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KEN-RAD RADIO TUBES

Techni-talk on AM, FM, TV Servicing

HORIZONTAL DEFLECTION CIRCUITS AND KICKBACK POWER SUPPLIES

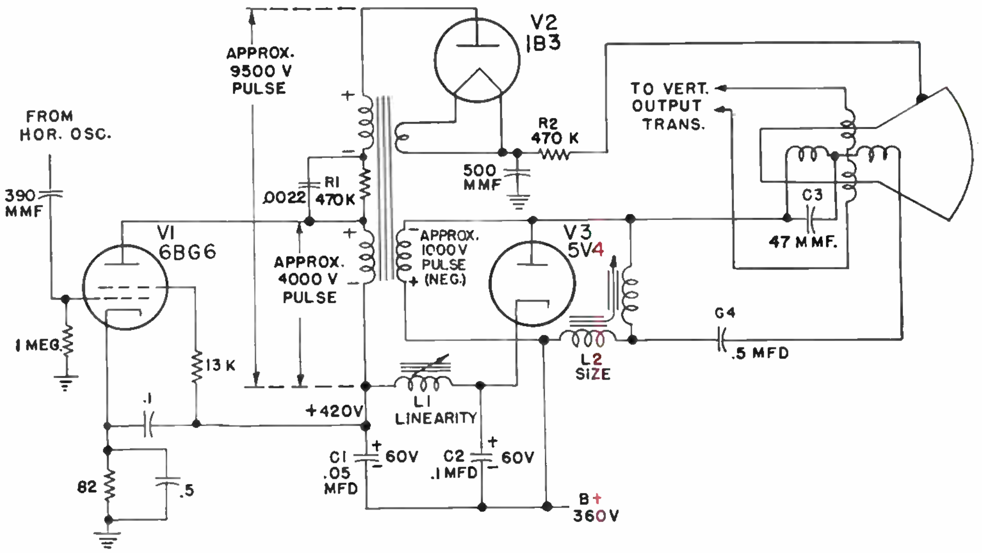


Fig. 1. Typical horizontal output circuit illustrating voltages developed in the output transformer and also the B+ boost developed in the cathode circuit of the 5V4 damping tube.

As was previously discussed the object of the deflection circuits is to cause the electron beam to move linearly across the screen from left to right at a rate of 15,750 times per second, and at the same time to move linearly from top to bottom at a rate of sixty times per second. We know that a sawtooth wave of voltage is required to produce this effect in a receiver using an electrostatic type of picture tube and that a sawtooth wave of current is required in receivers using an electromagnetic type of picture tube. We have discussed ways of producing both types of waves and have been primarily concerned only with the trace portion of these waveforms. It is equally important that the retrace portion of the sawtooth wave be steep enough to return the electron beam to its proper position on the screen in order to correctly reproduce all of the picture information. If the retrace isn't fast enough a foldover results. This means that some of the picture information is arriving at a time when the beam should be blanked out, but due to the retrace being too slow, it results in a portion of the picture being superimposed.

Due to the frequency of the vertical oscillator being 60 c.p.s., the retrace portion of the vertical sawtooth wave does not present the same problem as the horizontal retrace. This is apparent when the horizontal retrace time of about 7 microseconds is compared with the vertical retrace time of about 833 microseconds. In order to accomplish the horizontal retrace in the allotted time, the output transformer and deflection coils are so designed that the distributed and stray capacitance acts with the inductance to form a resonant circuit.

If a small capacitor, in the order of 500 mmfd, is placed across the horizontal deflection coils, the picture size will be increased both horizontally and vertically. This is the result of a decrease in the high voltage which allows the deflection coils to have more effect on the electron beam, increasing the swing limits in both directions. The addition of this capacitance will also affect the resonance of the horizontal output circuit thereby reducing the retrace time and causing a foldover on the left-hand side of the picture. The amount of foldover will of course vary with the amount of capacitance added.

KICKBACK H-V SUPPLY

When the plate current of the output tube is cut-off at the end of the trace portion of each horizontal line, the magnetic field in the primary of the output transformer collapses. This produces an inductive kick of voltage across the primary of about 4000 volts. An additional winding, connected in series with the regular primary winding, steps this voltage up through autotransformer action to about 9500 volts as illustrated in Fig. 1. This voltage is applied to the plate of a 1B3GT type rectifier which converts these pulses to d-c. An R-C filter consisting of a 500 mmfd capacitor and a 470 K ohm resistor provides sufficient filtering for application to the second anode of the picture tube. Due to the comparatively high frequency of the pulses (15,750 c.p.s.) very little filtering is required and a 500 mmfd capacitor is adequate for the purpose. Also since the capacitor is so small, it cannot store a dangerous charge and makes the high voltage supply relatively safe.

