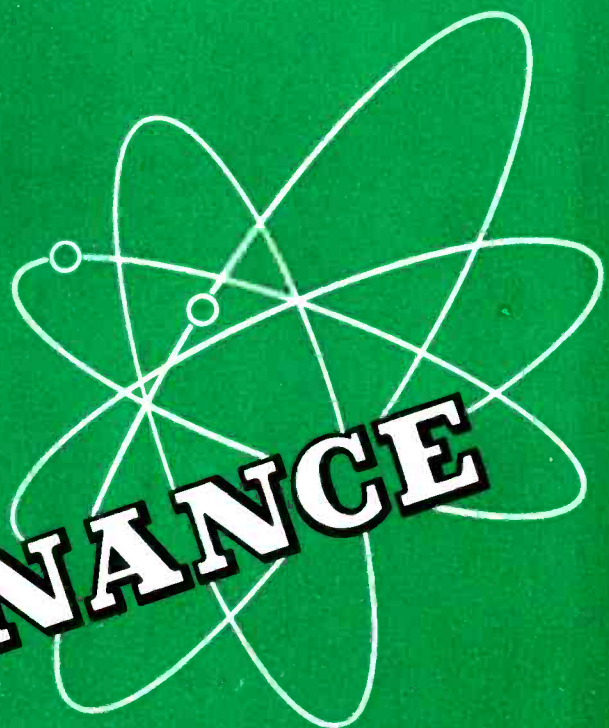
MARCH 1946

RADIO MAINTENANCE



TROUBLESHOOTING TELEVISION RECEIVERS
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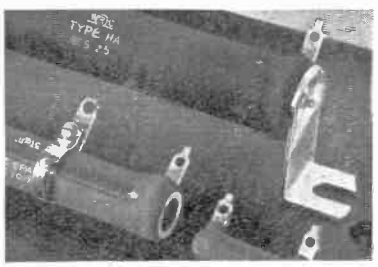

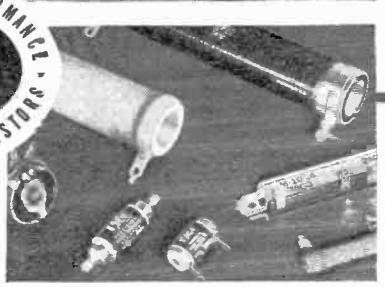

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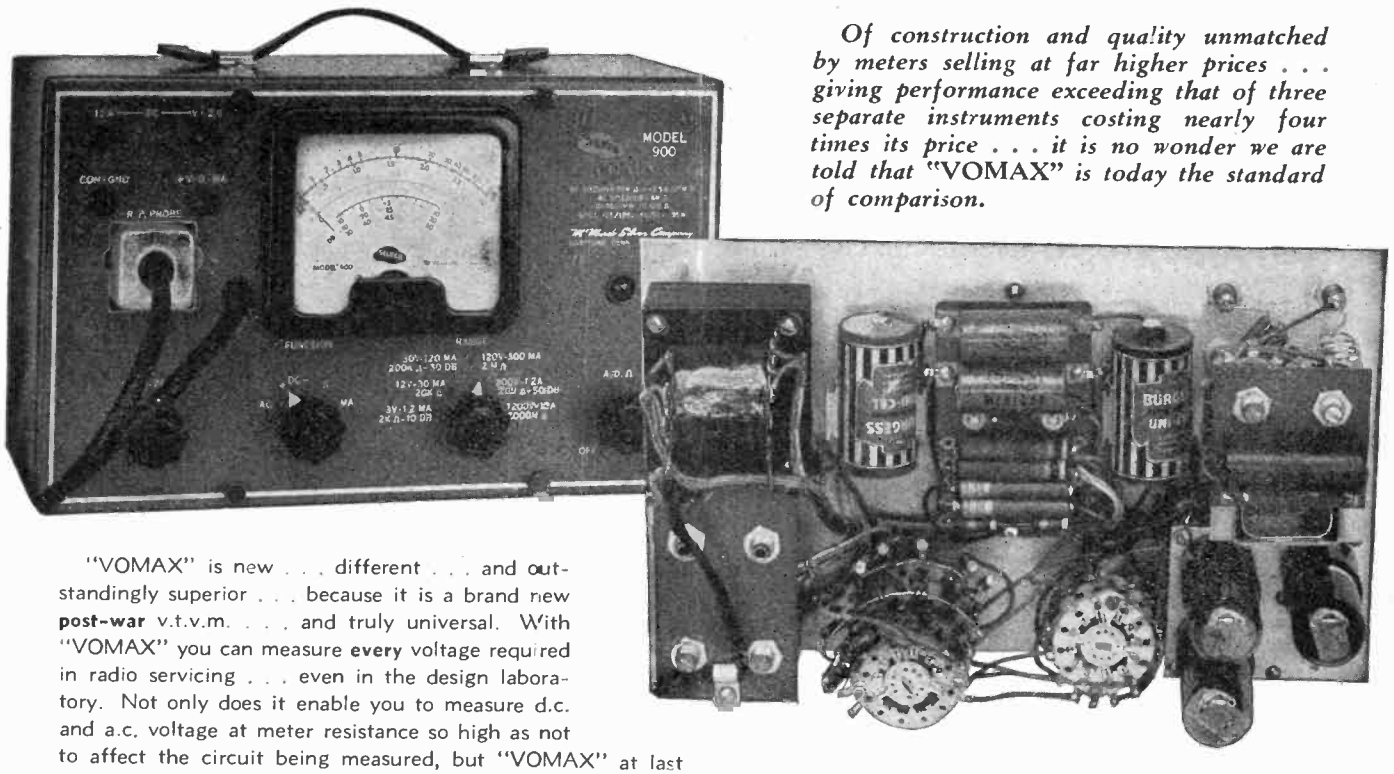

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Troubleshooting Television Receivers

by J. H. Ruiter

This is one of a number of articles on television receiver trouble-shooting by J. H. Ruiter this year in Radio Maintenance magazine. It covers the preliminary procedures in the checking of the receiver.

TROUBLE SHOOTING in a television receiver requires some knowledge of television transmission and at least a functional knowledge of the receiver itself. For this reason, this article will explain the elements of television transmission, and by means of block diagrams break down a television receiver to a functional discussion of each section. Having this knowledge, the repairman can immediately *localize* trouble in any television receiver to a particular section and from that point refer to the schematic of the particular receiver under observation. This method of trouble shooting is of infinite value with television because the average set contains from 20 to 30 tubes. Thus, merely checking all the tubes without attempting localization would require an hour's work. On the other hand, if the repairman takes time to localize the trouble, it will be necessary for him to check only a few stages.

Television transmission is more complicated than sound transmission to the extent that both the sound and the picture must be transmitted simultaneously. The transmission of the sound as part of a television program is similar to that employed in normal F-M sound transmission; namely, the sound is picked up by a microphone, amplified, and used to modulate the carrier of the transmitter. The sound carrier of a television transmitter is frequency-modulated.

The picture transmission requires different treatment. It is picked up by a television camera which contains a special tube called an iconoscope. The camera contains a lens system which focuses the image on a mozaic plate within the iconoscope. the mozaic is made up of a photosensitive material deposited on a mica plate in the form of thousands of tiny cells each insulated from the

The author removing the cathode ray tube from a television receiver. Notice the way in which the tube is held while being removed.

other. These cells become electrically charged on exposure to light. The iconoscope also contains an electron gun which produces an electron beam just as in a cathode-ray tube. The electron beam is then caused to sweep the mozaic both horizontally and vertically in a controlled, repeating pattern. As the electron beam makes contact with each of these cells, it causes the cells with light charges to discharge and a picture is thus transformed into electrical waveforms. These waves are the picture signal. This signal is suitably amplified and controlled and used to modulate the picture signal carrier. The picture carrier is amplitude-modulated.

Beam Controls and Synchronization

The frequencies of the sweep generators which cause the beam to scan the mozaic in a definite and repeating pattern are controlled by pulses received from a synchronizing generator. This generator creates two kinds of pulses—one which controls the horizontal path timing, and one which controls the vertical path timing. These pulses are added to the picture signal moduation so that the sweep generators in the receiver can be synchronized to the same pattern.

In order to transmit pictures with fine detail, it is necessary that the picture signal contain modulating frequencies as high as four megacycles. This is the chief reason for television transmission being at such high frequencies. The sound carrier, and the necessary clearance between sound and picture carriers, and between the carriers and the edges of the bands require another two mc. Therefore, a six-megacycle band must be allocated to each television transmitting channel so that both sound and picture signals may be broadcast simultaneously. The reason for such a wide channel is that although the picture signal is transmitted on an amplitude modulated carrier, there is a frequency displacement above and below the carrier frequency which is equal to the modulating frequency, and caused by the modulation. These frequency displacements are called "sidebands."

For practical purposes, sidebands are calculated quite simply. Let f_c be the carrier frequency and f_m be the modulating frequency. The upper sideband is then equal to f_c+f_m, and the lower sideband is equal to f_c-f_m. As an example, take the case of the carrier of Fig. 1, whose frequency is 55.25 mc, and modulate it with a 4 mc video signal. The sidebands are 55.25+4, and 55.25—4, or 59.25 and 51.25 mc, respectively. On the basis of this, the use of a much wider channel than the six-megacycle band referred to, is necessary. Allowing for guard spaces at each end of the band, it would indicate that the band should be about 9 mc in width. However, it was discovered that transmission of both sidebands was unnecessary, and it has become standard practice to filter out a large part of the lower sideband. As a result, picture signal transmission is accomplished by what is called "quasi-single-sideband" or "vestigial-single-sideband" transmission.

Since the discovery was made, the RMA has established that the picture signal carrier shall be 1.25 mc above the low frequency limit of the channel and the sound signal carrier shall be located 4.5 mc above the picture signal carrier. Such an arrangement allows 4 mc of the channel on which the picture signal may be transmitted without interference from the sound

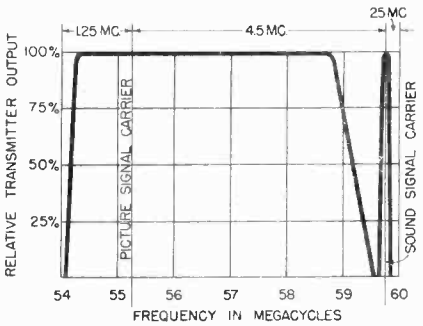

Fig. 1. Frequency division of typical television channel.

carrier. Since the useful sideband components of the frequency-modulated sound carrier do not extend more than 150 kilocycles above and below the carrier frequency, the sound signal occupies comparatively little room in the channel. Fig. 1 shows how a typical television channel is divided to meet RMA standards. The channel used in the figure

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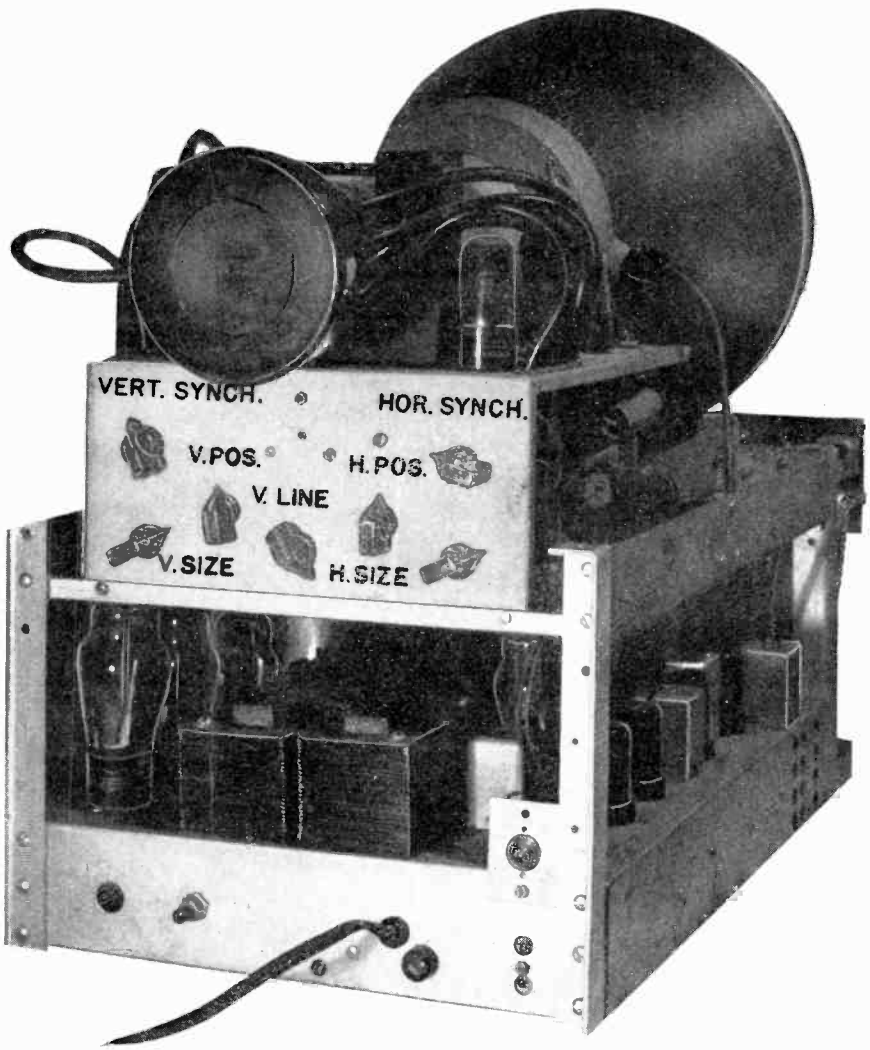

Rear view of a table model television receiver showing controls.

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is in accordance with the new frequency allocations of the FCC.

Now that the signals which the television receiver must receive and reproduce are clearly defined, we can see more easily how these signals are handled by the receiver through the various stages to produce finally the desired reproduction of picture and sound.

Block Diagram

A simplified block diagram of a television receiver is given in Fig. 2. This shows the television receiver divided into seven major sections, as follows: the R-F section, the Sound Channel, the Picture Channel, the Vertical Sweep Generator, the Horizontal Sweep Generator, the Cathode Ray Tube, and the Power Supply.

Functionally, the television receiver operates in this manner:

The R-F Section tunes to the desired frequency and picks up the two signals from the antenna. This R-F section contains a heterodyne oscillator which is tuned to a frequency which when mixed with the incoming signals, produces two intermediate frequencies, one from the picture carrier, and one from the sound carrier. These two intermediate frequencies appear simultaneously in the plate circuit of the converter tube. Tuned circuits at this point pass the picture signal through the picture I-F channel, and the sound signal through the sound I-F channel, and each of these channels is tuned to reject the I-F of the other signal.

The Sound Section amplifies the frequency-modulated sound I-F signal, passes it through a limiter to a discriminator where it is "detected," amplifies the audio signal, and finally feeds it to the loudspeaker.

The Picture Section amplifies the picture I-F signal, which is amplitude modulated, and "detects" it by means of a diode detector, and feeds the resulting video signal to the video amplifier. The video signal is further amplified and applied to the grid of the cathode ray tube to control the instantaneous intensity of the beam in accordance with the original picture pattern on the mozaic.

At some point in the video amplifier, generally at the plate of the first video amplifier tube, the synchronizing pulses are separated from the video signal and fed to both the Vertical and Horizontal Sweep Generator sections, and serve to synchronize

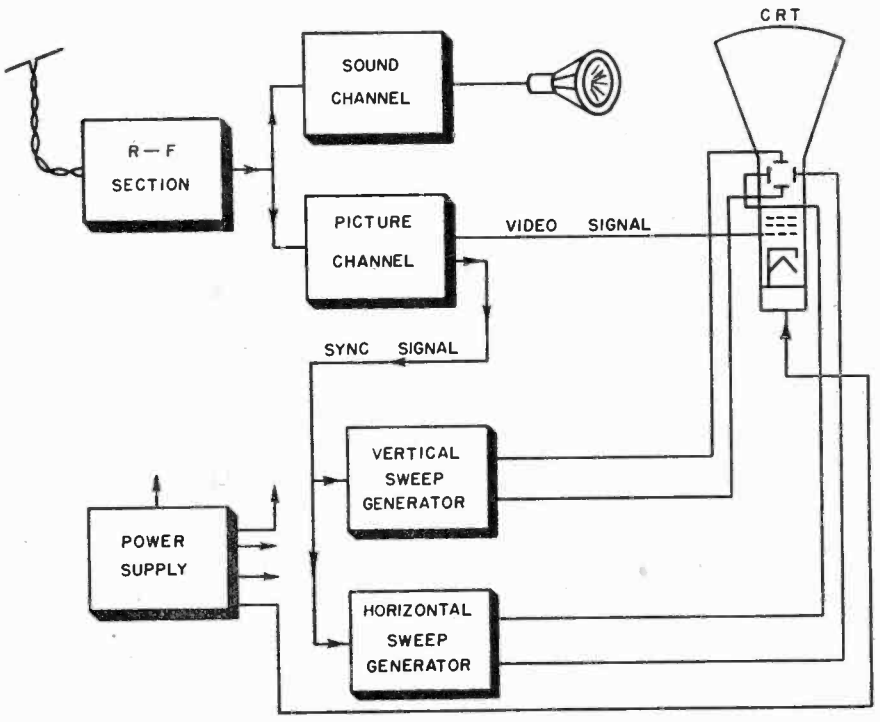
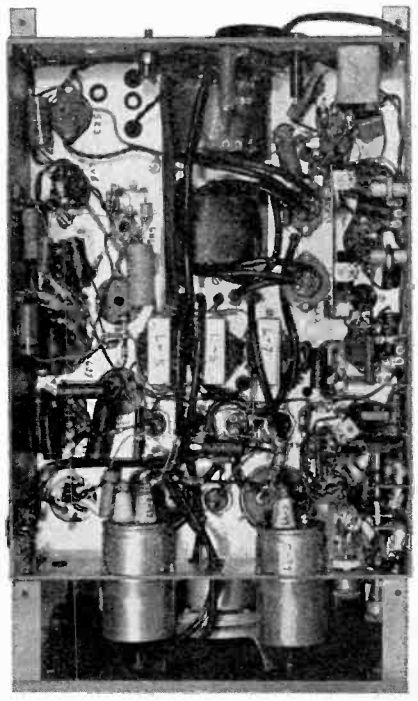


Fig. 2. Major sections of typical television receiver showing function of each portion of the circuit.

these two circuits which furnish the voltages required to sweep the beam across the screen of the C-R tube, or kinescope. The sync pulses therefore keeping the scanning of the kinescope in the receiver in step with the scanning in the iconoscope in the television camera. The sweep generators provide sawtooth waveforms of the proper frequencies to the deflection plates of the kinescope to deflect the electron beam and form a "raster" (a large rectangular pattern of light formed by the movement of the beam of electrons impinging upon the screen—this movement being composed of a series of lines spaced at definite intervals on the pattern).

