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KEN-RAD
RADIO TUBES

Techni-talk on AM, FM, TV Servicing

HORIZONTAL AFC SYSTEMS

The previous issue contained a description of the clipper circuit and the differentiating and integrating circuits which separate the horizontal and vertical synchronizing pulses for application to their respective sweep generator circuits. In this issue the automatic frequency control circuits will be discussed.

The vertical sweep circuits are ordinarily quite stable due to the design of the integrating circuit and in most receivers the output of the integrating circuit is applied directly to the vertical sweep oscillator. If, however, the output of the differentiating circuit is applied directly to the horizontal oscillator, considerable difficulty is experienced in maintaining stable operation. This is due to the higher frequency which makes it more susceptible to noise pulses. These noise pulses trigger the oscillator prematurely causing sections of the picture to appear either jagged or torn out completely. This condition was prevalent in many prewar receivers. Some receivers use one or more stages of noise limiting preceding the clipper to reduce the effect of noise. This, however, is not effective enough and most of the current receivers use some method of synchronizing the horizontal sweep generator indirectly by means of automatic frequency control circuits.

Fig. 1A and 1B show a block diagram and circuit of an improved type of AFC circuit known as the Gruen circuit which is used in all current G-E receivers and has better "hold-in" and "pull-in" characteristics than many AFC circuits. By "hold-in" is meant the range of the free running sweep generator frequency over which, when once locked in, automatic control can be maintained. By "pull-in" is meant the range of frequencies above and below the synchronized frequency of (15750 cps) at which lock-in always takes place. Since this circuit has excellent "hold-in" and "pull-in" characteristics it is very stable in the presence of noise.

It will be noted that the sweep generator (V3) is not the conventional type such as a multivibrator or blocking oscillator, but instead, is a sine-wave oscillator which develops a sweep wave form in its plate circuit.

As in a number of other AFC circuits, a portion of the sweep output is fed back where its phase is compared with the incoming sync pulses so as to develop the AFC voltage. This voltage is developed in the output of a double diode discriminator circuit and is then applied to a reactance tube circuit where it varies the bias on the reactance tube.

The reactance tube acts as a variable resistance in series with a fixed capacitor across the tank circuit of the sine-wave oscillator. An increase in the bias on the grid of the reactance tube will cause the frequency of the oscillator to increase, while a decrease in the bias will cause the frequency to decrease.

If the discriminator output is zero as is the case when the sync pulses and the sweep generator are exactly in phase, then the bias on the reactance tube is not changed and the sweep generator runs at its mean frequency of 15750 cps.

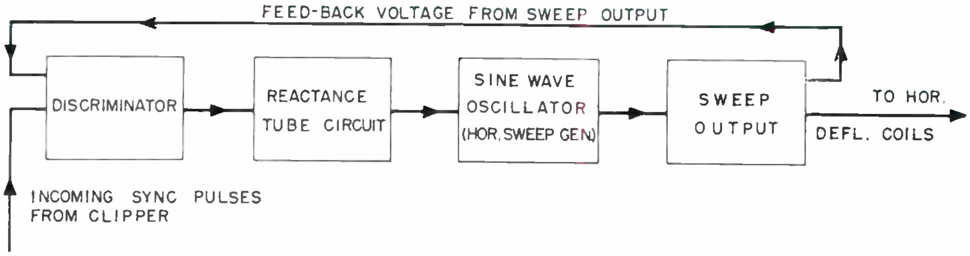


Fig. 1A. Block diagram of the Gruen Automatic Frequency control circuit.

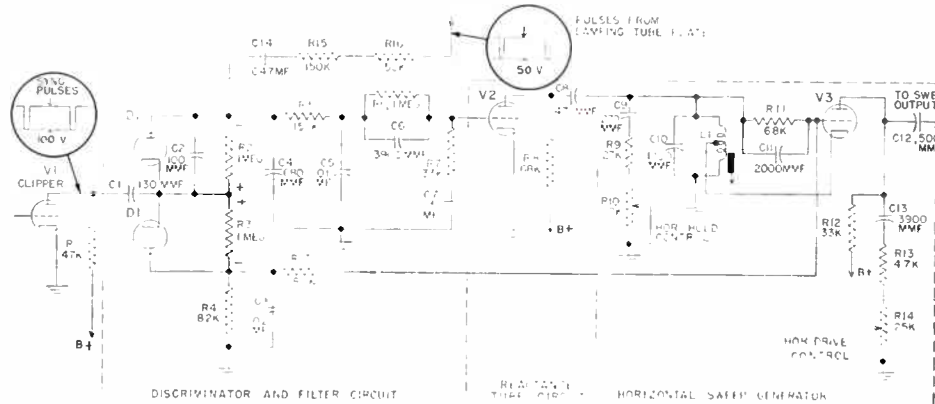


Fig. 1B. Gruen Automatic Frequency control circuit used in all current model G-E receivers.

SWEEP GENERATOR

The horizontal sweep output tube V3 in Fig. 1B is a triode, usually one-half of a 6SN7 or 12SN7, connected in a Hartley circuit, operating as a class C sine-wave oscillator. L1 is the tank inductance which is adjustable by means of an iron core. Three separate capacities, C10, C9 and C8, also appear across L1 and any change in their effective capacity will vary the oscillator frequency. C9 is in series with R9 and variable resistor R10 which is the horizontal hold control. Capacitor C8 and the variable resistance of V2 can also be considered as a hold control which varies the oscillator frequency as the resistance of V2 changes.