TRANSIENT OSCILLATIONS

As mentioned previously the sweep output circuit has a certain amount of distributed and stray capacitance which acts with the inductance to form a resonant circuit of comparatively high frequency. As shown in Fig. 1, the collapse of the magnetic field in the primary of the output transformer causes a high pulse of voltage (approx 1000 v) to be developed in the secondary. The sudden shock of this high pulse of voltage developed across the coil inductance during retrace will shock the resonant circuit into oscillation as shown in Fig. 2B. These transient oscillations will, if not properly damped, effect the sawtooth wave of current as shown in Fig. 2C. Since these oscillations distort the sawtooth waveform at the beginning of the trace portion of the sweep, they must be damped out. The result of proper damping of these oscillations is shown in Fig. 2E.

B+ BOOST FROM DAMPING ACTION

Damping is usually accomplished by the use of a rectifier tube connected as shown in Fig. 1. This tube (V3) is so connected that when the magnetic field in the deflection coils begins to collapse, the high pulse of voltage developed by this collapsing field is negative on the damping tube plate. Therefore, the damping tube will not conduct until the retrace is completed and the voltage becomes positive as shown at point 1 in Fig. 2B. At this time it conducts heavily due to the first half cycle of positive transient oscillation and charges capacitors C1 and C2 (Fig. 1). These two capacitors act as though a battery of 60 volts were connected in series with the regular power supply. This permits the operation of the sweep tube at approximately 420 volts although the regular B+ supply is only 360 volts.

DAMPING OUT TRANSIENT OSCILLATIONS

When the current through the deflection coils has reached its maximum negative value, as shown in point 1 in Fig. 2A, retrace is completed and the *current* through the coils will reverse its direction and start the trace portion of the sawtooth wave. However, during the retrace very little of the stored magnetic energy was dissipated since the damping tube was nonconducting and no load was placed on the oscillatory circuit. When the current through the coil reverses itself and starts the next trace period, the magnetic field also reverses itself and causes the oscillatory *voltage* to go in a positive direction as shown at point 1 in Fig. 2B. If no damping tube were placed across the deflection coils, the circuit would continue to oscillate at its natural frequency as shown in Fig. 2B until the stored up energy was finally dissipated in the circuit resistance. This would result in a current wave similar to Fig. 2C, which would destroy the linearity at the beginning of the trace.

With the damping tube in the circuit however, when the oscillatory voltage starts to go positive as at point 1 in Fig. 2B, the tube begins to conduct heavily and thus places a load across the deflection coil so that it cannot continue to oscillate.

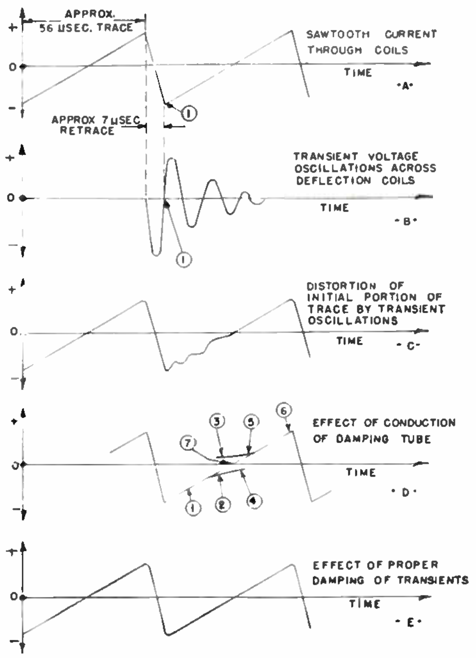


Fig. 2. Current and voltage waveforms illustrating trace and retrace time in A with transient voltage oscillations in B and the distortion due to these oscillations in C. The effect of damping tube conduction is shown in 1, 2 and 4 of D and output tube conduction in 3, 5 and 6. The resultant current waveform illustrating the effect of proper damping is shown in E.

