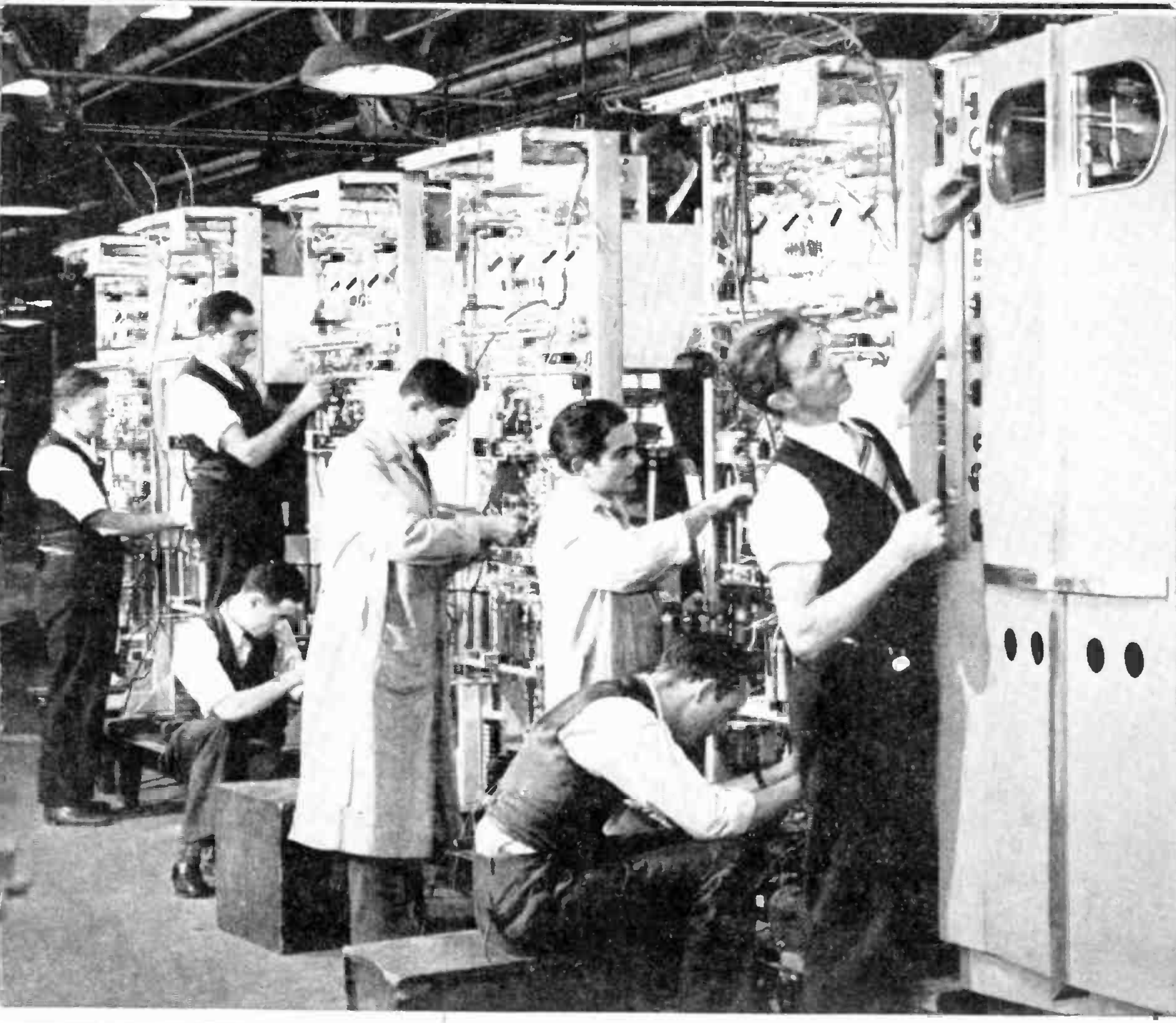
NATIONAL RADIO NEWS



IN THIS ISSUE

Diagnosis by Signal Tracing

F-M Receivers and Their Alignment

Alumni Association News

AUG.-SEPT.
1940

VOL. 9
No. 4

Radio Takes Another Forward Step

Radio is a live, vibrant industry, which constantly is moving forward, creating new opportunities for adventure, romance, excitement and financial rewards.

This is just as true today as at any time in the past quarter-century. New and startling developments, as yet unknown to the public, are sure to take their place in the forward march of Radio, creating new jobs—new careers for men who know the principles and intricacies of Radio technique.

The latest development in Radio is Frequency Modulation. Already forty wide-band channels have been made available for this new system of broadcasting by the Federal Communications Commission, which hails Frequency Modulation as one of the most significant contributions to Radio in recent years.

"Frequency Modulation is highly developed," declares the F.C.C. in a recent press release. "It is ready to move forward on a broad scale and on a full commercial basis. It can be expected, therefore, that this advancement in the broadcast art will create employment for thousands of persons in the manufacturing, installation and maintenance of transmitting and receiving equipment and the programming of such stations."

The statement released by the Federal Communications Commission is given in more detail on page 9 of this issue of the News. I have touched on it here to give emphasis to the important point that Radio is a progressive industry, continually offering new avenues of advancement for men with intelligence, training and determination. In this great industry, hard work remains as the key to unpredictable opportunities for prestige and financial rewards.

E. R. Haas, Vice President.

Diagnosis By Signal Tracing

By J. B. STRAUGHN

N. R. I. Servicing Consultant

Diagnosis by means of signal tracing may be accomplished by four methods—the forward method, the reverse method, the circuit disturbance method, and by an effect to cause reasoning process in which you mentally break down the receiver, section by section, bearing in mind at all times the symptoms which have been observed. The *reverse method* has been in use for many years and may be carried out with the equipment in the possession of every service man. The *forward method* is more elaborate and requires the use of special equipment which costs about the same as a good all wave superheterodyne. The *circuit disturbance method* has points in common with the reverse method and requires ordinary test equipment while *effect to cause reasoning* is a mixture of practical experience and common horse-sense, requiring a minimum of test equipment.

Equipment Required for Reverse Method

For signal tracing by the reverse method you need an all wave signal generator (SG) preferably modulated by a 400 cycle oscillator whose signal may be obtained directly from special jacks on the SG, and a multimeter whose copper-oxide type A.C. voltmeter may be used as an output meter. When employing this method of servicing, the output meter is connected in the usual manner and signals from the SG are injected in the various stages of the receiver, working from the output transformer through the A.F. amplifier, through the I.F. amplifier and finally through the first detector and preselector to the antenna binding post. When you pass through the defective stage this will be evidenced by a change in the signal at the speaker and output meter from normal to abnormal response. With the defective stage isolated it is only necessary to apply the usual tests to locate the bad part.

Equipment Required for Forward Method

As I previously stated, the cost of an instrument for signal tracing by the forward method is comparable to that of a good all wave superheterodyne. The reason for this becomes clear when the nature of the device is understood. The typical Signal Tracer (ST) consists of three vacuum tube voltmeters fed through selective amplifiers, one having variable tuning and covering all I.F. and broadcast band frequencies, another also having variable tuning and covering those frequencies commonly produced by the local oscillator in a receiver and the last being an untuned channel capable of handling all A.F. signals. The ST may also be equipped with a wattmeter which enables the operator to check on receiver power consumption. As indicators for the three channels, various instruments are used. One prominent manufacturer uses tuning eye tubes, another employs a cathode ray oscilloscope while still another uses ordinary meters. It is possible to feed the output of any of the channels into a reproducing device such as a pair of headphones or a loudspeaker.

In using a ST the set is tuned to a station in the broadcast band and the I.F.-R.F. channel of the ST is tuned to the same frequency. The ground lead of the ST is connected to the receiver chassis for all tests and the "hot" (ungrounded) lead touched to definite points in the circuit at which the signal should be present, the ST completing the signal path from its point of connection in the receiver to its output indicating device. By interpretation of the results the condition of the signal at all points between the antenna post and first detector is easily determined, and in this way the signal progress is traced through this section of the receiver. Then this channel is tuned to the I.F. frequency of the receiver and the signal picked off at the proper points between the first and second detectors and analyzed.

If the trouble still persists the A.F. channel is brought into play and the rest of the receiver checked right up to the loudspeaker voice coil. These rapid tests will either lead you right to the defective stage or will suggest farther tests, for example on the oscillator, which may be necessary.

Now that you have a bird's eye view of forward and reverse signal tracing methods we will give brief consideration to the circuit disturbance and effect to cause methods, later learning the exact details of the reverse and forward methods. The simple superheterodyne circuit in Fig. 1 is the set we have been given to repair and will be used in examples of the four methods. All that we know is that it doesn't work, being dead.

The Circuit Disturbance Method

Now let me tell you how I would go about this job. If I had this receiver on my bench I wouldn't reach for my tube tester, signal generator or multimeter. First I would verify the fact that the set was dead. I would turn it on, attach the aerial and ground, advance the volume control to maximum and tune over the broadcast band. Then I would look for surface defects.

Surface Defects are Important Clues. Are all the tubes and their top caps in place, do they light up (glass tubes) do they get hot (metal tubes) does smoke or a burned odor come from the chassis? Do any parts such as resistors seem to be abnormally hot? Does a sizzling sound come from the electrolytics or has sealing compound leaked out of the by-pass condensers?

Test Works 99 Times Out of 100 on Dead Receivers. Should everything appear in good condition I would proceed by means of a circuit disturbance test and in ninety-nine times out of one hundred it would lead me to the dead stage. The circuit disturbance test is one which you should master and it is thoroughly described in a job sheet sent you with your Fundamental Course. I would then check the operating voltages in that stage and make point to point resistance tests with my ohmmeter.

If the trouble continued I would try a new tube since everything capable of making the stage dead but the tube had already been tested. Of course, the tubes could have been tested at the start and since all tubes should be checked as part of a complete service job, most men would have made a check on all of the tubes after an inspection for surface defects. There are times when the circuit disturbance test falls down even on a dead receiver and when it is distinctly not the proper procedure to use, particularly when a set squeals, hums, is weak, distorts, is intermittent, etc. Therefore the correct service technique must be chosen and employed if you are to be a real expert.

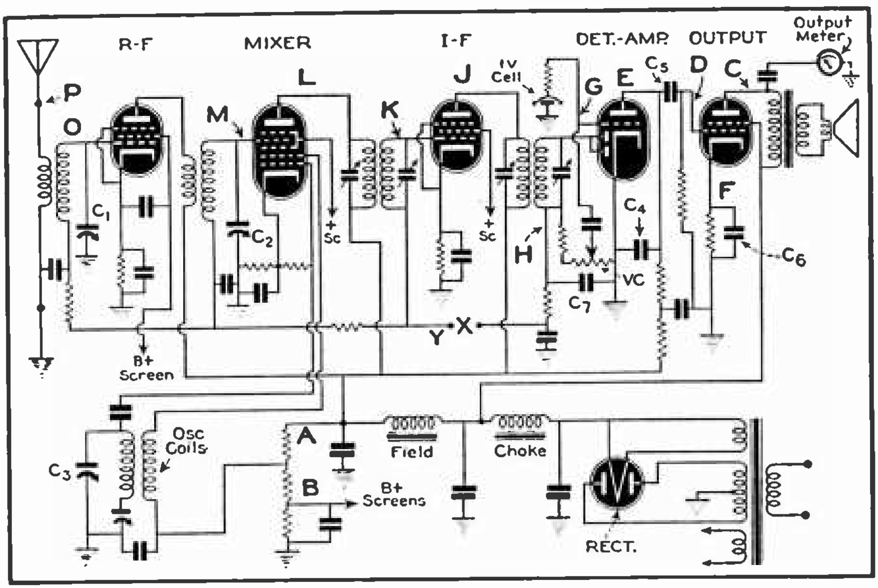


FIG. 1. Signal tracing provides a servicing technique for the systematic location of receiver faults.

Work from Past Experiences. I have told you how I would approach a dead receiver but it is a fact that human nature being what it is, I still wouldn't embark on a physical stage isolation procedure if some other definite trouble appeared. Human behavior is largely influenced by past experiences and somewhat by the reasoning ability of our mind. If we are confronted by certain set circumstances we will search back in our memory for a similar condition and try to remember how we solved the problem. The trained service man will also, when encountering definite symptoms, try to reason from these the possible cause.

Suppose you had previously serviced a set of the same make and model for distortion and had found it to be due to leakage in coupling condenser C_5. Would you try to isolate the trouble to some particular stage or would you first check the condenser? Past experience would win every time and you would no doubt spot the trouble at once.

Effect to Cause Reasoning

Now suppose the receiver distorted on only the most powerful local station regardless of the volume control setting. Again would you chase the signal or would you reason the trouble down to some particular circuit before making tests? That of course depends upon your ability and theoretical knowledge as gained from your study of the Fundamental Course. First, some signals come through undistorted even though the volume is advanced all the way. Therefore the distortion is not due to overloading of the A.F. system by excess signal strength and consequently the A.F. system is all right. So we are led directly to those stages ahead of the Det-Amp. Now why should a very strong signal cause the distortion? By overloading of some stage, of course; and why should the R.F., mixer or I.F. overload when each is supplied with A.V.C.?

The logical conclusion is that the A.V.C. voltage is not reaching some stage. This could not be due to an open circuit since the symptoms of an open control grid return are very definite and would have appeared as the weaker stations were tuned in. The trouble must therefore be due to a short which prevents the application of A.V.C. to all or some of the tubes. What in the circuit could cause such a short?

From the diagram (Figure 1) we see that there are three A.V.C. filter condensers and one of them must be leaky or broken down. With the soldering iron you disconnect the ungrounded lead of each condenser one at a time. You have a test condenser (.05 mfd. is the value commonly used in such a circuit) and you touch one of its leads to the chassis and the other to the point from which you disconnected the suspected condenser. When the distortion disappears and reception has become normal you have found the bad condenser.