REACTANCE TUBE

The reactance tube, V2, acts as a variable resistance in series with the 470 mmf capacity C-8, and varies the shunting effect of capacitor C-8 across the oscillator tank inductance. Since it changes in effect the capacitive reactance across the tank inductance, it is called a reactance tube. If V2 is highly conductive, due to a low bias voltage on its grid, then the cathode to plate resistance of the tube will be low and presents a low value of resistance in series with capacitor C-8. This causes C-8 to have considerable shunting effect on the tank inductance, resulting in a lower frequency for the oscillator. On the other hand, if the plate current of V2 is reduced, due to a high bias voltage on its grid, then the plate resistance of the tube will be high. This reduces the shunting effect of C-8 on the oscillator tank inductance, resulting in a higher frequency of oscillation.

For proper operation of the circuit the reactance tube grid is provided with an initial fixed bias, about which the AFC voltage varies. The amount of this fixed bias is somewhat critical as it influences the pull-in sensitivity of the system. As indicated in Fig. 1B, this bias is obtained from a voltage divider network between the grid of V3 and ground. The voltage is developed by grid rectification of the most positive portion of the sine-wave voltage across the tank circuit and is sufficiently high to keep V3 cut-off for approximately 70 per cent of the period of oscillation.

DISCRIMINATOR

The discriminator diodes D1 and D2 shown in Fig. 1B are connected in a balanced discriminator circuit where a d-c correction voltage (AFC voltage) is developed across the diode load resistors, R2 and R3. This voltage is the resultant of the phase error between the incoming sync pulses and a voltage derived from the horizontal sweep output circuit.

When the negative going sync pulses are applied to the common cathode of the two diodes, both diodes conduct simultaneously and develop a d-c voltage of approximately 60 volts across each load resistor. The polarity, however, across each resistor is opposite and therefore the net voltage across both resistors, from the high side of R2 to the low side of R3 is approximately zero.

In order to develop a d-c correction voltage (AFC voltage) from the discriminator it is necessary to feed back a voltage from the horizontal sweep output and apply it to the discriminator so that its phase may be compared with that of the incoming sync pulses. This is accomplished by feeding back the pulses of voltage appearing across the secondary of the horizontal sweep transformer. These pulses are negative going and are applied to the discriminator circuit by means of resistors R16, R15 and capacitor C14 in Fig. 1B. The equiva-

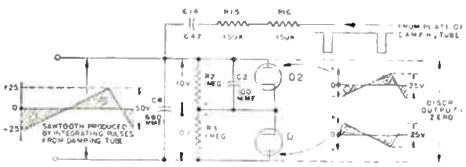


Fig. 2. Waveforms and voltages appearing in discriminator circuit.

lent circuit, as far as this fed-back voltage is concerned, is shown in Fig. 2.

As indicated in Fig. 2, the 680 mmf capacitor, C4, integrates these output pulses and a sawtooth voltage of approximately 50 volts peak to peak is obtained. This sawtooth voltage splits up across the two diodes according to the effective impedance of each diode circuit.

As shown in Fig. 2, the peak to peak sawtooth voltage appearing across each diode is approximately 25 volts, just half the peak to peak voltage appearing across the combination.

Due to conduction of the upper diode, D2, a d-c voltage is developed across resistor R2 in the polarity shown, the amplitude of which is somewhat less than the peak amplitude of the sawtooth voltage on the upper diode plate. Also, due to conduction of the lower diode, D1, a d-c voltage of equal amplitude but of opposite polarity is developed across resistor R3. Since these voltages are of equal amplitude but of opposite polarity, then the net d-c voltage developed in the discriminator output, due to the sawtooth voltage itself, is zero as indicated in Fig. 2.

Neither the sawtooth voltage by itself nor the sync pulses by themselves can produce a d-c voltage in the output of the discriminator. However, when both the sync pulses and the sawtooth voltage are applied they may produce a positive voltage, a negative voltage or zero voltage in the discriminator output, depending upon the phase relationship between them.

Before considering the combined effect of both sync pulses and the sawtooth voltage, a very important point should be brought out. It is the fact that the amplitude of the sync pulses is about twice that of the fed-back sawtooth voltage. This difference in amplitude results in the discriminator diodes conducting only during the sync pulse interval. This is due to the sync pulses charging C1 to approximately the peak potential of these pulses which develops a bias on the diodes of approximately 60 volts. This prevents them from conducting except during the sync pulse interval when the amplitude of the pulse is sufficient to overcome this bias. Therefore, since the amplitude of the sync pulse is greater than that of the sawtooth voltage only the portion of the sawtooth voltage (when the sawtooth voltage, and the pulses are combined) which will have any effect on the discriminator output, is that portion which occurs simultaneously with the sync pulse.

To illustrate the action taking place for various phase relationships, between the incoming sync pulses and the sawtooth voltage, it will first be assumed that the sync pulses and the sawtooth voltage are exactly in phase. In other words, the frequency of the sweep generator is the same as that of the incoming sync pulses, 15750 cps. This condition is illustrated by A, B and C of Fig. 3.

As shown in A of Fig. 3, the sync pulses occur at the moment the steep slope (retrace position) of the sawtooth wave crosses its a-c axis. B and C of Fig. 3 represent the composite voltage appearing at the plate of the upper and lower diodes respectively.