EFFECT OF DAMPING TUBE CONDUCTION

The sweep output tube is operated so that it cuts off not only during the retrace period, but remains cut off for a part of the initial portion of the trace. During this period the sawtooth current through the deflection coils is due to the stored magnetic energy. This is indicated on the portion of the sawtooth waveform marked 1 in Fig. 2D. As mentioned previously, the stored up energy in the magnetic field is dissipated by the load which the damping tube places across it at a rate that is suitable for linear trace. As the rate of decay starts to approach a nonlinear condition as at point 2 in Fig. 3D, the sweep output tube begins to conduct as indicated at point 3, and takes over the task of maintaining current through the deflection coil somewhat before the magnetic energy that was stored up in the coil is completely dissipated at point 4. The output tube supplies current to the deflection coil of almost constantly increasing amplitude from point 5 to point 6. When point 6 is reached the sweep output tube is again cut off, retrace is initiated and the entire cycle repeats itself. The current through the deflection coil due to conduction through the damping tube and that due to the sweep output tube are curved at the crossover point 7. When they are combined however, they produce a current through the coil that is linear at this point as indicated by the dashed line. The result is a linear sawtooth as shown in Fig. 2E.

TROUBLE SHOOTING

The current waveform across either the horizontal or vertical deflection coils can be observed by inserting a small resistor (about 10 ohms) in series with one lead of either coil. The vertical input leads of an oscilloscope should then be connected across this resistor. The waveform observed should be a sawtooth and any variation can be traced back through the respective circuits by comparing the waveforms at the grid, plate, and in some multivibrator circuits the cathode of each tube with those given in either the manufacturers service notes or some source of this information such as the Rider Television Manuals.

If loss of high voltage is indicated by little or no brightness, a voltage reading should be made between the anode cap and ground. If the voltage checks low at this point, a plastic handle screwdriver, held well back on the handle and not grounded, can be used to touch the cap of the high voltage rectifier first and then the cap of the horizontal output tube. If a good spark is noticed at the cap of the rectifier try a new tube. If this doesn't correct the trouble check for a short in the high voltage capacitor or an open resistor between the rectifier filament and the picture tube anode cap. If a good spark is obtained at the cap of the output tube, but not at the rectifier tube cap, try a new output tube first and then a damper tube. If this doesn't correct the trouble make a voltage check and then a resistance check in the output tube circuit. This test is only suggested for use on receivers having a kick back or r-f type of HV power supply, and then only with considerable caution. Under *no* conditions use this test in projection type receivers or *those having a 60-cycle h-r power supply*.

A defective output transformer will usually result in complete loss of high voltage or, if a picture is visible, it will be very faint or have the appearance of water running horizontally through it.

If the 470 K resistor (R2) in Fig. 1, located in the high voltage lead increases in value the picture will bloom when the brightness control is advanced. This resistor is usually only one-half watt in size and any temporary short at the anode cap may cause it to overheat and increase considerably in resistance.

If the .0022 mfd capacitor in Fig. 2, located between the plate coil and the high voltage coil opens up, the voltage will drop to the point where no brightness is visible. If this condenser is suspected, bridge it with a good .002 mfd mica. This condenser provides a path for the 15,750 c.p.s. voltage across R1 the 470 K ohm protective resistor.

ADDITION OF AGC TO G-E 805 SERIES T AND S VERSIONS

The T and S versions of the G-E 805 line of TV receivers did not include Automatic Gain Control. Instead the Contrast Control derived its bias voltage from the difference in voltage (−10 volts) between the two B− lines, B1− and B2−.

The inclusion of AGC in these receivers will be of assistance to some troublesome cases where difficulty in sync. and intercarrier buzz is experienced. With the addition of AGC, slight i-f and discriminator misalignment will not be apparent as the AGC circuit tends to hold the signal voltages to the sync. and audio i-f circuits fairly constant. It will also be found that leakage between the grid and cathode of the picture tube will not result in erratic synchronization due to the grid of the picture tube being removed from V7B and connected to B2−.

Fig. 1 represents a modified circuit which has been carefully worked out to use a minimum of new parts. The encircled numbers in Fig. 1 designate the step by step changes listed below. The d-c restorer, V7B, has been eliminated and this section used as an AGC rectifier. No discernible difference will be noted with the d-c restorer removed. Elimination of the d-c restorer is possible because:

1. The vertical blanking net work, R306, C301 and C302 in the vertical output transformer secondary effectively blanks out the return trace (not shown in Fig. 1).
2. The capacitor, resistor combination, C269 and R269 in the picture tube grid has the correct time constant to act as a d-c restorer, developing the correct bias for the picture tube to control background illumination.

