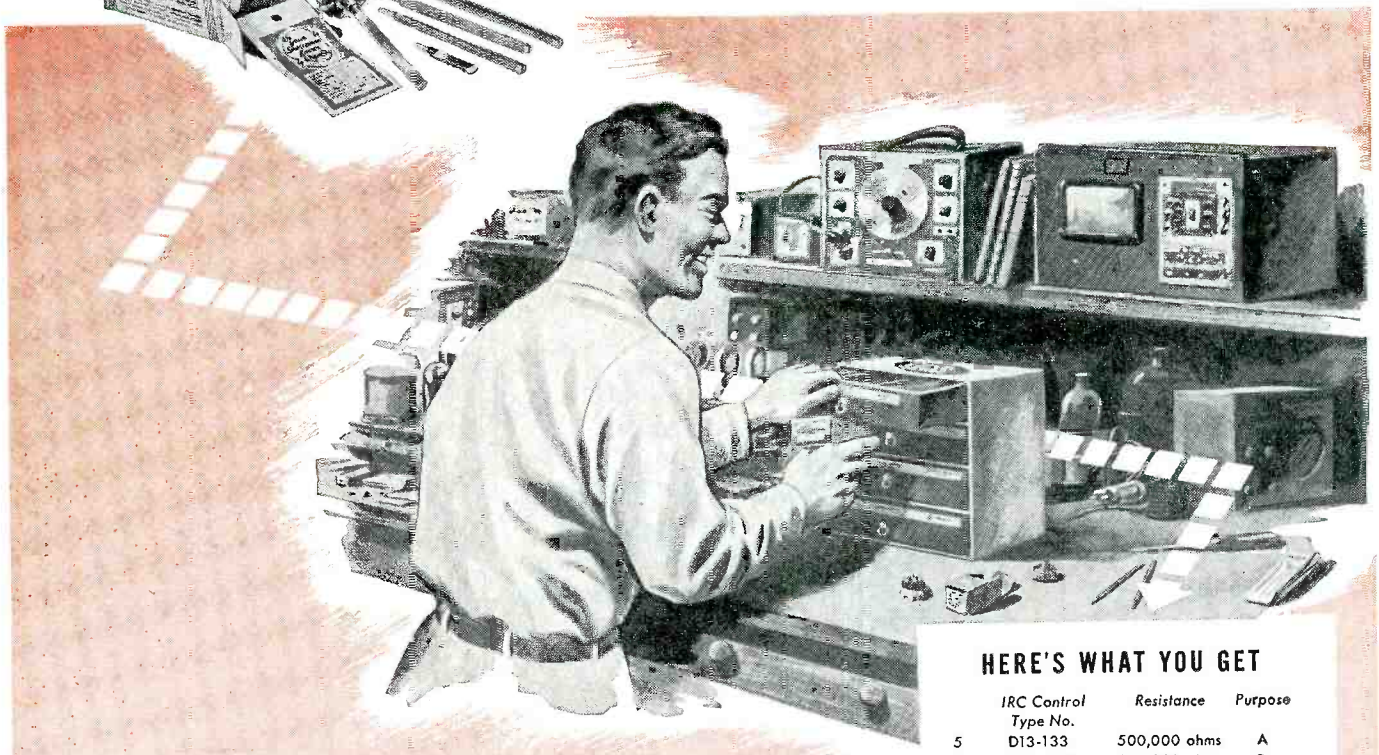

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About Wire Recorders

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of the wire is affected at any given instant.

The erase gap is five to ten times as great as the record gap. For high frequencies, it can be seen that a narrow gap will give better results since each cycle will take up a smaller element of the wire; whereas, conversely, a wide gap would be suitable for low frequency response. The wire material used on the Silverstone recorder is stainless steel with a diameter of 4 thousandths of an inch, and the speed is kept at about two feet per second. In case the wire should break, it can be mended by tying a square knot which will pass through the groove of the head without any difficulty.

Servicing problems in connection with this equipment are of two main types: namely, mechanical and electrical. Mechanical troubles which might occur are very similar to those encountered in ordinary record changer equipment and disc recorders which were described in the article on disc recorders in the

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will be fundamentally the same as the sets described above. These must usually work on a small loop alone; and with the very minute field strength of rural areas, they must be serviced and aligned very carefully if any results at all are obtained.

In conclusion, as with any other kind of set, a thorough, careful service job will pay off, with the added advantage that the farmer will usually be your good customer for life if you do him a good job at a fair price—but you will never see him again if you don't! His word-of-mouth advertising is better than any kind you could buy. From twelve years in a farming community, I know whereof I speak! I am sure you will find this philosophy applies to many other folks, too.

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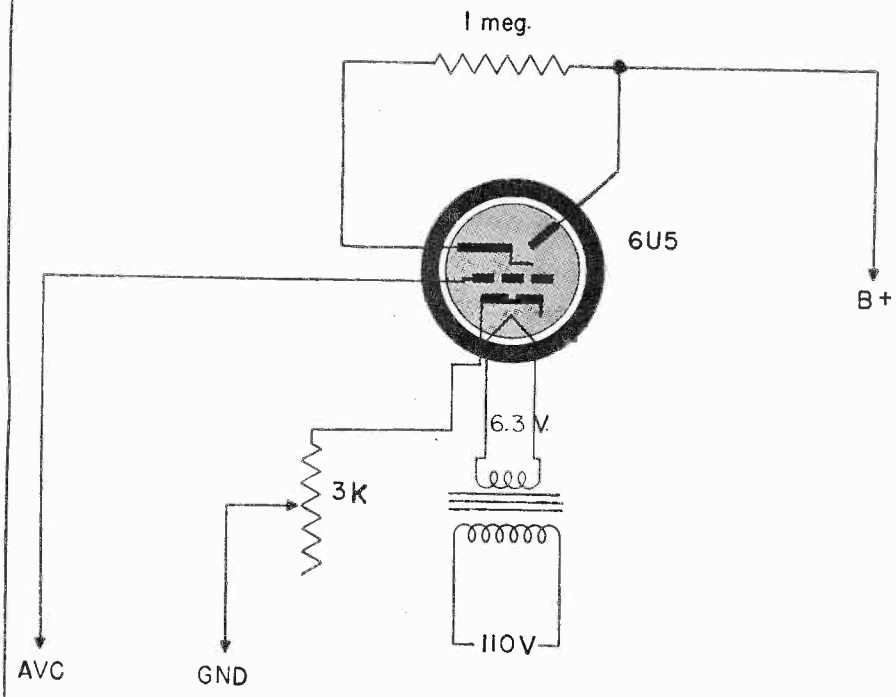

In the article "Gremlins—or Intermittents" by John T. Frye in the October issue of Radio Maintenance, a tuning eye tracer was described. Because of the many requests from our readers, we are publishing the above schematic diagram of that device. A photograph of the unit appeared on page 12 of the October issue.