All this without touching a piece of test equipment! Most servicemen however would, and properly, have resorted to test equipment when they had diagnosed the trouble as a bad condenser. An ohmmeter would have been the correct instrument although lack of A.V.C. voltage across any of the condensers, using a high resistance D.C. voltmeter would have been test enough.

The moral offered by this example of effect to cause reasoning is that no service man is better than his senses of perception and that if he has practical experience, gained by following the N. R. I. plan and uses his head he can get along with his signal generator and multimeter.

Mechanics of the Reverse Procedure

Now with our signal generator and multimeter we will tackle the set in Fig. 1 which doesn't work. We have finished our inspection for surface defects and have connected our output meter from the plate of the output tube to the chassis as shown in the schematic.

The receiver is tuned over the broadcast band and if a reading is obtained on the output meter this shows that the signal is present across the primary of the output transformer. Nothing is heard in the loudspeaker since this is a dead receiver. We immediately suspect an open in the voice coil or perhaps jamming of the voice coil so that it cannot move. A visual inspection together with an ohmmeter test will show the exact nature of the trouble. In the remainder of our tests to locate the dead stage we will dispense with a broadcast signal as a source not only because it fails to reach the output meter but because if it did we would obtain a fluctuating reading because of the changes in amplitude (strength) of the voice or music signal.

Using the Audio Oscillator. The audio oscillator is turned on and leads plugged into the output jacks provided on its panel. Its ground lead is connected to the receiver chassis and left there for all tests. The other lead known as the hot lead, which should have a built-in blocking condenser, is then touched to point C. This will cause a reading on the output meter and we should hear the 400 cycle note in the loudspeaker.

The hot probe is touched to point E, thus injecting the signal into the control grid-cathode circuit. A much lower reading on the output meter is to be expected because C_8 acts as a short for all practical purposes at 400 cycles. Now inject the signal at D. A considerable increase in output should be obtained due to the amplification of the tube. Lack of signal shows trouble in the circuit and the plate, screen, cathode and filament voltages should be checked as well as the control grid to cathode resistance value. The plate and screen supply sources for the other tubes are then measured between points A and B and the chassis. Any further tests will be on the output tube and this would be the time to test the rest of the tubes.

The hot probe is now touched to point E and the response should equal that at D since C_5 has a low impedance at audio frequencies. The probe is touched to G which will add the gain of the triode section of the Det-Amp. stage. Should you desire to know roughly the gain contributed by a stage, check the output meter reading before the stage is placed in the circuit, for example with the probe at point E. Then check the reading with the stage in the circuit (probe at point G) the last reading divided by the first will show the number of times the stage has amplified the signal. This same procedure may be used to determine the gain or loss contributed by any stage in the receiver.

To check the last section of the audio system, put the probe at H. The output meter reading may then be controlled by the receiver volume control since it is now in the circuit and it will be less than with the probe at G because of the slight drop in signal voltage which will occur in the resistor connected in series with the control. No output indication would point to a defective control, an open in the coupling condenser connected to the slider arm of the control, or a break down in C_7.

A.V.C. Considerations

As we move the hot probe back towards the antenna the output will increase and the greater A.V.C. voltage will tend to decrease the gain of each stage thus masking the true overall gain and giving a false impression of receiver sensitivity due to the leveling action of the A.V.C. We wish to have the output increase proportionately to the gain contributed by each stage as it is included so we simply prevent the application of A.V.C. to the controlled stages. This is easily accomplished by opening the circuit at X and by connecting point Y to the chassis. But this as you already know will result in overloading and distortion if a strong signal is employed. By increasing the bias on the controlled tubes overloading will be avoided. Instead of grounding point Y, connect it to the negative terminal of a 4.5 volt C battery, the positive battery terminal being grounded to the chassis.

At this point I wish to emphasize that the above A.V.C. substitution method is not necessary or even particularly desirable when aligning the tuned circuits, for then the A.V.C. voltage is simply measured across the volume control with a D.C. voltmeter having a sensitivity of 5000ω per volt or more. Then peaking (correct alignment) of the circuits is indicated by maximum reading on the meter.

For our test we will use the bias substitution method and leave the output meter connected as shown in Fig. 1.

High Frequency Gain Measurements. Due to the impedance of the signal generator cable which may be quite large there will be quite a drop in voltage in the cable. This means that the available SG voltage at the ends of the test probes will be less than at the output jacks on the SG. Even with this drop in the cable the SG can supply adequate signal voltage for test purposes. The fact that the impedance of the circuits into which this signal is to be fed is not constant, is another matter. The lower the impedance of the circuit the greater the voltage drop in the cable and the lower the voltage at the ends of the SG probes. Because of this different amounts of SG voltage will be fed to the various circuits, thus upsetting gain calculations.

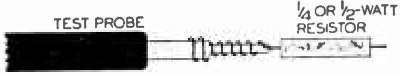


FIG. 2. Simple method for inserting a 100,000 ohm resistor in series with the hot test lead of the signal generator, at the receiver end of the shielded cable. Wind one resistor lead around the tip of the test probe, and shorten the other resistor lead so it can serve as a probe point.

In addition, the connection of the hot probe to a tuned circuit will result in the cable capacity being placed in shunt with the capacity of the tuning condenser of the circuit. This detunes the circuit, lowering its impedance. To avoid this a 100,000ω resistor is placed in series with the hot lead, at the end of the probe as shown in Figure 2. Then when the signal is injected by touching the free end of the resistor to the circuit, detuning does not occur. Since all resonant circuits present a high impedance to signals of their resonant frequency, each will receive about the same amount of signal voltage and fairly good estimates of stage gain may be obtained. When aligning each stage separately by injecting the signal into it directly the series resistance is required to prevent misalignment.

Checking the I.F. When using the maximum output jack of a signal generator you should determine from the SG schematic diagram if it has a series blocking condenser, for without one the grid bias and plate supply voltage will be shorted out by the SG attenuator (volume control) when the hot probe is touched to the control grid and to the plate.

To check the I.F. stages, place the test probes in the ground and max jacks of the SG. Connect the ground probe to the receiver chassis, then tune the SG, set to its modulated position, to the I.F. of the receiver which in this example we will assume to be 456 kc. Touch the hot probe to H. A very weak or no signal should be heard and this is a test of C_7 for its impedance at 456 kc. practically constitutes a short circuit.

Put the probe on J and adjust the SG attenuator to give a mid-scale reading on the output meter. Rock the SG dial either side of 456 kc. If this causes an increase in output the I.F. trimmers are incorrectly adjusted. Retune SG to 456 kc. and adjust the two I.F. trimmers for maximum output. Should it be impossible to peak the trimmers, a defective I.F. transformer is indicated and a new one should be installed after checking the trimmers for a possible short and to see if they are properly connected to the transformer windings.

If you touch the probe to the I.F. cathode you check the cathode by-pass condenser and no signal should be heard. With the probe at K a greater output should be obtained than at J. The probe is then moved to L which shows if the signal is passed through the transformer. The probe is then placed at M and the first I.F. transformer tuning may be checked and if necessary readjusted. This completes the check on the I.F. amplifier.

Mixer, Oscillator R.F. Tests. With the probe still at M, adjust the SG frequency to the receiver dial setting, which should be about 1400 kc. You should obtain an output and failure to do so indicates either oscillator misalignment or what is more likely, failure of the oscillator. Check on the alignment by swinging the SG frequency 50 kc. or so above and below 1400 kc. If the signal comes through, the oscillator is out of alignment and it should be readjusted. If the signal does not come through, all resistors, condensers and coils associated with the oscillator must be carefully checked. The probe is then moved to O and P, an increase in output being noted in each case.

The preselector and oscillator are next aligned by adjusting the trimmers mounted on the condenser gang for maximum output. The receiver and SG are then tuned to 600 kc. and the SG slowly tuned above and below this value while the oscillator low frequency padder is turned first in and then out. At the padder adjustment and SG frequency which gives greatest output the padder is correctly aligned and this completes the job.

In summarizing, remember that while we have traced the signal passage through the entire receiver, we would, since the set was dead, have located the defective stage when we went from a point of signal to a point of connection where no signal was obtained. Then with the multimeter the defective part would have been located.

Mechanics of the Forward Procedure

As in all service techniques the receiver is first checked for surface defects. The power consumption is then checked with the wattmeter in the ST. If the power consumption is high there is probably a broken down filter or bypass condenser and the power supply system is at once checked with a multimeter. Low power consumption on the other hand would point to an open main voltage supply circuit and this could be checked at once with an ohmmeter or first isolated by signal tracing. If the normal power consumption of the receiver is not marked on its name plate, you may figure 10 watts for each tube used in the set.

If the power supply indications are normal, proceed to trace the signal through the receiver.

Using R.F.-I.F. Channel. Either tune the receiver to the frequency of a powerful local station or feed the modulated output of your SG into the aerial and ground posts of the set. Then using the special cable supplied with the ST, touch its probe to point P. An output indication will be observed when the ST is tuned to the frequency of the signal being fed the set. The level control on the ST is adjusted to give a definite output indication (in the case of a tuning eye, full closure of the eye). Touch the probe to O. This will result in a greater output and the amount of gain is determined by readjustment of the calibrated level control to give the reading previously obtained at P. The ratio of the two settings is the amplification occurring in the antenna transformer. The probe touched to M gives the gain of the R.F. stage. The oscillator is next checked by using the special oscillator tracing section and by touching its cable probe to the stator of C_3. The frequency control of the ST should be set at the oscillator frequency which is the pre-selector frequency plus the I.F. of the receiver. In this way we check not only for oscillation but also for proper setting of the oscillator trimmer condenser.

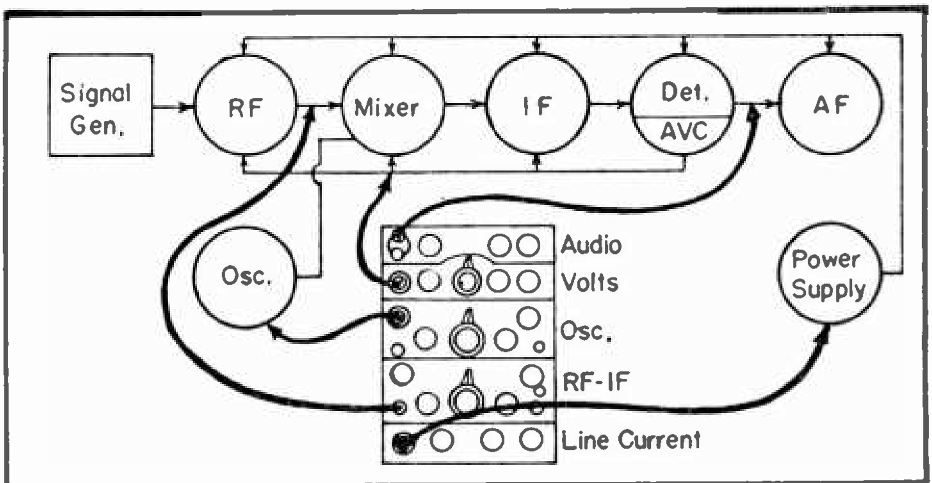
The I.F. section of the ST is next brought into play by tuning it to the I.F. value and touching its probe to L, establishing either the presence or absence of the I.F. signal. The condition of the first I.F. transformer and the gain contributed by it is checked by putting the probe at K. At this time the first I.F. trimmers may be adjusted to give maximum output, thus aligning the stage. Move the probe to J and check the gain of the I.F. tube. Check the second I.F. transformer by putting the probe on the diode plates of the second detector. With the ST still tuned to the I.F., touch point H. No signal should be indicated due to the by-pass action of C_7.

This completes the test up to the input of the first A.F. stage. In conducting this trace, lack of signal at the points of test would have isolated the trouble. The gain tests are quite accurate because the connection of the probe across the tuned circuits (the ground lead of the ST is permanently connected to the receiver chassis) does not result in appreciable detuning. This is due to the capacity which is in series with the probe lead and is built into the probe handle. The capacity may be as small as 1 micro-microfarad. Naturally this results in severe attenuation of the signal and accounts for the high gain which must be built into the I.F.-R.F. oscillator channel.

We now proceed, using the A.F. channel to

Other Uses of the Signal Tracer

We have now traced the signal from the antenna to the voice coil and would have by this time located the dead stage. In the same way we could have located the point of entrance into the receiver circuits of hum, noise distortion, insufficient gain, etc. The most important use of an ST however is not the location of simple troubles of this sort which could have been localized just as easily in some other way. It is in tracing down intermittent defects that the signal tracer really proves its worth. Many of us have encountered receivers which were intermittent and which cleared up whenever any part was touched or jarred. Such problems almost defy solution but with the ST it's easy. Simply con-



Courtesy, Meissner Mfg. Co., Mt. Carmel, Ill.

FIG. 3. Method of using Signal Tracer to check for intermittent action in a 7 tube superheterodyne. The Volts channel is a VTVM and is being used to measure the AVC voltage. The Line Current channel is a check on the receiver power consumption.

check the remaining stages of the receiver. The probe is first touched to point H to check on the operation of the second detector. With the probe at G we check the volume control and its coupling condenser. Moving the probe to E checks on the stage gain. No appreciable loss occurs with the probe shifted to D but lack of signal or a weak signal shows that C_5 is partially or completely open. A signal should not be picked up at F due, as explained for the reverse method, to the by-pass action of C_6. An increase over the signal obtained at D is to be expected at C showing that the output tube has contributed some gain. It is a curious fact that a large loss will be indicated with the probes across the voice coil and this is caused by the step-down action of the output transformer.

nect the I.F.-R.F. channel to M, the oscillator channel across C_3 and the A.F. channel to H. Then let the receiver play until it fades and note the point at which cut-out occurs. If the A.F. cuts out but the oscillator and preselector are O.K., move the probe from M to K and check this section. If none of the stages cut-out you would move the A.F. probe back to the speaker until the bad stage or part was included in the circuit. Then a substitution of parts would show the cause of the trouble. While touching the probes to the circuits might cause the trouble to clear up or to appear, the circuit will not be affected as long as the probe is firmly in contact with it. The voltage surge due to the make and break contact is what causes the trouble and by making the connection and then waiting for the trouble to show up, we have an easy solution.