Deflection of the electron beam in the cathode-ray tube may also be performed by deflection coils which develop magnetic fields for this purpose. This waveform required by deflection coils is practically a square wave, whereas the wave necessary to sweep the beam properly in a tube using electrostatic deflection is a sawtooth. The function of the sweep generators is the same in both types of circuits, although the actual waveforms differ, and therefore the circuits differ in detail.

The next step in this discussion is to break these seven major sections down into particular functions within them. In making this step our block diagram approaches that shown in Fig. 3. A working knowledge of this diagram will enable the repairman to take another step towards localizing trouble so that he may be able to attribute it even to a single tube.



Bottom view of television receiver. Note the high voltage wiring.

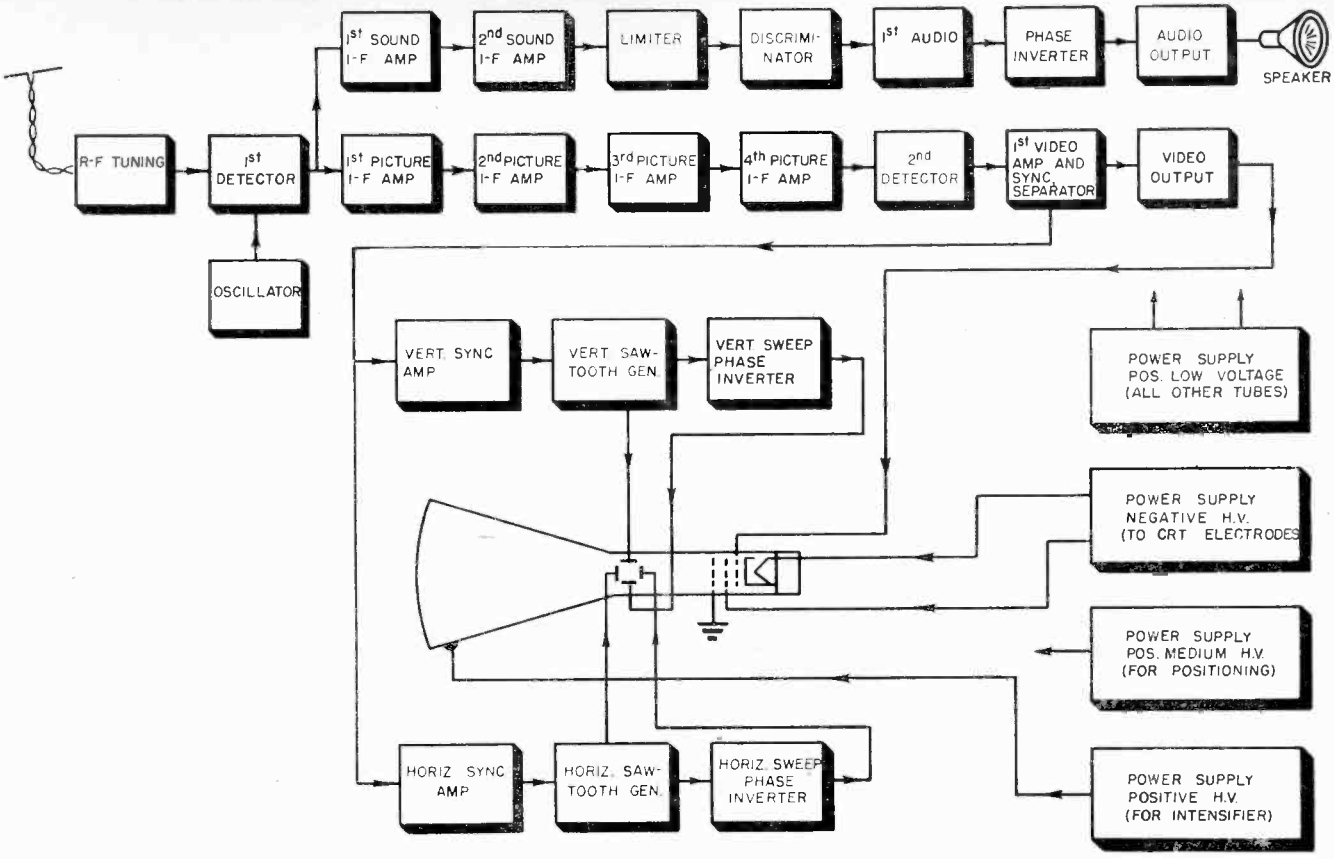


Fig. 3. Complete functional block diagram of the various stages in a large television receiver.

Power Supplies

The power supply consists of two to four separate units depending on the size of the cathode-ray tube. All sets have at least two. One is a normal B+ supply consisting of a full wave rectifier with suitable filter, and capable of supplying +400 volts at sufficient current to operate all of the tubes. The other is a half-wave high voltage rectifier, using an R-C filter in most sets, and capable of supplying a negative voltage from 1000 volts up, depending again upon the size of the cathode-ray tube. The current drain on this supply is approximately 5 ma. The next supply that would be added as the tube size increases is a high voltage positive supply to furnish an accelerating voltage to the intensifier. Finally, with tubes of face diameters above 10 inches, a fourth supply may be added which will furnish a medium-high voltage to the deflection plates for positioning the electron beam.

The next logical step is to break down the vertical sweep generator into its constituent functions. It usually consists of three tubes, a sync amplifier, a sawtooth oscillator, and a phase inverter. Refer to Fig 4. The vertical cync amplifier amplifies the vertical sync pulse which is received from the video channel. This amplified cync pulse synchronizes the vertical sawtooth generator so that it is in perfect synchronization with the vertical sweep generator of the iconoscope in the camera. Since the kinescope has two deflection plates for each mode of scanning, i.e., two vertical deflection plates and two horizontal deflection plates, the signal required for linear deflection must be push-pull. The output of the sweep generator tube is "single-ended," so that a phase inverter is used to obtain a push-pull signal. The horizontal sweep generator is identical in function with the vertical sweep generator, differing only in the frequency. The output from each of the sweep generators is fed to its corresponding pair of deflection plates in the electrostatic tube, or to the corresponding coil on the deflection yoke in the electromagnetic deflection tube.

Safety Precautions

Since the functioning of the various circuits has been explained, we now have a basis for shooting trouble. However, a few precautions must be observed by the serviceman if he wishes to continue in business. Even the smaller receivers employ voltages greater than 1000 volts. Some of the larger sets may have circuits which develop voltages up to 10,000 volts.

Remember at all times that it is better to shut off the set completely than to run the risk of a dangerous burn at least, if not electrocution. Remember, too, that even the 400-volt supply has plenty of kick to it. If, as in many instances, it becomes necessary to work on the set with the power on, by all means spend an extra two minutes to remove the input leads from the primary of the high voltage transformer. At the rear of the chassis of many sets, there is a safety switch which automatically cuts off the power supply when the back of the cabinet is removed. Thus, this

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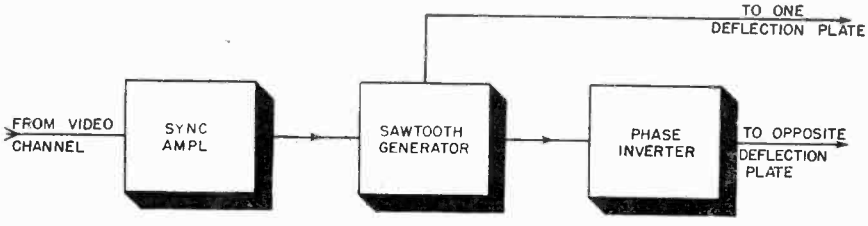

Fig. 4. Block diagram of elements of a typical sweep generator.

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switch must be closed purposely if power is desired.

Be careful, too, in handling the cathode-ray tube. Not only is it expensive, but it is dangerous if it is broken. These tubes are highly evacuated and a collapse is as dangerous as an explosion. They are reasonably strong but a sharp blow with a hard object will shatter them and scatter glass for many feet. The following precautions should be observed in handling cathode-ray tubes:

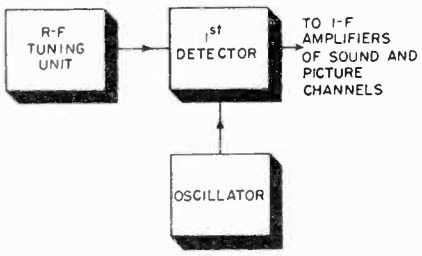

Fig. 5. R-F, first detector, and oscillator arrangement in R-F section of television receiver.

1. BE CAREFUL not to knock it against hard objects.
2. DON'T use tools near the tube.
3. DON'T scratch the surface of the glass.
4. Stand large tubes on face with soft piece of cloth underneath.
5. If a tube must be laid down, block both sides so that it won't roll.

Trouble Diagnosis

Now that sufficient warning has been given with respect to the danger points, consider the method in which a repairman should proceed to diagnose trouble. Before he even lifts a tool to attempt repair, an efficient repairman should locate the particular part of the circuit causing the trouble. The extreme case would be that of the fellow who had a set completely torn apart trying to find trouble which was caused by the safety switch not being properly closed, or a loose set screw which allowed a knob to turn without turning the shaft of the control.

Let us follow the reasoning involved in locating trouble. Here is a set on which you can receive the sound from all stations, but no picture on any of them. Turn the intensity control up to see if there is a raster. If the raster is present, certainly there is nothing wrong with either of the sweep circuits, or with the power supply. Since the sound channel is working properly, the trouble must be in the picture channel. The next step is to touch the grid of the first video amplifier. If white bands appear on the screen of the cathode-ray tube, the video amplifier is functioning properly. Therefore, the trouble must be in the picture I-F section. The first thing to do is to check the tubes in this section. If the trouble is not tubes, the next job is to feed a signal into the grid of the first picture I-F stage and trace it to the source of trouble. Once the trouble has been tracked down and corrected, try the set immediately. Remember that it is only on rare occasions that two parts give out at exactly the same time.

Let us go back a bit to the preceding paragraph. Suppose when the intensity was turned up, *no* raster was observed. The trouble then would not be in the picture channel at all because no sweeps were being generated. Assume that instead of sweeps a spot appeared on the cathode-ray tube. In all probability the trouble is not in the sweep generators, because *neither* of them is working. It is probably in the power supply which furnishes plate and screen voltages to both of the sweep generators. Certainly, you had better check the rectifier tube because a short circuit in this supply would have blown the fuse. If it is not tube trouble, it must be an open circuit.

Let us go back again to turning up the intensity control. If only a horizontal line is observed, the place to look for trouble is the vertical sweep generator; or conversely, if a vertical line is observed, the place to look is the horizontal sweep generator.

In large receivers having four rectifiers furnishing voltage to the set, one of the most difficult troubles to find is a short somewhere in the power supply (not a tube) which blows the fuse. One reasonably good procedure to follow in this respect is to remove the four rectifiers, replace the fuse, and turn on the power. If the fuse blows again, the trouble is in the transformers, or in the power wiring circuit. If the fuse does not blow, turn off the power and replace one rectifier tube. Turn the power on again. If the fuse does not blow, replace the remaining rectifier tubes, one at a time until it does blow. This determines in which circuit the short is located. Check all tubes fed by

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Fig. 6. Block diagram of complete sound channel of television receiver from first detector to loudspeaker.

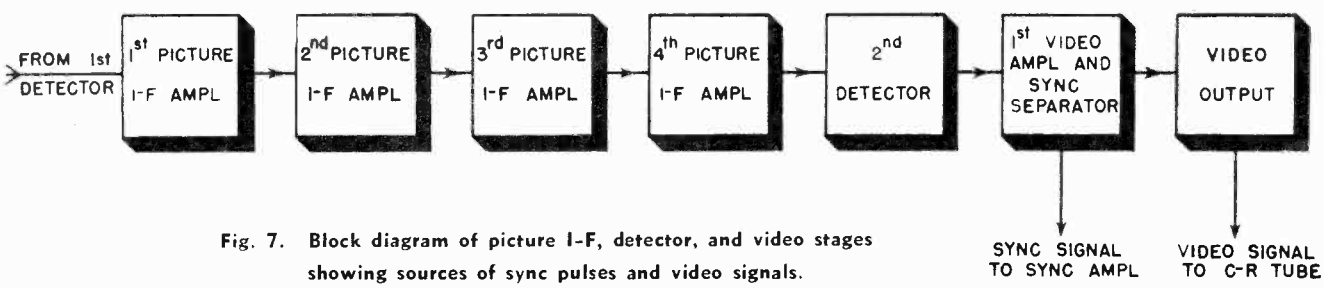

Fig. 7. Block diagram of picture I-F, detector, and video stages showing sources of sync pulses and video signals.

Applications of a Low Cost Signal Tracer

A handy piece of test equipment which has many uses in servicing.

By Rex Gilbert

A RADIO SET may be a t-r-f or a super-heterodyne or a super-duper-DXer; it may have four tubes or 34; it may feed a 15-inch speaker or a hearing-aid type earpiece. But in every type of set that is operating, there is a signal passing through it.

In trouble shooting, after the power supply has been checked, the measurement of the signal itself as it passes through the set from antenna to speaker is the fastest method of locating a defective stage. A compact Signal Tracer, Superior Instrument Company's Model CA-11, will measure this signal all the way from input terminals to output. In addition, it is possible to use it for a number of other applications, ranging from determining transformer impedance ratios to measuring the actual gain of a single stage. It is also of exceptional value in aligning super-heterodyne receivers, especially after replacement of R-F or oscillator coils.

The CA-11 Signal Tracer is a very simple instrument, as will be seen from the schematic of Fig. 1. The 1T4 tube is located in a probe, at the end of a three-foot flexible cable. The meter, batteries, balancing potentiometer, phone jacks and operating switches are located in an attractive wooden box, which has sufficient space for the probe when the instrument is not in use.

It will be seen that the circuit employed is that of a simple grid-leak detector. The input is fed through a 300-mfd condenser, the low value being used to reduce sensitivity at the lower frequencies, thus reducing the readings due to hum in the set. Resistor R-1 serves as a grid return. The plate and screen of the tube are tied together, so the tube operates as a triode. With no signal, the tube draws its maximum current, which is "bucked-out" by means of R-2 and an additional 1.5-volt battery. When a signal is applied to the probe terminal, the rectified grid current flows through R-1, thus increasing the bias on the tube and lowering the plate current. The meter is connected in the circuit in such a manner as to give an upward deflection as the plate current is reduced. S-1 controls the filament, and at the same time opens the bucking circuit when the filament is turned off. Another switch permits the use of either the meter or a pair of phones as the indicator.

Figure 2 shows the sensitivity of the instrument, as measured with a 400-cps signal. The scale calibrations are in arbitrary units, but it will be noted that the curve is essentially a straight line over the range from zero to one volt, with a gradual dropping off up to 1.8 volts, which gives full-scale deflection. The frequency response curve of Fig. 3 shows the falling off below 300 cps, the flat range between 300 cps and 10 mc, and the peak around 17 mc due to resonance conditions in the input circuit. Above 20 mc, the response falls off rapidly. The range is sufficiently broad to make the signal tracer of general application in radio testing.