About Wire Recorders

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October 1947 issue of RADIO MAINTENANCE MAGAZINE. However, there is the additional factor that the wire must wind and unwind in the regular fashion without variation of turns. This means that there must be no loose parts, brakes must be set properly, and the head should oscillate in such a manner that the wire will wind on a spool uniformly. Electrical points to be checked are relatively simple. The recording head windings should be checked for open circuits or shorts. The bias oscillator output should be checked for both frequency and voltage. The matter of frequency check at, for instance, 40 kc may seem a bit baffling but will be greatly simplified if the service technician will use the following method: Place the unit so that the oscillator is near or, if necessary, coupled to the antenna

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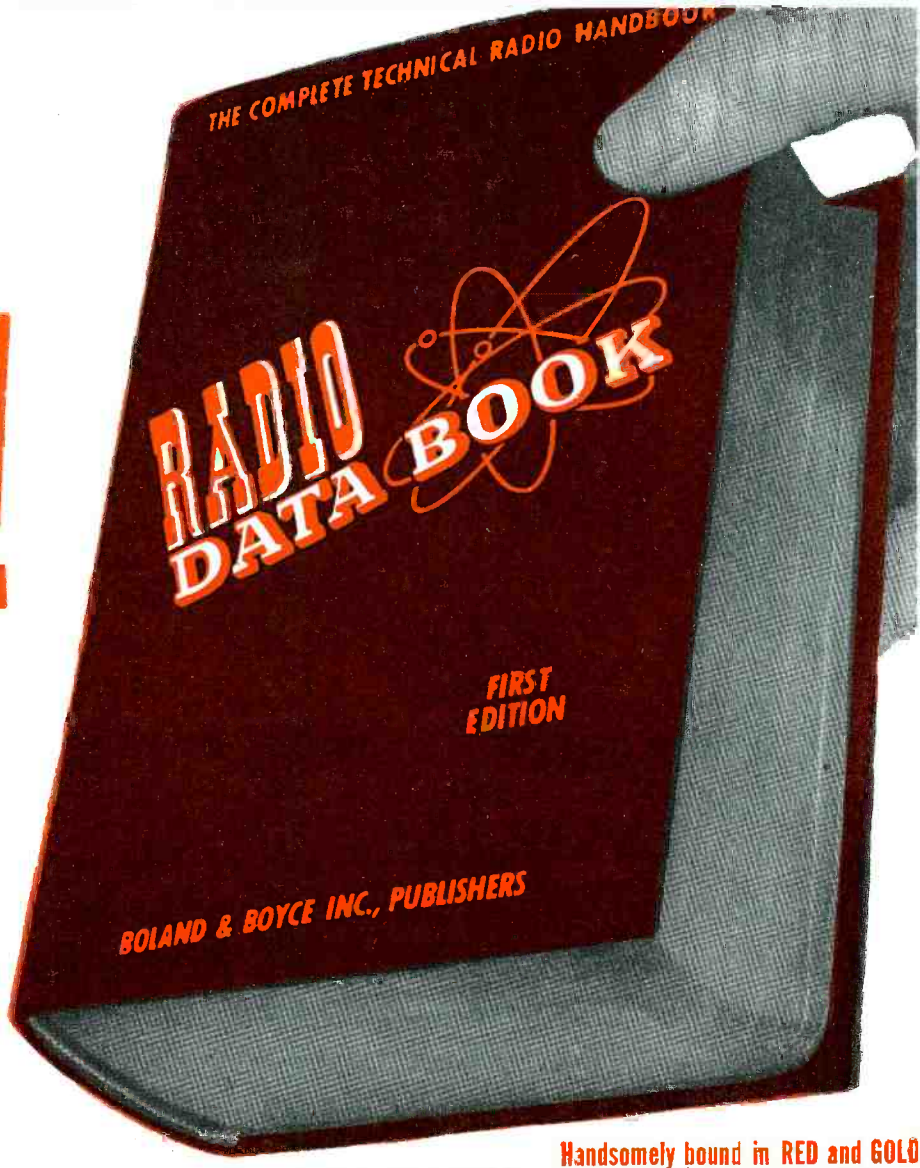

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About Wire Recorders

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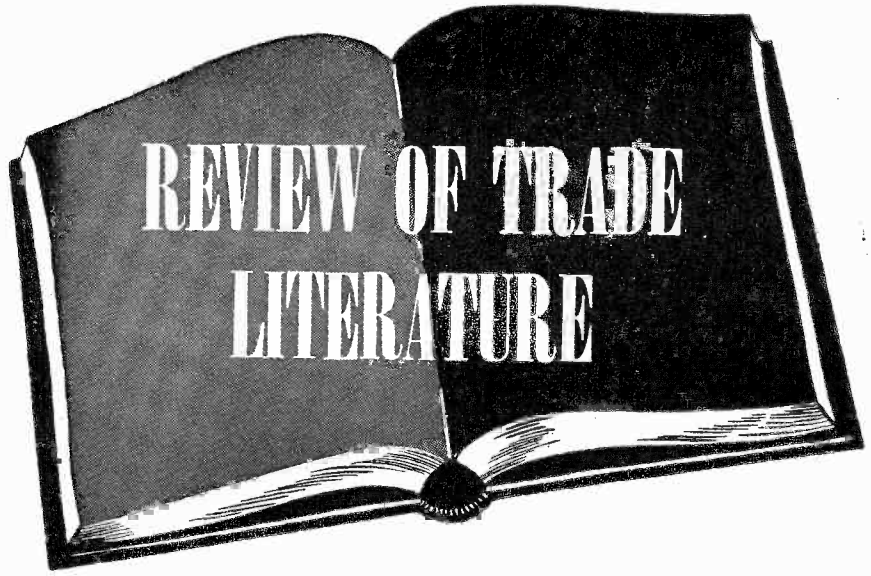
circuit of a good broadcast receiver. If the oscillator is oscillating, harmonics of the 40 kc frequency should be heard at various points on the dial of the receiver. The distance between these harmonic points, expressed in kilocycles, will always be the same and will be equal to the frequency of the oscillator.

Another point which should be remembered in servicing work is that many difficulties may arise from using an improper audio recording level. If the wire is overloaded, distortion will result during playback. It will also then be difficult to erase the wire for future recordings, thus some of the old recording will remain on the wire and will be audible in the background of any new recordings made. On the other hand, if insufficient audio level is used, the background noise level will be relatively too high and will be very annoying in play-back.



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

WALDOM Electronics Inc., manufacturers of speaker components, have issued a 16-page reference catalog on replacement cones. This catalog is a list of the models of over fifty receiver manufacturers and the proper speaker cone for each model is given. Also included in the catalog are illustrated instructions on how to replace a cone and how to find the replacement number for cones of unknown brands. Prices of all items are given. This booklet is designated Catalog No. 48, and can be obtained free. Write to Waldom Electronics Inc., 911 N. Larrabee, Chicago, Ill.

The General Cement Manufacturing Company has released illustrated literature on new products. Described in this literature are: carbon volume control cleaner, silver plating compound and four kits of assorted radio set knobs. Write for this literature to General Cement Mfg. Co., 919 Taylor Ave., Rockford, Ill.

The Stronghold Screw Products Corporation has just released a 32-page inventory of screws, nuts, bolts, and fasteners of all types. The line includes screws small enough to fit under the fingernail up to 2½" diameter bolts. To obtain this inventory, write to Stronghold Screw Products Inc., 216 W. Hubbard Street, Chicago 10, Ill.

The Hytron Radio and Electronics Corporation is presenting a line of literature and other sales aids. These include display cartons, reference guide for miniature tubes, "decal" advertising radio service and job record cards. Of special interest also is a combination pencil, eraser, and *tube tapper* which is available for 5 cents. It is useful in tracing intermittents and it fits nicely into the smallest sets. The above material is all available through your local Hytron distributor.

Cornell-Dubilier's Bulletin NB101 describes the new T121 television voltage doubler capacitor. This capacitor has a rating of 7500 v. DC and has two .075 ufd sections. For full details write for Bulletin NB101, Cornell-Dubilier Electric Corp., South Plainfield, N. J.

The E. W. Pike Company has issued a leaflet describing the "Flash-O-Lens." This instrument is a combination magnifier and flashlight. It is designed for inspection work and magnifies and illuminates small objects. It should be useful in service work for examining small objects in "out-of-the-way" locations. The leaflet contains photographs, descriptions and prices of the various models available. To obtain this leaflet, write to E. W. Pike Company, 492 North Avenue, Elizabeth 3, N. J.

Concord Radio Corporation's 1948 Catalog has just been released.

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SPRAGUE TRADING POST

FOR SALE—Rider's manuals, 14 separate volumes—1 to 14 inclusive, in good condition complete with index, $130. Wm. H. Carr, Boothby Park, Saco, Me.

FOR SALE—Rider Chanalyst with attachments and instruments, good condition, $80; also Superior 400 Electronic multimeter, almost new, $35. Ellis' Automotive & Electric, Perryton, Texas.