"F-M" Put On Commercial Basis

This article was released to NATIONAL RADIO NEWS *by the Federal Communications Commission, Washington, D. C.*

Hailing frequency modulation as "one of the most significant" contributions to radio in recent years and declaring that f-m broadcasting on a commercial basis is desirable in the public interest, the Federal Communications Commission recently announced the availability of the frequency band of 42,000 to 50,000 kilocycles for that purpose. This will provide 40 f-m channels, each 200 kilocycles wide—35 to regular high-frequency broadcast stations and 5 to noncommercial educational broadcast stations.

"Frequency modulation is highly developed," declares the Commission in unanimous report. "It is ready to move forward on a broad scale and on a full commercial basis. On this point there is complete agreement among the engineers of both the manufacturing and the broadcasting industries. A substantial demand for f-m transmitting stations for full operation exists today. A comparable public demand for receiving sets is predicted. It can be expected, therefore, that this advancement in the broadcast art will create employment for thousands of persons in the manufacturing, installation and maintenance of transmitting and receiving equipment and the programming of such stations."

At the same time the Commission points out that there was agreement among witnesses at its recent hearing that this new service will not supplant the service of standard broadcast stations generally and that, therefore, f-m will not make obsolete the receivers now in use. Standard broadcasting is on an entirely different frequency band from that to be occupied by frequency modulation. F-m will not interfere with it. Present standard broadcasting will continue, and certainly for a number of years will render full service. The extent to which in future years the listeners will be attracted away from the standard band cannot be predicted. Testimony at the hearing indicated that manufacturers will provide receiving sets capable of receiving both services.

The chief claims for f-m are that it gives more fidelity and less interference than standard broadcast. The principle of frequency modulation has long been known but its practical use was not demonstrated until recently.

There was unanimous agreement at the March hearing that f-m is superior to amplitude modulation for broadcasting on frequencies above 25,000 kilocycles. The use of a wide band of frequencies makes possible a reduction of noise to a greater extent than attained with narrow-band standard broadcast. There was testimony that a band width of less than 200 kilocycles can be used for f-m, but this lessens the noise-discriminating quality which has been established by experimental operation with the wide channel. Testimony advocating the narrower band width was not supported by experience in program service. Moreover, the narrower band width would jeopardize use of facsimile transmission on the same channel. The Commission believes that regular program service should begin on a 200-kilocycle band basis which can be conveniently reduced if developments warrant. By adopting the wide-band f-m channels at this time, it will be possible for the public to continue the use of receivers designed for wide-band reception even though narrower channels may later be authorized.

The opening of a new band for commercial broadcast will help to correct numerous defects and inequalities now existing in the standard broadcast system. These inequalities result from the scarcity of frequencies, their technical characteristics, and the early growth of broadcasting without technical regulation. There is today a lack of stations in some communities, and other communities do not have sufficient choice of program service. The establishment of the new broadcast band in the higher frequencies will enable many communities to have their own broadcast stations.

Experimental operations show that f-m stations can operate on the same channel without objectionable interference with much less mileage than is possible with standard broadcast stations. F-m has the ability to exclude all except the strongest signal. Also, f-m stations require much less mileage separation than do standard broadcast stations. The service range of f-m stations, though limited, will in many cases be greater than obtained from the primary service of comparable standard broadcast stations.

The licensing of classes of standard broadcast stations in the same area with different frequencies and different power has resulted in a wide disparity in the extent of service to the public. The system of classification now employed for standard broadcast stations will not be used for f-m stations. The rules and regulations and engineering standards to be issued for f-m in the near future will enable applications to be made for facilities to serve a specified area. F-m stations will be rated on the basis of coverage rather than power. Competitive stations in the same center of population will be licensed to serve the same area.

The present situation of certain standard broadcast stations having large daytime coverage and restricted nighttime coverage on duplicated channels will be avoided. The coverage of f-m stations will be substantially the same both day and night. However, f-m stations do not have the long-distance coverage of the present high-powered clear-channel standard broadcast stations. The latter may be required indefinitely, for widespread rural coverage. But for covering centers of population and trade areas, the new class of station offers a distinct improvement.

The Commission deems it in the public interest to allocate a contiguous band of frequencies to accommodate both commercial and educational f-m stations. The band between 42,000 and 50,000 kilocycles is particularly suited for this service. Under the new allocation, the same number of frequencies heretofore assigned to non-commercial educational stations has been retained, the only change being that the position of such stations has been moved 1,000 kilocycles higher in the spectrum. This arrangement permits the same receiver to be used for the two services. The three educational institutions now authorized to use amplitude modulation in the non-commercial band can continue to do so, but the Commission hopes that subsequent applicants for non-commercial educational broadcast facilities will find it economic and otherwise preferable to utilize f-m.

How Frequencies Were Reallocated

Readjustment of the ultra-high radio frequencies to provide the 40 f-m channels between 40,000 and 50,000 kilocycles, as well as seven channels below 108,000 kilocycles for television service, is pursuant to allocations contained in Commission Order No. 67.

The solution to finding space in the crowded radio spectrum for the needs of these two services was achieved with the cooperation of the Interdepartment Radio Advisory Committee in Shifting Government frequencies. This committee, representing 13 Federal agencies, advises the President in allocating radio channels for Government use.

The arrangement gives private services priority rights between 60,000 and 66,000 kilocycles and between 118,000 and 119,000 kilocycles in exchange for relinquishment to the Government of the bands 41,000 to 42,000 kilocycles and 132,000 to 140,000 kilocycles.

In addition, the Commission discontinued television service in the present television channels Nos. 1 and 8 (44,000-50,000 kilocycles and 156,000-162,000 kilocycles respectively). Accordingly, old television channel No. 2 will be renumbered television Channel No. 1; and a new television channel No. 2 will be assigned from 60,000 to 66,000 kilocycles. Former television channel No. 8 (156,000-162,000 kilocycles), together with frequencies between 116,000 and 119,000 kilocycles, will be used to replace the assignments in the band 132,000 to 140,000 kilocycles. There is no change in the other eleven channels comprising the 162,000 to 300,000 television band.

Unlimited Operation May Be Authorized After January First

The new allocations become effective immediately on a limited basis. After January 1, unlimited operation may be authorized. Regular commercial service employing wide-band f-m, which may include the multiplexing of facsimile transmission simultaneously with aural broadcasting, will use the 43,000 to 50,000 kilocycle band, and non-commercial educational broadcasting stations are given the new frequencies 42,100, 42,300, 42,500, 42,700 and 42,900 kilocycles. This provides a continuous band for f-m, thus assuring a degree of uniformity in the quality of the different frequency modulation channels and tending toward simplicity and economy of f-m receiving sets.

The rearrangement permits the Commission to maintain seven television channels below 108,000 kilocycles and at the same time provide an adequate number of channels for frequency modulation. It expects these and other services to benefit by the changes.

It points out that sky wave interference on frequencies immediately below 50,000 kilocycles is greater than on the higher frequencies. While it likewise recognizes that shadows and fading become more pronounced as the frequency increases, it nevertheless believes that such factors are not substantially different on frequencies in the vicinity of 60,000 kilocycles. Furthermore, it is generally conceded that the problem of diathermy interference is now most acute on frequencies immediately below 50,000 kilocycles.

Thus, by allocating 60,000 to 66,000 kilocycles instead of 44,000 to 50,000 kilocycles to the television service, a good balance has been achieved between the effects of sky waves and diathermy interference on the lower frequencies and the effects of shadows and fading on the higher bands.

The miscellaneous radio services now assigned frequencies between 132,000 and 140,000 kilocycles will benefit by the changes in that 9,000 kilocycles are now allocated where formerly only 8,000 kilocycles were available. This can provide 70 channels as compared with 57 channels in the past. The change has the further advantage of providing two large blocks of frequencies for experimentation with different propagation characteristics.

The Laboratory Page

By GEORGE J. ROHRICH

The purpose of this department is to furnish supplemental experiments to students who have completed their Home Laboratory Course, but who wish additional laboratory experience. You are not required to perform these experiments, but you will gain increased knowledge by doing so.

Most of the material required will be that received as part of the Laboratory Course. Any other material necessary can be purchased very reasonably and will constitute an investment rather than an expense, as it will serve as replacements in service work or be useful in your shop later.

George J. Rohrich Engineer in Charge N. R. I. Laboratory

HELPFUL INFORMATION ON EXPERIMENT NO. 25

Making each new radio assembly "click" the first time you put it together in the experiments bolsters a certain added amount of your confidence in your ability to work with radio circuits.

However, radio circuits do not always "click," even after repeated trials. The expert finds from experience that this is often true in his own case. Here is where the expert usually applies a series of "continuity tests" in order to locate that hidden "open circuit" or "short circuit" which he knows is so commonly responsible for his failure.

Yes, hidden defects can occur in the experiments, just as well as in those practical circuits which the expert handles. Therefore, there is no disgrace or reason for discouragement if you do run into trouble yourself in those demonstration circuits given in the experiments of the Home Laboratory Course.

If failure of Experiment No. 25 should occur then you have a splendid opportunity of getting added practical experience of applying your servicing technique. Do like the expert does and make a series of continuity tests. This can be done very simply in the original circuit of Figure 32 by completing the continuity of various circuits with the application of the red test prods to various terminals. When continuity does occur, you will get a deflection on one of the meters.

If you experience trouble with experiment No. 25 I would suggest that you connect the apparatus as shown in Figure 32, with the exception that you should reverse the connections to the 0-5 milliammeter. *Leave the tube out of the circuit.*

We are now ready to test the circuits for continuous wiring. Take the red test prod and hold one end of it on terminal 6. Hold the other end of the same red test prod on the positive terminal of the socket. Your milliammeter should deflect to approximately 1.5 milliamperes. This test allows you to measure the voltage of the two dry cells. The reading of 1.5 milliamperes indicates three volts, according to the scale which is shown in Figure 18.

Be sure that the ends of the wires attached to the meters do not touch the metal cases and if you do not obtain a reading of 1.5 milliamperes on your milliammeter, then this indicates that your two dry cells are defective. They will have to be replaced.

Hold one terminal of the red test prod on the grid terminal of the socket. Hold the other end of the same test prod on the positive terminal of the socket. You should obtain the same reading as before. If you do not obtain a reading then this indicates that you have an open circuit in the coil between terminals T_1 and T_2, or else in the wire which connects terminal 6 with terminal T_1.

Hold one end of the test prod on terminal 5. Hold the other terminal of the test prod on the negative terminal of the first B battery (the top one in Figure 32). Your voltmeter should deflect to approximately 45 volts.

In case that the 45 volts do not register on your meter, then you may have a short circuited .05 microfarad condenser. Remove the condenser temporarily and if the reading is obtained on the voltmeter then this shows that the condenser is defective. In case you still do not obtain a reading after the condenser is removed, then your B battery is defective, or else your voltmeter is defective.

After you locate the trouble and are able to obtain a reading of 45 volts in the above test, then hold one end of the test prod on the plate terminal of the socket. Hold the other end of the test prod on the negative terminal of the first B battery. Again, you should obtain a reading of 45 volts on your meter. In case you do not obtain this reading, then you have an open circuit in the tickler coil, between terminals T_3 and T_5.

In case your circuit tests correctly then proceed with adjusting the filament voltage to two volts, by using the following method:

Put all of the 30-ohm resistance in the filament circuit by sliding the adjustable contact toward the back edge of the baseboard. Hold one end of the test prod on terminal 6. Hold the other end of the test prod on the positive terminal of the socket. The milliammeter should deflect to 1.5 milliamperes, as before. Insert the tube. Again hold the test prod on terminal 6 while the other end is held on the positive terminal of the socket, as before. The milliammeter should now register less than 1 milliampere. In case it does not register less than 1 milliampere, then the filament of the vacuum tube is burned out.

In case your milliammeter does register, and registers less than 1 milliampere, then the filament is operating satisfactorily. Continue to hold the test prod across the two terminals mentioned above. Now adjust the slider on the 30 ohm resistor until the milliammeter registers 1 milliampere. This indicates that the filament voltage is now two volts, according to the voltage scale which is given in Figure 18.

Under no circumstances should the milliammeter read more than 1 milliampere *while the test prod is held across the positive terminal of the socket and terminal 6*. Otherwise, more than two volts will be applied to the filament and the filament is likely to burn out.

Upon removing the test prod from the two terminals, and while rotating the tickler, your milliammeter should read *backwards*. This indicates that the circuit is oscillating. You may now reverse the connections to the milliammeter. Your connections will then be exactly as shown in Figure 32. Your milliammeter will now read up scale when the circuit is oscillating.

Should you still fail to obtain oscillation, then carefully inspect the three wires which lead from the tickler to terminals T_3, T_4 and T_5. Possibly these wires are short circuited and this condition will prevent oscillation. There is little danger that you will have this trouble unless you continually rotate the coil in one direction and destroy the insulation on the wires.

If you still fail to get oscillation up to this point of your tests, then you probably have a defective contact between one of the socket terminals and its corresponding prong of the vacuum tube. In order to check this continuity between each contact and its tube-prong you should raise the tube out of its socket about one-eighth of an inch so you can touch each prong with the metal tip of the red test prod. Then repeat those tests described in the first part of this Laboratory Page. For example, repeat the first test, but this time leave the tube slightly raised while inserted in its socket, then hold the tip of the red test prod *on the prong* corresponding to the positive terminal of the socket, while the other end of this test prod is held on terminal 6. Your milliammeter should deflect to 1 ma. No deflection indicates a defective socket-contact near the *positive* tube prong while a deflection of 1.5 ma. indicates either a burned out filament or a defective socket-contact near the *negative* tube prong.