The most common use of a signal tracer is, as the name implies, to actually trace signals in their passage through the set. Before delineating some of the more unusual applications, a description of the general method of signal tracing will point out the advantages of such an instrument. Briefly, if a signal from a test oscillator is introduced at the antenna terminals, its presence may be measured on the grid of the first stage. By putting the probe of the tracer on the antenna terminal, A in Fig. 4, and noting the voltage at that point, and then shifting the tracer probe to the grid of the first tube at B, the gain (or loss) in the antenna transformer can be observed. Shifting the probe to the plate of the first tube, at C, will show an amplified signal, and it will undoubtedly be necessary to reduce the signal output from the generator. Using this pro-

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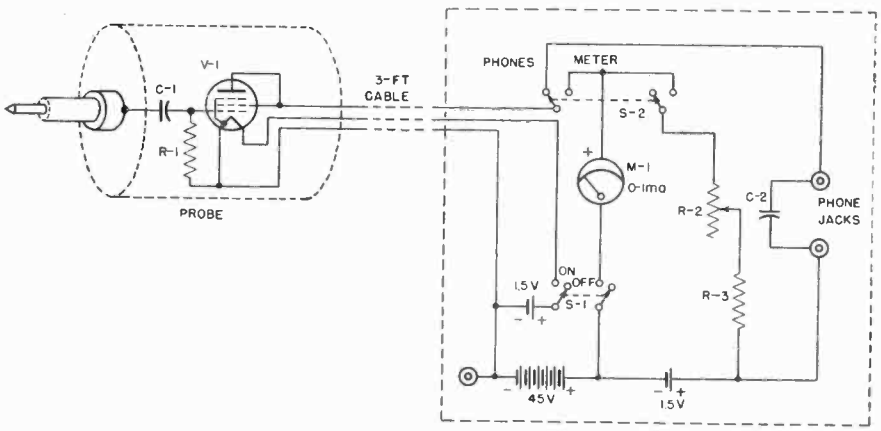

Fig. 1. Schematic of CA-11 Signal Tracer, applications of which are discussed in this article.

C-1	300 mmfd, mica	R-3	600 ohms, ½-watt
C-2	.002 mfd, paper	S-1	DPST switch
M-1	0-1 milliammeter	S-2	DPDT Switch
R-1	20 megs, ½-watt	V-1	1T4 tube
R-2	300-ohm rheostat		

Low Cost Signal Tracer

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cedure, it is possible to follow the signal through the set if the set is operating. But if some stage in the set is defective, no signal will be present beyond that point. The R-F signal from the generator should be modulated at 400 or 1000 cps, whichever is available in the generator being used. This permits the use of the signal tracer through the audio section as well as the R-F and I-F sections, as it is equally sensitive to both types of signals, within the limits shown in Fig. 3.

A few of its applications in addition to the straight signal tracing uses are as follows:

Let us assume that the R-F and oscillator coils of a receiver have been replaced. In order to adjust the circuits to optimum efficiency at both ends of the band, and to make the dial track properly, it is necessary to set the dial at the proper position on the tuning condenser shaft and to adjust the oscillator low-frequency padder at approximately 600 kc. This latter adjustment can be made at a number of settings of the tuning condenser in those cases where the padding condenser is adjustable. However, to obtain maximum sensitivity, the R-F circuit must also be in resonance at the same point. To make certain of this adjustment, feed a 600-kc signal into the set from a generator. With the signal tracer probe on the grid of the first detector, tune the dial to obtain a maximum reading; then loosen the dial scale, set it to indicate 600 kc, and tighten it on the shaft at the new position without disturbing the position of the tuning condenser. Then, with the signal tracer, probe on the second detector diode plate, adjust the oscillator padding condenser for maximum output. Retune the generator to 1400 kc, set the receiver dial at 1400, and with the probe still on the diode plate, adjust R-F and oscillator trimmers on the tuning condenser to obtain maximum output. It is well to recheck these adjustments, as any change of either trimmer or padder capacities will have a slight effect on the other adjustment; several checks will cause the final adjustment to approach the optimum.

As an indication of the actual values which may be expected, one

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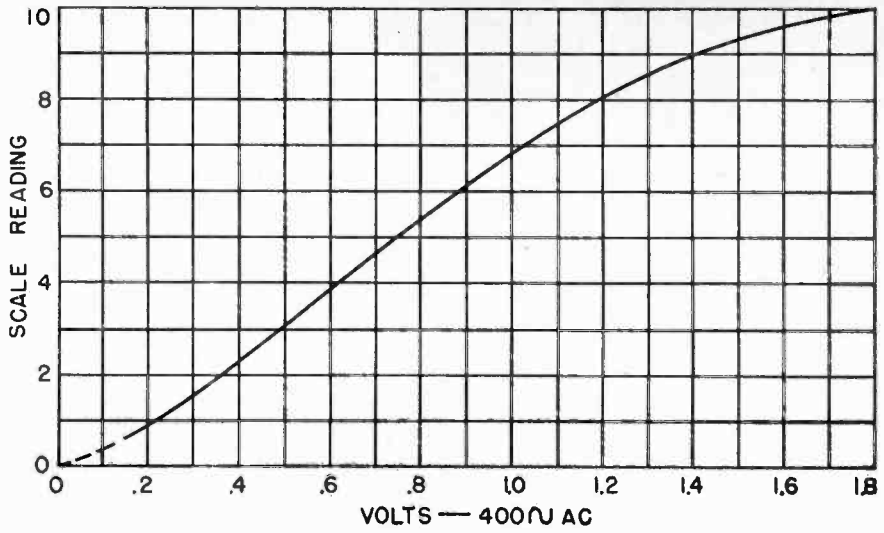


Fig. 2. Curve showing sensitivity of signal tracer, with input volts plotted against arbitrary units with which meter dial is calibrated.

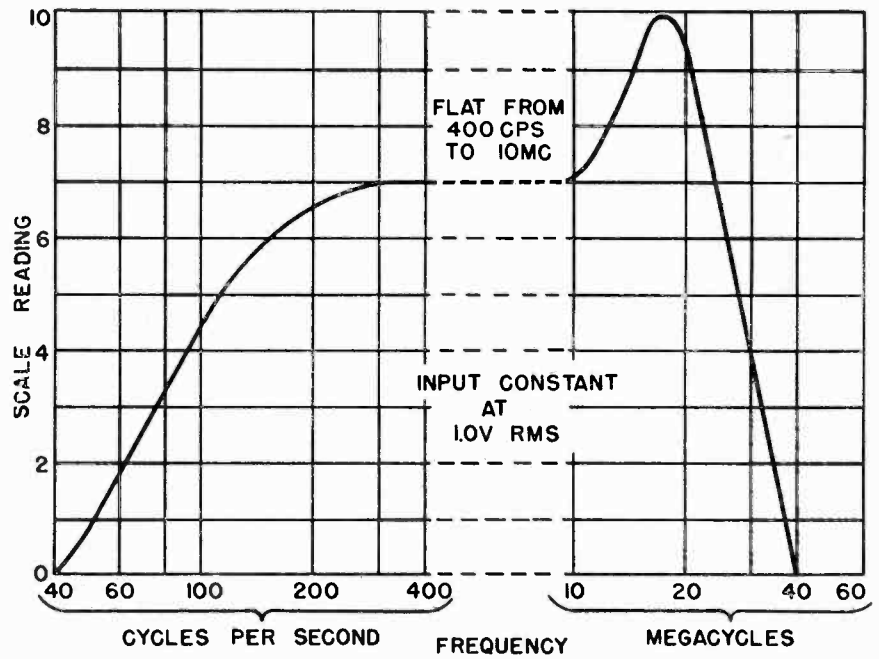


Fig. 3. Frequency response curve, flat over most useful range of frequencies, with reduction in sensitivity at low frequencies to reduce hum readings. Peak at 17 mc is caused by resonance in probe circuits.

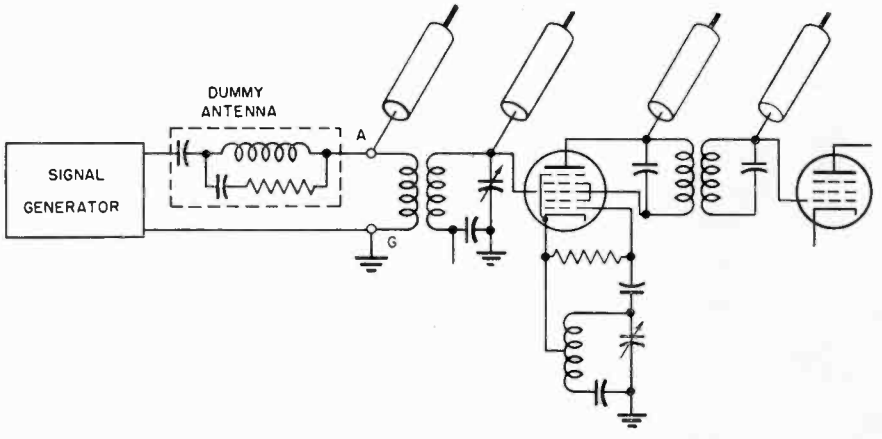


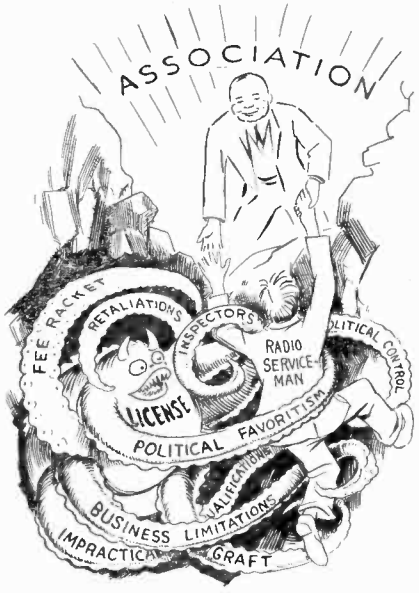
Fig. 4. Method of using tracer to follow passage of signal from stage to stage.

Radio Repairman's Associations

by John F. Rider

CONTINUING with the problems of radio servicemen's associations, the last year witnessed the rise of an issue which is tending to deflect the attention away from association effort. This is the matter of licensing radio servicemen. The advocates of the plan contend that licensing of radio repair personnel will accomplish the many aims so much desired by the industry as a whole, especially the attainment of public confidence and the removal of the so-called undesirables from the ranks.

To say the least, such an issue as this one is extremely broad. The ramifications of the subject extend over a great deal of territory. To deal adequately with each phase—to discuss fully the advantages and disadvantages, the dangers and the experiences of those already licensed—would require more space than is available in this entire issue. Such space is naturally not available; nevertheless, it is still possible to consider what might be the very crux of the matter: namely, will licensing gain the public confidence? This point is foremost among all the aims. If space permits, some of the industry's internal problems—which the advocates of licensing believe have reached critical proportions—can be considered.



This writer's attitude towards licensing in general is not a total denial that it offers benefits. It is contended that the use of a legal restriction as a means of accomplishing a goal is not the most logical approach. This goal is within the realm of possibility by the simple expedient of mutual trust, understanding, and cooperation. At this stage of the game, a well-knit association, properly supplied with funds from its members will do more than licensing. Unless there are hidden motives, such as limitation of competition, it seems peculiar to this writer that the personnel of the repair industry would pick a time when the bud is blooming into a flower—that is, when the industry is at the threshold of tremendous expansion—to freeze the activities of its personnel. Especially when it is considered that the basis for this freeze will soon be obsolete, for the technical requirements of the industry are subject to minor changes in the not far distant future.

Changes in the Offing

It is the contention of this writer that the entire radio repair field is subject to major changes during the next five years. These changes will be along technical lines and also in the scope of equipment to be handled. Unlike many of the existing activities operating under licenses, technological advancements are moving at a terrific rate. The most experienced repairman will require further technical training. This will not be accomplished overnight; in fact, it will require several years of study. The competition developing from regular set dealers, many of whom dropped radio service work almost two decades ago thereby giving birth to the independent operator, will require expansion of activity by the independent repair group.

To think in terms of licensing along electronic lines, when actually the prospects of the future include many non-electronic items such as washing machines, home freezers, domestic refrigerators, and the like, invites difficulties. It is possible that many independent operators cannot see themselves venturing into other fields, but does it not make more sense to leave that decision to the future? Why impose restrictions upon one activity when it is not necessary? If anything at all, it will mean additional restrictions if and when an individual should decide that he wishes to expand. Bear in mind that every accomplished legal act is a precedent upon which are founded other legal acts. If there is any semblance of truth in the impression gained by reading some of the writings upon the subject of licensing that one goal is the limitation of repair activity by students and others who have not been in the business, then it is not inconceivable that those who now are doing radio repair may find themselves confronted with other licensing programs when they may find it necessary to spread into other fields in order to fight the competition which is developing from the set dealer. It does not require a crystal ball to visualize the man doing washing machine or home freezer or domestic refrigerator servicing, seeking a similar licensing program to keep the electronic repair shop within bounds—at the time when the latter needs expansion most!

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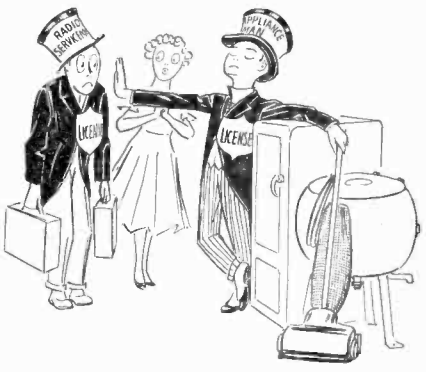

RADIO REPAIRMAN'S ASSOCIATIONS

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Public Confidence

By far the greatest weakness in the licensing program is the belief that it will gain public confidence for the radio repair shop. Public confidence is never awarded by legal edict. *Public confidence is the reward for performance!* This is proven by the fact that many service shops have grown substantially during the past fifteen years, right through the most trying times. Naturally they felt the pinch during the depression, just like everyone else—*but they made progress.* In fact, the entire industry made progress! This is said in the face of low level of confidence being displayed by the public, because there are many service shops who are trusted by the public and they are to be found in every city.

Lack of public confidence can be attributed to two unfortunate situations. One of these is that the public does not understand the operation of the radio repair industry; the other is the unfortunate presence of a comparatively few dishonest men doing radio repair work.* Just how licensing will make the public understand and be more tolerant, this writer cannot see, for the solution is education of the people. It is admitted that licensing when properly accomplished sets the competent apart from the incompetent, but even the most competent have had to suffer because the public does not appreciate some very significant facts.

Service Charges vs. Set Sales Price

For example, the relationship between the service charge and the original sales price of the receiver has been a bone of contention ever since the sale of the first midget. The public does not realize, and never has had the situation explained properly. What the public does not appreciate is that low-priced sets represent production; that the greater the *public* demand for low-priced sets, the greater the production, and the lower the relative price of the sets. *Quantity* is the keynote for everything which goes into the set. Tremendous numbers of resistors, condensers, transformers, and tubes make it possible for the manufacturer of the equipment to satisfy the public on a price basis.

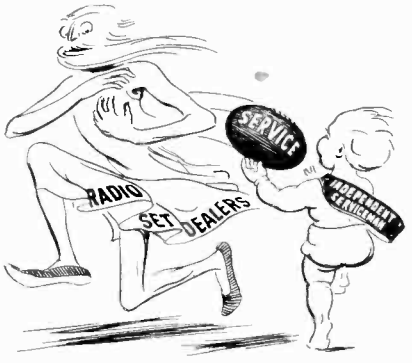
But when that set comes into the radio repair shop, it is an *individual* item; it must be handled in the same manner as a set which costs ten times as much. As a matter of fact, so much is crowded into the small space available in a midget cabinet that handling of the internal elements is actually *more difficult* than in a large set costing perhaps from five to ten times as much. When that receiver is brought in for service, all semblance of production-line activity disappears, there being no such thing in the diagnosis or in the repair operation. Moreover, when it is necessary to replace a part, no matter how inexpensive it may be, the price paid by the repairman to the jobber does not reflect great quantity sales, consequently the cost to the customer must be much higher than the actual proportionate value of that part relative to the original cost of manufacturing the receiver.

What the public has not been told is that the possible troubles in such an inexpensive receiver are the same as in a more expensive job; that in many cases it is more difficult to remove a part from a midget than from a very expensive receiver. Now, if the proponents of licensing feel that this is the truth—and we know they will admit it—will any kind of licensing teach this to the public? Of course not! This is an educational job which must be done collectively, and it can be done much more effectively by association effort than by any other means.

In the estimation of this writer, licensing will tend to aggravate this condition of misunderstanding, for the presence of a licensed form of control—even though it has no relationship to prices—will give the people the feeling that they now have a stronger weapon to wield in the effort to knock down the repair charges. Today they feel that they must go to court if they think that an "injustice" has been committed, wrong though they may be.

The loudest wail heard from the public has been on the matter of prices.* For every repair job on which there was a deliberate overcharge, there have been hundreds which were either undercharged, or which represented a fair and equitable price based upon the circumstances. It is an undeniable truth that a great deal of the subterfuge which has been practiced was brought about by the refusal of the public to pay a fair price. The public sat in judgment upon the repairman and evaluated his services.