FOR SALE—Davard 27, 6 toggle tube tester, $10 with instructions. Roy K. Brandt, Fort Atkinson, Iowa.

FOR SALE—12 tube super skyrider Hallicrafter radio AX16, with 5 new tubes, 6 bands, in good shape. James F. Morgan, 811 Park Ave., Anderson, Ind.

WANTED—All kinds of war surplus radio equipment will swap or pay cash. Also have parts, tubes, etc. Wood Radio & Electric Shop, 2036 Chalfant St., Wilkinsburg, Pa.

FOR SALE—Precision 920-P tube and set tester; also R.C.A. signal generator, 167-B, $75 and $60 respectively or both $125. T. J. Neumeister, 2110 Park Ave., Minneapolis 4, Minn.

FOR SALE — Sams Photofact folders with binder, never used, $23. H. Opel Radio Service, Melbourne, Ky.

FOR SALE—Hallicrafters S-40 receiver about 6 months old; New Maguire 7 tube radio phonograph, twin post changer plays records with lid closed; has AVC, tone control, 5" x 7" dynamic speaker, slide rule dial, crystal pickup with permanent needle in table cabinet, $69.80. R. R. Schmidt, Jacksonville, N. C.

FOR SALE—Webster-Chicago $820, 20 watt, 110 volts a-c, 6v d-c amplifier and phono, complete, extra vibrators; 2 Utah 12" pm speakers in carrying case; Amperite PGAH h.i., dynamic mike, all in A-1 condition, $150. F.O.B., J. Starr, P. O. Box 422, White Plains, N. Y.

FOR SALE—NRI red dot signal generator will tune from 130 kc to 28 mc, complete with voltohm-milliameter measuring up to 1500 v, current to 15 A and resistance to 20 megohms, $25; 1210A tube tester with instructions, $10; BN capacity bridge condenser tester, $10. All in good condition. George Lane, Clarendon, Ark.

WANTED—Riders manuals, good signal generator, amateur parts. Very urgently need 10 to 15, 3½" meters and about 25 misc. transformers. What have you. Eddie Howell, Gastonia, N. C.

FOR SALE—New, standard brand tubes, sealed cartons, 50 to 80% off. 50L6—59c; 35Z5—49c; 70L7—79c; 12SK7—59c; 9001 or 9002—79c; 6J6—69c. G.E. 5" PM speakers, 1 oz. magnet—$1.45—with output attached—$1.89. ½, 1 & 2 meg. vol. controls with switch—47c. Write for catalog. Commercial Radio, 36 Brattle St., Boston, Mass.

WANTED—Second hand American model RC crystal microphone with cable, good condition. State price post paid. All letters answered. C. B. Cowper, 58 Rhyl Ave., Toronto, Canada.

WILL TRADE—1935 Pontiac, 4-door sedan, excellent condition, radio and heater, $250 value. Wanted — complete radio testing equipment. Send list. Leonard Ginsberg, 1553-46 St., Brooklyn 19, New York.

FOR SALE—Hickok 203, new, perfect $70; Silver 904, new, perfect $39.50; two letter size duplicators $20 each. Sporna Radio Service, Escatawpa, Alabama.

WILL TRADE — RCP-447 VOM new, Readrite 431 tube tester, radio magazines. Want signal generator. John Moskal, 85 Gardner Ave., St. Attleboro, Mass.

FOR SALE—Nationally advertised and guaranteed signal tracers, list at $24.95. Will sell at $18.95. Edward Howell, General Delivery, Gastonia, N. C.

FOR SALE — Transvision television receiver with antenna, latest factory changes, excellent condition $140; Hallicrafters SX25 perfect on 10M, $100; Suncraft sunlamp 100% pure ultraviolet rays, like new, $45. Gordon, 182 Hegeman Ave., Brooklyn 12, N. Y.

FOR SALE—Instructograph with 7 tapes and built-in AC-DC oscillator, perfect, $15. R. A. Fox, 7912 S. E. Alder St., Portland 16, Oregon.

FOR SALE—RCA 833 tube and G.R. socket, both new, $15 or will trade for SCR-522 or APN/1 or BC-929A or BC-946B. R. D. Jablonsky, 5332 Gladstone, St. Louis 20, Mo.

WILL TRADE—$1,000 in radio parts. Want—photographic and enlarging equipment or accessories. C. A. Norwood, 824 S. Aycock Street, Greensboro, N. C.

FOR SALE — Electronics Development Laboratory #41 oscilloscope, used three times, good as new, cheap. Hall's Radio & Electric Company, Ltd., Eupora, Miss.

FOR SALE — Vision-television coil kit #500; design and construction of a 7" television receiver booklet; 17" x 13" x 3" heavy aluminum chassis. All for $8. Max Spies, 533 E. 150th St., Bronx 55, New York.

WANTED—Small hand operated adding machine, Victor or Corona preferred. Brickley Electric, Farmland, Indiana.

FOR SALE—New Electromatic phonograph, 3 tube radio amplifier, 6" speaker, astatic pick-up, tone and volume control, on-off switch, light indicator, leather case, 2 locks, $20. Herman Fischer, 626 Carlton Ave., Brooklyn 17, N. Y.

FOR SALE—Abbott TR-4 converted 2 meters and SW-3 receiver with four sets bandspread coils and headphones; will trade one or both for transmitter power supply parts, approx. 100 watts. E. V. Stolberg, 1029 E. Knapp St., Milwaukee 2, Wis.

FOR SALE—BC-348 receiver converted for 110 A.C., $55; BC-545 receiver with dynamotor less tubes, $4; 70 mil 28-270 v. dynamotor $3.00; BC-348 conversions & repairs made for cash or trade. E. G. Schwartz, 134 Weber Street, Havre de Grace, Maryland.

FOR SALE—Remains of radio stock, cheap. New and used parts, tubes and supplies. Send for list. Eddie Howell, General Delivery, Gastonia, N. C.

FOR SALE—Model 140 Sylvania tube tester $75; Solar exameter condenser tester $55; like new, purchased April 1947; Rimco dynalyzer, 1940, good working condition $45; Sams Photo Fact, #1 thru #21 with binders, $35. Joseph Wunderlich, 236 W. Brooks St., Galesburg, Illinois.

SALE OR TRADE — Japanese radio 6 volt dynamotor with standard American tubes, 140 KC-20 MC. Want Phono oscillator with motor and pickup. Inquiries answered. Jack Jones, Box 809, Custer, S. Dakota.

FOR SALE—BC-348R receiver practically new with enclosed 110v, 60 cycle a-c power supply $60. Want HQ-120X or HQ129X. L. F. Barker, Apt. 7, 2109 Harbert Ave., Memphis, Tenn.

WANTED—Information and data on conversion of Bendix TA-12B transmitter, other than that furnished with purchase of unit. F. King, 18 Helena, Larchmont Manor, N. Y.

FOR SALE—Hallicrafters receiving set S-38. W. Glick, 339 Hawthorne Ave., Newark 8, N. J.

FOR SALE—NC-46 receiver used only three months. Arthur S. Groff, 1050 Lehigh St., Allentown, Pa.

WANTED—Good ham receiver with or without speaker such as SK-25 or better. Have Schneider f2.9 10cm lens in ring set compur shutter on 6 x 9 cm box with spring back also Federal 312 enlarger with f4.5 & 6.3 lens, new. Doug Stewart, Arcadia, La.

FOR SALE—3 tube Meissner ac-dc receiver complete with new tubes and set of four coils covering 545 to 17 meters, with instructions and pair of earphones for use with set; all in excellent condition, $17.50 postpaid. Sheldon Dunham, Box 121, Cary, N. Car.

WANTED—Hallicrafters SX-28A or SX-42 in good condition; will accept best offer. Walter J. Bartell, 1107 N. Western Ave., Chicago 22, Ill.