Step by step procedure for adding AGC to T & S Version 805 Series Receivers:

1. Remove R269 (390K) from Pin No. 1 of V7B (DC restorer) replace with a 1 meg resistor and reconnect to B2−.
2. Replace C274 (.05 uf) on Pin No. 1 of V7B with .1 uf cond.
3. Replace R278 (1 meg) on Pin No. 1 of V7B with 150K resistor.
4. Lift bottom end of R279 (47K) Pin No. 7 of V7B off B2− and insert .1 uf cond. in series to B2−.
5. Remove sync. line from Pin No. 7 of V7 and insert .05 uf cond. in series to Pin No. 4 of V11A.
6. Install 2.2 meg resistor from Pin No. 4 of V11A (phase inverter) to B2−.
7. Connect a 22K resistor from junction of L249 (2uh) and R265 (5100 R) to any convenient tie point (A) not in use.
8. From this tie point (A) install 5000 uuf cond. to B2−.
9. Remove lead (brown) from B2− side of contrast control at B2− end and reconnect to tie point A.
10. Remove B1− jumper that's connected from B1− side of contrast control to B1− side of Brightness Control. From the B1− side of the contrast control (now empty) run a new lead to point of junction of R279 and new .1 mfd cond. previously installed.
11. Replace R243 (100K) with 470K resistor.
12. Install .5 uf cond. across C242 in contrast control circuit.

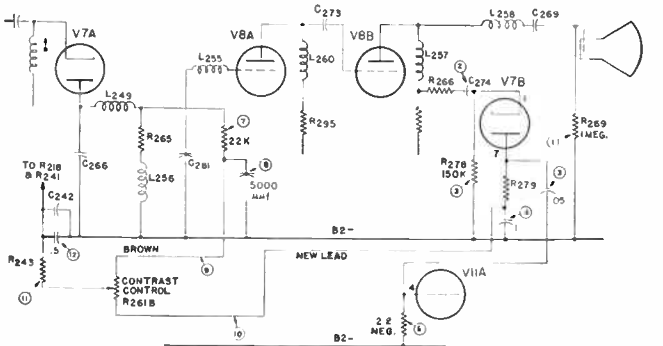


Fig. 1. Circuit diagram showing the changes required to add AGC to the T and S versions of the Model 805 line of receivers.

PARTS FOR AGC CONVERSION

1—22K ½W
1—470K ½W
1—150K ½W
1—1 MEG ½W
1—2.2 MEG ½W
1—.5 uf 120V
1—5000 uuf.
2—.1 uf 400V
1—.05 uf 600V

Tele-Clues

The Tele-Clues in this issue indicate eight defects which may occur in the horizontal deflection circuit. The waveforms shown were obtained by connecting an oscillograph across the 10 ohm resistor which is inserted between C83 and the horizontal deflection coil as shown in Fig. 1.

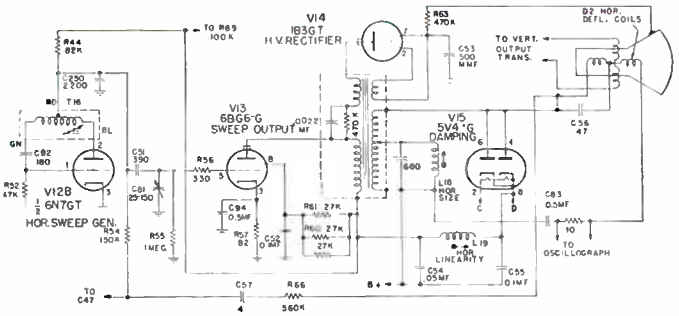
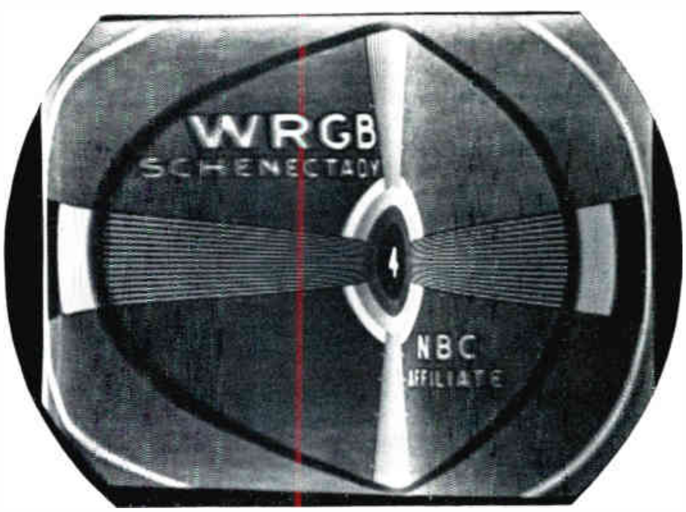
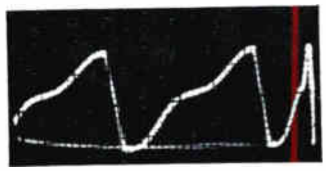