The voltage developed by the sawtooth neither adds nor subtracts from the pulse voltage at either diode and the effect is the same as though no sawtooth voltage were present. Therefore each diode will conduct equally, developing equal and opposite d-c voltage across the discriminator load resistors, R2 and R3. This results in the net d-c voltage appearing in the discriminator output being zero and no correction voltage (AFC voltage) is applied to the grid of the reactance tube. This is the desired condition when the sync pulses and the sweep generator are exactly in phase.

If, for some reason, the frequency of the sweep generator should increase, then the sweep would lead the sync pulses. This condition is illustrated by A, B and C of Fig. 4. Since, in this case, the sweep is leading the sync pulses, the retrace portion of the sawtooth wave across capacitor C-4 will cross its a-c axis somewhat before the sync pulse occurs as indicated in A of Fig. 4. Therefore, at the moment that the sync pulse occurs, the sawtooth voltage across capacitor C-4 will be negative (below its a-c axis) as indicated by point 1, in A of Fig. 4. The composite voltage under this condition, on each diode plate is shown by B and C. This results in unequal d-c voltages being developed across the discriminator load resistors R2 and R3, Fig. 1B, with the d-c voltage across resistor R3 (E_{D1}) being greater than that across resistor R2 (E_{D2}). Since the net d-c voltage in the discriminator output is equal to the algebraic sum of the voltages across resistors R2 and R3, the net d-c voltage in this case will be positive. This results in a positive correction voltage (AFC voltage) being applied to the grid of the reactance tube. A positive correction voltage applied to the reactance tube grid causes its plate resistance to decrease, which increases the shunting effect of the capacitor C8, Fig. 1B, in the oscillator tank circuit. This reduces the frequency of the sweep generator correcting its phase with respect to the incoming sync pulses.

If, on the other hand, the sweep generator tends to run too slow, then the phase relationship between the sync pulses and the sawtooth voltage will appear as in A of Fig. 5. As shown, the sawtooth wave laps the sync pulses and the sync pulse occurs somewhat before the retrace portion crosses its a-c axis. Therefore, at the moment that the sync pulse occurs, the sawtooth voltage across capacitor C-4 will be positive (above its a-c axis) as indicated by point 1 in A of Fig. 5. The composite voltage, under this condition, on each diode plate is shown by B and C of Fig. 5. This results in an unequal d-c voltage being developed across the discriminator load resistors, with the voltage across resistor R2 (E_{D2}), being greater than that across resistor R3 (E_{D1}). The net d-c voltage in the discriminator output in this case, will be negative. This results in a negative correction voltage (AFC voltage), which increases the frequency of the sweep generator correcting its phase with respect to the incoming sync pulses.

From the foregoing, it is seen that correction takes place from either direction. If the sweep generator tends to run too fast, a positive AFC voltage is developed and if it tends to run too slow, a negative AFC voltage is developed.

The output voltage from the discriminator is passed through a filter circuit before being applied to the reactance tube grid. This filter performs three important functions. First, it prevents the fed-back voltage pulses from directly affecting the bias on the reactance tube grid. Secondly, it prevents random noise pulses from developing a voltage which if passed on to the reactance tube grid would defeat the purpose of the use of automatic control. The third function is to prevent hunting of the system.

Referring to Fig. 1B, the first two functions are accomplished by the low-pass filter formed by C-4, R-5 and C-5, which has a relatively long time constant, so that rapid voltage changes due to random noise pulses or the fed-back voltage pulses will have no effect on the reactance tube bias. However, its time constant is still short enough to permit the normal error or correction voltage developed, due to a phase difference between the sync pulses and the sweep generator, to change the bias on the reactance tube grid.

The third function is accomplished by the anti-hunt circuit formed by R-6, C-6, R-7 and C-7. The characteristics of this circuit are such as to reduce the normal overswing (hunting back and forth) which exists when a correcting voltage is applied to a control circuit.

The horizontal hold control, R-10 of Fig. 1B, is set so that the free running frequency of the sweep generator is very close to the mean frequency of 15,750 cps. so that any deviation from this mean frequency will produce the desired correction voltage.

Space limitation does not permit a detailed discussion of other types of AFC systems. There are a number of different systems in current use which are fundamentally quite similar to the Gruen circuit in that the frequency of the horizontal sweep oscillator is compared with the frequency of the horizontal sync pulses. Any difference in frequency produces either a positive or negative voltage which is used either directly or indirectly to correct the horizontal oscillator frequency and thereby keep it in step with the sync pulses. The method used to apply this voltage to the horizontal oscillator varies somewhat with each system and also with each type of oscillator circuit.

TROUBLE SHOOTING

Defects which occur in the horizontal oscillator usually fall into four general classifications: (1) horizontal oscillator not operating, which in most receivers results in complete loss of high voltage and a blank picture tube, (2) insufficient width, (3) loss or instability of horizontal synchronization and (4) horizontal non-linearity. The first two defects are ordinarily quite easy to locate and correct. The third and fourth may be somewhat more difficult.

All of the tubes which could contribute to or cause the defect should be tested first and the necessary replacements made. New tubes may then be substituted in order to completely eliminate the possibility of defective tubes causing the trouble. Open or shorted capacitors and coils, as well as resistors which have changed value, can usually be found with an ohmmeter. Leaky capacitors can be located by using a capacitor tester or by the substitution method. An oscilloscope will usually be invaluable when used to localize defects in the horizontal oscillator circuit. This is particularly true when a wave-form comparison can be made with those usually shown in the manufacturer's schematics.