SELL OR TRADE—Tube tester, BC-342 in A-1 shape; ham and service gear. Will exchange lists. H. G. Smith, Park Homes, 50, Brownwood, Texas.

FOR SALE — Oscilloscope transformer, 100v, a-c, 60 cycle, 1100v, 780v ct, 5v ct, 2.5v ct, 2.5v, 2.5v, 2.5v; low voltage windings okay for amplifier, rectifiers and cathode ray tube heaters. $7. Anthony Brocato, Jr., Box 1344, State College, Miss.

SELL OR TRADE—Bug speed key hardly used, worth $17. Want ham gear. B. L. Blanks, Box 86, Milledgeville, Ga.

FOR SALE—Hal. R-100/URR receiver in black wrinkle case with BFO, Bandspread; send/receive sw's added, good condition. f.o.b. A. L. Albright, 81 Beauregard, Maplewood, La.

FOR SALE—N.R.I. vacuum tube voltohm meter complete with tube, batteries, test prongs, $10 postpaid. Ben Marcond, 120 Gatling Place, Brooklyn 9, N. Y.

SELL OR TRADE—2 meter mobile transceiver with built in vibropack, complete and small walkie talkie for 2 meters, complete, new batteries. Want multitester or any type usable test equipment. F. R. Dugas, W3WTT, 1812 Mary St., Pittsburgh 3, Pa.

WANTED—Used communications receiver in good condition. Must tune 80, 40, 20 & 10 meters. Give complete description and price. F. J. Hackett, P. O. Box 182, Keewatin, Ont. Canada.

FOR SALE OR TRADE — New RCA Rider chanalyst. $145 or trade for new Hickok 288X. J. Stark, 1111 E. 15th St., Brooklyn 30, N. Y.

FOR SALE—SX-28 Hallicrafters used 3 months, $150 or what have you to trade. Maurice J. Ojserkis, 5701 Atlantic Ave., Atlantic City, N. J.

SELL OR TRADE—Hallicrafters S-38 ac-dc broadcast and longwave band, $45 express prepaid; also Springfield 22 rifle #15 single shot new, $7.50. John Moy, 136YE79, Box 169 Canal St. Station, New York 13, N. Y.

The Organizations

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whatever might be before the trade at the moment. Generally business and technical meetings are alternated. The name of the club is rather misleading as no actual research is done—unless you might call our delving into problems affecting radio business 'research.' There are no dues and no fees other than the cost of the lunch. We have a rotating chairmanship so everyone gets a chance to participate. We have several committees, technical, entertainment, apprentice school, etc. Most of the members are affiliated with the Northwest Appliance Dealers which work closely with us on our problems when the occasion arises.

"We believe we have accomplished much good for the trade and the individual members if only by meeting and getting to know each other."

R. D. Thomas

"The Log," official publication of the **Associated Radio Technicians of Alberta**, comments as follows in its August issue:

"In a recent survey of the radio trade it has been found there are some 50 radio servicemen's associations in the United States and Canada. It would appear to be about time for some of these to amalgamate and produce a parent organization to which all might belong.

To which we wish to add our approval. Radio service technicians' organizations represent a mighty important part of our society and by working together they can be an even greater influence for good, both for themselves and the radio listeners of North America. Members of organizations are experiencing the good which can be realized from group action; "continent-wide" coordination of efforts is certainly not such a wild dream and offers the possibility of great benefits to all concerned. Efforts in Pennsylvania and Alberta show that things are already moving in this direction. ✓ ✓ ✓

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946, of RADIO MAINTENANCE published monthly at East Stroudsburg, Pa.

State of New Jersey } ss.
County of Essex }

Before me, a notary public in and for the State and county aforesaid, personally appeared William F. Boyce, who, having been duly sworn according to law, deposes and says that he is the publisher of RADIO MAINTENANCE, and that the following is to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily, weekly, semiweekly or triweekly newspaper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Acts of March 3, 1933, and July 2, 1946 (section 537, Postal Laws and Regulations), printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, William F. Boyce, 460 Bloomfield Ave., Montclair, N. J.; Editor, Joseph J. Roche, 460 Bloomfield Ave., Montclair, N. J.; Managing Editor, J. Richard Johnson, 460 Bloomfield Ave., Montclair, N. J.; Business Manager, Paul H. Wendel, 460 Bloomfield Ave., Montclair, N. J.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) Boland & Boyce, Inc., William F. Boyce, Joseph J. Roche, Mary Ann Boyce, Howard Shonting.

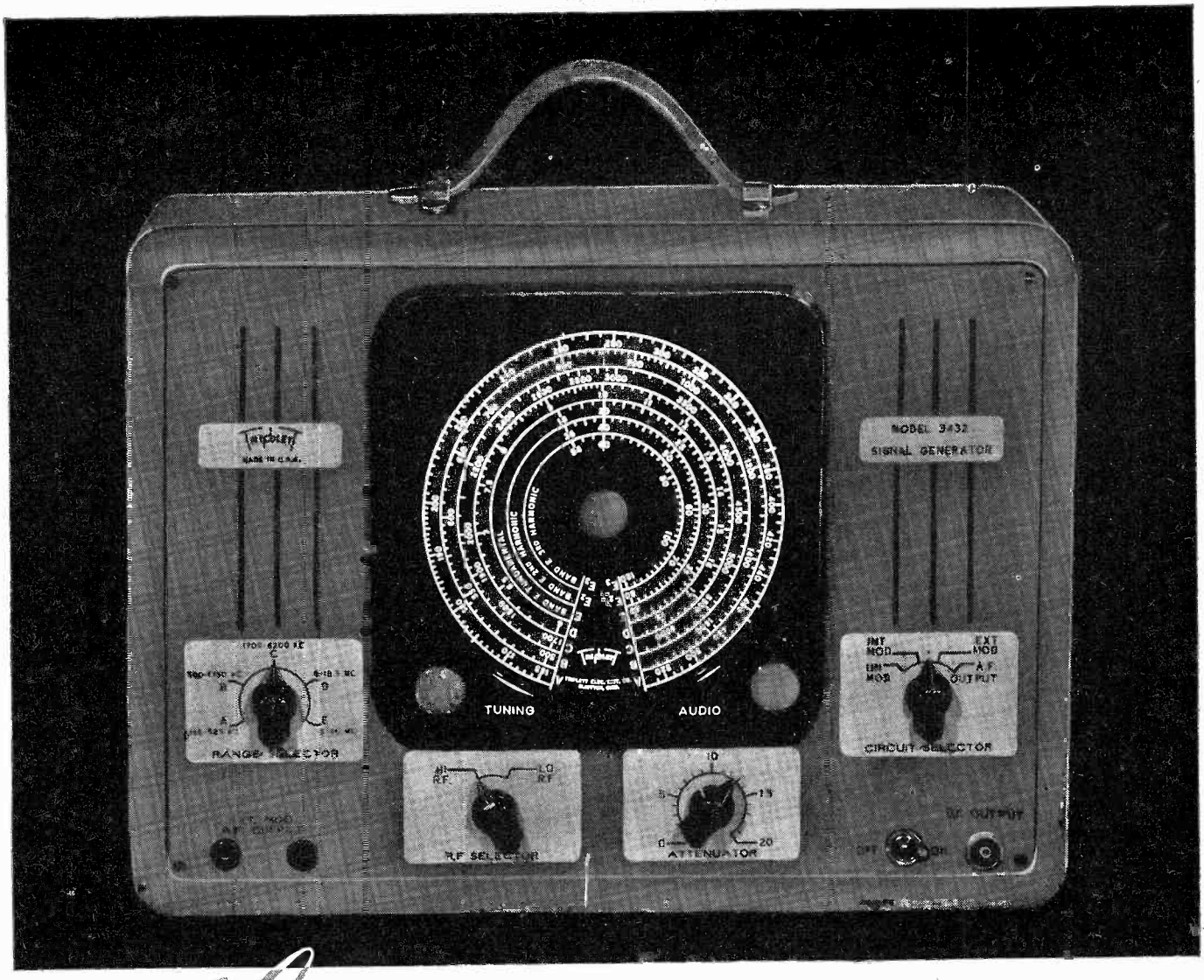
3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of the total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

WILLIAM F. BOYCE,
Publisher.