Next, hold the tip of red test prod on the *grid prong* of the tube. Hold the other end of this same test prod on the positive terminal of the socket. You should get a reading of 1 ma., this being the same as for the preceding test; no deflection indicates an open socket-contact near the grid-prong; a deflection of 1.5 ma. indicates a burned out filament; a deflection less than 1 ma. indicates that the two dry cells for heating the filament are partly exhausted, or that the movable contact on the 30-ohm resistor needs readjustment in order to raise the filament voltage.

The final tube-prong test involves holding the tip of the red test prod on the plate-prong while the other end of this test prod is held on the negative terminal of the first B-battery (the top one in Fig. 32). Failure to get a 45-volt reading indicates an open circuit. A correct reading, followed by no reading when the test prod is removed, now indicates the tube has to be replaced with a new one.

By carrying out the above procedure you will be able to locate any defective parts and then you can take the necessary steps to have them replaced.

RADIO-TRICIAN

REG. U.S. PAT. OFF.

Service Sheet

Compiled Solely for Students and Graduates

NATIONAL RADIO INSTITUTE, WASHINGTON, D.C.

SILVERTONE Chassis 101.535

Models 6133, 6141, 6139, 6137, 6202, 6203, 6252, 6253, 6199

ALIGNMENT PROCEDURE

PRELIMINARY:

Output meter connection .... Across loud speaker voice coil
Output meter reading to indicate 500 milliwatts .... 0.89 Volts
Generator ground lead connection .... Receiver chassis
Dummy antenna value to be in series with generator output .... See chart below
Connection of generator output lead .... See chart below
Position of Volume Control .... Fully clockwise
Position of Tone Control .... HI
Position of Dial Pointer with variable fully closed ... Center of first mark to left of 550 kc calibration mark

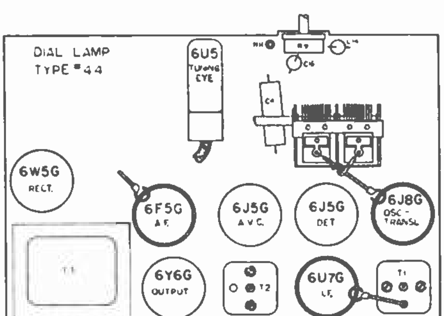
Wave Band Switch Position	Position Of Variable	Generator Frequency	Dummy Antenna	Generator Connection	Trimmers Adjusted (In Order Shown)	Trimmer Function
"AM"	Closed	455 kc	.1 mfd.	6J8G Grid	T2, T1	IF Output IF Input
"AM"	600 kc	455 kc*	.0002 mfd.	Ant. Term.	C1*	Wave Trap
"AM"	Fully open	1730 kc	.0002 mfd.	Ant. Term.	C7	Oscillator
"AM"	1400 kc	1400 kc	.0002 mfd.	Ant. Term.	C2	Translator
"AM"	600 kc(rock)	600 kc	.0002 mfd.	Ant. Term.	C8	Padder
"SW"	15 mc(rock)	15 mc	400 ohms	Ant. Term.	C3	Translator

IMPORTANT ALIGNMENT NOTES

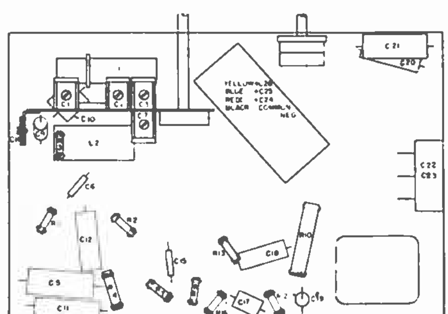
*The generator should be adjusted for high output. The trimmer should be adjusted for minimum output meter reading instead of the usual maximum reading. If the frequency of an interfering station around 455 kc is known, the generator should be adjusted to the frequency of that station instead of to 455 kc.

Where indicated by the word, "Rock," the variable should be rocked back and forth a degree or two while making the adjustment.

The alignment procedure should be repeated stage by stage, in the original order, for greatest accuracy. Always keep the output from the test oscillator at its lowest possible value to make the AVC action of the receiver ineffective.



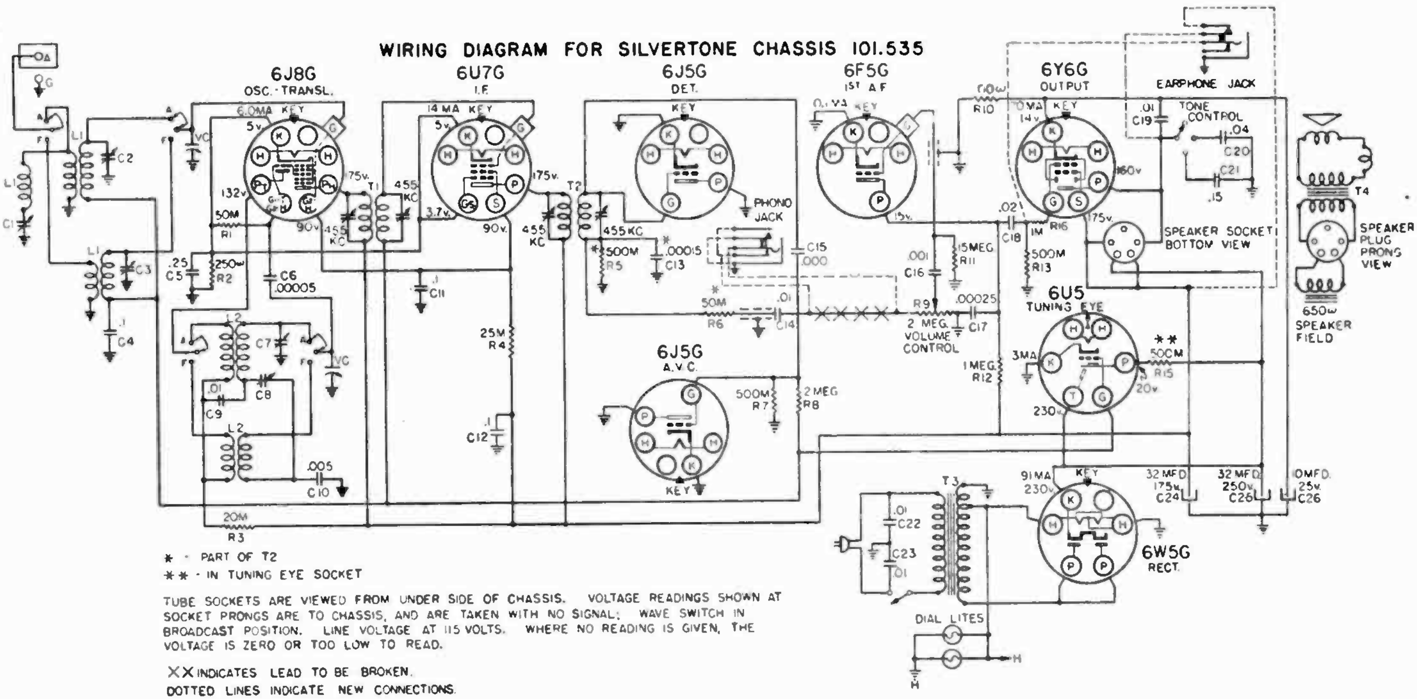
Locations of parts on top of chassis



Locations of parts under chassis

Readers who file Service Data in separate binders remove page carefully, trim on dotted line for same size as data published heretofore.

WIRING DIAGRAM FOR SILVERTONE CHASSIS 101.535



* - PART OF T2

** - IN TUNING EYE SOCKET

TUBE SOCKETS ARE VIEWED FROM UNDER SIDE OF CHASSIS. VOLTAGE READINGS SHOWN AT SOCKET PRONGS ARE TO CHASSIS, AND ARE TAKEN WITH NO SIGNAL; WAVE SWITCH IN BROADCAST POSITION. LINE VOLTAGE AT 115 VOLTS. WHERE NO READING IS GIVEN, THE VOLTAGE IS ZERO OR TOO LOW TO READ.

XX INDICATES LEAD TO BE BROKEN.
DOTTED LINES INDICATE NEW CONNECTIONS.

ELIMINATING WHISTLE AT 910 KC:

A whistle, due to a beat between the second harmonic (910 kc) of the 455 kc IF, and a 910 kc signal may be experienced. In localities where the 910 kc station is one that is frequently listened to, it will be desirable to shift the whistle to some other point where it will not be objectionable. This can be done by shifting the IF frequency of the receiver.

Determine at what point between 880 kc and 940 kc the whistle will be least objectionable. Dividing this frequency by two will give the new IF frequency to which the receiver should be aligned. For example, if it is determined that a whistle at 890 kc would not be objctionable, the IF should be realigned at 890/2 or 445 kc. Try to select the new IF frequency as close to 455 kc as possible.

Align the IF at the new frequency and then realign the rest of the receiver as described under, "ALIGNMENT PROCEDURE."

THE AVC CIRCUIT:

The diode current of the 6J5G AVC tube flowing through the 500M ohm resistor, R7, creates a voltage drop across it. This voltage is applied to the control grids of the translator and IF tubes to provide AVC.

Novel Radio Items

—BY L. J. MARKUS—

Portable Radios Are Nuisance

Portable radio receivers are the newest menace facing radio engineers during broadcast pick-ups from remote points, according to a report from station KDYL of Salt Lake City. Members of the audience at the scene of a remote broadcast tune their portables in on KDYL, thereby creating feed-back. Before future broadcasts, engineers plan to seek out the portable radios and issue appropriate instructions or warnings.

—n r i—

Electrolytics Freeze at Little America

Not a single mercury vapor rectifier tube is used in the dozens of transmitters and receivers for the Byrd Antarctic Expedition. All rectifiers are of the high-vacuum type, for mercury is slow to vaporize at the low temperatures encountered. Likewise, there are no electrolytic condensers in any part of the equipment. Apparently the electrolyte freezes at temperatures below zero, for chief radioman Bailey says you might just as well use blocks of wood.

—n r i—

Electronic Speedometer for Typists

Typing speed is indicated directly in words per minute by a unique new electronic gadget employing two radio tubes and a vacuum tube voltmeter. Hitting a typewriter key closes a relay circuit, thus applying a charging impulse to a condenser. Between strokes, a motor-driven cam switch discharges the condenser a certain amount through a resistor. A vacuum tube voltmeter connected across the condenser is calibrated to read words per minute instead of volts.

—n r i—

Phonograph Sells Tune for Penny

An automatic phonograph which will play any one of ten different songs when a penny is inserted, has been developed recently by Dr. Gordon K. Woodward, a Los Angeles physician. The special record used with this phonograph is sixteen inches in diameter, and contains ten separate songs on each side.

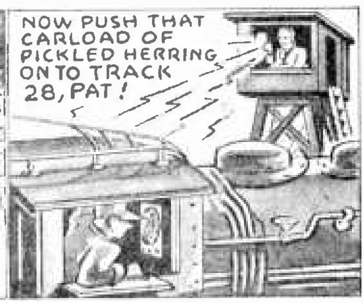
—n r i—

KDKA Changes Tubes Automatically

Broadcast interruptions due to rectifier tube failures are eliminated in the new 50-kilowatt transmitter of KDKA at Allison Park, Pennsylvania, by tube-changing relays. These automatically disconnect a burned-out tube from the circuit and connect a new tube into the circuit.

When Washington residents dial WEather 1212, they hear a sweet-voiced lady predicting the weather over and over again. Those who would like to enjoy the voice indefinitely are cut off automatically after about nine reports. A $20,000 telephone company gadget provides this unique service. The report, as read by a young lady selected for clearness of speech, is recorded on an endless wire tape by magnetizing the molecules in the tape in proportion to the variations in the audio signals. The message can be erased by a second magnet in preparation for re-recording whenever the U. S. Weather Bureau decides to change its prediction.

A St. Louis resident complained to the sheriff's office that his chickens were being shocked by an electric fence put up by a neighbor. The deputy who investigated found that a bare wire, supported on insulators at the level of a chicken's head, had been erected around a flower bed to discourage destruction of young plants by the chickens. Since this fence was on private property, the law decided the neighbor was entirely within his rights in maintaining the fence. The officer gave orders, however, that a sign be erected warning that the fence was charged. It is now up to the complainant's chickens to learn how to read.



Experiments in the transmission of orders by radio from the central control tower of a railroad freight yard to switching locomotives are being conducted by the Central Railway Signal Company of Proviso, Illinois, after receiving authorization for this purpose from the Federal Communications Commission. Construction permits were issued for two 15-watt stations, one operating somewhere between 300,000 and 400,000 kc., and the other being assigned to four different frequencies in the range from 35,000 to 40,000 kc. This newest application of radio may mean hundreds of additional jobs for men with radio training.

Joseph Kaufman

F-M Receivers and Their Alignment

By JOSEPH KAUFMAN,
N. R. I. Director of Education

With about thirty frequency-modulated (f-m) broadcasters in operation and one hundred station permits granted, and with the F.C.C. formally acknowledging that f-m signals will serve public interests, localized radio broadcasting enters a new spectrum, namely 42 to 50 megacycles.

Even the most enthusiastic admit that with forty-five million amplitude-modulated (a-m) receivers in use today in these United States, wide public acceptance of f-m will take from five to ten years. At this early date, well-informed receiver merchandisers say that the evils which f-m is said to overcome are not as "wicked" as most people would like to have us believe; hence they argue that f-m may not be the "whirl-wind" that initial publicity leads us to believe.

However, it cannot be denied that f-m provides an almost noise-free signal, to a degree not attainable with the a-m system. To be sure, local man-made interference has been greatly reduced in our present system, but atmospheric and lightning disturbances still affect a-m receivers. With f-m transmission, however, reception can be noise-free even during local electric storms. Its victory over noise is the greatest appeal, but f-m can provide high fidelity with depths of volume never before considered feasible for a-m.

Whether the public as a whole wants true fidelity and natural reproduction is still a highly debatable subject; a great deal of evidence indicates that after years of ear subjugation to false reproduction, broadcasting has developed an ear for reproduction peculiar to radio.

How f-m will be accepted by the public, only time will reveal; it is here, however, and offers a real opportunity to trained radio technicians.