Licensing will not cure this evil. If anything, it may tend to aggravate it, for the public will take it upon itself to interpret the meaning of licensing. It is wishful thinking to expect that the public, after being appraised of competency by the fact that the shop is licensed, will develop



a sudden change of heart and be willing to pay a fair service price. There is every reason to say that this will not happen. This issue of prices has been discussed for years. Time and again the public has demonstrated its refusal to take cognizance of any controlling factors, except their pocketbooks.

If the maximum service charge for a receiver repair was $1.00, the public would stop complaining, but all radio repairmen would starve to death! Just think back upon the past fifteen years. For years prior to the war, when servicemen were experiencing the greatest difficulty earning their daily sustenance, the fundamental reason for cut-price operations and the low earning power was that

*Ed. Note—Just as in any other business.

the public refused to pay; they shopped from place to place for the lowest price. The man who charged more than the public thought was a fair price was branded as a thief. The progress was slow, but little by little the public learned to pay. They kicked and squawked, but the repairman who was honest in his charges and was in a locality where he had sufficient customers to draw upon, built up his business and founded public confidence. Until the war years it was a continual fight to show a profit, and it was not because there were dishonest people in the business. It was because the people did not understand—and do not understand even today. The wail certainly has a familiar sound!

Education of the Public Needed

Another correction which must be effected is to acquaint the public with the fact that a radio repair shop is a business; that it is as much of a business as the A & P, the neighborhood clothing store, the butcher shop, the baker, the milliner. People pay what they must for those things which they consider essentials of life. When you hear them talk to one another, they agree that the radio is a medium of education, that it aids culture, that it is a medium of communication—yet, they squabble about recognizing the expense involved for its upkeep. Where upkeep is concerned, they view the device as a luxury.

Licensing will not teach the public that a radio repair shop is a business. Founded upon the adverse publicity given the radio repair industry, licensing will receive public acclaim—but not because it will aid their comprehension of the situation. If anything, the public will be happy because it will envision control of the men, control which will enable the set owner to get cheaper servicing. It will not make the public more appreciative of the need for a profit in the repair business as well as in every other commercial enterprise.

Will licensing make the public understand that a receiver may go bad one hour after a major repair has been completed? This has been a frequently heard gripe. The public expects the repair man to do more than guarantee his repair; it expects him to guarantee the entire receiver. Yet, if the repairman, desirous of making such a guarantee would take it upon himself to check the electrical condition of each and every component—that is, if he could—and then rendered his bill for the time spent and for those parts which were replaced in anticipation of failure, the set owner would hit the ceiling.

This relationship between a defect repaired and a new one occurring has caused much grief to the industry. Education of the public is the only remedy. They are educated to understand this condition in a car—but only because it is much simpler to identify that which was repaired and the new defect. Unfortunately, most electrical defects in a receiver manifest themselves in the same way. The most elaborate description of what is wrong means nothing to the public; all they know is "the receiver was recently repaired and it is bad again. Fix it gratis."

Licensing will not correct this. *Education of the public is the cure!* By this we do not mean that an effort must be made to make each individual a radio technician. One would expect that common-sense would dictate the possibility of different defects following one another, but not with the public! They have the common-sense. It is the willingness to understand which is lacking, and licensing will not cultivate this willingness to understand.

Licensing No Cure-All

As we said earlier, we do not deny that licensing has merits. Since a license is not issued to a reprehensible character, some of the dishonest operators would be removed from the ranks. Granting that they are removed, is it reasonable to assume that the entire panorama would change? Of course, the removal of even a few undesirables is worthwhile, but even while thinking along these lines, it is necessary to weigh the justice of jeopardizing the future of the honest in the effort to curb a comparatively few dishonest people.

It is wrong to look at a number of activities which are licensed and consider that as sufficient justification for licensing of every other. A great deal depends upon the type of occupation. In general, dishonest people do not seek technical occupations except when they already possess the specialized knowledge. Some may, it is true, but in comparison to the other lucrative fields of endeavor which do not require preliminary education, the radio repair industry has many more honest people than dishonest. At least that was the cry raised prior to the war when that masterpiece of literary effort appeared in "Reader's Digest," indicting the entire radio repair industry. Then came the war, and with it a reduction in the number of men actively engaged in radio repair. Yet today we hear much about the need for licensing in order to curb the great number of "gyps." Where did they come from so suddenly? Is it not possible that radio repairmen, like many others with something to sell, fell prey to a human weakness—to take advantage under the influence of war hysteria drunkenness? Not that it is the most commendable action, nor is it something to write into the book for posterity. Competition and an adequate supply of parts will restore these people to their sanity. Those who can't see the light can be cared for by proper and sensible association efforts—that is, if the efforts are made.

Association Advantages

The writer contends that a properly run association can protect the interests of every honest radio repairman and nullify to a very great extent, if not completely, the operations of the dishonest. We feel that public confidence can be recovered by making the association responsible to the public, by having the association guarantee the work of its members. If people are honest and sincere in their efforts, and display mutual trust and cooperation, the association can keep from its ranks the same unsavory characters who would be eliminated by licensing.

The association can accomplish every aim being set as a goal by the proponents of licensing, and the industry will still remain free from restrictions; it will still be a free enterprise. This business of having an electrical inspector enter the premises and examine work may not seem like much when it is described rapidly, but the principles which it violates are great!

These paragraphs will not swing

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Radio Service Along the Airways

by Myron F. Eddy

How do you break into the aviation radio game? It is not hard to get a government airways job if you know your stuff. Once appointed—these are civil service jobs—you will receive special aviation training.

The case of a friend of mine whom we will call Joe is typical. Four years ago he had a little radio repair shop in a small midwest town. The most important thing he did was to make some local bigshot's receiver bring in New York broadcasts. His home town fame grew for this sort of thing but he didn't make much money at it. So he studied up on theory. Then the Civil Aeronautics Administration put in a small "emergency" landing field nearby, complete with radio and weather station. Joe saw his chance. From that time on he studied aviation sets. Sometimes when the CAA maintenance technician flew in and checked the installation he looked on and asked questions. The questions were answered. In time he came to feel that the work done by the CAA technician was both more important and more interesting than his own. That is why he sold his shop and joined CAA. He is one of many ambitious small town repairmen who have entered government service as aviation radio technicians and field engineers to "keep 'em flying" and "keep 'em safe" and found they liked it. There are reasons for liking it. According to Bill Boesch, Chief of the Airways Radio Section, the CAA upkeep program is based upon five points:

1. Employment of competent technicians with sound theoretical background and broad practical experience as trouble shooters, each of whom is given full responsibility for the operation of facilities in his charge;

2. Training of technicians both by written instructions and personal contact to insure standardized methods and results;

3. Routine use of electrical tests and visual inspections to check equipment, with prompt action to correct unsatisfactory performance;

4. Adequate reporting of all irregularities and breakdowns;

5. Complete analysis of such reports to correct indicated weaknesses in existing equipment and to improve specifications and factory inspection technique for new equipment.

The keynote of both CAA and airline maintenance work along the airways: safeguard all flight, always; this means *all radio sets always operative.* As a result of this attitude a doctrine of preventive maintenance has been developed to a very high degree of effectiveness. It starts with the operator or "communicator" (as he is called) on duty at the CAA radio communication station. He carefully notes and logs all essential performance data. Knowing what readings to expect in every case, it is easy to spot impending trouble. This is called "residence maintenance". Then, on specified days, a field man flies or drives in to the station prepared to give everything the once over, performing what is called "sector maintenance". This technician is given complete responsibility for maintenance, adjustment, trouble-shooting, and normal repair. He is responsible for the proper functioning of two or more fan marker stations and at least one radio range operated by remote control from the local airport. The control station at the airport has five or more superheterodyne receivers guarding intermediate and high frequency channels, a speech amplifier and moving-coil microphone for broadcasting, teletype machines for collecting and transmitting reports on weather and aircraft movements, a gasoline engine-generator for emergency power supply.

Also, at radio range stations there are two identical 200-400 kc. dual transmitter units. They provide simultaneous radio-telephone and radio range service. These are put in use alternately, each serving as a stand-by for the other. The dual units consist of two separate single frequency transmitters operating in one rack. Through a coupling device two separate antenna systems are fed. One antenna is for range course signals, (dot-dash) the other for voice transmissions. The antenna systems are tuned to frequencies differing by 1.2 kc and are phased to produce field patterns of definite shapes. There is another pair of transmitters to be maintained: the station location marker. It must operate continuously, unkeyed, on 75 mc. It must be kept at a modulation frequency of 3,000 cps.

These are certain things the technician must watch. In the voice transmitter the technician closely watches R-F output, audio wave shape, percentage modulation, and overall frequency response. R-F output is checked daily. Percentage modulation and wave shape are checked monthly. Audio response is checked semi-annually.

To do this work you must have proper equipment. Each technician is provided with an audio oscillator, A-F attenuator, power level meter, and cathode ray oscilloscope. A modulation meter and distortion meter can be secured from the regional office if required but is not ordinarily included in the set of test equipment.

You also have to watch the carrier frequency. The carrier of the range transmitter serves two purposes. Sixty-five per cent of its power is available for voice modulation, thirty per cent for range modulation. The percentage of modulation is an important adjustment. If the percentage

of voice is too high it may interfere with the range signal and if the percentage is too low, the voice does not carry well. You adjust modulation percentage for the range signal by varying the relative power output of the two transmitters. Optimum voice transmission is obtained through use of a constant output speech amplifier at the range station. This prevents over-modulation and tends to compensate for varying levels of the communicator's (operator's) speech. The correct adjustment of the constant output amplifier is checked monthly, in addition to the audio response and wave form checks.

The smaller tubes in the transmitters are checked with a portable tube checker; the larger tubes are checked by the meters in the transmitter.

The radio range course signals are produced by the use of radiated field patterns of definite shapes. These patterns are dependent upon proper phasing of currents in antennas, and to a lesser extent upon the values of such currents. The most reliable check you can make of the field patterns and of the courses is through actual field measurements. For this purpose there is a battery-operated receiver installed on the truck of each sector technician. He also has an R-F impedance measuring set. With this he can determine whether or not the R-F transmission lines are properly terminated. The radio range courses or "beams" which go out like spokes in a wheel from each station must be kept "in the groove", so they are checked daily where there is a resident radio electrician and weekly at stations maintained by the sector electrician.

The testing of station location markers and fan markers is done by checking tubes, meter readings, and currents in the antenna elements, and by adjusting the standard output. As these transmitters cannot be given a ground check, reliance must be placed in antenna current checks and reports of pilots. At the radio range control station all tubes are checked monthly, and the gain of amplifiers checked when modulation percentage of the transmitter is measured.

Each technician is furnished with an R-F signal generator, a "wobbulator", and an output meter for receiver checking. Where remote receiving antennas are used, the technician checks the tuning of such systems either by operating his signal generator as an antenna and noting output of station receiver, or by connecting the generator to the station end of the receiving antenna transmission line and picking up transmitted signal on his truck receiver.

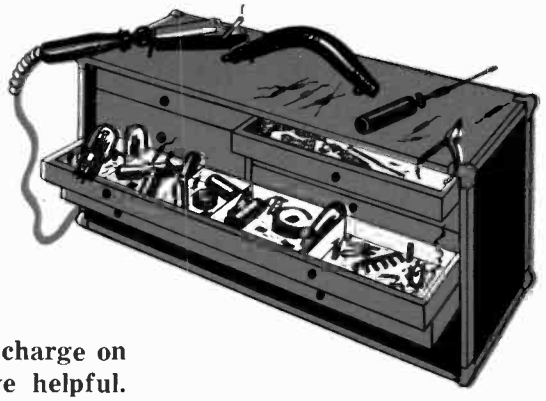
If the average civilian shop radio repairman followed a CAA sector technician from one air field to another for a week, I believe he would come to the conclusion that airways radio servicing is maintenance work at its highest level of skill and importance and that it is work which any conscientious radio technician can successfully undertake after a short tour of familiarization duty.

Furthermore, the more you investigate the results of the work done by radio service men in aviation, the more highly you think of the airway personnel engaged in radio servicing, because practically all aviation radio men are recruited from commercial shops. I have worked with radio mechanics for twenty years and I think they are tops among the technicians.

Courtesy CAA

CAA inspector off to work, all set to combat the elements as well as radio gremlins.

Service Kit



It is often difficult to make an accurate estimate on the charge on a service job. Here are some pointers which will prove helpful.

by E. T. Bicak

IN PREVIOUS ARTICLES, some aspects of outside servicing were discussed, dealing principally with the contents of the Service Kit and with salesmanship.

The purpose of this article will be to discuss some of the considerations involved in trouble shooting a receiver in the customer's home and making an estimate of the cost of repairs.

A prime objective for the outside serviceman should be the development of a systematic and methodical test procedure. Short cuts and "kinks" have a definite place, but inasmuch they are not applicable in every instance, reliance must be placed on a series of routine checks. These checks involve the application of the fundamental principles that are old stuff to experienced men, but the newcomer will find them of great value.

A reasonable degree of familiarity with circuit arrangements is presumed. By this is meant that the technician must be able to make and interpret simple measurements without recourse to circuit diagrams. If this ability is lacking, it will be found more profitable to remove the receiver to the shop before an estimate is given. If experience is limited on any particular set and you are unable to trace the trouble within the first few minutes of your call, don't make matters worse by bluffing your way through. The average customer, with no knowledge of radio, can tell almost instantly when you are experiencing difficulty, and once this happens, the set-owner's confidence in your ability takes a nosedive.

Until such time as you have developed a sense of poise and self-confidence, your best bet is to try to persuade the customer into allowing you to remove the set to your shop. This should present little difficulty if you explain to him that the defect is of such nature that the full facilities of your shop are required in order to trace the trouble and determine an equitable service charge. Make it clear that you do not wish to take advantage of his unfamiliarity with technical details to make a guess as to the source of trouble. If you explain that a guess is invariably accompanied by unreasonably high charges, much of his resistance will be overcome. (Of course, a guess sometimes will result in a substantial loss to you, but the customer doesn't *have* to know that!)

For the clincher, make it a practice to carry along on all service calls a table-model set that can be left on loan while his set is being repaired.

While on the subject of sets on loan, be smart enough to leave a radio that is presentable and attractive. Many men "miss the boat" by leaving an old piece of junk that tells the customer, better than words, that he is not to be trusted with anything worthwhile. Loan a set that will stimulate the housewife's desire for an extra receiver for the bedroom or kitchen. Aside from the extra dollars that can be made in this fashion (and they can amount to a sizeable portion of your income) you are building one of your most profitable assets: Good Will.

Removing the set to the shop for an estimate is recommended to even the experienced man in those instances when the trouble is obscure. There are numerous times when an hour's work is required, with all the facilities of the shop, to trace the defect. In the customer's home, this hour could grow into a two or three hour affair, with no guarantee of ultimate success.

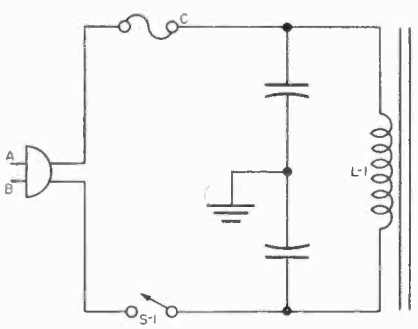


Fig. 1. Typical line power circuit for A-C receiver.

Once the set is in the shop and the estimate has been made, contact the customer by phone if possible and give the results of your findings. Be specific about the repairs you propose to make. Stress the results of your work, e.g., "The radio will receive station WBUNK with greater clarity, there will be no more hum, etc., etc."

If it is necessary to contact the owner by mail, be sure to enclose a stamped self-addressed envelope.

Returning to the problem of service technique, let us first consider the matter of the "question and answer period" during the time that you are getting out your tools and otherwise preparing for the job. Induce the customer to talk about his radio. Not so much for the sake of obtaining clues toward the source of trouble, but more for the purpose of determining the *specific* complaint. There are any number of defects which you, as a technical man, will consider of prime importance but which to the customer are insignificant and unimportant. On the other hand, some minor defect, which you are apt to overlook, may form the major, and in some cases, the sole complaint.

For example, you may discover that an ailing receiver is out of alignment —there may be evidences of poor selectivity, side band cutting, etc. The customer, however, may have called you in only because the cabinet rattles on loud notes, or because the tuning dial sometimes slips. The evidences of misalignment may have developed so gradually that the customer has grown accustomed to them, but that rattle is something else

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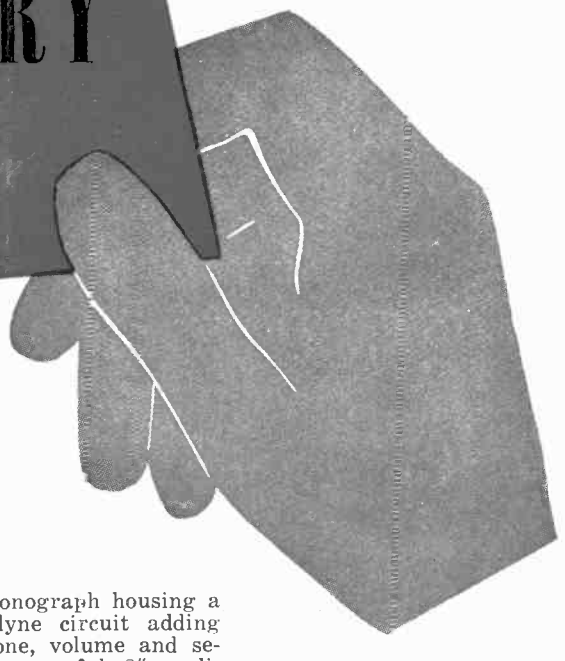
THE INDUSTRY PRESENTS



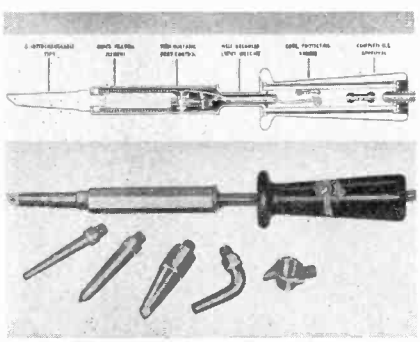
KWIKHEAT SOLDERING IRON

The Kwikheat Thermostatic Soldering Iron, featuring built-in thermostatic heat control has been developed by Sound Equipment Corporation of Calif.