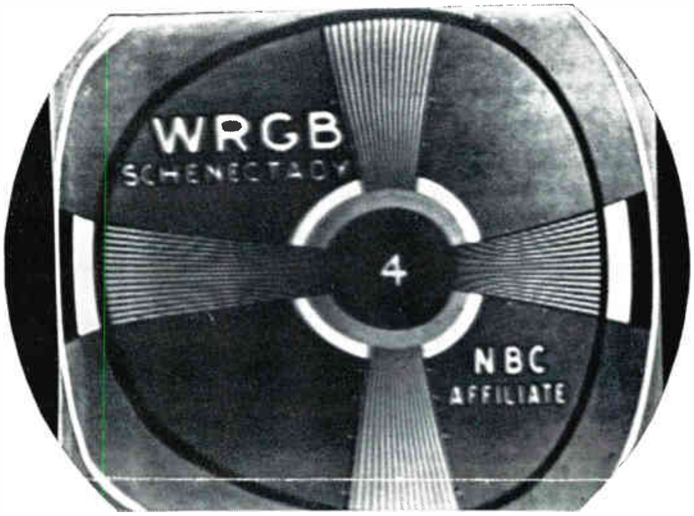
Fig. 1. Horizontal sweep generator and output circuit as used in G-E Model 810 receivers.

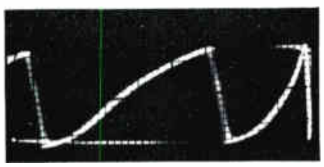




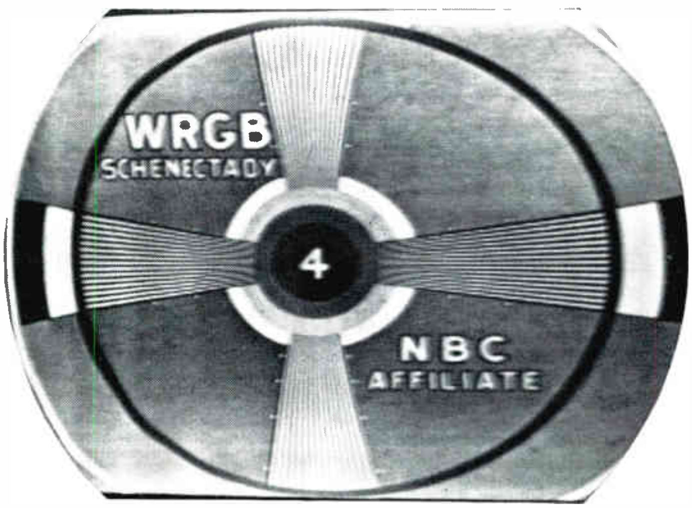
Tele-Clue No. 41. The capacitance of C55 in Fig. 1 is quite critical as indicated in Tele-Clues No. 41, 42 and 43 which show the effect of changing the value to .01, .02 and .05 mfd. Any change to this capacitor varies the constants in the damping tube circuit. This affects the initial portion of the trace which, as explained on pages one and two, is supplied by the conduction of the damping tube. Tele-Clue No. 41 is the result of changing C55 to .01 mfd. The waveform graphically illustrates the condition shown on the test pattern. The beginning of the trace, starting from left to right, is very slow as shown by the flat portion of the waveform. This caused the foldover and squeezing of the left edge of the pattern. The wave then rises sharply resulting in the left side being stretched. The leveling off in the center resulted in the pattern being squeezed at the center and part of the right side. The balance appears normal with the exception of the peak being rounded off which apparently occurred after the beam was blanked out.

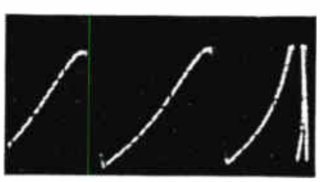
In order to understand this, it must be remembered that the picture information contained in each horizontal line is based on a linear trace. Therefore if a portion of the trace is too slow, the picture information which should appear over say a two-inch horizontal space appears, due to the beam slowing down, in a one-inch space. The reverse condition occurs of course if a portion of the trace is too fast.





Tele-Clue No. 42. The above photographs show the result of changing C55 in Fig. 1 to .02 mfd. The start of the trace is still slow resulting in the left edge being squeezed. The rather sharp rise and then the leveling off of the wave caused the stretching on the left and the squeezing on the right.