Review of Fundamentals

Before we go on to consider the f-m receiver, a review of the differences between amplitude and frequency modulation deserves consideration.

With amplitude modulation, a basic r.f. signal called the *carrier* is increased and decreased in amplitude, in accordance with the sound intelligence that is to be conveyed. The basic r.f. signal amplitude is never increased more than twice the carrier level, and never reduced to such an extent that an r.f. signal does not exist for an instant. Amplitude modulation produces side frequencies with the highest audio frequency determining the band width. For example, if a 10-kc. audio signal is the limit, modulated on a 1,000-kc. carrier, the side frequencies will extend from 990 kc. to 1,010 kc.

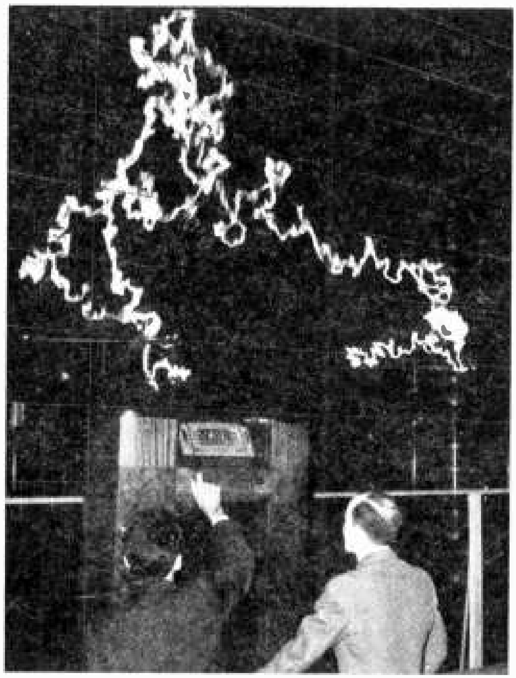
With frequency modulation, the amplitude of the r.f. carrier remains fixed at all points in a given communication system. When no sound is being transmitted, the frequency of the signal is a definite value which is often referred to as the "resting" frequency. This frequency is increased and decreased in accordance with the level (or volume) of the sound being transmitted.

Let us look at it this way; sound is the result of condensation and rarefaction of air particles. Condensation results in a dense group of air particles, and rarefaction results in a below-normal amount of air particles. We could arrange to increase the radio frequency for conditions of condensation, and decrease the frequency for rarefaction.

There must be a limit to the frequency swing from the resting value, depending on the maximum sound level intended, and this range is referred to as the *frequency deviation*. Thus, for the loudest sound to be transmitted, the swing could be limited to 75 kc. Since the frequency is varied above and below the resting frequency by this value, the total deviation will then be 150 kc. For example, if the resting frequency is 43,000 kc., for the loudest sound the frequency will swing from 42,925 kc. to 43,075 kc. Should this loudest sound have a 1,000-cycle pitch, the r.f. signal will vary from 43,000 to 42,925 to 43,075 and back to 43,000 kc., one thousand times in a second. If this 1,000-cycle sound has a lower level, the swing could be from 42,995 to 43,005, one thousand times a second.

In frequency modulation, the *instantaneous frequency* corresponds to the *sound level* at that instant, and *the rate* at which the frequency is varying above and below the resting value is the *pitch* of the sound.

As far as fidelity of transmission is involved, the deviation can be any value; in fact, equally as good fidelity can be obtained with an overall deviation of 20 kc. as with 150 kc.



General Electric frequency modulation receiver undergoing comparative listening tests while subjected to million volt lightning discharge.

For maximum elimination of noise, however, a large frequency deviation is desirable. A noise pulse received along with the f-m signal affects the instantaneous amplitude by creating peaks on the r.f. signal, and also affects the instantaneous frequency of the signal.

As we will see later, the amplitude peaks of noise are removed by the "limiter" in the f-m radio receiver, but any instantaneous change in the signal frequency will introduce volume pulses after the f-m signal is converted to amplitude changes. If a large frequency change is employed to produce an appreciable change in sound level, the frequency change due to a noise will normally have little effect in producing noise interference. On the other hand, if full range in volume is produced with a small frequency deviation, the frequency change produced by noise pulses will be quite apparent.

Essential Stages in an F-M Receiver

Once you understand the basic principles involving f-m receivers, you will find these new sets are no more difficult than ordinary sets.

As you will shortly see, no radically new circuits are used in a f-m receiver. Conventional vacuum tube circuits, designed to meet special requirements are predominant. The superheterodyne circuit is employed, usually with a stage of r.f. ahead of the frequency converter, and with one or more i.f. stages following the converter.

After sufficient amplification has been obtained, a stage which will convert f-m to a-m is required. This modulation converter must be followed by a normal amplitude type of detector.

There is, however, a modulation converter which also detects at the same time. The discriminator circuit used in automatic frequency-controlled receivers will produce positive and negative voltages, the instantaneous voltage depending on the deviation in frequency from the reference frequency. Thus, f-m can be converted directly to audio signals by an a.f.c. discriminator circuit.

Between the frequency discriminator and the last i.f. stage, a special tube circuit (called the limiter) is introduced. Although its elimination would not prevent f-m reception, its use definitely results in the unique features which make f-m transmission superior to a-m. A limiter removes all amplitude noise pulses, so the discriminator output contains negligible noise signal. The limiter keeps all signal amplitude levels below the permissible swing of the discriminator, thus preventing amplitude distortion. The discriminator also operates so as to favor the desired (stronger) signal and suppress the weaker undesired signal. Finally, the limiter supplies a negative d.c. voltage proportional to carrier intensity, hence it is used as an a.v.c. source.

Following the discriminator is a potentiometer which serves as a volume control; its output feeds into a conventional a.f. amplifier and loudspeaker. For high fidelity, both the a.f. amplifier and loudspeaker must be designed to have essentially uniform response over a wide range of audio frequencies. The loudspeaker system usually consists of a low-frequency unit and a high-frequency reproducer, acoustically compensated for high-fidelity reproduction.

For some time, f-m receivers will also include circuits for a-m reception. The preselector and oscillator coils for any a-m band will be switched into the circuit; the same switch will also switch of the tube to which they are connected, as shown in Fig. 2. If this is not done, transfer through both transformers would exist, and the selectivity of the circuits would be lost.

The i.f. channel for f-m will employ a number of stages, only one of which is shown in Fig. 2. This i.f. channel will feed into a limiter-discriminator type of detector for f-m. The input of the a.f. amplifier will be switched from the f-m detector to the a-m detector according to the type of reception desired.

F-M Antenna System. The all-wave antenna used for a-m signals is not designed for high-frequency radio waves. An additional antenna will be desirable. Half-wave antennas are being widely used; these are connected directly to the input terminals of the receiver, and these in turn connect to the primary of the 42-50 mc. antenna coil.

Two antennas will thus be normally used for f-m and a-m reception, as shown in Fig. *1*.

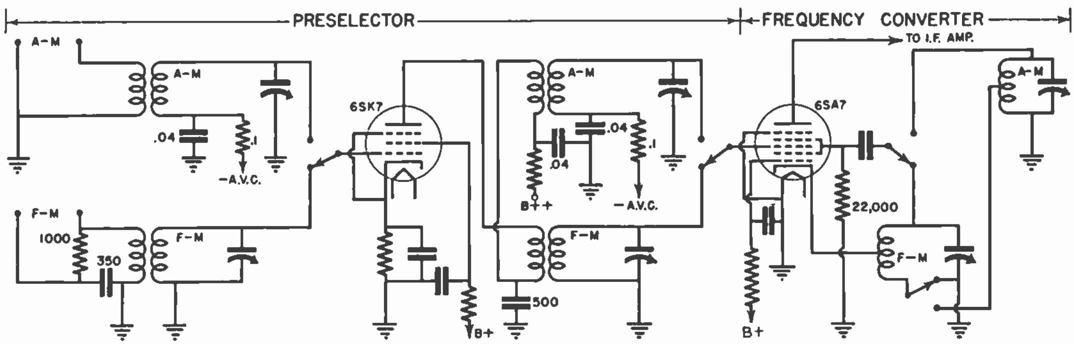


FIG. 1. Preselector and frequency converter stages of an a-m and f-m combination receiver.

in the 42-50 megacycle coils, and in all probability will also introduce the low-capacity variable condensers required for band-spread tuning. Such a combination f-m and a-m circuit is shown in Fig. *1*.

In each i.f. section of the circuit in Fig. *1*, the secondary of the i.f. transformer for a-m (usually about 456 kc.) will be connected in series with the secondary of the f-m i.f. transformer (usually about 1 to 7 megacycles). By connecting the secondaries in series and by preventing any mutual coupling, one i.f. transformer will have negligible impedance at the other frequency, hence its presence will not interfere with amplification of the desired frequency.

The primaries of the a-m and f-m i.f. transformers will be switched into the plate circuit

Any of the antennas found acceptable for television reception can be used. Reflection will not be a problem. The horizontal antenna should preferably be faced broadside to the f-m transmitter and adjusted for the least phase cancellation, so the strongest signal possible is accepted. A horizontal di-pole about 11½ feet long will be required.

Preselector-Frequency Converter. A stage of amplification preceding the mixer-first detector is to be expected in an f-m receiver in order to over-ride converter noise. The tuning condenser will have a low capacity so the L-C ratio of the tuning circuit will provide high gain. A remote cut-off pentode tube will be used and will be a.v.c.-controlled. Sufficient selectivity must be

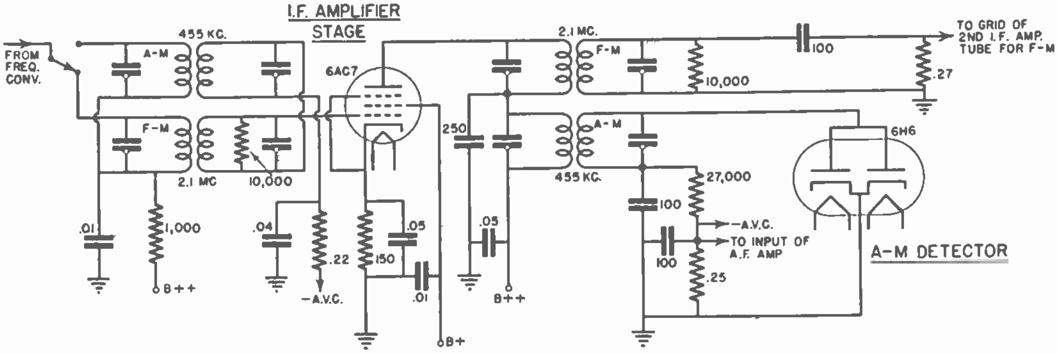


FIG. 2. Type 6AC7 tube serving as i.f. amplifier tube for both a-m and f-m reception; primary switching is employed. Since the output is through independent a-m and f-m channels, switching is required only at the input of the combined i.f. amplifier and at the input of the a.f. amplifier.

embodied in the preselector to eliminate image interference and i.f. signal interference.

A conventional pentagrid converter may be employed in the converter stage, although a triode-pentode tube combination will serve equally well. The local oscillator should be stable, so that the i.f. amplifier and the discriminator characteristics need not be made too broad.

F-M Intermediate Amplifiers. These will be of the conventional double-tuned type, carefully designed for optimum coupling so that a resonance curve with a flat top and steep sides will result. As we will see later, perfectly flat tops are not required for strong signals, as the limiter will give the entire r.f. system a flat-top resonance characteristic. However, sufficient broad response will be required so that amplitude distortion does not arise for weak signals. To get sufficient broadness in tuning, either the primary or the secondary of the i.f. transformer will be loaded with a resistance, about 10,000 ohms. Because of loading and the use of a high i.f. value, about 1 to 7 mc., low gain will result and at least two i.f. tubes will normally be required.

Limiter. This stage, important as its functions are, is a simple tube circuit. An ordinary pentode tube, operating at low plate and screen grid voltages (about 60 volts) and with no initial grid bias, is used. Grid current flows upon application of an r.f. signal, and this rectified current is made to flow through grid return resistors R_1 and R_2 as shown in Fig. 3.

Using low plate voltage causes the plate current to cut off at low negative grid voltage values. The upper limit of plate current is also kept low by the low plate current, for the space charge readily prevents the flow of electrons to the plate when low accelerating potentials exist; excessive grid current contributes to low plate current. As a rule, this circuit is designed so that the limiter output does not vary more than 1 volt for all input r.f. voltages above the saturation value.

While the limiter circuit prevents excessive rises in the amplitude of the current output, the grid current in the limiter stage causes the operating

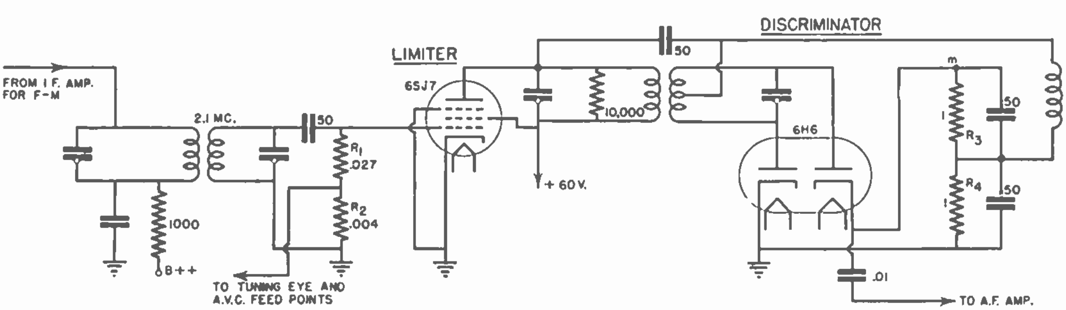


FIG. 3. Typical limiter and frequency discriminator circuit.

point to move more negative from the no-signal point shown as *a* in Fig. *4*. The operating point may assume a position such as *b*, *c* or *d* as the input level of the signal increases. The normal operating point will be somewhere between *c* and *d*, a condition for high signal input. In such a case, the r.f. signal will undergo half-wave rectification, and plate current will flow for half a cycle or less. Since the plate load of the limiter (Fig. *3*) will be a resonant circuit, the voltage developed across the tank circuit will have both alternations of the cycle with the tuning circuit possessing the ability to sustain oscillation at its resonant frequency by virtue of the energy stored in this circuit.