Sworn to and subscribed before me this first day of October, 1947.

(Seal) FRED SCHARFENBERG,
(Advt.) Notary Public of N. J.



Look at that dial!

It's Triplett's new method of dial lighting—one of the features of Model 3432 Signal Generator. The dial is BIG (330°) and correctly illuminated . . . accurately calibrated . . . quickly readable at a glance . . . with 10 to 1 Ratio Vernier Tuning for ease of adjustment. The seven long scales on the dial of Model 3432 have five fundamental ranges 165 KC to 40 MC and two harmonic ranges directly calibrated 36 MC to 120 MC. Variable 400 cycle modulation 0 to 100%; special copper plated internal shielding, R.F. attenuation—and many other features that have to be seen—*and used*—to be fully appreciated. Model 3432 is a Triplett top value that's priced *right*. See it now and buy it from your distributor.

Model 3432
Illuminated Dial
Signal Generator

PRECISION FIRST . . . TO LAST
Triplett

TRIPLETT ELECTRICAL INSTRUMENT COMPANY, BLUFFTON, OHIO

Auto Radio Noise Elimination

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A sharp pocket knife will serve momentarily to short the antenna through the paint if there is no chrome trim handy. If shorting the antenna rod will not kill the noise, the pickup is obviously in the lead wire. It must be grounded perfectly at both ends.

Where noise comes through even with both ends of the lead-in grounded, either there is a break in the shielding or the braid is not adequate. And it must be good. Sometimes it pays to try a new lead-in. (See "Auto Antenna Installation," Radio Maintenance, September, 1947.)

Assuming the lead-in satisfactory, and that the noise comes in only via the antenna rod, it remains only to ground or bond the hood or the side panel of the car in the vicinity of the aerial. Our pocket knife can be used here again to determine the best spot to establish a good ground.

The pocket knife with a keen edge and a sharp point is a most useful tool to probe through the painted metal of auto bodies in search of ground points; *however, it is to be remembered that some owners may resent such procedure.* This method is not recommended unless the paint is already scratched up and additional tiny marks will not be noticeable.

Wheel Static

Another difficulty which often arises in connection with auto radios is what is known as "wheel static," or "tire static." It manifests itself as rapidly recurring bursts of

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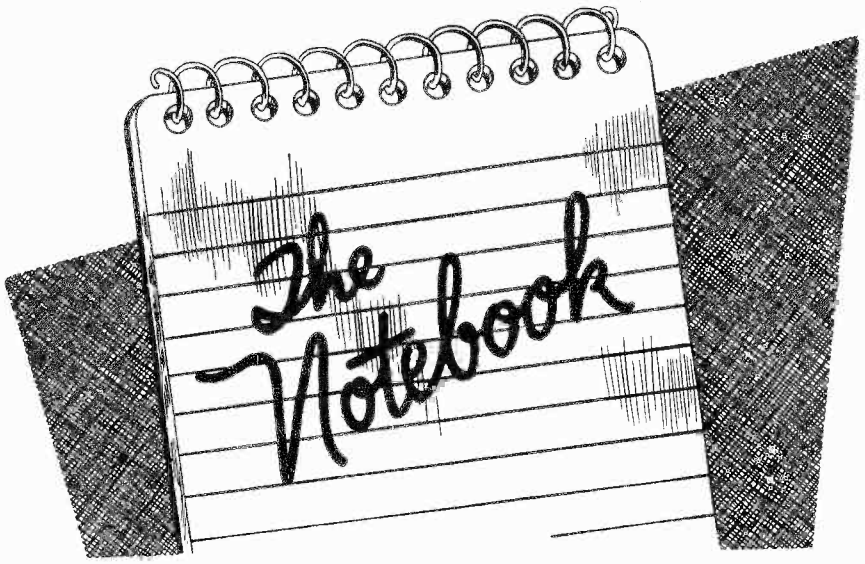
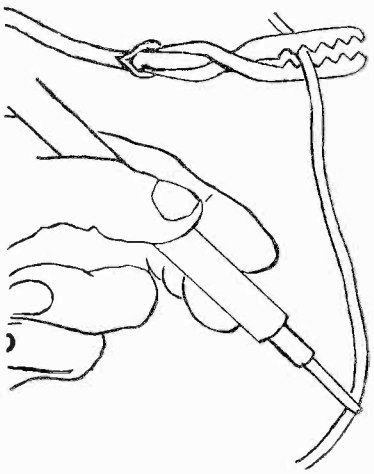


Each month the reader sending in the best suggestion receives a crisp ten dollar bill. For all others published, RADIO MAINTENANCE will pay five dollars. Let's hear from you.



Broken Wire Checker

"UNDER-insulation" breaks in wire are usually found by prodding and piercing methods which tend to damage the insulation. Here is a method which finds breaks quickly and keeps your wire in good shape. A signal generator and a signal tracer are used. Connect your signal generator "high" lead to one end of the wire. Then hold the tracer probe in your hand and feel along the wire. At the same time listen to the signal in the tracer. When the signal drops sharply, you've found the break.

J. F. Appleton
App's Music House
Burlington, Iowa

Rubber from Vibrators

Don't throw away your old vibrators. Many of them contain high grade sponge rubber. You can use this rubber in many ways. Some examples are: tube socket mountings (anti-microphonic), speaker housings and microphones. You can punch nice clean holes in this rubber with a leather punch.

J. D. Murphy
Statesboro, Ga.

A Eliminator Control

If you are having trouble getting just the right voltage from your A battery eliminator, a good way to provide control is to put a variable transformer, ("powerstat" or "variac"), in the primary circuit. With

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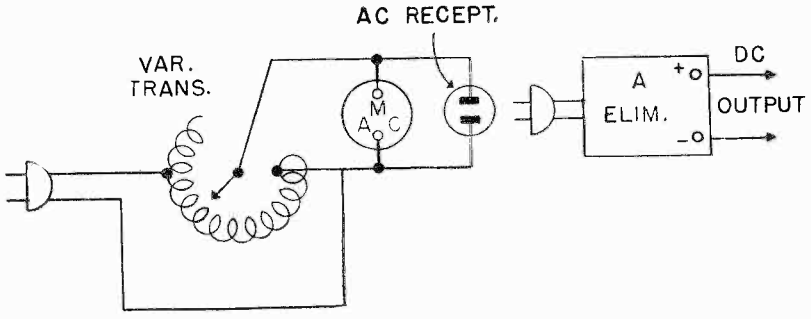

BACK NUMBERS

Our most recent back numbers of RADIO MAINTENANCE have now been made available. Listed below are the back issues which we still have on hand. Their contents are listed to enable you to select those magazines of interest to you. We don't know how long we will be able to fill orders for those earlier issues as the supply is dwindling fast, so if you want to get your back copies, fill out the coupon below today.