The Kwikheat Iron with an unusually long life expectancy because it eliminates the excessively high temperature acquired by the conventional soldering iron when in "idle" condition is called Kwikheat because it heats up, ready-to-use only 90 seconds after plugging in.

Six different tip styles can be easily interchanged on any Kwikheat iron. The tips are made of corrosion-resistant copper alloy. They screw into the iron for good contact and are tapered for efficient heat conductivity.

Although the Kwikheat Thermostatic Soldering Iron has been in use for several years by large industrial users it is now available generally for the first time on a nationwide basis through supply houses.

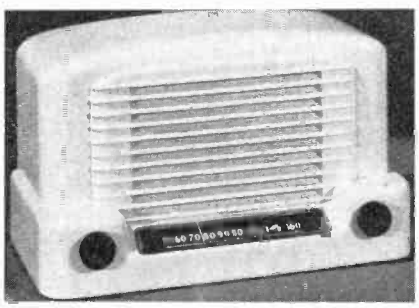


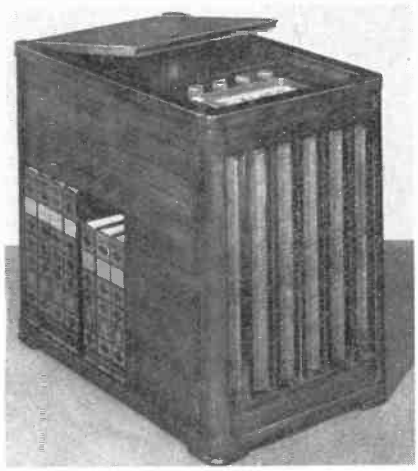
NEW GAROD MODELS

Garod Radio Corporation, Brooklyn, N. Y. announces a new plastic table radio and a chairside radio-phonograph in its 1946 line.

The table model "Senator," model 6B1, incorporates the latest electronic advancements in a 6 tube AC-DC circuit employing 3 gang tuning condenser with an RF stage. Automatic volume control plus tone control for reproduction of colorful music and clear speech. Large concealed loop antenna increases receptive power. It is available in glistening ivory or walnut plastic cabinets with contrasting dial and knobs.

Garod 5CPS2 is a chairside combination radio phonograph housing a new superheterodyne circuit adding colorful range, tone, volume and selectivity with a powerful 8″ auditorium speaker. Automatic record changer safely handles twelve 10″ or ten 12″ discs. A spacious record storage compartment is built in the side of the walnut cabinet.



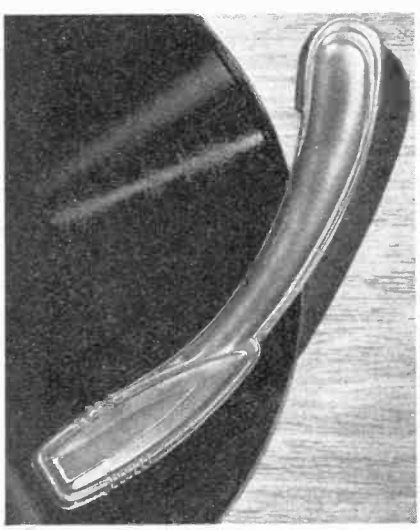


THE "GLIDER"

Shure Brothers announces the development of the "Glider," their new Post-War Crystal Phonograph Pick-up. It features two advanced engineering achievements: the Lever-Type Cartridge and the low-mass Tone Arm.

The Cartridge houses the lever-driven Crystal, which results in lower needle impedance and higher needle compliance. The lever is so designed that it gives a greater shock immunity to the Crystal. The light aluminum Tone Arm is curved and is free from resonance. It has an adjustable swivel screw that prevents the needle from striking the turn-table if the arm is dropped.

The Glider has a scientifically determined frequency response. The standard output voltage is 1.6 volts. Another model will be available in the near future with a higher output voltage.



NEW MICROPHONE

A new cardioid unidirectional crystal microphone, with high output, dual

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Service Kit

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again! Your realignment job, however workmanlike, will go for naught if you are called back after the job is ostensibly finished to correct a fault you knew nothing about.

Now the question arises—shall the set be checked in or out of the cabinet?

The writer's practice has been to leave the set in the cabinet while testing, wherever space limitations do not make it impossible. From the topside of the chassis, a few simple checks can be made. About 90% of the time, the trouble will be revealed by these checks.

To begin with, a great number of service calls are taken care of with tube replacements. Certainly there can be no justification for pulling out the chassis to change a tube or two.

Secondly, it must be borne in mind that no service man is going to bat 1000 on outside service calls. At the best, about five calls out of one hundred will result in "no-sale." If to the cost of gas and traveling time, you must add the time and trouble needed to remove a chassis and then replace it when the customer can't be sold, you are apt to be operating at a loss. Figuring labor at a minimum of $4.00 an hour, it costs from $1.00 to $2.00 or even more to remove the set, test it, and then re-install it in the cabinet. The minimum service charge of $1.00 or $1.50 will just about pay for gas and traveling time. Of course, if you figure your labor at 75¢ or $1.00 an hour, then this is a minor consideration.

So much for the preliminaries.

Now for a look at some of the tests that are possible from the top of the chassis.

1) **Set does not light when switch is turned on:**

The most obvious check is not on the receiver, but on the power outlet. Connecting a voltmeter across the contacts of the plug will quickly eliminate the outlet as a source of trouble. If the receptacle is defective or a house fuse is blown, it is just as well to find out about it at the outset instead of tracing non-existent trouble in the receiver. Some men prefer to check receptacles with a trouble lamp rather than with a meter. This has the advantage that the customer can see for himself that his receiver is defective and that it is not a "loose plug" that is causing the trouble.

If the receptacle checks okay, proceed with the following:

Fig. 1 shows a fairly representative arrangement of the primary circuit in receivers.

Measuring resistance between "A" and "B" with the switch ON should give 4 - 10 ohms.

Fuses, practically always, are located where they may be conveniently reached. Testing from "A" to "C" will check the fuse.

An open in the transformer primary, L-1, will be revealed by infinite resistance between "A" and "B."

Where the receiver uses a universal power supply, the set is generally as shown in Fig. 2.

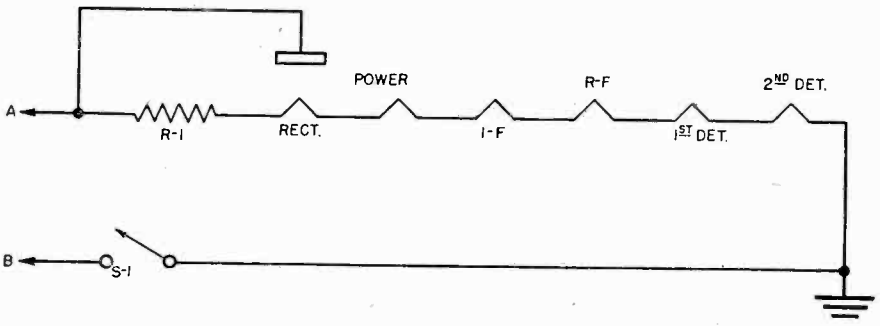

Fig. 2. Line power circuit for six-tube AC-DC set.

Since the rectifier filaments are almost invariably at the highest potential with respect to ground, the dropping resistor, R-1, may be checked by measuring from "A" to the filaments of the rectifier.

If R-1 is okay remove all tubes and check for filament continuity.

R-1 may sometimes be in the form of the speaker field resistance, (D-C sets only. ED.) or may not be used at all in cases where the combined filament drops equal the line voltage. Regardless of the arrangement, the rectifier filaments will be nearest point "A."

2) **Tubes light up but the set remains inoperative.**

Allow the set to warm up. Removing or loosening the detector or driver tube will be accompanied by a sharp click if the audio section is in order and the power supply has suffered no major breakdown. Working back toward the input, the defective stage can be isolated when passing from a "click" to a "no-click" stage.

Should no click be forthcoming when any tube is pulled out, then look for trouble in the speaker or power supply.

This circuit disturbance test can be of great aid if the user is reasonably familiar with common circuit arrangements.

In transformerless power supplies where series-connected filaments are the rule, removing tubes, cannot reveal much, since all tube circuits are interrupted when any tube is removed.

Although we are dealing primarily with console type sets in this discussion a word of caution may be necessary. This test is definitely "out" in the cases where low voltage, low current tubes (such as are used in portable sets) are encountered.

Now for some of the checks that may be made from the topside of the chassis.

Fig. 3 is a representative circuit of the voltage distribution system in recent sets. With minor variations this system will be found in any of the common receivers.

If power supply trouble is suspected, the procedure would be as follows:

Remove and test the rectifier tube. Then with the rectifier tube out, measure resistance across P-1 and P-2 at the socket. Open secondary (T-1 or T-2) will be located immediately.

Testing from the rectifier filament to ground should give about 21,000 ohms. Readings other than this would be interpreted as follows:

(a) Zero resistance. Shorted C-1.

(b) 800 ohms. Shorted C-2. Confirm by checking for zero resistance from screen of output tubes to ground.

(c) 1600 ohms. Shorted C-3. Confirm by repeating check of (b). C-3, if shorted, will show 800 ohms from screen to ground.

(d) 11,600 ohms. Shorted C-9. Screen of converter tube is zero ohms to ground.

(e) 18,100 ohms. Shorted C-8. Screen of R-F tube to ground gives zero ohms.

Shorted filter condensers that place an effective load on the rectifier of 3000 ohms or less will wreck any of

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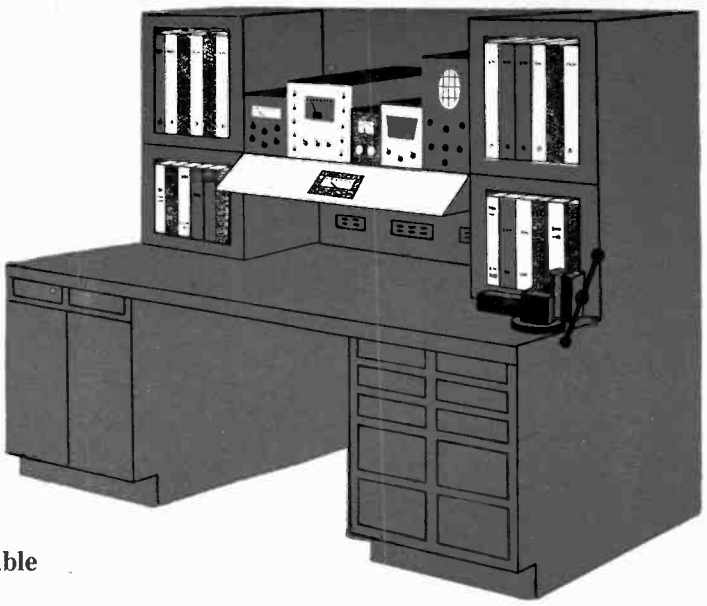
The Radio Service Bench



Here is some helpful info on a group of portable receivers which use an unusual circuit.

by John Joseph

THE EMERSON FU SERIES *of* portables are unusual in their use of separate power tubes for battery and line current operation and also in the method of lighting the filament tubes when using line current. As many of these receivers were produced prior to the war, and assuming the design will be adopted again, the serviceman should become familiar with the circuit arrangement and attendant troubles.

Referring to the schematic of Fig. 1, it will be seen that the power tubes are a 3Q5GT and a 117P7GT. The latter also contains a rectifier section. With battery operation, the entire 117P7 is inoperative, and the insertion of the power plug in the female receptacle at the rear of the chassis connects the "B" battery and places the 9-volt "A" battery across the series filament string of the five remaining tubes. On AC-DC operation, the rectifier section in the 117P7 furnishes the "B" voltage and the other section of this tube is used for power output. Notice that the filament type tubes, excepting the 3Q5 which is now unused, have their filaments connected from the cathode of the 117P7 output tube and the chassis (B-) hence, when the 117P7 is operating, the cathode current of the output section flows through the four-tube filament string, lighting the filaments and also providing the cathode bias for the output section. This arrangement eliminates the usual hot voltage dropping resistor found in other portables, and due to the characteristics of the 117P7, the output when operated on line current is much greater than if the 3Q5 were used as the power tube.

A somewhat frequent complaint with these radios, when operated from line current, is that the signal cuts off in the region between 550 kc and the middle of the dial, and this is due to the 1A7GT oscillator-modulator ceasing to oscillate.

After first removing any tubes that test definitely weak on the tube tester, further check the 1A7 by trying a *new* tube in its place. The reason for doing this is that while used tubes may check okay in a tube tester having full filament voltage, their performance may be uncertain when operating in a series filament string in the receiver. Now try the receiver again on a station around 500 kc and if it still cuts off, leave the new 1A7 in the set and measure the filament voltage on this tube—it must be above 1.3 volts for reliable operation. If it is not, note that due to the circuit arrangement, *both* sections of the 117P7 have to perform perfectly to build up sufficient voltage for the filament string in the output section cathode circuit. Hence, it is worthwhile to try a new tube in this position also, especially if the rectifier

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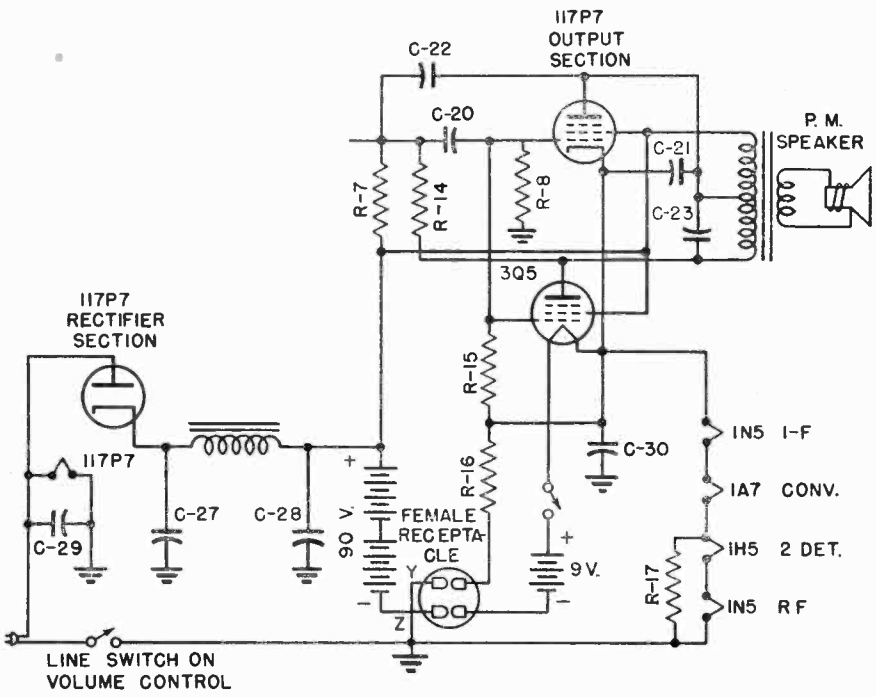

Fig. 1. Output system and method of securing filament current for R-F, converter, I-F and 2nd detector — first audio tubes.

A PAGE DEVOTED TO LETTERS FROM OUR READERS

Las Vegas, Nevada

Gentlemen:

John F. Rider is certainly a consistent gentleman judging from his views expressed in "The Problems of Organization" (RADIO MAINTENANCE, January '46) and compared with his spoken views at the Radio Serviceman's Association convention at the Stevens Hotel in Chicago during the late thirties. He was preaching the pitfalls of organization, insufficient funds, etc., even then. I still agree with the organization thoughts of Mr. Rider.

There is, in my opinion, one phase of the radio serviceman's public-relations that has been neglected. Day-by-day the previously commonplace duty of repairing radio receiving apparatus is approaching a profession calibre—in fact I would be tempted to believe that we have already reached that state. Once the business of maintaining radio equipment is recognized by the general public (and more important by the radio technician himself) as a *profession*, unethical practices will diminish to a negligible quantity and organizations will be founded upon technical social basis rather than upon a business (how - to - make - more - money) basis. Such a state of affairs would lend itself neither to malpractice nor to derogatory public opinion.