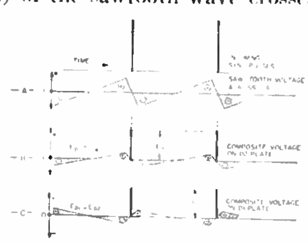


Fig. 3. Horizontal sync pulses and saw-tooth voltage in phase.

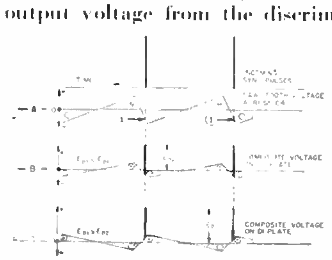


Fig. 4. Saw-tooth voltage leading horizontal sync pulses.

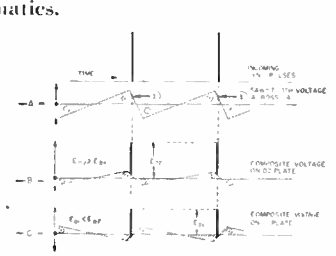


Fig. 5. Saw-tooth voltage lagging horizontal sync pulses.

Tele-Clues

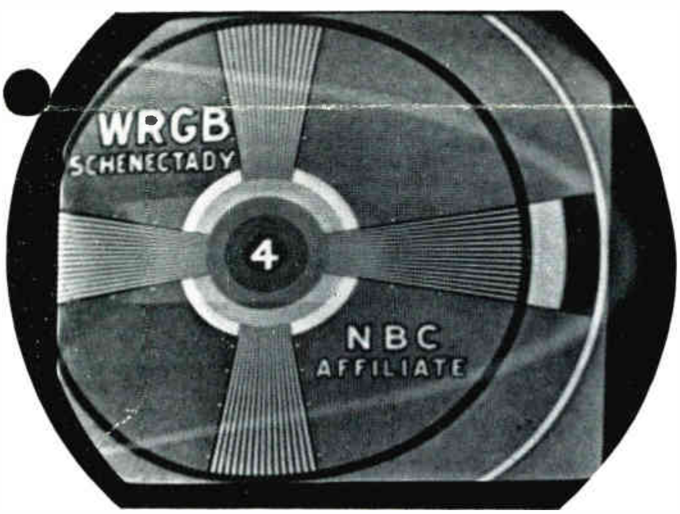
The Tele-Clues in this issue indicate eight more different defects which may occur in different circuits of a TV receiver.

Tele-Clue No. 25 This photograph illustrates loss of horizontal synchronization and may be due to any of the following components shown in Fig. 1:

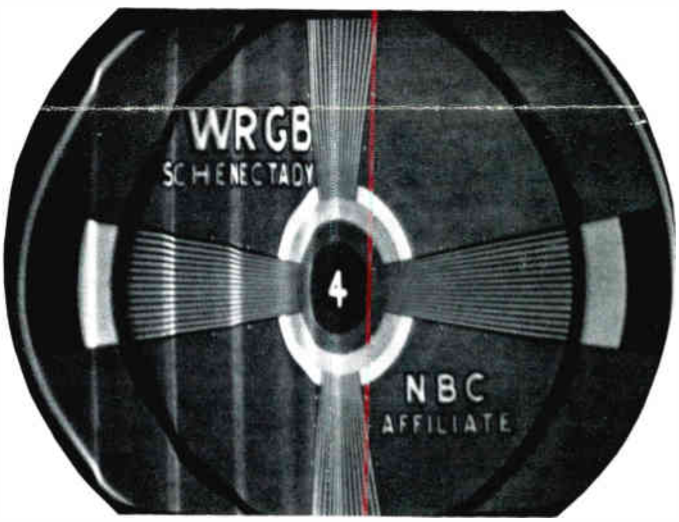
1. Misadjustment of horizontal hold control or tuning slug in L1.
2. Shorted windings in L1.
3. Improper voltages on V1, V2, or V3.
4. Defective tubes.
5. Open, leaky or shorted capacitors C1, C2, C8, C9, or C14.
6. Resistors either open or having changed value particularly R2, R3, R4, R5, R6, R8, R9, R10, R12, or R17.

Tele-Clue No. 26 This defect commonly known as a "Cog-wheel" or "Pie-crust" effect is due to "hunting" of the AFC circuit caused by improper action of the anti-hunt portion of this circuit. This is usually caused by:

1. R7 in Fig. 1 being open.
2. C7 in Fig. 1 being open.



Tele-Clue No. 27 The fold-over or overlap on the left-hand side was caused by capacitor C3 in Fig. 1 being open. This caused unstable horizontal synchronization with a tendency to tip either to the left- or right-hand side. If this capacitor is shorted a readjustment of L1 is necessary to obtain synchronization. This affects the hold-in characteristic causing the picture to weave back and forth horizontally.



Tele-Clue No. 28 The vertical white lines are caused by a misadjustment of R14 in Fig. 1. This is usually known as a horizontal drive or horizontal peaking control.