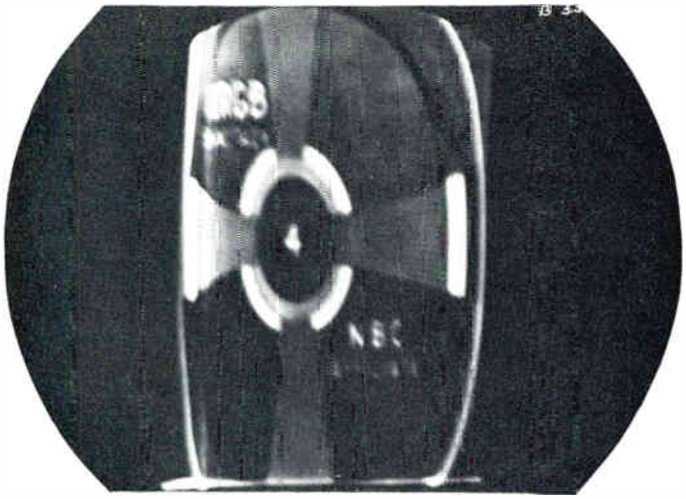




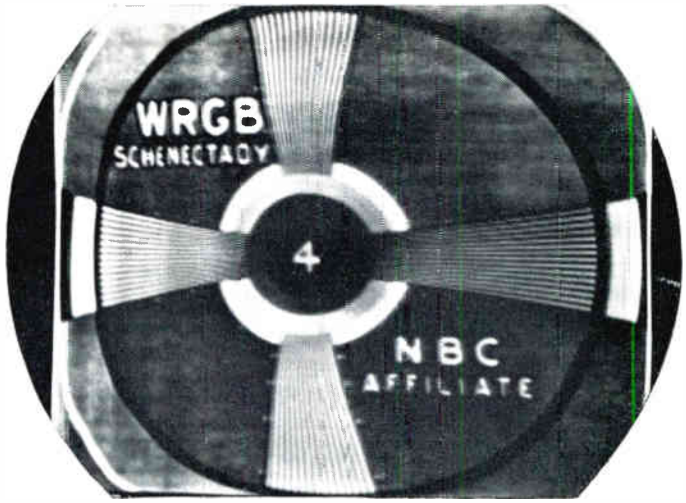
Tele-Clue No. 43. In the above photographs C55 was changed to .05 mfd. The beginning of the trace is now almost normal and this is apparent in both the waveform and test pattern. The trace is slightly bowed however, resulting in the left side being compressed and the right side elongated. It can be seen from the above that the limits of linearity correction can be extended by adding to or reducing this capacitance.

Tele-Clue No. 44. The striations or ripple in both the test pattern and waveform is the result of cross-talk of the horizontal sweep frequency components into the vertical deflection coils. The coupling takes place within the deflection yoke where the horizontal pulse and wave variations are impressed into the vertical deflection coils. This causes a slight amplitude modulation of the vertical sweep voltage that gives the picture the rippled effect. The repetition is maintained until the transient is dissipated in the vertical coils, as indicated by the fact that the ripple gradually disappears in going toward the right-hand edge.

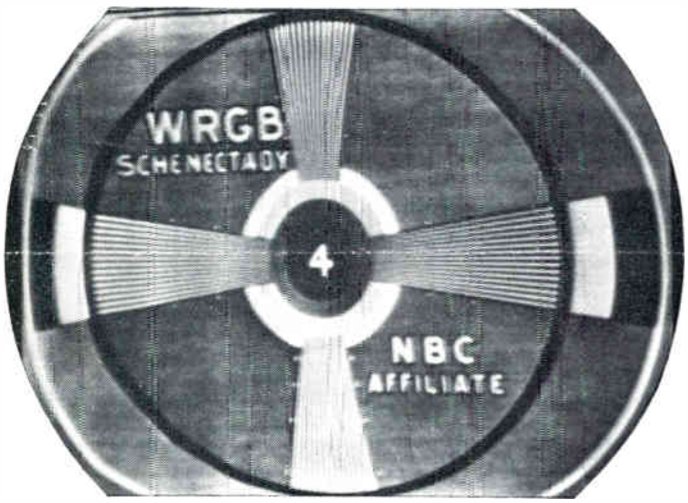
One source of this trouble is when the capacitor shunting one-half of the horizontal deflection coils is incorrect. This capacitor, C56 in Fig. 1, balances one coil against the other with respect to ground, resulting in a minimum of cross-talk. The condition shown in the above photographs resulted when C56 was changed to .001 mfd. These photographs represent an extreme variation which would seldom be seen. Light vertical lines can frequently be eliminated by varying this capacitance. Another possible source is a defective yoke which can only be checked by substitution.