Furthermore, when a professional status has been acclaimed, state registration will be practicable. Please notice I refer to state *registration* rather than some form of city licensing. A system may well be designed upon the present methods used by the several states in the registration of professional engineers.

Best regards and continued success,

PHILIP N. PARTRIDGE.

Brooklyn 30, N. Y.

Gentlemen:

I recently saw advertising in reference to your magazine, and also saw the article in the Cornell-Dubilier "The Capacitor" reprinted from your magazine. Both of these things have made me feel that, this is possibly the magazine I have been looking for. However, before I subscribe I would like to see a copy of the magazine itself. Would you please send me a copy? I will be glad to pay the cost of it.

Yours very truly,

LOUIS UDELL.

Pittsburgh, Pa.

Dear Editor:

Being of the firm opinion that sooner or later I'm going to be called upon to service a television set—I am very much interested in articles dealing with that subject. I just wanted to take this opportunity to thank both you and Mr. J. H. Ruiter for the Television article in your January issue.

Yours truly,

CHARLES MATTISON.

Long Beach, Calif.

Dear Sir:

I wish to take advantage of the special offer of two years for $3.00 on your magazine "Radio Maintenance".

Your magazine won great admiration in our Radio Technicians Association meeting.

Yours truly,

VERN PRESTON.

Baltimore, Md.

Dear Editor:

In your October issue, you started some articles about "Residence Radio" and never followed up with the series. I would like more of this kind of information, as I think many of my customers could be sold a built-in radio system. Will there be any more of these articles, and if so, when?

Very truly yours,

KENNETH MATTHEWS

Seems as though you are the only reader who is particularly interested in this series. If enough others join you in your request, we will finish the series.

San Francisco, Calif.

Dear Editor:

This is my first "letter to MM the Editor" but I want to express my appreciation for a magazine that is out of the ordinary in that it aims to give the kind of dope that is useful to the serviceman who is tired of reading page after page of stuff about radio experimenting, short-wave set building, and novelty gadgets.

If I can get one worth-while idea from each issue, Radio Maintenance will pay its own way for me—so far I've gotten much better than one idea per issue.

Sincerely yours,

WALTER BARRY

RM is always glad to know what its readers think of any of the articles in its pages. It helps in the selection of material that the readers want.

The Radio Service Bench

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section tests even slightly low in the tube tester. If the D-C voltage at the cathode of the rectifier section of the 117P7 is not higher than the A-C line voltage, assuming that nothing in the receiver is causing abnormal "B" current, C-27 is defective. Replace C-27 and C-28 (dual 20 mfd, 150 v). Also change the cathode by-pass C-30 (40 mfd, 25 v) if the original unit is several years old, as the life of these condensers seems to be relatively short, and in a few cases this change has restored steady operation. If the low filament voltage can be traced to initial low line voltage, and the line voltage averages low most of the time, it will be necessary to bleed more current through the filament string by connecting a resistor between the screen and cathode of the 117P7 output section. Start with 25,000 ohms and use lower values if necessary, but in no instance should the voltage of the filament string be raised to over 5.5 volts. Now try using the original 1A7 again.

Another problem is matching the speaker to the different load requirements of the two power tubes when it becomes necessary to replace the output transformer and an exact duplicate is not available. In using a universal replacement center-tapped type, keep in mind that the impedance ratio of half the winding to the whole winding is 4 to 1 and the ratio of load requirements for the tubes is 2 to 1—being 8,000 ohms for 3Q5 and 4,000 ohms for 117P7—therefore it is impossible to have the optimum plate load on both tubes. If a secondary tap is selected for 8,000 ohms on the whole primary for 3Q5, this will reflect 2,000 ohms at the center-tap for the 117P7. While theoretically this is a serious mismatch for the 117P7, the inclusion of inverse feedback in the output circuit provides some compensation and the tone is quite acceptable. Substituting a 117N7GT will improve the tone and volume.

MAJESTIC RADIO & TELEVISION models 6P1 and 6P2 three-way portables use a circuit similar to the aforementioned Emerson, the only changes being a 7OL7GT substituted for the 117P7 and a tap switch to change from battery to line operation. The preceding paragraphs will then also apply to these receivers.

DETROLA 389-1 and -2 series also have this type of circuit, with variations. Here, a separate 35Z4 is the rectifier and a 50L6 the power output tube for line current operation. There is no R-F stage in these receivers, hence only three of the filament tubes are in the cathode return of the 50L6 and a 45-ohm resistor takes the place of the fourth tube.

In complaints of erratic operation with this receiver, after reassuring yourself on the points covered in the Emerson analysis, check the 30-ohm resistor in series with the plate of the 35Z4, as it sometimes increases in value. In some regions of low line voltage this resistor may have to be eliminated to insure steady operation of the set, but this should only be done as a last resort.

Perhaps the most time-consuming problem encountered by the repair man is that of intermittent drop of volume in the receiver. Often, when one starts probing in the various circuits, the defect will clear itself and the receiver may operate perfectly for days. The trouble then has to be reasoned out by the serviceman, but if certain components are known by experience to have a weakness for causing this trouble, much time and effort can be saved.

In the writer's experience with Philco sets, one component has proven such a repeated cause of intermittent reception that it immediately becomes first thought in an intermittent receiver containing it. This is the condenser marked 30-4020, a paper tubular of .05 mfd, used in great numbers for audio coupling and also for a-v-c bypass in those Philco models produced around 1937. When it opens in the audio, the signal becomes nearly inaudible and the tone is high pitched and distorted. In the a-v-c position, the volume drops and the receiver hiss increases. When it is mounted in cramped quarters on the band change switch, it may be replaced on the same wiring point outside the band switch shield can.

While it is not in the province of the serviceman to re-design receivers, oftentimes changes have had to be made in the circuit when certain parts were not available, and in a few instances these changes performed better than the original arrangement.

An example of this is a simple change that can be made in the EMERSON U6A chassis. Originally this receiver used a bias cell which is a tiny 1-volt dry cell, to provide the bias for the grid of the first audio tube, a 75. During the last few years, these cells were hard to obtain, so in a case where the cell was exhausted, causing low volume and distortion, the following changes were made. Remove the bias cell from its holder and solder a 10-megohm resistor across the holder and this being in series with the 0.5-megohm resistor will total 10.5-megohms from "B-" to audio grid to ground. Change the audio coupling condenser connected from the volume control to the audio grid to a .002-mfd, 600-volt unit. Hence, as the cathode of the 75 tube returns to "B-", we are now using contact potential bias or "zero bias" as it is commonly known. This system works very well with this set and it may be tried in other receivers using bias cells.

An interesting case of audio oscillation was recently encountered in an RCA model 96T3. The receiver also had an intermittent drop in volume. Refer to the service diagram for this model.

The audio oscillation was at a low frequency, very loud, and would continue regardless of the volume control setting. Tracing out the audio circuit, it was found that the cathode current of the output 6F6 also flowed through the 33-ohm bias resistor in the cathode of the 6F5, hence if the cathode bypass C-16 opened, the two cathodes would be more "common" to each other and, not having a low enough impedance to "B-", feedback was produced. A 10-mfd condenser would *not* stop this oscillation and it was necessary to install 20-mfd, 25-v unit. Clip the green lead running to the fibre can housing the electrolytic condensers. If a glass 6F6G tube has to be used in the output, a high pitched audio whistle may be heard near the maximum volume control setting. The remedy is to use a small shield over the 6F5 grid cap.

The intermittent drop in volume was due to loose ends on the coupling condenser C-10. The small size condensers in many of the RCA receivers cause intermittent trouble, and this can generally be detected by grasping the condenser in the middle with long nose pliers and *very slightly* wiggling it. Don't overlook the condenser on the volume control tap as this has also been found to cause a slight drop in volume.

Another cause for intermittent cut-off in this particular receiver is the resistance wire disintegrating in the 12,000 ohm resistor R-14 which is used to reduce the voltage for the mixer and I-F screens. This resistor is covered with a rough cement, colored blue.

Service Kit

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the common 125 ma rectifiers if the set has been operated for any length of time. Test the rectifier tube, and if it is found defective make the above checks before replacing with new tube.

(f) Infinity. Open in any of the following: L-1, L-2, R-1, R-2, or R-3.

I n the event of an open in I-1, L-2, R-1 or R-2, bear in mind that the original cause of trouble may have been a short in C-2, C-3, etc. For example, an open at L-1 may have been caused by shorted C-2 or C-3.

3) **Defective stage isolated, power supply normal.**

Check from the filament of the rectifier to the plate of defective stage as follows:

(a) Plate of output tube—open transformer primary revealed.

(b) Plate of driver—open transformer primary or decoupling resistor.

(c) Plates of R-F, converter, and I-F tubes—open transformer primaries or decoupling resistors.

One significant point emerges from the foregoing: Resistance checks must be made with care. The man who uses an ohmmeter set to highest range at all times and is content to observe only circuit continuity will find these tests of little value.

4) **No response from circuit disturbance test, power supply okay.**

Check the speaker voice coil and the secondary of the output transformer. Here the low resistance voice coil shunts the transformer secondary, making it necessary to disconnect the voice coil if it is suspected. Since the connections are generally made on an exposed terminal board or strip, this poses no great problem.

Familiarity with the basing arrangements of the common types of tubes is, of course, very necessary. Figs. 4 to 6 are illustrative of the most frequently encountered types. Fig. 4 shows the arrangement of the most used types of octal based tubes such as 6K7, 6J7, 6V6, 6K6, 6L6, etc.

Single ended types vary considerably.

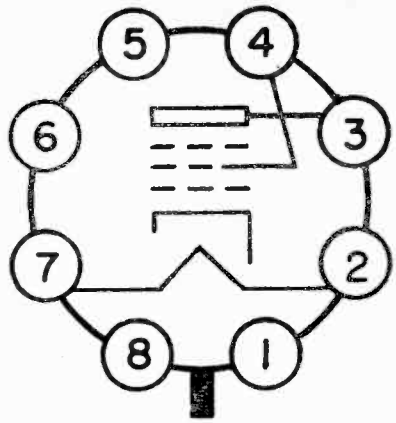

Fig. 4. Top-of-socket location of elements in most-used power pentodes and beam tetrodes, as well as older types such as 6K7, 6J7, etc.

The majority of lock-in tubes will follow the arrangement shown in Fig. 5.

With the old type 6-prong tubes, the arrangement most often found is that of Fig. 6.

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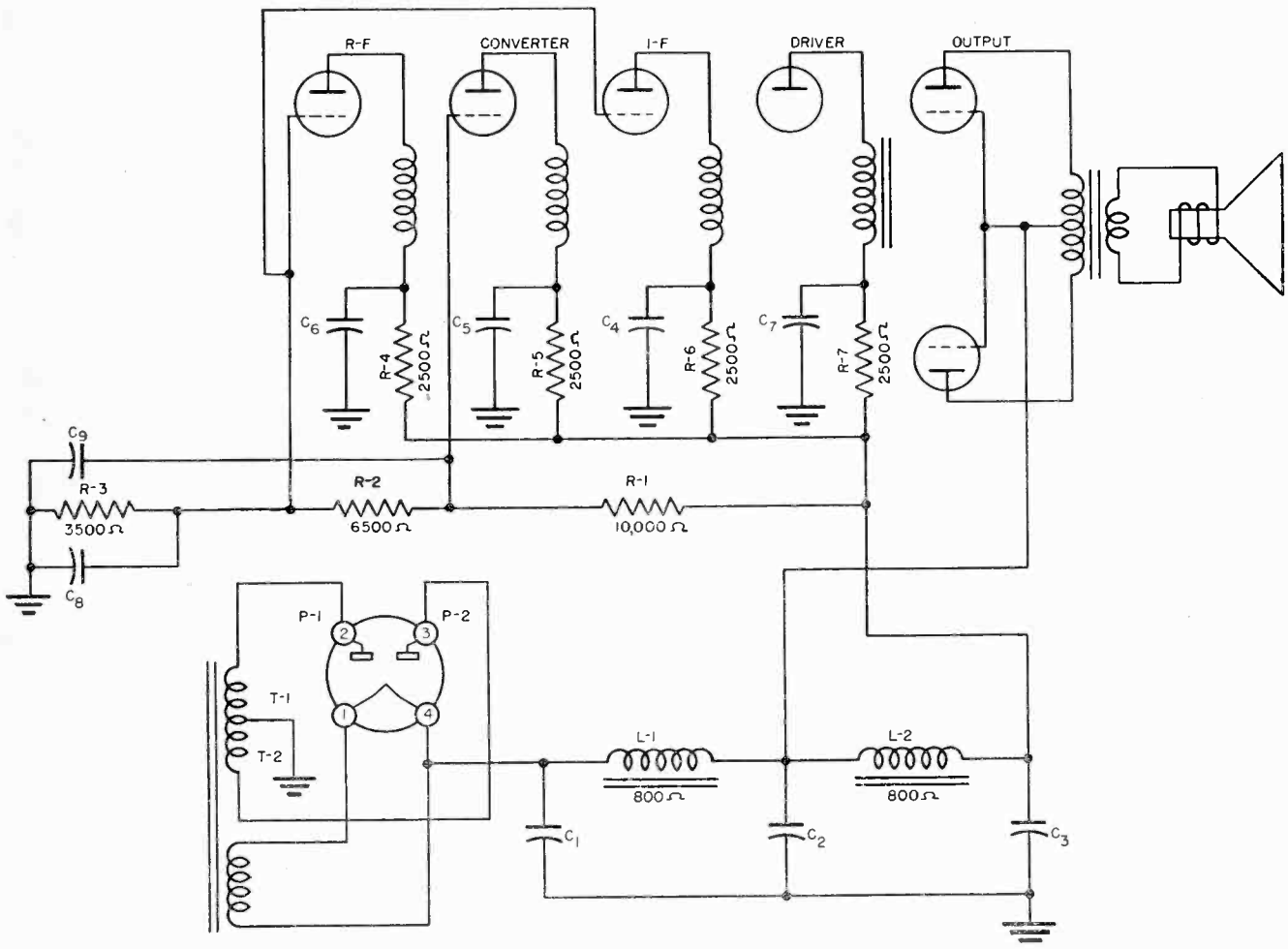

Fig. 3. D-C power distribution throughout 7-tube super-heterodyne.

Service Kit

→ From Preceding Page

Service Charges

Now for a few words about the subject of proper service charges. This is largely a matter of personal choice of the individual service man. Some men value their services highly, others are content with only a very nominal fee. No hard and fast rule can be laid down; however, I have found that no charge, however high, is exorbitant if the set is repaired and *stays* repaired. I have seen good servicemen charge $6.00 to repair a $9.95 AC-DC set and have the customer well pleased. On the other hand, I have known men to charge $1.50 to repair a $275.00 console and have the customer highly displeased because the set developed trouble shortly after the repair job.

In determining the charge, set certain definite standards for yourself. Charge a fair price and leave room for a decent profit. Above all, don't try to cut corners on a repair. If the customer will not pay your price it is poor policy to attempt to sell a repair job by "doping" parts or ignoring components that you suspect will give trouble in the near future. If the customer wants a bargain price job, let someone else do it and get the headaches. Don't make the mistake of reasoning that a job refused represents a loss.

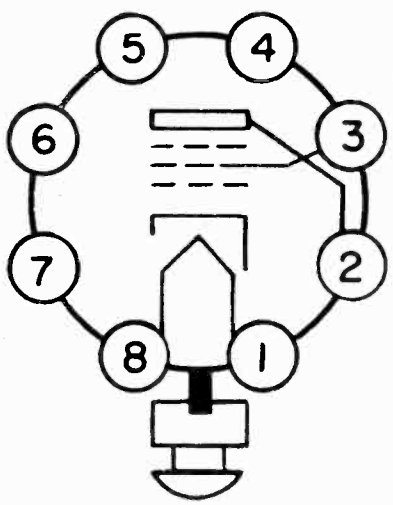

Fig. 5. Top-of-socket connections for the commonly used lock-in types.

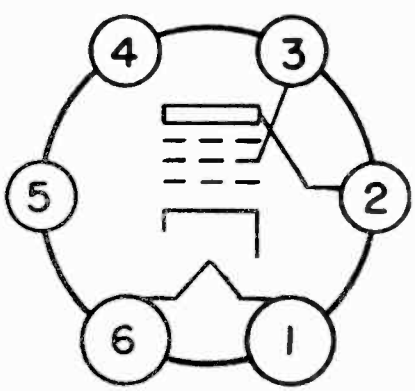

Fig. 6. Typical connection for 6-prong tubes, such as 6D6, 58, 2A5, 41, 42 from top of socket.

When called upon to service a set over a year old, the possibility of selling an overhaul arises. Since an overhaul works to the advantage of both the serviceman and the customer, every attempt should be made to sell it.

Although there are many ideas about what constitutes an overhaul, the following items, in my opinion, represent the minimum requirements:

1) New set of tubes.

2) Replacement of filter condensers.

3) Replacement of volume and tone controls.

4) Cleaning or replacement of wave band switches.

5) Cleaning and re-centering of speaker.

6) If the voice coil shows evidences of rubbing against the pole piece, replace the cone, or at least dope the coil.