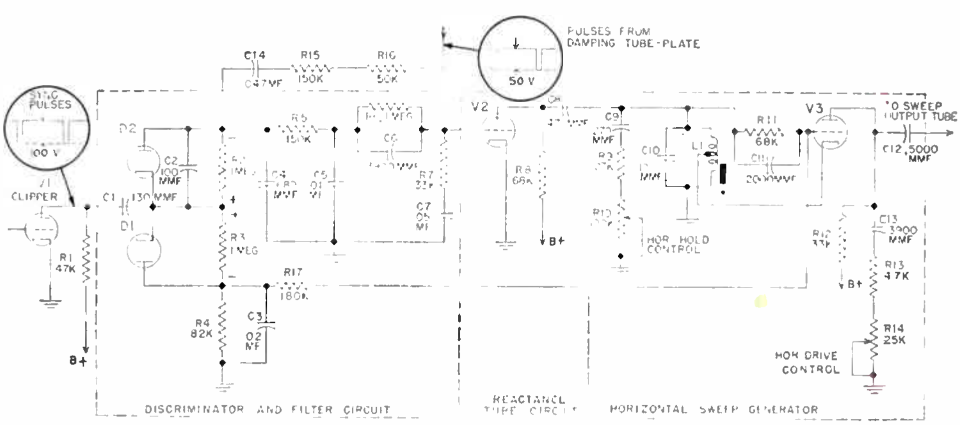
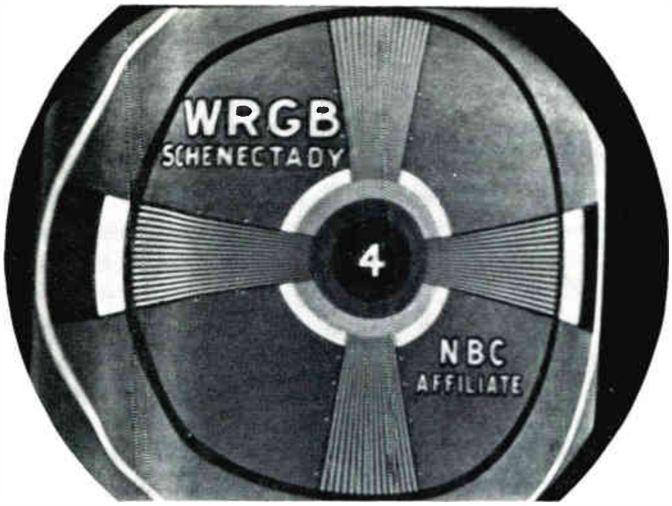
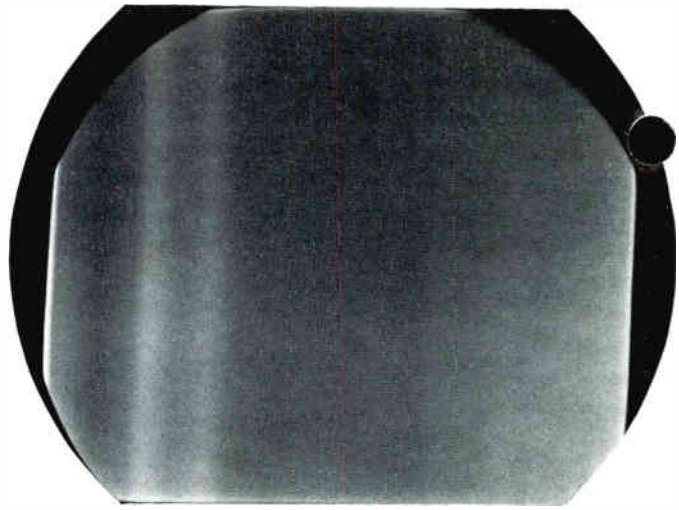


Fig. 1. Horizontal AFC and sweep circuit used in G-E receivers.

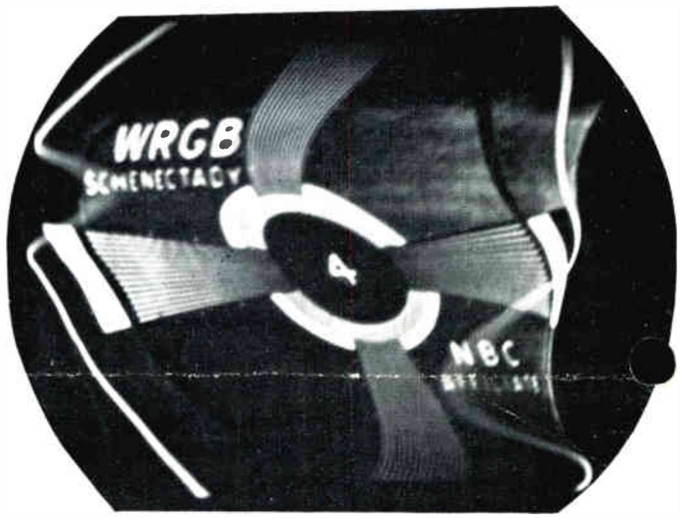


Tele-Clue No. 29 The vertical white lines on the left-hand side and a squeezing on the right side is due to capacitor C335 in Fig. 2 being open. This results in defective damping and poor linearity. If C328 is open the only noticeable result is a slight reduction of sweep width. See Tele-Clue No. 30 for effect on plain raster.



Tele-Clue No. 30 This Tele-Clue is the same as No. 29 except that it shows the effect on a plain raster.

Tele-Clue No. 31 This Tele-Clue illustrates the effect of a-c hum in the video signal indicated by the horizontal dark and light areas; and also the effect of a-c hum in the horizontal sweep circuit which caused the curvature in the top and bottom vertical wedges and the edges of the raster. This was due to one of the capacitors C-383 or C-384 in Fig. 3 being open.



Tele-Clue No. 32 This Tele-Clue is similar to No. 31 except that it indicates the effect of additional a-c hum being present in both the video and sweep circuits. This was due to the total capacitance of C-383 and C-384 in Fig. 3 being reduced to a total of 40 mfd.