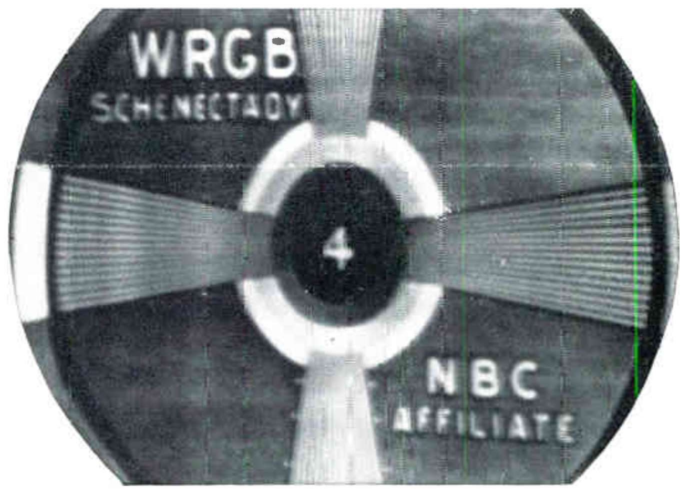
Tele-Clue No. 45. The above photograph resulted from leakage across C56 in Fig. 1. A 2000-ohm resistor was connected across this capacitor resulting in the compression on the left and reduction of the width due to the reduced efficiency of the horizontal coils. Due to the constants in the circuit also being affected, the high voltage was reduced as indicated by the increase in height and loss of focus. The amount of distortion will of course vary with the amount of leakage. If this capacitor is shorted the result will be a keystone effect similar to Tele-Clue No. 1. It is necessary to disconnect one end of the capacitor in order to make a resistance check due to the low resistance of the deflection coil.



Tele-Clue No. 46. The above photographs are quite similar to those shown in Tele-Clue No. 43. This condition was caused by changing R55 from one megohm to 100,000 ohms which of course, changed the characteristics of V13 the sweep output tube. If we compare this waveform with Tele-Clue No. 43 we find that the principal difference is in the beginning and end of the trace portion of the sawtooth wave. This resulted in the foldover and compression at each edge of the pattern. The same bowed condition, found in the waveform of Tele-Clue No. 43, caused a similar non-linearity of the test pattern.



Tele-Clue No. 47. A short across capacitor C94 in Fig. 1 changed the bias and therefore the characteristics of V13, the sweep output tube. This resulted in the slightly non-linear waveform which caused the test pattern to be compressed at the center and stretched at the right side. It is interesting to note the effect on the test pattern of a distortion in the waveform which is barely perceptible.



Tele-Clue No. 48. The "blooming" effect shown in the above photograph is the result of R63 in Fig. 1 being increased in value to 10 megohms. This resistor frequently increases in value as a result of the anode voltage being temporarily shorted or arcing to ground. This causes an overheating which usually results in a considerable increase in resistance value. As the brightness control is advanced, more current is drawn through the resistor and consequently the voltage drop across it increases. The result is a lower anode voltage on the picture tube which causes the picture to expand both horizontally and vertically with loss of focus.

TELE-TIPS

16. If you are puzzled by the apparent absence of the HV rectifier tube in some new TV receivers, it can be located by removing the chassis from the cabinet and looking underneath. It will be necessary of course to remove the chassis whenever this tube is either tested or replaced.

17. An open filament in a 6AB4 RF amplifier tube used in series-filament type G-E receivers will not result in the whole string of tubes going out as would be suspected. This is due to a 43 ohm resistor connected in series with this filament. An open filament will therefore result in a snowy picture due to the reduction in signal strength.

18. Don't forget to inform your customers regarding the directional characteristics of "built-in" aerials. This may save you a service call whenever the furniture is rearranged.

19. In case HV insulated wire is needed the inside portion of a piece of coaxial cable works very nicely.

20. A faint white line appearing either at the center or somewhat to the left of center may in some receivers be due to an incorrect setting of the horizontal linearity control.

HOW TO GET THE MOST OUT OF YOUR TEST EQUIPMENT

THE CATHODE-RAY OSCILLOGRAPH

Part Two

In the previous issue we discussed some general operating hints and suggestions for using a cathode-ray oscillograph for hum checking in receivers. The power supply shown for illustration was a conventional full-wave transformer type. In even more common use today is the half-wave transformerless or a-c/d-c type of power supply.