7) Clean tuning condensers and tighten grounding clips.

8) Replacement of cracked or overly brittle mica in trimmer condensers.

9) Re-alignment.

10) Replacement of parts that do not pass visual inspection, regardless of their electrical condition, as for example, paper condensers that have begun to leak wax. Sure they may last for years this way—and then again, they may not. Why take chances when the cost of replacement is so small?

11) After all these steps have been taken, allow a set to play for at last two hours. During this time, subject it to thorough vibration check by tapping chassis and components with rubber mallet or other suitable instrument.

12) Finally, a complete and thorough check of the customer's antenna system when the set is returned is a worthwhile feature of your 12-point plan.

Admittedly this is an expensive procedure, but the customer is getting his money's worth and you may rest assured that the possibilities of complaint are minor.

Industry Presents

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frequency response selection, and other features is announced by Electro-Voice, Inc., South Bend, Indiana.

This new model 950 *CARDAX* gives true cardioid performance—has wide angle front pick-up, but is dead at rear. Stops feedback. Substantially reduces pick-up of background noise and reverberation. Nearly doubles front pick-up range. Allows users more freedom of movement. Permits increased loud speaker volume. Simplifies microphone and speaker placement. Solves everyday problems of sound pick-up under adverse acoustic conditions.

In addition, the new *CARDAX* has a Dual Frequency Response selector on back of microphone which enables you to obtain wide range flat response for high fidelity sound pick-up or wide range with rising characteristic for extra crispness of speech or high frequency emphasis.

For full details write to Electro-Voice, Inc. 1239 South Bend Avenue, South Bend 24, Indiana.

COAXIAL SPEAKER

The first of a new series of post-war Coaxial speakers has just been announced by Jensen Radio Manufacturing Company. This new speaker provides quality of reproduction desirable and essential for home receivers and phonographs — particularly for F-M reception and high quality phonograph reproduction.

The Type H Jensen Coaxial consists of two units, each reproducing a portion of the total frequency range. A compression-type high-frequency unit is attached to the back of a 15-inch direct-radiator low-frequency unit. The horn for the h-f unit is formed by a passage of expanding cross section through the core of the l-f unit, the carefully shaped diaphragm of the l-f unit forming a continuation of the h-f horn. The l-f diaphragm is driven by a conventional voice coil assembly.

The Type H Coaxial, with field coil unit is available for applications in which field power for the l-f unit is readily accessible, as in complete radio receivers. A unit identical with this in performance is also available, having Alnico 5 in both l-f and h-f units.

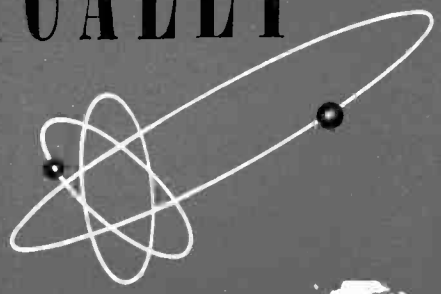
This new Jensen Coaxial is being tooled for production and samples will be available shortly.

PLUG-IN PILOT LIGHT

It's ON or OFF, reports the Handi Glow regarding any electric outlet, socket or power cord. Wafer-thin, this neon-light indicator takes the usual plug prongs slipping through its slots and into the standard electric outlet or the female plug. Protected by a metal housing, the neon bulb is over the head of the plug, in full sight at all times. It can be operated for a cent or two per year for current.

Offered by Industrial Devices, Inc., 22 State Road, Edgewater, N. J.

ELECTRONICALLY SPEAKING



IT IS INTERESTING to note that servicemen operating overseas were responsible for many new electronic war operations such as radar countermeasures. Radar countermeasures constitute the science of immobilizing enemy radar. Recently at the Radio Club of America it was told how the United States spent about 300 million dollars during the war on such equipment designed to jam, confuse and take advantage of German and Japanese radars. Our efforts in this direction were strikingly successful; so much so, indeed, that thousands of lives and hundreds of our bombers were saved. At many crucial moments during the war the enemy was positively afraid to turn on his radar, thereby losing this all-important detection means.

While still far short of a volume scale, the radio manufacturing industry at the beginning of the New Year is geared for steadily increasing production in 1946 unless more strikes occur to curtail the industry's output, or price rollbacks on radio parts lead to further shortages in radio components.

With the threat of strikes in some radio set production plants, a tabulation of statistics compiled by the U. S. Bureau of Labor Statistics shows that wage increases in the radio-phonograph industry since January, 1941, have exceeded the 30 per cent increase being asked by some unions.

Average hourly earnings in January, 1941, in the radio-phonograph manufacturing industry were 63.7 cents, according to the Bureau of Labor reports, whereas in September, 1945, the last month reported, the average hourly earnings in the same industry were 91.3 cents, or an increase of 43 per cent.

Cooperation between manufacturers, broadcasters, dealers and radio servicemen is absolutely essential for proper service to their mutual customers, the public, Samuel B. Levaur, Sales Manager for Television Receivers, Allen B. DuMont Laboratories, Inc., recently told members of the Hudson Valley Radio Servicemen's Association at Poughkeepsie, N. Y.

He described the tremendous efforts being made by broadcasters to bring local and national programs of interest and importance to the public in order that audiences may be built up as soon as possible. He showed how the manufacturers are designing attractive receivers which will go well with furniture now in the home and that the price range would fit a cross-section of the public. Dealers, too, he explained, were making plans to merchandise television receivers so that sales will be many, fast and permanent.

Suggestions made to the service dealers included:

1. Plan a constructive public relations job for even the smallest shops to offset ill will engendered by war shortages.

2. Study literature supplied by the various manufacturers.

3. Keep the shop clean and attractive with well planned and well arranged displays.

4. Insist that personnel maintain pleasing appearances and personalities.

5. Be particular about the quality of all installations and television receiver repair work.

6. Support your own trade associations and help them cooperate with retailers, broadcasters and manufacturers' trade groups for their common purpose of quality television reception.

7. Set prices fairly.

(Editor's Note—Also please remember all television receivers use high voltages.—Be careful. Death is permanent.)

Installation of combined receiver-transmitters on more than 100 buses of the Greyhound Corporation was expected to begin shortly after the first of the year. Permission to operate a central control transmitter in the Chicago loop has already been granted to Intercity Bus Radio, Inc.

Samuel H. Cuff, General Manager of WABD, DuMont Television Station in New York, announced that the test pattern schedule to be maintained for an indefinite period is from 10 a. m. to 12 noon and from 2:30 p. m. to 5 p. m., five days a week, Monday through Friday. This is an invaluable aid to servicemen in the repair and installation of television receivers in the daytime. It is the beginning of this type of service in the Metropolitan area. We hope it develops in other parts of the country.

Arrangements have been completed with Anderson, Davis and Platte for that advertising agency to present an hour-long television program in the new WABD-DuMont-John Wanamaker studios six days a week. Plans call

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Radio Repairman's Associations

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the pendulum of thought from one extreme of its arc to the other, but the points mentioned should be weighed seriously. The conclusions are not the result of a few moments' deliberation. They are the result of much activity during the past 15 years. All people are entitled to their opinions and this issue of licensing is a matter of concern primarily to those who are actively engaged doing the work; consequently, they are the ones who must decide upon those actions which determine their activities.

Assuming perfect sincerity among the proponents and not an effort to ward off competition from recent school graduates or dischargees from the armed forces, it appears that too much emphasis has been placed upon a less important problem of the radio-repair industry. This does not mean that licensing should never have been instituted. Licensing is an unorthodox procedure and should not be applied if it can be avoided. To say the least, its institution should be held in abeyance until it has proved definitely that radio repairmen's associations cannot do what is desired. It should be held in abeyance until the present expansion of the electronic field is crystallized so that its potentialities and possibilities, as well as its true limitations, can be more clearly seen.

It may be a very strange thing to say, but in the writer's opinion the radio repair industry, although about twenty years old, has not yet hit its stride. It will become a technical industry and a profitable industry. This transition will take time. But it must be free! It must be unhampered! It must afford employment for all who seek it. It must be freely competitive. Only if it is fair within can it expect those who are outside to be equally fair.

Troubleshooting Television Receivers

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this circuit for a short, and check the filter condensers.

In short, never go looking aimlessly for trouble in a television receiver nor, for that matter, in any receiver. Make the trouble tell you where it is by effect it produces on the set.

The following is a table which lists some of the more common troubles that a serviceman will run into.

TROUBLE LOCATION CHART

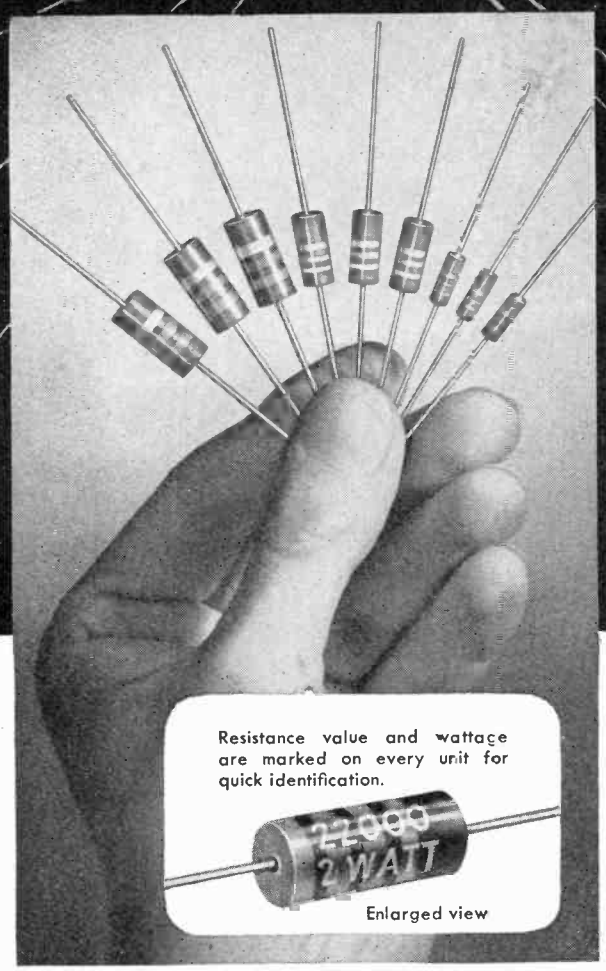
SYMPTOMS	PROBABLE LOCATION	POSSIBLE CAUSE
A—General		
Receiver dead	A-C input power	a. Check A-C power cord b. Check safety switch to be sure it is closed.
Receiver dead, fuse blown	Power Supply	a. Check for shorted or arcing rectifier tube b. Check for shorted filter condenser
B—C-R Tube and Deflection Circuits		
Bright spot on screen of CRT	Power Supply	Defective tube or shorted condenser in power supply which furnishes voltage to sweep generator
Narrow vertical line on CRT	Horizontal Sweep Generator	Check for defective sweep generator tube
Narrow horizontal line on CRT	Vertical Sweep Generator	Check for defective sweep generator tube
Short sweep either horizontal or vertical	Sweep Generator	Check for defective phase inverter or open capacitor coupling the sweep generator to the deflection plates
C—Sound		
Poor Sound	Sound Channel	Defective tubes or tubes not properly seated in sockets
No Sound (Picture okay)	a. Audio Amplifier	a. Check for defective tubes
	b. I-F amplifier, discriminator or limiter	b. Check tubes
	c. R-F section	c. Drift in oscillator — realign trimmer
D—Picture		
Poor Sync—Picture "tears out"	a. Sync separator	a. Defective tube
	b. Sweep generators	b. Check frequency controls for correct adjustment
	c. Antenna	c. Weak signal due to shorted or broken antenna lead-in
Picture rolls from top of screen to bottom or vice-versa	Vertical Sweep Generator	Adjust vertical sweep frequency control
Picture jumps all over horizontally. Several dim images seen	Horizontal Sweep Generator	Adjust horizontal sweep frequency control
No picture (sound okay)	Video Amplifier Picture I-F Section	a. Check video amplifier by touching the grid of the first video amplifier tube. White bars on the screen of the CRT indicate that the video amplifier is okay.
No control of Focus or Intensity	Power Supply	b. Check I-F amplifier Check bleeder circuits on high voltage supply
Streaks across picture	Outside	a. Usually local interference from automobile ignition or diathermy apparatus
		b. Check for voltage leak at the tube socket and tube base
Sound in picture (Dark streaks varying simultaneously with sound volume)	a. Video Amplifier	a. Check video amplifier tubes
	b. R-F Section	b. Antenna and R-F circuits may have drifted. Realign if necessary
Intensity and Focus controls affect the picture and scanning	Cathode-ray tube	CRT defective — probably leaking
Greatly distorted picture	Picture Channel	Contrast control set too high thus overloading the amplifier
Picture sways back and forth	Power Supply	Filter condenser in power supply open
Test pattern shows flattened circles and lines of uneven length	Sweep Generators	Linearity controls not properly adjusted
Intermittent sound and /or picture	Antenna	Shorted antenna lead-in

NEW ...and Individually Marked

OHMITE Little Devil

INSULATED COMPOSITION RESISTORS

½ Watt • 1 Watt • 2 Watt • ±10% Tolerance



NOW . . . OHMITE makes available to you three *Little Devils* of exceptional ruggedness and stability!

Millions of these tiny molded fixed composition resistors have been used in critical war equipment and in the nation's foremost laboratories. They meet Joint Army-Navy Specification JAN-R-11, including salt water immersion cycling and high humidity tests. They can be used at their full wattage ratings at 70°C (158°F) ambient temperature. They dissipate heat rapidly—have low noise level and low voltage coefficient.

Ratings for maximum continuous RMS voltage drop are high: 500 volts for the ½ watt unit—1000 volts for the 1 watt unit—3500 volts for the 2 watt unit. Units have high insulation breakdown voltage.

Little Devils are completely sealed and insulated by their molded plastic construction. Leads are soft copper wire, hardened immediately adjacent to resistor body—strongly anchored—and hot solder coated.

Light, compact, easy to install. All units color coded. Resistance value and wattage are marked on every unit for quick identification. Available from stock in Standard RMA values from 10 ohms to 22 megohms.

Little Devils are ready for any job . . . anywhere. And they're low in cost. Order them now!

Authorized Distributors Everywhere

OHMITE MANUFACTURING COMPANY
4883 FLOURNOY STREET, CHICAGO 44, U.S.A.

Meet Joint Army-Navy Specification JAN-R-11

AVAILABLE FROM STOCK IN STANDARD RMA 10% TOLERANCE VALUES

TYPE	SIZE		RESISTANCE RANGE	MAXIMUM VOLTS	LIST PRICE
	LENGTH	DIAM.			
½ Watt	3/8"	9/64"	10 Ohms to 22 Meg.	500	13c
1 Watt	9/16"	7/32"	10 Ohms to 22 Meg.	1000	17c
2 Watt	11/16"	5/16"	10 Ohms to 22 Meg.	3500	25c

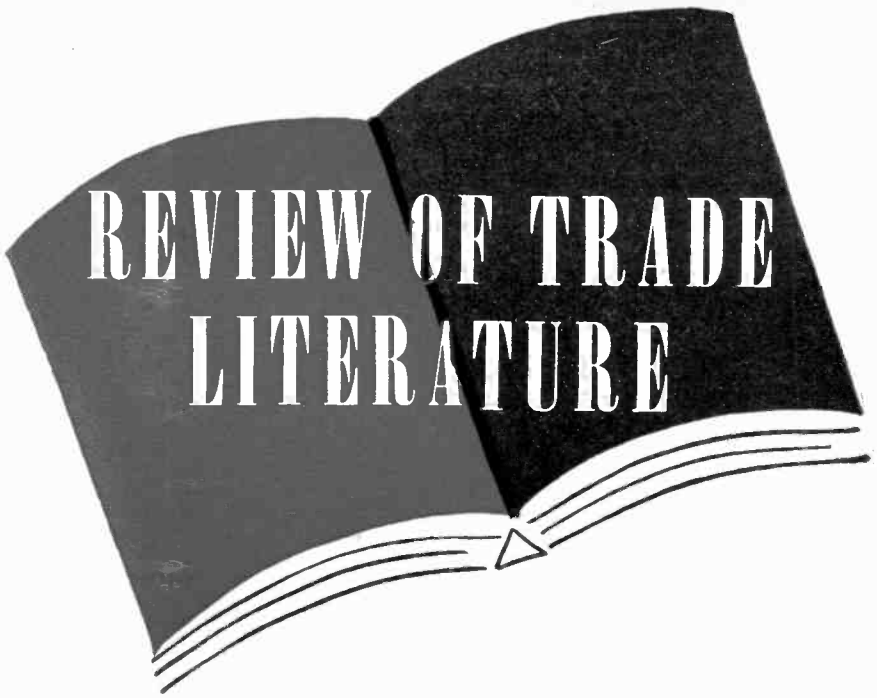
Send Now for BULLETIN No. 127

Gives complete data and list of RMA values. Includes dimensional drawings and handy color code. Write for it today!