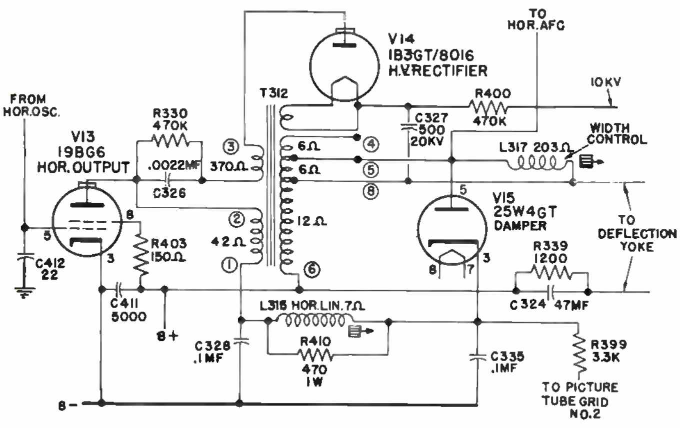


Fig. 2. Horizontal output and HV power supply used in G-E receivers.

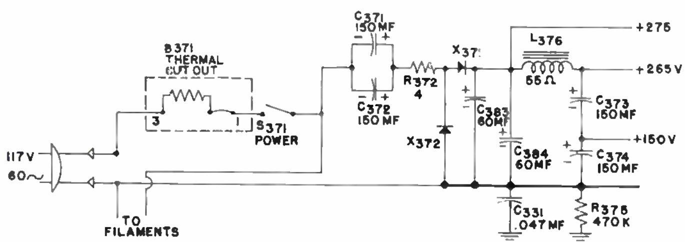


Fig. 3. Selenium rectifier type low-voltage power supply used in G-E receivers.

TELE-TIPS

6. A weak spot in HV oscillator circuits is the oscillator trimmer capacitor. This type of supply is used in most 7" receivers and also in some of the larger size receivers. This capacitor may check OK and only break down intermittently when in use. Try substituting either a new variable or a fixed capacitor of approximately the same value.

7. When the brightness control does not properly control the picture tube brightness check for a leaky coupling condenser in the picture tube grid circuit.

8. A minute leakage of the HV coupling condenser in the vertical deflection circuit of electrostatic type picture tubes may cause erratic operation of the vertical oscillator and fold over at either the top or bottom.

9. An open grid resistor in the 6BG6G horizontal output tube will result in the raster coming on for a few seconds somewhat narrower than normal and then narrowing into a vertical line before completely blanking out.

10. Insufficient width may be due to low emission of either the horizontal oscillator or horizontal output tube either of which may check "Good" in a tube tester. If both height and width are affected try a new low voltage rectifier even though it may also check OK.

HOW TO GET THE MOST OUT OF YOUR TEST EQUIPMENT

THE SIGNAL GENERATOR—PART 2

In this second part on how to get the most out of your signal generator a few additional precautions are explained that should be taken to assure full and satisfactory performance from your equipment as well as some general instructions on using these instruments in aligning FM and TV receivers. Since various types and models of receivers differ, the alignment procedure as given in the service notes should of course be followed closely. However, if one has a thorough knowledge of the basic principles involved, a great deal of time can be saved on those service jobs requiring alignment, and that of course means more dollars in your pocket at the end of the week.

It may seem superfluous to say that you should obtain the best possible signal generator that you can afford, but since there are many so called bargain ones being sold for TV and FM work it is well to keep a few points in mind when buying. Probably, the most satisfactory arrangement is two signal generators, one to be used as a marker generator and having AM modulated and unmodulated outputs over the range of 100 kc. to perhaps 200 mc., and an FM modulated sweep generator with an output frequency of from about 8 mc. to 240 mc. and a sweep width of 0 to 10 mc. or greater. Both should have a high degree of accuracy of calibration and an output of constant amplitude over the frequency range. The sweep generator should have a constant output over its deviation range. These factors plus the many worth while refinements which are common are almost certain to mean that the price will be at least $75.00 and probably more.

Before a satisfactory job of alignment can be done, the test equipment necessary should be arranged safely and conveniently on the bench. Nothing can slow up work like a disorderly bench with test leads running all over and getting mixed up. In addition to creating confusion, this condition can give rise to many mystifying and peculiar results due to AC pickup by the leads and equipment. One trick is to provide a good ground plate for your sweep generator, marker generator and scope. Since most everyone has his own ideas on how a service bench should look, no attempt will be made here to suggest a layout. After you have decided on an arrangement for your equipment that is convenient to you, cover the top of the bench under the equipment with a sheet of copper. This may be ordinary roofing copper obtained from any roofing shop. Extend this ground sheet far enough to provide ample room for the chassis under repair and connect it with a good solid lead to a water pipe ground if possible. Then solder or bolt to it short ground leads running to the ground terminals of the equipment. This will eliminate several leads running between the equipment and will do much to prevent unwanted pickup. When using this grounded system, be sure to have an isolation transformer to provide AC power for those sets using transformerless circuits. A 250 or 500 watt isolation transformer should be a "must" for any service bench to protect both the serviceman and the equipment. Then by using shielded leads for the hot connections to the equipment, no trouble should be encountered with stray pickup.