Get Them While They Last

JANUARY 1946

THE PROBLEMS OF ORGANIZATION
TELEVISION RECEIVER INSTALLATION—This article will initiate the serviceman into the first step in television—its installation.
RADIO MAINTENANCE IN AVIATION
USING THE OSCILLOGRAPH FOR DISTORTION MEASUREMENTS

APRIL 1946

PA SYSTEMS—This article covers a general discussion of all the opportunities and procedures for the serviceman about to enter the public address field.
A MIDGET AUDIO FREQUENCY OSCILLATOR
IF I WERE A SERVICEMAN
AN EQUALIZED AMPLIFIER FOR MAGNETIC PICKUPS

MAY 1946

PA SYSTEMS—This article covers initial layout of a modern PA system in bars, dance halls, auditoriums, etc.
TEST PANEL FOR THE MODERN BENCH
RINGING THE BELL

JUNE-JULY 1946

FUNDAMENTALS OF TELEVISION
VOLUME CONTROL TAPERS
THE ELECTRONIC VOLT OHMMETER
VECTOR ANALYSIS

AUGUST 1946

AVC CIRCUITS
FM TROUBLESHOOTING
TELEVISION RECEIVER FUNDAMENTALS
RECORD CHANGERS

NOVEMBER 1946

PART II TEST & ALIGNING TELEVISION RECEIVERS
DON'T FORGET THE DIAL LAMP
THE OSCILLOGRAPH . . . HOW TO USE IT
CRYSTAL PICKUPS

DECEMBER 1946

TELEVISION RECEIVERS . . . THE RF SECTION
TUNING INDICATORS
PART II THE OSCILLOGRAPH . . . HOW TO USE IT
REPLACING AUTO CABLES

JANUARY 1947

SERVICING BY EAR
TELEVISION RECEIVERS . . . VIDEO CHANNEL
PART III THE OSCILLOGRAPH . . . HOW TO USE IT
MINIATURE TUBE CHART

FEBRUARY 1947

THE OSCILLOGRAPH . . . HOW TO USE IT PART IV—It covers the alignment of receivers using the oscillograph and a frequency swept generator.
TELEVISION RECEIVERS . . . THE SOUND CHANNEL
THE AUDIO OSCILLATOR
SELENIUM RECTIFIERS—The theory and application of the selenium and other dry metal rectifiers.

MARCH 1947

ANTENNAS . . . FM AND TELEVISION PART I—First of two articles giving an easily understood explanation of transmission lines and matching systems.
SERVICING AUTOMATIC RECORD CHANGERS
OSCILLATORS AND CONVERTERS
TELEVISION RECEIVERS . . . THE VERTICAL SWEEP—Article No. 4 on the television receiver.

APRIL 1947

ANTENNAS . . . FM AND TELEVISION, PART II
PHASE INVERTER CIRCUITS
A UNIVERSAL SPEAKER—Although comparatively simple, this universal speaker is a big time-saver in the shop.
TELEVISION RECEIVERS . . . THE HORIZONTAL SWEEP

MAY 1947

THE OPEN AND CLOSE CASES—A unique and effective method for locating open coil windings.
VOLTAGE DOUBLERS
SIGNAL TRACER
TELEVISION RECEIVERS . . . THE CATHODE RAY TUBE

JUNE 1947

WHEN THE CUSTOMER ISN'T RIGHT—How to handle some difficult situations.
TEST EQUIPMENT MAINTENANCE—First of a series of three articles explaining how to increase the life and efficiency of your equipment.
CRYSTAL CONTROLLED SIGNAL GENERATOR
TELEVISION RECEIVERS . . . THE POWER SUPPLY

JULY 1947

SERVICING FM RECEIVERS—First of several articles giving the latest information needed for servicing FM receivers.
TEST EQUIPMENT MAINTENANCE, PART II
TELEVISION RECEIVERS . . . FLYWHEEL SYNC
TEST SPEAKER

AUGUST 1947

SPEAKER MATCHING—A logical approach to the problem of dividing the output of a PA system among several speakers.
TEST EQUIPMENT MAINTENANCE, PART III
SERVICING FM RECEIVERS
TELEVISION . . . HF POWER SUPPLIES

SEPTEMBER 1947

AUTO ANTENNA INSTALLATION
ANTENNA SYMPOSIUM—A comprehensive list of available FM and television antennas.
RADIO SERVICING IS BIG BUSINESS
THE TELEVISION PICTURE TUBE
SERVICING FM RECEIVERS

RADIO MAINTENANCE MAGAZINE
460 BLOOMFIELD AVE.,
MONTCLAIR, N. J.

Please send me the back numbers checked here . . .
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- ☐ February 1947
- ☐ March 1947
- ☐ April 1947
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- ☐ June 1947
- ☐ July 1947
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by John T. Frye

THERE is probably no more troublesome problem for the beginning serviceman than that of how much he should charge for his work. His concern over this matter is fully justified, too, for the success or failure of his budding business will depend to a very large extent upon his decision.

There are two main systems of charging: the flat-rate system in which each job, such as installing a filter condenser, is charged for at a fixed price; and the time-consumption system in which the charge is directly proportional to the amount of time consumed in making the repair. Each has its advantages and drawbacks.

The trouble with the flat-rate system is that it is difficult to allow for the great difference in time consumption between doing the same job on two different model receivers. For example, replacing an out-in-the-open plate bypass condenser is a simple and quick matter, but the picture is greatly changed when the condenser lies up inside an IF can and several other components have to be unsoldered and removed before the condenser can be reached, and all of these parts have to be replaced and resoldered after the condenser has been replaced. Another objection lies in the fact that it makes it hard for the serviceman to charge for the most difficult part of his job, locating the trouble.

Charging by the hour, on the other hand, is based on the assumption that all radio men are equally and expertly proficient. Unfortunately, this is not so. Highly skilled A will locate and repair a defect in one-third the time that it takes bumbling B to do the same job. Is is fair that B should receive three times as much as A? Hourly rate charging often results in the customer's having to pay for the serviceman's ignorance.

On the credit side of the ledger, time-charging makes it much easier to tie the charges in with overhead. When you know all of the expenses of your shop, including the wages of any hired repairmen, it is comparatively easy to figure out how much you have to receive per hour to make a reasonable profit.

There are various other unorthodox factors that often determine charges, such as the prices a competitor charges, the financial condition of the customer, and how much the customer charged you for some other service. I mention these deplorable charge incentives merely to recognize that they do, unfortunately, exist, but I hasten to add that none of these or similar factors should ever influence the charging in a reputable shop. Whatever the basis for the charges is, it should be absolutely impersonal, and it should be designed to bring in a reasonable profit above the cost of doing business.

The common fault of beginning servicemen is to charge too little. He usually is a little lacking in self-confidence, and he is eager to secure as much work as he can. In order to secure this volume of business, he sets his prices well below his competitors.

This is a mistake. In the first place, he is branding himself as a "cheap" serviceman, and he is fostering the idea in the back of potential customers' minds that inferior workmanship goes along with cut-rate prices. What is more, he will find that raising his prices will meet with a surprising amount of resistance from the customers he has secured on the cut-rate basis.

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Auto Radio Noise Elimination

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static while the car is in motion. The origin of this trouble is the static electricity generated by the tires as they move along the road surface. Fig. 2 shows why this static builds up. The axle and the wheel are separated by bearings and a thick coat of grease. Since grease is ordinarily a good insulator, the static electricity built up by the tire does not ground out to the automobile chassis until it has built up a considerable potential.

As mentioned above, tire static is recognized by rapidly repeating bursts of scratching noise, due to the discharges taking place. A good way to check for this trouble is gentle application of the brakes while the car is zooming along the highway; if the static stops, tire static is your trouble. The brake lining pressing against the drum grounds the wheel to the chassis.

Fortunately, rare indeed is the case which will not respond to properly installed *collectors* in the wheels. These collectors are gadgets designed to fit inside the hub cap over the bearing nut, and to bear against the cap itself. They thus complete a circuit between the wheel and the axle, so as to provide a good ground. Fig. 3 shows how to install a collector. A complete job calls for one on each wheel.

When the little gremlins cannot sneak into the radio via the back gate, or by sliding down the antenna, their nasty sharp voices will not come through the loudspeaker. Confusion to all of 'em, we say.