Be Right with

OHMITE

RHEOSTATS • RESISTORS • TAP SWITCHES • CHOKES • ATTENUATORS



The Concord Radio Corporation of 901 W. Jackson Blvd., Chicago and 265 Peachtree Street in Atlanta, Ga., recently released a brief catalog of Radio Parts. It's a victory clearance and no priorities are needed. The catalog features all kinds of radio parts ranging from a 1/3 watt carbon resistor selling at 2¢ to a Facsimile Receiver & Printer RCA model FAX-2A, for sale at $99.50. Now's your chance to get those extra parts. Write Concord at the addresses above.

Racon Electric Company, Inc., 52 E. 19th Street, N.Y.C. 3, have released their pamphlet on speakers, horns and horn units. A copy can be had upon request.

Listen to what Hickok has to say about their new tube testers, featured in a catalog just received from them. "Every tube tester shown in this catalog is a Dynamic Mutual Conductance Tester embracing many new features developed and incorporated in the thousands of instruments that aided victory. . . . Plus new improvements made since the close of the war."

The catalog showing models 532P, 532C, 534 Portable, and 536 and 538, can be obtained by writing The Hickok Electrical Instrument Company, 10514 Dupont Avenue, Cleveland 8, Ohio.

A new 8-page publication, Electronics for Education, has been prepared by General Electric Company's Electronics Department.

The booklet, illustrated with charts, pictures of electronic equipment and actual scenes of the use of electronics for educational purposes, describes the ways in which electronics can be used for education.

Television, F-M radio, public address systems and specialized electronic equipment are among the electronic tools which, Electronics for Educations predicts, "are destined to play important roles in the educational processes of tomorrow and provide the means to reach vast audiences not only in schoolrooms but also in homes throughout the nation."

Copies of the booklet (EBR-28) are available free on request to the Publicity Section, G-E Electronics Department, Thompson Road Plant, Syracuse, N. Y.

General Electric has also announced a new 4-page booklet on the personal plane radio, which describes the features of the radio and lists the technical specifications of the unit. Copies of this booklet (EBA-2) are also available on request.

Antenna systems properly geared to new and old radio sets alike, as well as to those F-M, facsimile and television receivers now beginning to appear on the post-war market, are included in the 1946 Taco catalog just released by Technical Appliance Corp., 46-06 De Long Street, Flushing, N. Y. The catalog describes, illustrates and lists various noise-reducing and multiple antenna systems, a new store-demonstrating antenna system, transmission lines, couplers, and a variety of dipoles. A copy of the catalog may be had on request.

Cathode-ray screen characteristics in the form of concise data and curves are contained in two new bulletins issued by Allen B. DuMont Laboratories Inc., Passaic, N. J. These bulletins deal with the P5 and P11 screen characteristics. Both of these screens are designed for photographic recording applications where extremely short persistence is required. The bulletins contain curves of average screen efficiency and spectral distribution of emission from the screens. The P5 and P11 Screen Characteristics Data Sheets are available upon request.

Marion Electrical Instrument Co., of Manchester, N. H., announce that their new comprehensive catalog is avaliable.

This 28-page book illustrates and

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Electronically Speaking

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for presentation of a daily program from 12 noon to 1 p. m. with cooperative sponsorship upon opening of the new studios.

One of the best kept secret weapons of the war was the "Azon Bomb". This "guided missile" using radio controls, produced by Emerson Radio & Phonograph Corporation, was used in both major theatres of war. An officer from Wright Field's Equipment Laboratory, flying as a bombardier, placed an Azon Bomb directly on the Avisio Viaduct, shutting off the Brenner Pass as a German supply route. During the Burma campaign, a squadron of 10 B-17's, equipped with Azon bombs, destroyed all bridges of strategic value to the Japs in Burma.

The Azon is a radio controlled fin attached to the bomb. Using a small radio transmitter in the bomber, the bombardier can steer the bomb to the right or left as it whistles down toward the target, thus assuring perfect accuracy in attacks on bridges, roads, railroads, and other "line shaped" targets.

The lives of many American airmen were saved by the use of Azon since one plane did the work of forty, and in some cases even this high ratio was surpassed. In addition to the savings of lives, Azon meant a saving of manpower, planes, bombs, and helped materially to shorten the length of the war.

Leading set manufacturers attending the OPA hearings stated that they are equally interested with the parts manufacturers in stabilizing the pricing of radio components and are interested in "getting into production" rather than concerned over dangers of occasional overpricing of radio parts.

Parts manufacturers told OPA that actual production costs since V-J Day clearly show that the trend in labor rates has been upward rather than downward as anticipated by OPA. They also pointed out that due to technological advances, the quality of many parts has been upgraded as a result of war production experience and that consequently no reduction in costs could be expected from this quarter.

In an RMA survey of receiving set manufacturers regarding dial markings of FM receivers, a large majority—47 of the 82 RMA set manufacturers—indicated that they favored use of the official FCC channel numbers (from 201 to 300) with 19 companies favoring dial markings using the assigned megacycles. Nine companies made qualified reports, and seven companies did not submit any replies.

The new Audio Video Institute has been appointed educational dealer for RCA Victor in the Texas, Oklahoma, and New Mexico territory. In cooperation with RCA Victor, the Institute will provide complete facilities for sound and visual education, including all types of equipment and professional services in planning and utilizing scientific aids to learning in education and industrial training. Offices are located in Dallas, Houston, San Antonio, Lubbock, Albuquerque, and Oklahoma City.

Emerson says that all their models have three times more power, super sensitivity, and tone fidelity. Among the new technical developments, Emerson's postwar models offer wider reception range, new cabinet and construction materials and new beauty of design.

Applications Of a Low Cost Signal Generator

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set was measured at 600 kc, with 1.0 volts on the antenna terminal, and 0.85 volts on the grid of the first tube. Actual measurements of the signal intensity from WOR indicated 0.55 volts on the antenna terminal, and 0.36 volts on the grid of the first tube. This measurement was made late at night, and the signals from other stations were undoubtedly included in the input measurements of 0.55 volts, although the signal from WOR was the strongest in the band at the time the measurement was made.

In the circuit of Fig. 5, it was desired to determine the load reflected upon the plate of the 6V6. Measurements were made on the plate, at A, wiith a 400-cps tone from a modulated 600-kc R-F signal, which was fed into the antenna terminals. With the volume control set to obtain a voltage of 1.8 on the plate of the 6V6, a voltage of 0.61 was measured on the 500-ohm winding of the output transformer at B. This is a voltage ratio of 2.95 to 1. Since the impedance ratio of two windings of a transformer is equal to the square of the voltage ratio between the two windings, the load offered to the 6V6 plate may be determined by multiplying the secondary load, 500 ohms, by $(2.95)^2$, which gives a plate load of 4350 ohms. While this is low for a 6V6 under normal conditions, the tube was being operated at 275 volts on the plate and screen, and considerable inverse feedback was being used.

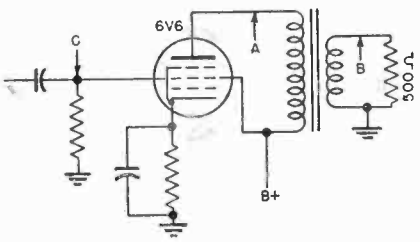

Fig. 5. Typical circuit of 6V6 output tube, used in determination of transformer impedance ratio and gain of the stage.

To determine the actual gain of the 6V6 stage, the voltage on the 500-ohm winding at B was adjusted to full-scale reading, 1.8 volts, on the signal tracer. From the voltage ratio of the transformer as determined above, it will be seen that the voltage on the 6V6 plate is 2.95 x 1.8, or 5.32 volts. Under these conditions, the signal on the grid of the 6V6 at C was measured and found to be 0.4 volts. Thus the gain of the 6V6 alone is seen to be 5.32/0.4, or 13.3.

These are only a few of the applications which will suggest themselves to the user of this signal tracer. The convenience of a small instrument which is entirely self-powered, and which uses so little current from the batteries that they need be changed only two or three times a year cannot be disputed, and familiarity with such an instrument will make it a very desirable addition to the serviceman's shelf of test equipment.

Review of Trade Literature

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describes the Marion line of standard and hermetically sealed electrical indicating instruments.

The catalog also shows the development of instruments at Marion, various production procedures and the tests to which the instruments are subjected during manufacture. The catalog will be sent, free of charge.

The features and specifications of the post-war General-Purpose Oscillograph for all-around use are contained in a bulletin issued by Allen B. DuMont Laboratories, and will be sent on request.

Have you seen the new Presto Recording Corporation catalog?

Designed for professional users such as phonograph record manufacturers, commercial transcription studios, and broadcasters, Presto equipment is also manufactured for commercial and educational use. If you are interested in a copy, write Presto Recording Corp., 242 W. 55th Street, N.Y.C.

The Andrew Company catalog showing a complete line of coaxial cables and cable accessories can be had by writing The Andrew Company, 363 East 75th Street, Chicago, Illinois.

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Review of Trade Literature

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BOOKS

Television Simplified

D. Van Nostrand Co., Inc.

by Milton S. Kiver 375 pp, $4.75

The author of "UHF Radio Simplified" has found the formula for explaining the functioning of television and radio circuits. This book is clear enough to serve as a treatise for the beginner in the video art, yet is sufficiently authoritative to be a television handbook.

Commencing with an introduction to the new art, the author deals with u-h-f waves and antennas. Then, logically following the signal through a typical receiver, he covers circuits in detail from input to C-R tube and speaker. Chapters on Color Television and Frequency Modulation are right up-to-the-minute in current practice, both U. S. and British. The chapter on servicing television receivers covers the subject as thoroughly as can be expected in the absence of an accumulation of field history. The book closes with a glossary of television terms. Since the book is not written at the engineering or scientific level, it merits the attention of the wide-awake serviceman who wants to get an early start in the new techniques.

Inside the Vacuum Tube

John F. Rider Pub., Inc.

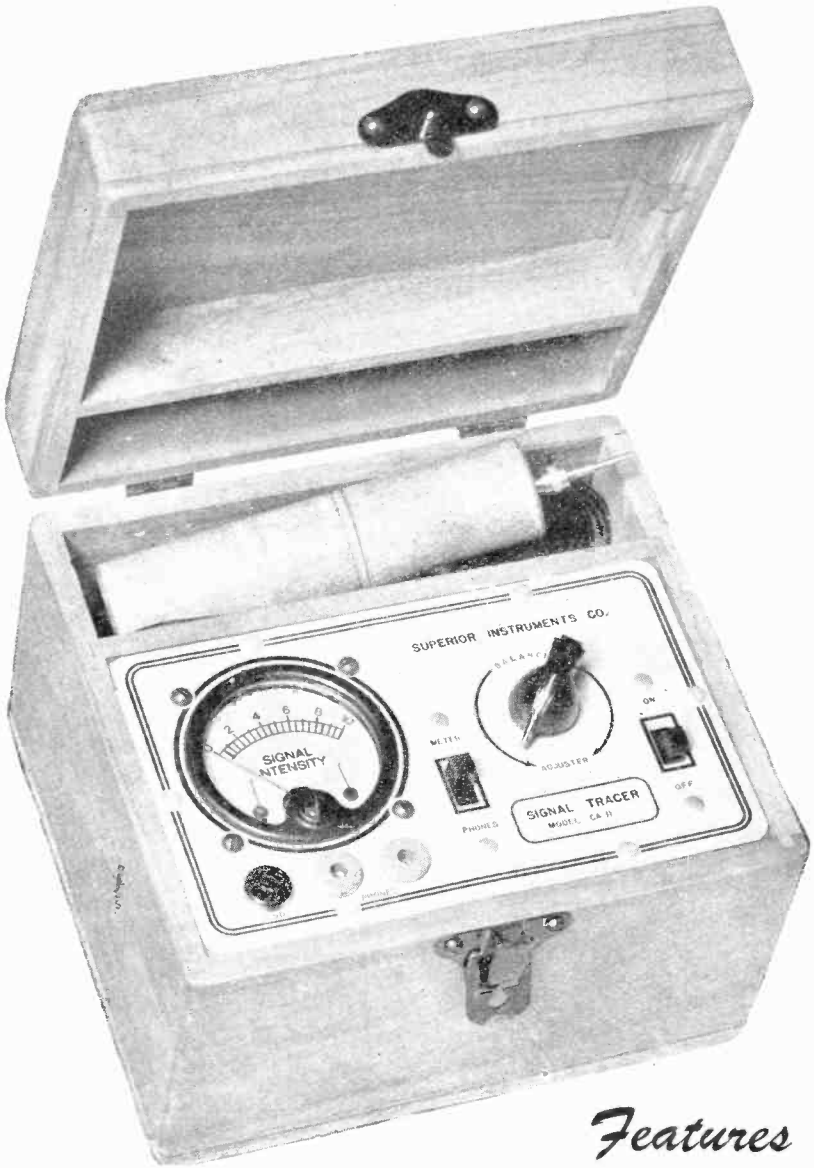
by John F. Rider 424 pp, 6x8½ $4.50

Though vacuum tubes have been treated in a number of books, most of which are too technical for the serviceman reader, this volume takes an entirely different approach to the subject. Using an interesting style of drawings in which electrons are pictured as small bodies complete with legs and arms, the action that takes place inside a tube is clarified so that even the serviceman's wife will be able to understand what makes a radio tube work. After thoroughly grounding the reader in electron action, the book then becomes more technical, and describes the various types of characteristic curves of tubes and the information that can be gleaned from them. On the whole, the author has presented a solid, understandable concept of the theory and operation of the basic types of tubes as a foundation upon which the reader can build a more advanced knowledge of tubes in general. One interesting feature is the use of three steroscopic "anaglyphus" which are viewed through two-color spectacles, furnished with the book, giving a three-dimensional effect to atomic arrangement in a crystal of salt, the lines of force around electrons and protons, and the lines of force which exist within a triode tube.

PLEASE PLACE YOUR ORDER WITH YOUR REGULAR RADIO PARTS JOBBER. IF YOUR LOCAL JOBBER CANNOT SUPPLY YOU, KINDLY WRITE FOR A LIST OF JOBBERS IN YOUR STATE WHO DO DISTRIBUTE OUR INSTRUMENTS OR SEND YOUR ORDER DIRECTLY TO US.

The New Model CA-11

SIGNAL TRACER



Introduced in 1939-1940 Signal Tracing, the "short-cut" method of Radio Servicing quickly became established as the accepted method of localizing the cause of trouble in defective radio receivers. Most of the pre-war testers (including ours) were bulky requiring a number of connections before the unit was "set for operation" and included a tuned amplifier which had to be "retuned" to compensate for signal shift. The new model CA-11 affords all the advantages offered by the pre-war models and only weighs 5 lbs. and measures 5" x 6" x 7". Always ready for immediate use without the necessity of connecting cables, this amazingly versatile unit has NO TUNING CONTROLS.

Essentially "Signal Tracing" means following the signal in a radio receiver and using the signal itself as a basis of measurement and as a means of locating the cause of trouble. In the CA-11 the Detector Probe is used to follow the signal from the antenna to the speaker—with relative signal intensity readings available on the scale of the meter which is calibrated to permit constant comparison of signal intensity as the probe is moved to follow the signal through the various stages.

The Model CA-11 comes housed in a beautiful hand-rubbed wooden cabinet. Complete with Probe, test leads and instructions.

$18.75 NET

Features

- ★ **SIMPLE TO OPERATE**—only 1 connecting cable—NO TUNING CONTROLS.
- ★ **HIGHLY SENSITIVE**—uses an improved Vacuum Tube Voltmeter circuit. Tube and resister-capacity network are built into the Detector Probe.
- ★ **COMPLETELY PORTABLE**—weighs 5 lbs. and measures 5" x 6" x 7".
- ★ **Comparative Signal intensity readings are indicated directly on the meter as the Detector Probe is moved to follow the Signal from Antenna to Speaker.**
- ★ **Provision is made for insertion of phones.**

SUPERIOR INSTRUMENTS CO.

Dept. RM - 227 FULTON ST., NEW YORK 7, N. Y.

IMMEDIATE DELIVERY
for all radio service replacements

Now it's N. U. Panel Lamps, as month by month the N. U. line of quality tubes and parts grows broader . . . opens up more avenues for profitable business for service engineers. And now, you can pick up extra sales of panel lamps *by the box.* That smart looking new vest-pocket N. U. package of 10 lamps does it! Countless numbers of replacements are needed, for radios, cars, flashlights, and other uses. *Order now from your N. U. Distributor.*

Vest-pocket box of 10 lamps—easy to sell that way—and profitable!

Complete line of types for all radio dials, panel boards, tuning meters, instruments, auto radios, flashlights, parking lights, coin machines.

The right bulb for every job—engineered to initial equipment standards—builds your reputation for accuracy and good work.

Torsion-tested filament wires . . . torque tested basing cement . . . shock and vibration tested bulbs . . . all combine to assure better service—*longer.*

NATIONAL UNION RADIO CORPORATION, NEWARK 2, N. J.

NATIONAL UNION
RADIO TUBES AND PARTS

Transmitting, Cathode Ray, Receiving, Special Purpose Tubes • Condensers • Volume Controls • Photo Electric Cells • Panel Lamps • Flashlight Bulbs