Now that the necessary equipment is operating properly, an inspection of Figure 1 will show the points of connection for an over-all IF alignment of a typical TV receiver. In aligning an FM receiver the procedure is the same as will be described for a TV receiver sound channel so no additional notes should be necessary. In locating the points of connection the circuit diagram and service notes should be consulted, and any adjustments made as recommended by the manufacturer. These may include such things as disabling the AGC circuit and substituting fixed bias on the IF stages so that the level of the input signal will not affect the operation. A general rule for sets having AGC is to provide a fixed bias from a battery and resistor of about minus 4 volts on the IF tubes. In receivers without AGC, set the contrast control to give approximately this same amount of negative bias.

Next, connect the sweep generator to the grid of the mixer tube through a 500 mmfd. condenser, preferably of the ceramic type. This point may be hard to reach on some well shielded sets but a couple of tricks will oftentimes solve the problem. One simple way is to pull the mixer tube out of its socket and wrap a piece of fine bare wire around the grid pin and replace the tube in its socket being careful not to let the wire short to the chassis. This wire should only be long enough to connect to the sweep generator lead. Another system recommended for some receivers is to use a snug fitting shield over the mixer tube which does not ground to the chassis and attach the lead from the sweep generator to this shield through a fairly large capacitor, .005 mfd. or so. This shield then represents one side of a condenser and the tube elements the other. The ground side of the sweep generator lead should, of course, go to the chassis.

The marker generator can be connected in several ways. The antenna terminal usually makes a good point but oftentimes enough signal can be obtained by merely connecting the hot lead to the chassis.

The scope with a 10,000 ohm resistor in series with its hot lead, or the VTVM can now be connected to the proper point as recommended, or if no notes are available, to the video detector load resistor. A check should be made first to determine whether or not the load resistor has a high DC voltage on it as is found in some circuits. If this is the case the VTVM should not be grounded and care should be taken in handling the instrument. A scope can be connected from the high side of the resistor to the chassis instead of across the resistor.

The first step in alignment is to set the IF traps. This is accomplished by using the marker generator either modulated with 400 cycles with the scope as an indicator or unmodulated and using the VTVM. Adjust the traps for minimum output at the prescribed frequencies. As the alignment progresses it is well to recheck the traps as there may be some interaction between the IF windings themselves and the traps depending on how tightly coupled they may be.

If the IF System is of the stagger tuned type, this same set-up may be used to tune the IF transformers by peaking them in the recommended order and at the frequencies given in the alignment chart. In both of these cases it may be necessary and is advisable to connect the marker generator to the grid of the mixer in order to obtain sufficient signal. As explained in Part 1, the output from the signal generator should be just great enough to get a good output indication in order to prevent overloading of the stages. If the set is badly out of alignment it may be necessary to move the generator to the grids of the IF stages as explained in Part 1, but this should rarely be necessary unless the IF transformers have been replaced. While this method should produce a properly aligned IF system, it is always wise to check the shape of the curve by the method described in the next paragraph as there are several factors which may alter the curve from the original such as high or low limit GM tubes, etc.

In the alignment of overcoupled IF stages the sweep generator is used and connected as shown in Fig. 1. The synchronizing of the sweep generator and the scope is accomplished as explained in Part 1. With the sweep generator set to give a 10 mc. or greater sweep width, a picture of the over-all response curve will appear on the scope. The picture can be made stationary by properly setting the sync controls on the scope. A typical curve is shown in Fig. 2. Depending on the particular receiver, this curve as seen, may be either upside down or reversed. This is caused by the video detector producing either a positive or negative signal as required by the circuit in question. Next turn on the marker generator and set it at the proper frequencies as given in the table for the receiver under repair. No modulation should be used. It will be necessary to adjust the level of the output of this generator so that the pips as observed on the scope are just clearly visible. Too great a signal from the marker generator will distort the pattern. It may be difficult to get a good indication of the marker pips on some parts of the curve, particularly in the sound notch, but a little imagination will suffice here. Here the need for accuracy cannot be stressed too strongly for if the marker frequencies do not fall exactly right on the response curve, you might end up with a picture without sound, or sound without a picture. A method of checking your marker generator calibration will be explained later. Watch the top of the response curve closely and if it starts to flatten out and appear as a straight line check the level of the signal and reduce it to prevent overloading. This is extremely important as the response curve cannot be properly shaped if the top is distorted by too much signal.

The FM sound channel is aligned in much the same way by using the sweep and marker generators and tuning the IF and discriminator transformers as prescribed in the manufacturer's instructions so as to produce a curve as shown in Fig. 3. The marker generator pip should appear in the exact center when set to the sound IF frequency.

Now that the method of alignment has been described, it will do well for the serviceman to keep in mind that a TV receiver should not be realigned unless all indications point to the fact that it is absolutely necessary. Despite the fact that an accurate alignment is necessary the very nature of the IF systems involved

(Continued on page 6)

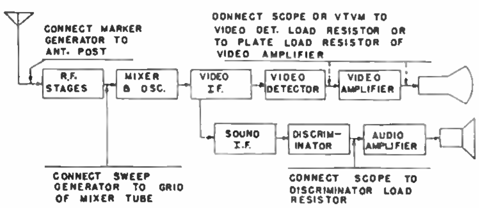


Fig. 1. Block diagram showing points of connection for an over-all IF alignment of a typical TV receiver.

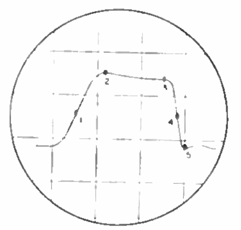


Fig. 2. Typical IF alignment curve.

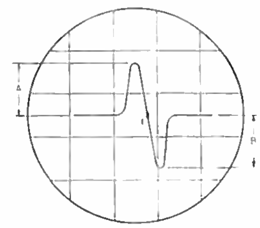


Fig. 3. Typical FM discriminator transformer curve.