Picture Credits

Page 4	Top—Lear Incorporated Bottom—Webster Chicago Corp.
Page 6	Sylvania News
Page 8	Burgess Batteries
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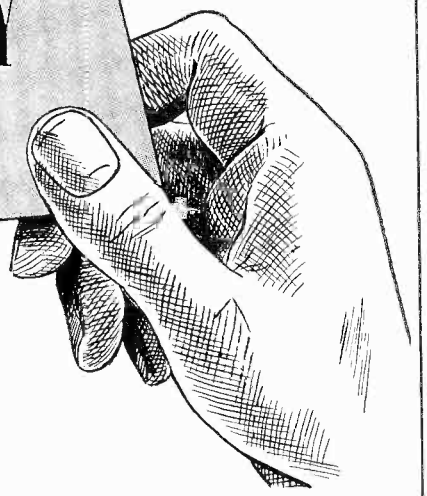
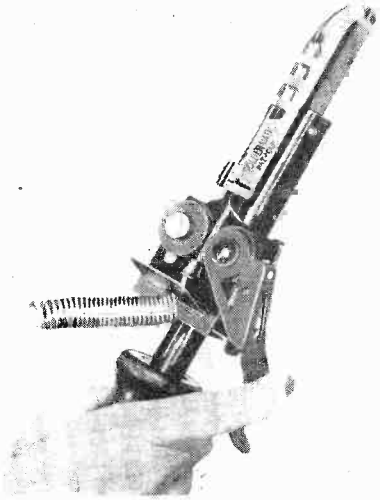
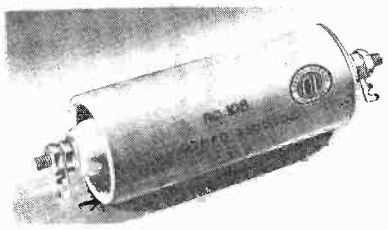




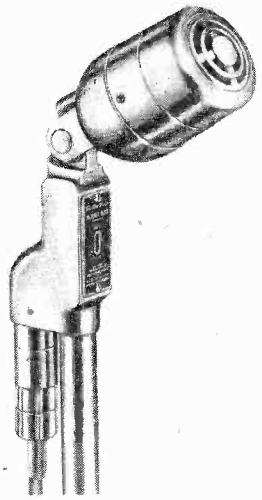
SOLDER FEEDER

The Solder-matic solder feeding arrangement clamps on to any standard electric soldering iron. With this device, solder can be fed to the iron tip with one finger of the hand which holds the iron. The other hand is thus freed for other operations such as holding a wire in place. Solder in small coils or spools up to 25 lb. can be handled and a length of up to 3/16" per stroke can be fed. Further information can be obtained from Nelpin Manufacturing Company, 45-17 Davis Street, Long Island City 1, N. Y.



HV CAPACITOR

The Cornell-Dubilier new type RC-108 capacitor is the latest addition to their line of television types. Suitable as filters in high voltage low current supplies, they are useful for the power supplies for cathode ray tubes in television receivers. Further details may be obtained from Cornell-Dubilier Electric Corp., South Plainfield, New Jersey.



DYNAMIC MICROPHONE

The Electro-Voice Model E-V 635 is a new high fidelity dynamic microphone designed for broadcasting and recording. Response is flat within 2.5 db from 60-13000 cycles per second, and the output is minus 53 db. Impedance can be either 50 or 250 ohms as chosen by a selector switch. For further data, write for bulletin No. 135 to Electro-Voice, Inc., Buchanan, Michigan.

VACUUM TUBE VOLTMETER

Allied's new model. 730 Vacuum Tube Voltmeter, features an RF proble with flat response to 120 mc, positive and negative readings on DC, six ranges and an accuracy of ±3% on AC or DC. Low weight and compact size are obtained by the use of miniature tubes and power consumption is less than one watt. For further information,

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On the Bench

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This is not surprising when you consider that his clientele will be chiefly made up of "bargain hunters."

If he would just stop to think, he would know that the competitors who have been in business for years must have a pretty good idea of what prices must be charged to earn a decent living. If he charges substantially less than what has been established as a fair price, he will soon find himself working day and night for a niggardly profit, if any. What is worse, he will have won for himself the contempt and hostility of his competitors. I am not advocating that any attempt should be made to match the prices of your competitors, but I am advising that you make very sure of what you are doing before you offer any cut-rate service. Cut rate pricing not only leads to your own ruin; it injures the whole servicing profession.

In most of the shops that I have visited, charges are made on a combination of flat-rate and time-consumed basis. Jobs that are routine, such as replacing volume controls, filter condensers, etc., are charged for on a flat-rate basis. Other jobs that are likely to vary widely in the amount of time required are charged for at an hourly rate. Complete alignment is an example of this last kind of job. It may require only the adjustment of two screws on a four tube TRF midget, or it may take you two full hours to connect up your 'scope and completely and exactingly align an all-wave AM or FM console or communications receiver.

Personally, I am a firm believer in a fairly high minimum charge. I make my minimum charge high enough so that I can afford to take all the time I need to go over each set very thoroughly and locate *everything* that is wrong with it. I can afford, too, to perform all of those little extras, such as alignment, cleaning, cabinet repair, etc.

Another thing that I try to keep clearly before me is that my charging is not for what I *do;* instead, it is for what I *know.* In making out my bills, I list the price of parts first—and there is never, never, *never* any deviation from the manufacturers list price here—and then, instead of labor, I write "For knowing what to do and doing it." This heads off those people who would exclaim, "You mean you are going to charge me two dollars for soldering in a new condenser? Why I'll bet it didn't take you ten minutes."

In conclusion, then, I advise the beginning serviceman to employ both flat-rate and hourly-rate charges in his business, to charge enough to make a reasonable profit, to have a fairly high minimum charge, and to keep firmly in mind that he is charging for hard-earned technical knowledge and not for common labor. These are good guides to keep in mind until he has acquired enough experience to formulate his own rules. ✓ ✓ ✓

Industry Presents

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write to Allied Laboratory Instrument Corporation, 355 West 26th St., New York 1, N. Y.

Among the especially interesting items described are FM tuners and high fidelity amplifiers and speakers, PA systems and reproducers, intercom systems. Nine full pages are devoted to test equipment alone; over 100 types are listed. All available radio components and materials are included in the catalog. To get your copy free, write to Concord Radio Corporation, 901 W. Jackson Blvd., Chicago 7, Ill.

Ohmite Catalog No. 19 gives ratings, dimensions, full electrical data, and list of prices of various types of resistors. Included in this 15-page catalog are rheostats, vitreous enameled resistors, dummy antenna resistors, precision resistors, tap switches, knobs, and dials. All items are illustrated with photographs. To obtain this free 15-page catalog, write to the Ohmite Manufacturing Company, 4835 West Flournoy Street, Chicago, Illinois.

ELEMENTS OF RADIO SERVICING, by William Marcus and Alex Levy. Published by McGraw-Hill Book Co., Inc., 475 pp. Price $3.60.

This book is written directly for the serviceman and aims to develop a scientific, orderly approach to his problems. To quote from the introduction, the authors have attempted to present "whole dynamic procedures for application to specific radio troubles." Each receiver section is treated as a unit. The sections are presented in the order in which they would be encountered in service work. For instance, the AC power supply is considered first, loudspeakers next, AF power stage, etc. Multimeters and signal generators are discussed in early chapters and other test equipment later in the book as the need arises.

Such subjects as AC-DC power supplies and auto radio power supplies are given a full chapter each. A survey of servicing procedure and list of graphic symbols and abbreviations are included. The book is well illustrated with line drawings and photographs. The style of writing is a little heavy and could be easier to read. The subjects of FM and Television are hardly mentioned, and the subject matter is limited strictly to the AM receiver field. ✓ ✓ ✓

The Notebook

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this arrangement, primary voltage can be adjusted to any value between 0 and 130 volts and output DC voltage will vary accordingly. Other DC voltages below 6 volts can thus easily be obtained.

E. J. Balcom
Balcom Radio &
Sound Service
Tulsa, Oklahoma

Cutting Aluminum Sheets

In making panels or brackets it is often necessary to cut aluminum sheet stock into smaller pieces. Scribe a line along the cut to be made. Then go over this line with a heavy knife or glass cutter until the metal is slightly dented. The metal can then be easily broken along the desired line.

Joseph Novak
Binghamton, N. Y.