If noise pulses make the input r.f. signal swing positive beyond point *x* in Fig. *4*, the pulses will be removed by the saturation effect of this limiter; negative noise peaks will be removed by the cut-off characteristic of the limiter. Of course, this only occurs when a strong signal is received, and the a.f. system is hence designed to load the limiter fully for the weakest signal to be received.

If the desired signal fully loads the limiter, causing the operating point to be more negative than point *c* (see Fig. *4*), a weak signal entering the limiter will either cause no plate current variation or will reduce the plate current variation to such a low amplitude that the limiter output resonant circuit will not receive enough energy to sustain this oscillation. It is possible to design the limiter so that a desired signal which has twice the amplitude of an undesired signal, both operating at the same resting frequency, will so completely over-ride the undesired signal that the latter will not be heard.

The flow of grid current through grid resistors R_1 and R_2 in Fig. *3* produces a voltage across the resistors which self-biases the limiter to cut-off or beyond for normal and above-normal signal levels. This negative voltage may, in some receivers, be used to operate an electronic tuning eye,* or to feed an a.v.c. voltage to any of the i.f. or r.f. stages which it may be desirable to control. The resulting a.v.c. action will prevent the limiter from being overloaded too much on very strong signals.

In passing through the r.f. amplifier of the f-m receiver, the signal is varying in frequency above and below the resting frequency. If the r.f. system is sharp, as shown by curve *1* in Fig. *5*, the signal amplitude will vary from *a* to *b* to *c* to *d* to *e* and back to *a* for one audio cycle. To prevent such extreme variation in amplitude, the frequency deviation would have to be limited so the swing would be from *y* to *z*, or the r.f. system would have to be made much broader by loading.

As was previously pointed out, the limiter in itself causes the over-all response of the r.f. system to act broad. If the level of the signal is so proportioned that all signal amplitudes above *b* (amplitudes greater than *x* in Fig. *4*) are in the saturation region of the limiter, then all such peaks will be removed. The r.f. amplifier and the limiter together will then have the resonant response portrayed by curve *2* in Fig. *5*. The f-m signal may thus embody wide deviation in modulation.

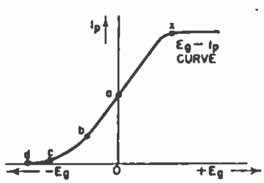


FIG. 4. Limiter characteristic.

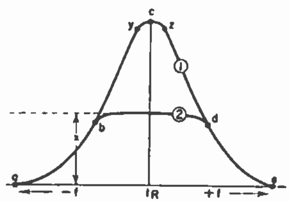


FIG. 5. How the limiter flattens the r.f. response.

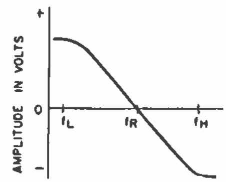


FIG. 6. The S curve of a frequency converter.

The r.f. system is never made too sharp for signals which do not drive the limiter to saturation. Weak signals do not benefit by this action; to receive them with good response, the r.f. and i.f. amplifiers must be reasonably broad.

Frequency Discriminator. This circuit does not differ from the circuit used in automatic frequency control, except that it is designed for the i.f. value used in f-m receivers. Such a circuit is shown at the right in Fig. *3*.

Note that two diode rectifiers are used, each diode being fed with one-half the voltage of the final resonant circuit. Being a split secondary connection, one diode input r.f. voltage is 180° out of phase with the other diode input voltage. At the same time, both diodes get the full r.f. voltage which is present at the plate of the limiter. When the frequency is off the resting value, as it is during transmission of intelligence, the phase relationship between the r.f. voltages act-

(Page 23, please)

*A f-m receiver should be tuned for least noise, not for maximum sound level. An electric eye working on peak limiter grid current offers an excellent tuning indicator.

RADIO-TRICIAN
REG. U.S. PAT. OFF.
Service Sheet
Compiled Solely for Students and Graduates

NATIONAL RADIO INSTITUTE, WASHINGTON, D.C.

SILVERTONE MODEL 6320

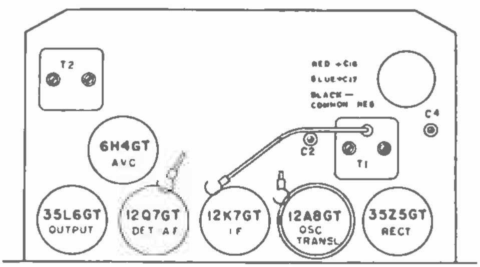
Chassis 101.585

ELIMINATING HUM MODULATION WHEN USING AN EXTERNAL ANTENNA:

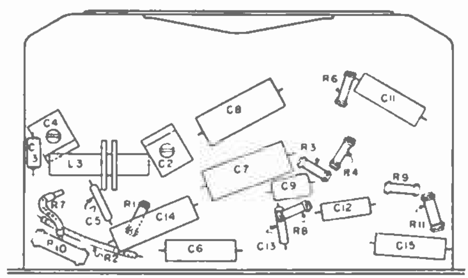
As shown by the Schematic and by the Location of Parts diagram, there is a 2200 ohms resistor, connected from the external antenna clip to chassis. This resistor prevents hum modulation **when using an external antenna.** If such hum is experienced, examine the chassis to see if this resistor has been incorporated. (The resistor is mounted alongside of the loop antenna connection board. It was not incorporated in early production.) If necessary, addition of the resistor will eliminate the complaint.

PUSH BUTTON TUNING:

Each button is set up by loosening the screw (under the call letter tab), tuning in the station, depressing the button and then tightening the screw.



Locations of parts on top of chassis



Locations of parts under chassis

ALIGNMENT PROCEDURE

PRELIMINARY:

Connection of generator ground lead . . . . To external ground
Position of Volume Control . . . . Fully on

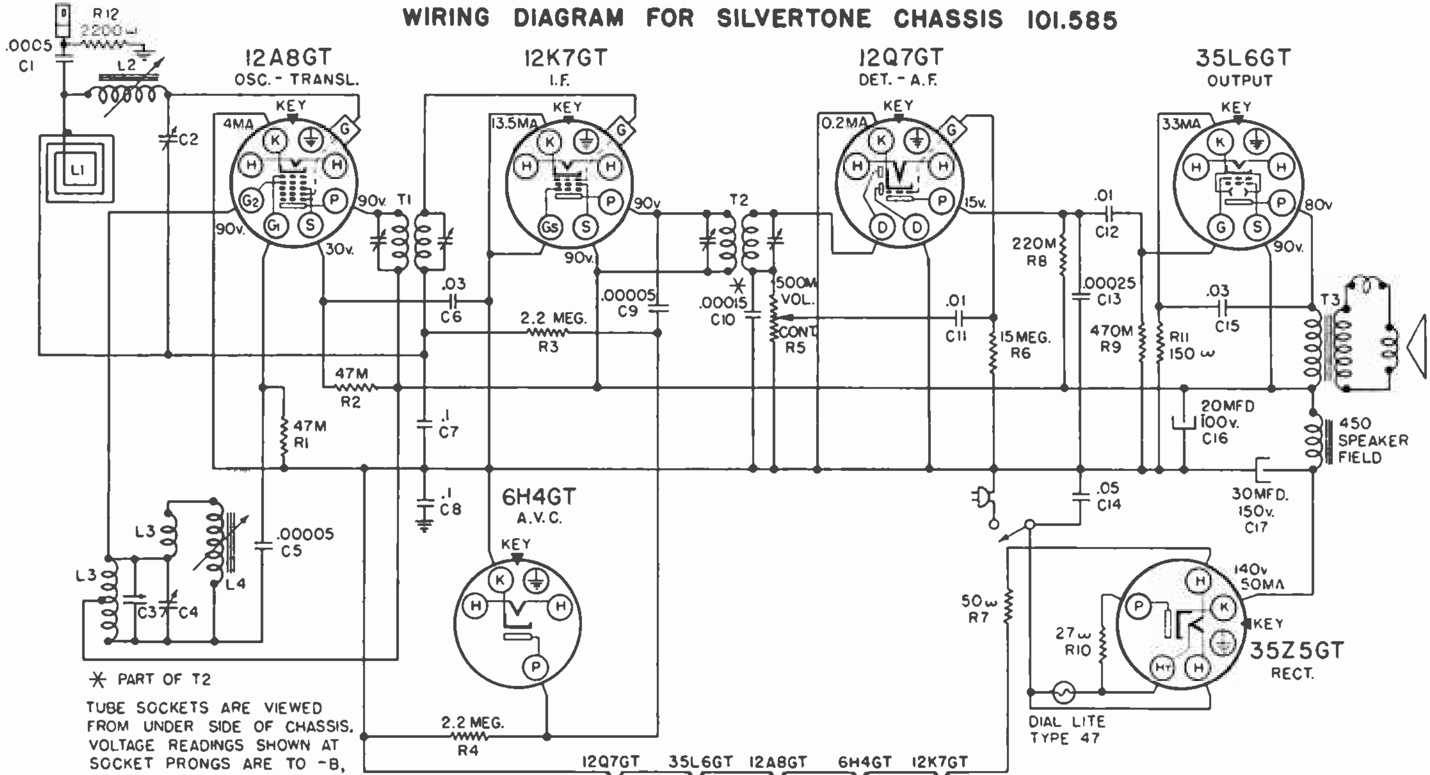
Position Of Dial Pointer	Generator Frequency	Dummy Antenna	Generator Connection	Trimmers Adjusted (In Order Shown)	Trimmer Function
550 kc	455 kc	.1 mfd.	12A8GT Grid	T2, T1	IF
540 kc	540 kc	.0002 mfd.	Ant. Clip	C4	Oscillator
900 kc	900 kc	.0002 mfd.	Ant. Clip	C2	Translator

IMPORTANT ALIGNMENT NOTES

The alignment procedure should be repeated stage by stage, in the original order, for greatest accuracy. Always keep the output from the test oscillator at its lowest possible value to make the AVC action of the receiver ineffective.

Readers who file Service Data in separate binders remove page carefully, trim on dotted line for same size as data published heretofore.

WIRING DIAGRAM FOR SILVERTONE CHASSIS 101.585



✳ PART OF T2

TUBE SOCKETS ARE VIEWED FROM UNDER SIDE OF CHASSIS. VOLTAGE READINGS SHOWN AT SOCKET PRONGS ARE TO -B, AND ARE TAKEN WITH NO SIGNAL LINE VOLTAGE AT 117 VOLTS. WHERE NO READING IS GIVEN, THE VOLTAGE IS ZERO OR TOO LOW TO READ

F-M Receivers and Their Alignment

(Continued from page 20)

ing on each diode varies. As a result one diode gets more r.f. voltage than the other, and the rectified d.c. voltages differ. The difference in d.c. voltage is the f-m demodulated signal; its amplitude is proportional to the amount the signal frequency differs from the resting value and its polarity depends on whether the signal is above or below the resting value.

Thus, while the f-m signal is varying in frequency due to modulation, the net d.c. voltage across R_3 and R_4 in Fig. *3* is changing in amplitude, with point *m* becoming alternately positive and negative with respect to ground. Condensers across R_3 and R_4 remove all r.f. components.

The discriminator must be designed so that increases and decreases in frequency from the resting value produce proportional changes in d.c. output voltage, as shown in Fig. *6*. This linearity must extend for the full deviation in frequency. It is important to standardize on the maximum deviation that will be used, and design the discriminator accordingly. In fact, the discriminator should be able to handle even a greater deviation, to take care of the normal drift in the frequency of the receiver oscillator.

By designing the discriminator for wide frequency deviation, this stage will function for f-m signals with low frequency deviation. A discriminator designed for a narrow frequency deviation would distort when an f-m signal with a wide deviation was received.

Alignment of F-M Receivers

Alignment of an f-m receiver will differ somewhat from the procedures used for a-m receivers. It may surprise you to learn, however, that this alignment can be done with standard servicing equipment having suitable ranges.

First, the discriminator will be lined up. A high-resistance d.c. voltmeter, preferably a vacuum tube voltmeter, is connected across one diode load resistor. To introduce a signal, connect the service signal generator to the grid-chassis of the limiter tube. The signal generator should be set exactly to the i.f. value for f-m, and its output should be as high as possible, about 1 volt. Adjust the primary of the discriminator transformer for *maximum* output. Now connect the d.c. voltmeter across both diode loads, and adjust the secondary of the discriminator transformer for *zero* output voltage.

To align the resonant circuit ahead of the limiter stage, connect the signal generator (still set at the i.f. value for f-m) to the grid-chassis of the stage ahead of the limiter. A 0 to 100 microampere meter can be connected in the grid return of the limiter, or a high-resistance voltmeter (or v.t.v.m.) can be connected across the grid return resistor which produces the a.v.c. voltage. Adjust the resonant circuit ahead of the limiter for maximum deflection.

When a peak reading is obtained, the output reading should be high enough to indicate that the limiter is being saturated. To do this, the signal generator output should be set up to a high output value. This can be checked by noting the output across one diode load in the discriminator; increased input to the limiter should show little rise in output voltage. This condition is essential, for it is necessary to have the same loading of the limiter on the resonant circuit as would exist in normal operation. This loading affects the response of the resonant circuit. If you align this circuit with little load, a different peak setting will result.

Advancing the signal generator one stage at a time aligns each resonant circuit for maximum limiter grid current or self-rectified d.c. voltage. The i.f. channel for f-m will be aligned when the signal generator is connected to the input of the mixer-first detector.