BENCH NOTES

Contributions to this column are solicited. For each question, short cut or chronic-trouble note selected for publication, you will receive $10.00 worth of electronic tubes. In the event of duplicate or similar items, selection will be made by the editor and his decision will be final. Send contributions to The Editor, Techni-Talk, Tube Division, General Electric Company, Schenectady 5, New York.

VERTICAL VIBRATION ELIMINATION

I have found "talking" vertical sweep transformers in several G-E TV receivers of the 12 C and T series.

I have been able to correct this condition by placing approximately 1/8" of metal between the transformer plates and chassis and drawing the mounting screws up snugly. This is the only way I have found to tighten plates so they will not vibrate.

The piece of metal will save dealers the expense of removing defective transformers and the time of replacement.

Mr. James Patrick
Lincoln Avenue
Mexico, New York

AN OUNCE OF PROTECTION

When TV sets do not have a fuse in the 6BG6G flyback circuit, I cut the B+ wire from the No. I terminal and solder on two metal tube grid caps which will just fit a 1/4 amp. 3AG fuse. The cost of this protection is only about 13¢.

Mr. James G. McGuire
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ELIMINATING VISIBLE SOUND

Most 12" Philco TV sets give a lot of trouble with wavy lines in the picture when the sound is tuned properly on channel #4. After considerable investigation by the writer it was proven that the trouble was the third harmonic of the sound I.F., supposedly 22.1 mc. beating with the Video Carrier of channel #4, supposedly 67.25 mc.

Some stations shift their carrier frequencies within a given channel to avoid heterodyne interference with other stations on that channel and that condition, plus the fact that all the I.F. frequencies within the receiver shift or are off in frequency, aggravates the condition of internal beats within the set. Some sets fresh from the factory apparently work perfectly and after about two weeks these wavy lines grow progressively worse. The writer's theory is that as the coil dope ages, the tuning of the I.F. shifts from 22.1 mc. to 22.40 mc., one third of the channel #4 Video Carrier.

Instead of aligning the set at 22.1 mc. for the sound I.F., the sound I.F. was aligned at an even 22.0 mc. the third harmonic of which is 66 mc. the exact edge of the channel where carriers are forbidden by FCC rules. And at the same time to maintain picture quality in the set all I.F. frequencies were shifted .1 mc. lower. After this was done the wavy lines which destroyed picture quality completely disappeared and no returns resulted since the I.F. had to drift an additional one tenth of a megacycle, to repeat the condition.

Therefore, when you notice wavy lines through the picture as you tune through the sound with the fine tuning control, pull out any one of the Sound I. F. tubes, and if the trouble disappears, you're getting beats between the sound I.F. harmonics and a Video Carrier.

John R. Laudermilch
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Palmyra, Pennsylvania

PILOT LIGHT HUM

Several cases of bad hum in AC-DC receivers when the "reception" switch is in the phono position has been traced to faulty pilot light sockets. The position of the pilot light in the average circuit will cause hum regardless of polarity of the power line if there is leakage to the "neutral" chassis. Replacement of the socket will cure the trouble. This trouble has been found in the Hallicrafter's S-58 and several other AC-DC radio combinations.

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MORE HOWL ELIMINATION

I have had trouble with Television antennas making a great amount of noise. I discovered that antennas with open tube ends cause this, so it is best to pinch the ends closed with pliers. Also be sure your twin lead-in is tight or you may get a flicker in your picture when it is windy.

Fred B. Jones
Jones Radio Company
Douglassville, Pa.

HOW TO GET MORE OUT OF YOUR TEST EQUIPMENT—continued from page 5

make them quite unlikely to become misaligned due to aging, etc. since they are very broad tuned and small normal changes are of little consequence.

A method of checking the calibration of a signal generator which is to be used for marker frequencies, or for any other use requiring a high degree of accuracy is to check it against the Bureau of Standards station WWV. This station transmits on 2.5, 5.0, 10.0, 15.0, 20.0, 25.0, 30.0 and 35.0 mc. and its transmissions may be used in several ways to calibrate your equipment. One simple method makes use of a receiver that covers the frequency range of 2.5 to 20.0 mc. If you don't have one in the shop perhaps you know an amateur who will let you use his communications receiver. The output of the signal generator can be connected (through a 500 mmf. condenser) with a regular antenna to the antenna terminals of the receiver. The accuracy of the signal generator can then be determined by zero beating its output against one of the WWV frequencies mentioned above.

Another method is to use a second signal generator, set at 1,000 KC and connected to the antenna terminals. The 1000 KC setting must be exact and can be obtained by zero beating a harmonic of this signal against one of the WWV frequencies and then left at this setting. The output of the signal generator which is to be calibrated is then connected in place of the regular antenna and set at a check frequency which is a multiple of 1000 KC (1 mc.). The fundamental frequency of the generator being calibrated is mixed with the 1 mc. frequency of the other generator. This results in a zero beat which can be heard on the receiver at 1 mc. intervals when the generator and the receiver are tuned to the same fundamental frequency, e.g. 21 mc., 22 mc., 23 mc., etc. It is usually necessary to vary both the generator and receiver slightly while listening for the zero beat. The generator setting at the point where the zero beat is heard indicates the plus or minus frequency that the generator is off. There are several minor variations of this scheme and a little practice should enable you to keep your equipment in tip-top shape and produce dividends by making the first alignment job the final one.

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