Trade Literature

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Thousands of radio components and units are listed in its 160 pages.

JOHN RIDER SAYS...

Repair your Public Standing

● It is not inconceivable that the popularity of record changers will tend to improve the relationship between the general public and the radio serviceman.

As a mechanical device, its workings are not mysterious; when it refuses to change records, rotate the turntable, or otherwise perform as it should, the presence of a defect is clearly evident. We doubt seriously if the public's view of such a repair will be surrounded with the uncertainty which prevails in connection with the repair of radio receivers.

Prompt and efficient correction of defects in record changers is an opportunity to win the public respect and confidence which servicemen rightfully deserve. A perfect repair will help achieve this goal.

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Television Test Equipment, Morton Scheraga	Nov.	'47	8
TEST CLIPS			
The Notebook, Novel Test Clips	Apr.	'47	31
TEST EQUIPMENT			
Symposium on Test Equipment	Feb.	'46	6
The Electronic Volt Ohmmeter, Ralph B. Roland	June-July	'46	10
Over the Bench, John T. Frye	Mar.	'47	33
Test Equipment Maintenance, I, John B. Ledbetter	June	'47	6
Test Equipment Maintenance, II, John B. Ledbetter	July	'47	4
Test Equipment Maintenance, III, John B. Ledbetter	Aug.	'47	4
Over the Bench, John T. Frye	Oct.	'47	41
TEST PANEL			
Test Panel for Modern Service Bench, Joseph J. Roche	May	'46	14
TEST SPEAKERS			
A Universal Speaker, J. B. Crawley	Apr.	'47	12
Test Speaker, J. R. James	July	'47	14
TRANSFORMERS			
The Notebook, Isolation Transformer	Apr.	'47	39
The Notebook, IF Transformers	June	'47	36
TUBES			
Miniature Tube Chart	Jan.	'47	16
The Notebook, Dummy Tube	Sept.	'47	51
The Notebook, Tube Remover	Oct.	'47	43
TUNING INDICATORS			
Tuning Indicators, Fred W. Schmidt	Dec.	'46	12
UNIVERSAL SPEAKER			
A Universal Speaker, J. B. Crawley	Apr.	'47	12
VECTORS			
Vector Analysis for the Radio Serviceman, N. B. Cook	June-July	'46	15
Servicing FM Receivers, Milton Kaufman	Sept.	'47	20
VERTICAL SWEEP			
Vertical Sweep—Television Receivers, Morton Scheraga	Mar.	'47	10
VIDEO AMPLIFIERS			
Television Receivers—The Video Channel, Morton Scheraga	Jan.	'47	4
VIBRATORS			
Vibrators, R. M. Ellis	July	'45	9
Vibrator Supplies, Peter Markantes	Oct.	'46	16
VOICE COIL LEADS			
Voice Coil Leads	Oct.	'47	43
VOLT OHMMETER			
The Electronic Volt Ohmmeter, Ralph B. Roland	June-July	'46	10
VOLTAGE DOUBLERS			
Voltage Doublers, J. Richard Johnson	May	'47	4
VOLUME CONTROLS			
Volume Controls Tapers, Bernard Grob	June-July	'46	8
VTVM			
Fundamentals of Vacuum Tube Voltmeter, C. G. McProud	Feb.	'46	14
The Electronic Volt Ohmmeter, Ralph B. Roland	June-July	'46	10
Know Your VTVM, Walter Weiss	Oct.	'46	26
WIRE			
The Notebook, Wire Stripper	May	'47	31
The Notebook, Finding Wire Breaks	Oct.	'47	44
The Notebook, Wire Stripper	Nov.	'47	32

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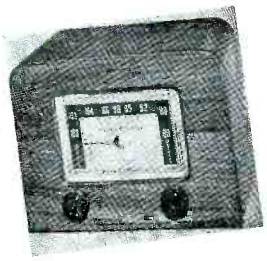

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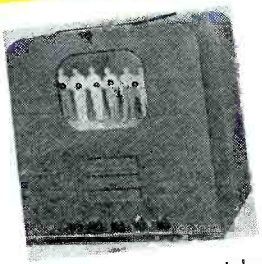

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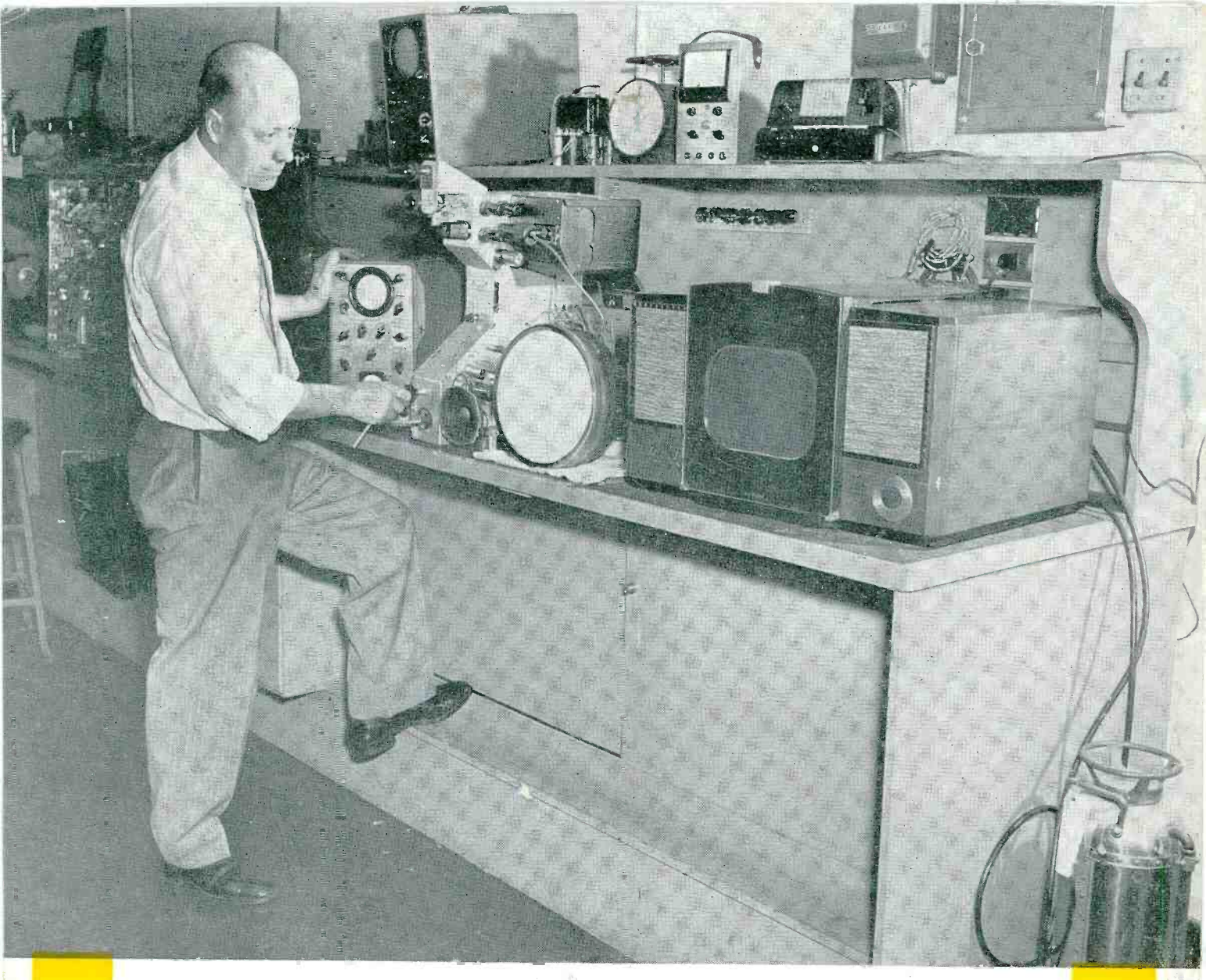

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