Next is the alignment of the preselector and oscillator. For this adjustment, the signal generator is connected to the two antenna posts. The oscillator is always aligned first, and the preselector is adjusted for maximum grid current or voltage in the limiter. Alignment will, of course, depend upon the type of tracking employed. One method worth mentioning involves the iron-core coil in the oscillator. The signal generator and the receiver dial are set at a low frequency (about 42 to 43 mc.), and the oscillator core aligner is adjusted for maximum output. Then the signal generator and receiver are set to a high frequency (about 49 to 50 mc.) and the trimmer shunting the oscillator variable condenser is adjusted for maximum output.

——— *n r i* ———

Our Cover Photograph

The fabrication of high-quality modern broadcast transmitters requires the efforts of many skilled hands, from the time of welding the first framework to the final assembly, inspection and running test. In our cover photograph you see trained radio men at work on five units, while the panel is being attached to the sixth unit at the extreme right.

These units will be used in Western Electric broadcast transmitters. Photo by courtesy of Specialty Products Division, Kearny, N. J. Works, Western Electric Company.

Puzzling Radio Questions From Students

Filter Condenser Code

Question: I have observed that on some of the new filter condensers, the capacity value is followed by a number of markings such as a square, triangle, circle and other geometric figures. What do these symbols represent?

Answer: An examination of this type of condenser will disclose the fact that the terminals of the condenser come through a bakelite or rubber washer. Right beside the various terminals you will find a piece cut out of the washer which is exactly like the shape of the marking used in the code. In other words, if there are 8 and 16 microfarad sections in a particular unit, and there is a square after the 8-mfd. marking and a triangle after the 16-mfd. marking, the terminals for these sections on the bottom of the condenser will have the same square and triangle marking respectively.

Blue Glow In Tube

Question: I notice a blue glow which seems to be on the glass envelope of some of the tubes in my receiver. What does this indicate?

Answer: This blue glow is due to electronic bombardment of the glass. Generally, it will be noticed that this glow varies with the strength of the signal, particularly if the tube happens to be an audio power tube. This condition is due to the fact that the glass, when bombarded, becomes fluorescent. This is a natural condition and does not indicate any trouble whatever. You need worry about a glow in a tube only when it appears about or between the elements, in which case it indicates excessive plate current or a gassy tube. A mercury vapor rectifier is an exception; a glow in this tube is normal, but these tubes are seldom found in radio receivers.

Push-Button Sets

Question: I have a push-button receiver, and I notice that the volume is louder when a station is tuned in by means of the push-buttons, than when tuned in by means of manual tuning. What causes this?

Answer: It will sometimes be noticed that volume appears greater when the push-buttons are used. This in many cases is due to the fact that a receiver seldom is aligned exactly all over its dial. However, the push-button unit is accurately aligned to tune in each particular station. Of course, this occurs only where the push-button tuning unit is of the substitution type in which individual tuning condensers or coils are inserted in the circuit. Sometimes the coils used in the push-button units are of the pulverized iron core type. These coils have a much greater Q factor and better coupling exists, both of which would give a stronger signal.

Using Defective Receiver For N. R. I. Training Plan

Question: I want to get experience by following the N. R. I. plan. The receiver I have is defective and I want to repair it first, however.

Answer: The purpose of the N. R. I. plan for getting practical experience is to teach you how to do service work in the proper manner. Therefore, you can see that it would not be very practical to attempt to repair the receiver with which you are going to experiment. If you could do this, there would not be much value in following the plan, as you would already be capable of servicing sets. In other words, you should make every attempt to gain practical experience before trying to repair receivers.

I would suggest that you either have the set repaired by an experienced service man or that you put it to one side and use a receiver in good operating condition. After having gained some experience, you could then return to the defective receiver and locate the trouble.

F.C.C. Examination Question

Question: This question is taken from an F.C.C. operator's examination, element No. 4, question No. 205. Define high level and low level modulation.

Answer: The term "high level modulation" means that the plate circuit of the last radio stage in a radio transmitter is modulated. The term "low level modulation" means that either the grid or plate circuit of some radio stage *before* the last radio frequency stage in the radio transmitter is the one that is modulated, and that the radio stage or stages between the modulated and output operate only as a linear power amplifier.

Using A.C.-D.C. Set For N. R. I. Training Plan

Question: I have an A.C.-D.C. radio receiver which I wish to use for gaining practical experi-

Are Answered By N. R. I. Experts

ence according to the N. R. I. plan. Can this set be used?

Answer: An A.C.-D.C. receiver is not suitable for gaining practical experience if you intend to follow the complete N. R. I. plan. If you live in an A.C. district, then by all means obtain a standard A.C. operated radio receiver as recommended in the N. R. I. Course. This standard receiver should have a power transformer.

There are many reasons why an A.C.-D.C. receiver is not altogether suitable. Perhaps the most important is the fact that the rectifier tube has a very limited current output. As a result, any excessive leakage or short circuit you might introduce is practically certain to burn out the rectifier tube. This would mean that in attempting to gain experience according to our plan, you would have to replace rectifier tubes frequently. Furthermore, as the filaments are arranged in series, it is impossible to learn the results of a stage-by-stage elimination procedure in which you pull out a tube, as this interrupts the filament circuits of all of the tubes. Other complications arise, such as the fact that one side of the power line connects to the set chassis generally and you can obtain shocks from such receivers.

Of course, even an A.C.-D.C. receiver could be used for learning to trace circuits and to read the diagrams, following our plan of instruction.

If you live in a D.C. district, then the problem is somewhat complicated. An A.C. receiver could not be made to operate from such power lines. The best thing to do would be to obtain an automobile type receiver, as this is the closest receiver to a standard A.C. receiver in its operation. Remember that this receiver is being used to gain practical experience; after the experience is gained, you will be capable of working on any type receiver. The recommended type of automobile receiver is one having a tube type rectifier. If you do not have a storage battery, it is generally possible to rent one from a local garage.

Portable Set In Automobile

Question: I have a battery-operated portable type receiver. I would like to be able to use this radio in my car as well as at home, but the moment the motor is started it becomes very noisy. Is it possible to correct this trouble?

Answer: In many cases it is not possible to eliminate altogether the interference set up by an automobile engine, when using an ordinary portable type receiver. First of all, an auto radio which is properly designed for installation in a car, is always housed in a metal cabinet so that it is completely shielded from interference produced by the automobile electrical system.

Portable radios are not shielded at all, for a metal housing would increase their weight and cost, and would render any built-in loop aerial ineffective.

Furthermore, when an automobile receiver is installed, even though the set is shielded, interference-eliminating devices such as ignition suppressors and condensers are necessary in most cases to keep the interference at a minimum.

Naturally, most autos which do not have such radios in them would not have these suppression devices. The auto receiver itself frequently has built-in condensers and choke coils for further suppressing the interference.

Therefore, in order to eliminate this interference, it would be necessary to install interference-supressing devices in your car. Even this may not prove altogether effective due to the lack of shielding on your set. Sometimes such receivers can be made to work satisfactorily by placing them on the rear seat of the car, as far away from the engine as possible. If reception is still unsatisfactory, rather than spending a great deal of money trying to suppress the interference, I would suggest the purchase of some standard automobile receiver which would simplify the problem greatly.

Radio Effect On Weather

Question: Does radio broadcasting have any effect on the weather?

Answer: Although from time to time there have been statements made that the tremendous outpouring of radio energy all over the world has had an effect on weather, there is as yet no scientific proof of this fact. One must remember that a tremendous amount of energy is being released continuously into the atmosphere from thunderstorms. In many cases this energy far exceeds that being radiated by radio stations.

Therefore, until some definite proof can be presented as to the actual effect of such radio wave radiations, we can assume that radio broadcasting has no effect on the weather.

The Service Forum

Conducted by

J. B. Straughn, N. R. I. Service Consultant

Send in your service notes. We will re-word them for publication. To qualify your note for the NEWS you must have observed the same trouble on two or more identical receivers.

PHILCO MODEL 38-4 AND 38-5 — FREQUENCY DRIFT

You may reduce frequency drift on the high frequency end of the broadcast band by replacing compensator No. 16 with a new compensator part No. 31-6206 and two fixed condensers part No. 30-1097, connected in parallel with the new unit. An improvement in performance of the oscillator circuit on the short wave bands can be made by changing original resistor No. 19 (70,000 ohms) to 50,000 ohms.

—n r i—

PHILCO MODEL 38-7 — FREQUENCY DRIFT

To reduce frequency drift on the high frequency end of the broadcast band, replace compensator No. 7A with a new compensator part No. 31-6206 and two fixed condensers part No. 30-1097 connected in parallel with the new unit.

—n r i—

PHILCO MODEL 16 CODE 121 — DEAD AT HIGH FREQUENCIES

This trouble due to failure of the oscillator at the high frequency end of the broadcast band can be eliminated by changing the oscillator cathode resistor from its original value of 500 ohms to 300 ohms. Try another 76 type tube before making this change as the fault could be in the tube.

—n r i—

MIDWEST MODEL 16-35 — DISTORTION

If distortion is noted when the volume control is advanced about half way, look for a broken lead on the .1 mfd. condenser connected from the plate of the first audio tube to the tone control.

—n r i—

HALSON MODEL AW-6 — DISTORTION AND HUM

This is often caused by the candohm resistor shorting to the frame. Either install a new resistor of another type or insulate the frame from the chassis.

—n r i—

HALSON MODEL 5LR — DISTORTION AND HUM

This is generally due to a defective input filter condenser. Check by substitution.

—n r i—

HALSON MODEL 05 — BROAD TUNING

This is usually due to a poor contact in the grid return circuit of the detector. The detector coil grid return goes to the chassis. Remove the lead and solder directly to the pigtail contact on the rotor of the tuning condenser after which realign the receiver.

—n r i—

HALSON A.C.-D.C. MODELS — PILOT LIGHTS

It is sometimes difficult to obtain dial lights for these sets in which the lights are placed directly in series with the tube filaments. To use an ordinary 6-8 volt light, shunt a 25 ohm resistor across the pilot light socket. Use a resistor rated at 10 watts.

—n r i—

RECEIVERS USING LOOP ANTENNAS — INCREASED PICK-UP

This applies to all radios that use the built-in antenna. Radios using this antenna that are not near a local station, will usually be rather weak and slightly distorted. The remedy is to remove the cardboard covering from the loop antenna, disconnect the one turn that goes directly to the antenna lead and solder on enough wire to make two extra turns around the loop, in the same direction, and solder the end back on the antenna lead-in post. If the set is an A. C.-D. C. connect a small condenser from the ground side of the loop to the chassis. (The ground side usually has a black wire running out the back for an external ground which, of course, isn't connected directly to the chassis.) This ground to loop condenser is not necessary on the A. C. receivers as the loop starts at ground.

—n r i—

ATWATER KENT MODEL 165 — DEAD AT LOW FREQUENCIES

If this set cuts out between 800 kc. and 550 kc. the red and blue antenna leads are connected together. Break the connection and join the antenna lead-in to the blue lead, leaving the red lead free.

—n r i—

ATWATER KENT MODEL 246 — AUDIO OSCILLATION

This condition which is intensified as the volume control is advanced and with the tone control in the bass position is generally due to a defective volume control and a new one should be installed.

ATWATER KENT MODEL 310 — INTERMITTENT RECEPTION

This is probably due to a defect in the .0014 mfd. oscillator series condenser. If tapping the front of the cabinet causes the trouble to show up, a new condenser should be installed. Should this fail to clear up the difficulty, suspect a faulty wave band switch.

—n r i—

ATWATER KENT MODELS 317 AND 337 — WEAK AND INTERMITTENT ON LOW FREQUENCY END OF DIAL

Check the resistor in the oscillator anode grid circuit of the 6A8 type tube. If found to be defective, install a new 30,000 ohm 1 watt replacement unit.

—n r i—

CROSLEY MODEL 8H1 — HIGH NOISE LEVEL

If excessive hissing occurs between stations, replace the 500 ohm cathode bias resistor of the 6F7 type tube with a 250 ohm unit. Also try shunting a 2,000 ohm 1 watt resistor across the cathode bias resistor of the 6D6 type tube which is nearest to the power transformer.

—n r i—

CROSLEY MODEL 5515 — DEAD

This is often due to an open in the candohm resistor at the rear of the chassis. There are two resistors in this unit, the long section having a value of 25,000 ohms and the short section a value of 8,500 ohms. If either section opens, use a 10 watt resistor of approximately the same size for replacement purposes.

—n r i—

CROSLEY MODEL 5628 — INTERMITTENT AND DISTORTED

Install a new type Crosley control which was designed to eliminate this difficulty.

—n r i—

GENERAL ELECTRIC MODEL GD500 — INTERMITTENT

Check the R. F. and antenna coils for a poorly soldered connection.

—n r i—

EMERSON CHASSIS A-4 — WEAK AND DISTORTED

This is often due to a defective 500,000 ohm resistor connected to the pentode plate of the 6F7 type tube. The installation of a new resistor rated at 1 watt should eliminate the trouble.

—n r i—

RCA MODELS R-78 AND R-78A — DISTORTED AT RESONANCE

If distortion occurs at any volume control setting and you note that it may be eliminated by slightly detuning the receiver, the trouble is due to leakage in the .05 mfd. A. V. C. filter condenser. The easiest way to check on the condenser is to try another rated at 600 volts.

—n r i—

RCA MODELS 98K AND 99K — FREQUENCY SHIFT AND INTERMITTENT

In some of these receivers the temperature compensating condenser associated with the A band oscillator is placed too close to the corner of the lug, thus causing intermittent operation and a change in the oscillator frequency. To correct the trouble, simply move the condenser away from the lug.

—n r i—

RCA MODELS 96E, 99T AND 99T1 — MOTORBOATING

This is due to an open in the output filter condenser or an open in the .1 mfd. condenser from the bottom of the antenna coil secondary to ground. The installation of new condensers will clear up the trouble and you can check for a bad condenser by temporarily shunting those in the set with others of about the same size.

—n r i—

RCA MODEL R-99 — DISTORTION

Check the .05 mfd. coupling condenser between the 6C5 and 6L7 type tubes for leakage. If the condenser is found to be bad, install another of the same capacity rated at 600 volts.

—n r i—

RCA MODEL 6K2 — INTERMITTENT OPERATION OF SET AND PILOT LAMP

This is due to a small rivet in the center of the band pilot lamp shorting to ground.

—n r i—

RCA MODEL 5-T — WEAK WITH LOW VOLTAGES

If low voltages are measured throughout the receiver, check the 200 ohm resistor connected to the high voltage center tap of the power transformer. If it is open, replace with a 10-watt resistor of the same ohmic value.

—n r i—

PHILCO MODEL 38-40 — REDUCTION OF BATTERY CURRENT CONSUMPTION

The entire tube complement can be changed so as to afford a considerable reduction in current consumption. There will be a certain loss in performance efficiency when the change is made. The following list shows the old and the suggested tube line ups:

ORIGINAL	NEW
6A8G	6D8G
6K7G	6S7G
6J5G	6L5G
6K5G	6T7G
6K6G	6G6G
6X5G	6ZY5G

—n r i—

WESTINGHOUSE MODEL WR-203 — DEAD

Look for a short in the .1 mfd. 400 volt tubular condenser used to by pass the plate supply of the 6A8 and 6K7 type tubes. If the condenser is bad, install another .1 mfd. condenser rated at 600 volts.

—n r i—

MAJESTIC MODEL 460 — INTERMITTENT MOTORBOATING

This is often caused by shorted turns in the diode winding of the second I. F. transformer. A new transformer may be ordered through any radio parts jobber.

N.R.I. ALUMNI NEWS

Clarence Stokes .... President
Dr. Geo. B. Thompson, F. E. Oliver .... Vice-Pres.
Allen McCluskey, Alfred E. Stock .... Vice-Pres.
Earl Merryman .... Secretary
Louis L. Menne .... Executive-Secretary

Philadelphia-Camden Chapter Holds Anniversary Meeting

Our anniversary meeting was more than that—it was a "home-coming" party in honor of our own Clarence Stokes, this year President of the N.R.I. Alumni Association.

A special hall was engaged in anticipation of a large gathering and it was well that we provided for plenty of room because the turn-out exceeded our expectations. It was a fine tribute to Stokes, who has been a power in the affairs of Philadelphia-Camden Chapter, and who richly deserves the high office he holds in the National Organization.

Our honor guest was Mr. J. E. Smith, President of N.R.I., who made the trip from Washington especially to attend this meeting. He was accompanied by Mr. Menne and Mr. Straughn. Pete Dunn, Chairman of Baltimore Chapter led a delegation over from Baltimore including Gralley, Snider, Gosnell, Hachmeister and several others whose names seem to have escaped from our notes.

J. E. Smith and J. B. Straughn enjoying the entertainment.

Chairman Gordy, of New York Chapter, sent a telegram of congratulations and expressed regret that none of the members of his Chapter were able to make the long trip.

One of Stokes' own "Texas Twisters" acted as master-of-ceremonies. He did a fine job. The music was excellent. Dancing, entertainment, singing, refreshments—nothing was lacking to make the party a big success.

Mr. Smith delivered a very inspiring talk. Menne, Straughn, Dunn, Gralley, Gosnell, Blackwell, Champ, Kraft, Fehn, Haraburda, Doberstein and others took a turn at the microphone for brief comments.

We are grateful to the many wives and sweethearts of our members who contributed so much in spirit to our party and we hope all will again be present at future social events of this Chapter.

We regret to announce the resignation of Dave Blackwell as Chairman and John Biaselli, Jr. as Secretary. Dave lives fifty miles from Philadelphia. He is in the Radio business in Skillman, N. J. Dave found the long trip and late return, together with the responsibilities of Chairman, drew on him for time which he could not afford to give without sacrificing attention to his own business. Biaselli found it necessary to resign because he has been temporarily transferred from Philadelphia. He will be back with us later.

To fill these offices Norman Kraft has been elected Chairman, and L. A. Michalski was chosen for Secretary. James McCaffery, Jr., has been elected Vice Chairman to fill the vacancy created by the advancement of Mr. Kraft.

New members are Warren A. Keer, Edward Peters, and James Peters. Charley Fehn, our Treasurer, is doing a good job as official greeter. He sees that all are properly welcomed and made to feel right at home.

At our regular meetings we discussed "Frequency Modulation," "Automatic Frequency Control" and "Single-side Band Transmission." These were fine meetings.

We will hold regular meetings right through the summer. The fellows feel that time is too valuable to be lost for any excuses and we will continue to "make hay while the sun shines."

L. A. MICHALSKI, *Secretary*.

— n r i —

New York Chapter

Many of our members prefer our open forum discussions to meetings at which we have a speaker. Therefore, we have held informal discussions during our last several meetings which proved highly interesting. Our Chairman I. Gordy and our Vice Chairman A. Burt presided. Our officers are expert Radio men in their own right and they understand the problems of our members better than outside speakers. Gordy, for example, writes articles for a number of Radio publications.

The secretary of New York Chapter visited headquarters in Washington and was shown through the Institute by Mr. Smith and Mr. Menne. It is too bad every student cannot visit this fine school. It would prove to be an inspiration to every N. R. I. man if he could meet the members of the various departments and see how efficiently the work is handled.

Our meetings will be held through the summer on regular schedule.

Already we are preparing our program for next season. Our meetings are all planned in advance thus assuring our members of a worthwhile session on every meeting date.

If you live in the New York Metropolitan area, whether student or graduate, you are welcome to meet with us every first and third Thursday of the month, at Damanzeks Manor, 12 St. Marks Place, New York City.

LOUIS J. KUNERT, Secretary.

— n r i —

Baltimore Chapter

Our meetings have all been lively sessions. Our own members have been leading us in discussing general servicing problems. In addition we had some fine talks by Mr. Kaufman who spoke on "Frequency Modulation" and Mr. Straughn, who brought a receiver to our meeting and proceeded to give us a talk on trouble shooting.

On other occasions we visited Station WBAL and Station WFBR. We were cordially received by pre-arrangement through our Chairman, Pete Dunn, and every consideration and courtesy was extended to us.

Our attendance has been exceptionally good and we express our appreciation to our members for their fine support.

E. O. E. GRALLEY, Secretary.

A snapshot taken at the Anniversary Party given by the Philadelphia-Camden Chapter in celebration of its anniversary and as a compliment to one of their own members, Clarence Stokes, this year's president of the N. R. I. Alumni Association.

And here is a picture of part of the group that attended the party given by the Chicago Chapter in honor of L. L. Menne, Executive Secretary.

Chicago Chapter

Our regular meetings have been well attended. For the most part we have been holding informal discussions. These meetings are popular with our members because they give everyone an opportunity to ask questions or offer information.

Executive Secretary Menne visited us recently. On that occasion we arranged for one of our social meetings which are always successful owing to the fine cooperation given to us by our ladies, who not only attend in liberal numbers, but prepare and serve food and refreshments in a way to appease the appetite of any man. Dancing was the main magnet to bring out all of our regulars and a good number of new members and friends. We are grateful to Mrs. Schultz, Mrs. Sorg, Mrs. Johnson and others for the tasty food. It would take almost the roll call to mention all the fellows who did their bit to make this party one long to be remembered.

Ed Sorg, as usual, did his "ballet" dance. Sorg has a knack for getting everyone in just the right mood. His supply of pep seems endless.

Our annual picnic is next on our schedule. This will be held in July—too late for a report for this issue—and will bring our activities to a close until the first week in September, at which time we will also announce our new meeting place. We have outgrown our present quarters.

Watch Chicago Chapter Grow!

Eric E. Johnson, *Secretary.*

———— *n r i* ————

Vice President McCluskey

Allen McCluskey of Birmingham, Alabama, is serving his third successive term as Vice President of the N. R. I. Alumni Association. For three years we have been trying to get a photograph of him. Finally he broke down, overcame his modesty, and sent us the picture at the right. The youngsters are the McCluskey twins, Emily Gay and David Page, four years of age. We also received a snapshot of Mrs. McCluskey. Just why a fellow with such a fine family should hold out on a picture for so long is hard to understand.

McCluskey says the little fellow, David Page, is a born Radiotrician. He would rather watch his daddy work on a Radio set than eat and he is a great hand for running away with the tools.

Fellows, meet one of our Alumni Vice Presidents, Allen McCluskey, a booster for Radio servicemen, first, last and always.

Vice President Allen McCluskey with his twin children.

Here and There Among Alumni Members

Lou Kunert, Secretary of New York Chapter, brought his very charming wife to Washington for a visit with us at headquarters. Now we know why Lou always seems so contented with life.

—n r i—

D. S. Major is Station Engineer for the All-India Radio at Trichinopoly, India.

—n r i—

Dale H. Hoag of Saginaw, Mich., is now partner in the firm of Radio Tube Merchandise Co., which is one of the largest radio parts distributing concerns in Michigan.

—n r i—

"Father is doing well," writes H. J. Stephens of St. Louis, Mo., as he reports the arrival of an eight pound boy at his home. Listen, Stephens, they've never lost a father yet.

—n r i—

Alfred McConnell of Pittsburgh was married recently. Congratulations, Al.

—n r i—

Lee Oliver Falwell is a second class radioman in U. S. Navy working in the Radio laboratory on one of Uncle Sam's big battle ships in the Asiatic fleet.

—n r i—

During the past twelve months Alison A. Lomax of Spencer, Iowa sold, through his firm, $12,500 worth of Radios and did $4,000 in service business. And to make the year a still happier one—a baby was born to the Lomax family.

—n r i—

Aime Simard, Chicoutimi, P. Q., Canada, is in full time Radio now and recently was married.

—n r i—

Paul F. Carlson is now connected with United Air Lines in Des Moines, Iowa.

—n r i—

Seven years ago Herbert F. Lucke of Palmyra, Mo., started the N. R. I. course with only a few dollars in cash. Today he has a thriving business doing $50,000 volume a year which he expects to boost to $65,000 by the end of 1940. He has twelve employees. There's a "go-getter" for you.

—n r i—

This fellow, Clarence Stokes, our National President is quite a speaker. When he talks you just want to listen. Stokes has been on the air dozens of times over Philadelphia stations.

—n r i—

Robert Scheurer, of Cliffside Park, N. J., met with an accident in January and is just returning to work. Karl Westover of Alum Bank, Penna., also had some hard luck. He hurt his back and is glad to be in Radio because he is not required to do any heavy lifting.

A pretty pink and blue card announces a baby boy born to Mr. and Mrs. Malcolm L. Decker of Lakeville, Conn. They gave him a real boy's name too —William John. Congratulations to the proud parents, from all of us at Washington headquarters.

—n r i—

Stanley Barstead is doing swell in his full time Radio job in Renfrew, Ont., Canada.

—n r i—

Al Stock, our Vice-President and past Chairman of New York Chapter, is the first member to report a call to service a television receiver. Stock is all prepared for business of this kind.

—n r i—

W. R. Nichols, formerly of KSRO Santa Rosa, California, is now chief operator and engineer for Station KINY, Juneau, Alaska. Arriving at his new post he was happy to meet Gordon France, also an N. R. I. man, who is operator-announcer at KINY.

—n r i—

We have been tipped off that Allen Schiavoni, former Secretary of Phila-Camden Chapter, was married in June. Let's hear from you Allen! And congratulations.

—n r i—

William Locke of Beulah, Wyo., secured the position of Radio operator at the Black Hills Airport.

—n r i—

The fellows from Baltimore who drove to Philadelphia to attend the anniversary party say they had a great trip. Gralley, who drove his new car, was sideswiped and lost a fender. But nobody worried about that—nobody except Gralley.

—n r i—

Another fellow who is moving right ahead is Howard Spangler of Spangler's Radio Service Shop, Knoxville, Tenn. Howard is making real money through his nice business and gives much credit to the help of his wife. They have been able to take a nice Florida vacation the last several winters.

—n r i—

Jack Droitcour has opened a Radio shop at Buffalo, S. Dak.

—n r i—

Charley Fehn's mother was an interested spectator at the Phila-Camden Chapter party. She is a very pleasing character.

—n r i—

The purpose of this page is to have a place for a friendly exchange of news items of a personal nature. Have you anything to contribute?

Detroit Chapter

At last we are located in ideal surroundings. Our new meeting place is in the establishment operated by our own Chairman, John Stanish, at 2500 Jos. Campau, Northeast corner of Vernor Highway. Here we have our own workbench set up with plenty of room and equipment to do things properly. This new location is easy to reach and has many advantages over our former headquarters.

At a recent meeting attended by L. L. Menne from Washington, we went right to work on practical Radio servicing. The fellows took turns at the bench and under the guidance of Stanish, Oliver, Mills and Briggs, we worked the wrinkles out of some balky Radio rece'vers.

Charles Mills of Detroit Chapter at work at the bench.

Stanish also provided us with some data he had secured from Radio manufacturers. We spent most of the evening on good old fashioned superheterodyne servicing. At the close of the meeting refreshments were served.

This brief report will give some idea of the informal but fruitful discussions to which we devote ourselves.

On another evening we attended a meeting of the Automotive Maintenance Association to hear a talk related to Radio. Our time was well spent and those who attended felt that this was an interesting diversion from our regular meeting.

The N.R.I. Tester is now part of our equipment. This affords our members an excellent opportunity to become familiar with its many uses.

A number of new members have been admitted recently. Meetings are now suspended until the second Thursday of September.

F. Earl Oliver, *Secretary.*

NATIONAL RADIO NEWS

FROM N.R.I. TRAINING HEADQUARTERS

Vol. 9 — No. 4

August-September, 1940

Published every other month in the interest of the students and Alumni Association of the

NATIONAL RADIO INSTITUTE
Washington, D. C.

The Official Organ of the N. R. I. Alumni Association

Editorial and Business Office, 16th & You Sts., N. W., Washington, D. C.

L. L. MENNE, EDITOR

L. J. MARKUS, TECHNICAL EDITOR

Index