Fig. 1 illustrates such a supply as used in the General Electric Model 123 receiver. The wave shapes and peak voltages as shown in the illustration were obtained by connecting a calibrated scope across the input filter condenser for curve (A), across the output filter condenser for curve (B) and across the 22 ohm peak current limiting resistor for curve (C). These three curves are for the normal operating condition of the receiver with an a-c line voltage of approximately 119 volts.

Now let's see what happens when the input condenser is open. The peak voltage in curve (A) increases to 45 volts, in curve (B) it increases to 4 volts and in curve (C) it decreases to 1 volt. If the output condenser is open, curves (A) and (C) will remain at the same values as in normal operation but curve (B) will increase to about 8 volts peak. The d-c voltages measured with the input condenser open were 65 volts across the input capacitor and 43 volts across the output of the filter. With the output capacitor open, these voltages measured 120 volts and 100 volts respectively. From this data it is readily seen that the condition of the power supply components can be determined visually by connecting the oscilloscope across the output of the filter circuit.

One other bit of information we can obtain by our analysis of curve (C) is the peak current that is being handled by the rectifier tube and the input condenser. You have probably noticed when looking at tube data sheets that rectifier tubes are always given a peak current rating in addition to the normal d-c operating current rating. This peak current rating is often overlooked because it is difficult to measure by means other than with a scope, but it is fully as important as the d-c current rating and will account for short tube life if exceeded.

The reason for this is evident from curve (C), as it can be seen that the plate current through the rectifier tube flows for only a part of a cycle and during this time it must supply enough energy to replace that lost in the filter due to the d-c load current drawn by the set. If a milliammeter is inserted in series with the rectifier plate it will read the d-c load current instead of the peak plate current because it is an averaging device and does not follow the instantaneous variations as explained in the preceding installment.

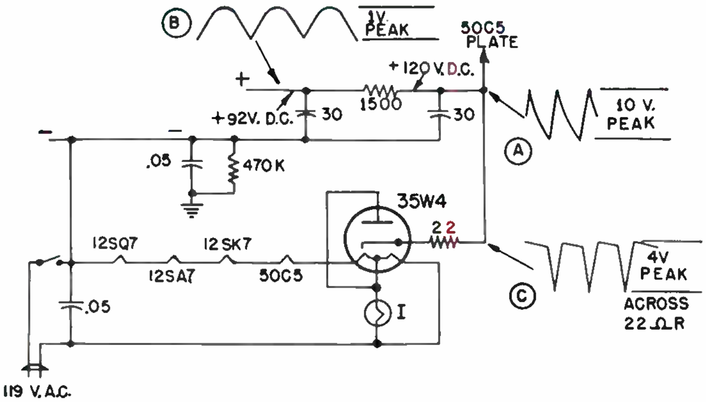


Fig. 1. Typical half-wave transformerless power supply used in a-c d-c radio receivers.

By placing the scope across the peak current limiting resistor in the power supply circuit, in this case the 22 ohm resistor in the cathode of the 35W4 tube, and determining the peak voltage drop across the resistor, the peak current through the tube can be formed by dividing this voltage by the value of the resistor. In the illustration the peak current figures slightly less than 200 ma. which is well below the 600 ma. peak rating of the 35W4 tube. Many older a-c/d-c receivers did not have this limiting resistor in the circuit, and if the input condenser was of a high enough value short rectifier tube life resulted. When you get one of these in for service it is a good idea to install a 20 to 50 ohm, 1 watt resistor between the tube and the input condenser. This may cut your replacement tube sales somewhat but will also result in another satisfied customer which is more important in the long run. This resistor will also help to keep the input filter condenser in service longer by reducing the heating effect caused by high peak charging currents. Don't worry about loss of plate voltage across this resistor as it will amount to only a couple of volts and will cause no difference in the receiver's operation.

SERVICING CAR RADIO VIBRATORS

Another very useful function of the scope is in checking car radio power supplies for correct functioning of the vibrator and buffer condenser. Figs. 2 and 3 show a typical non-synchronous vibrator power supply with the voltage waveforms in Fig. 2 and current waveforms in Fig. 3. In connecting the scope as shown in Fig. 3, the hot lead should be connected to the battery lead at the set end as we are measuring the peak voltage drop in the connecting lead caused when the vibrator draws a pulsating current from the battery.

An inspection of the waveforms shown in Figs. 4 through 9 will tell us all we need to know about the condition of the vibrator, buffer capacitor and transformer. No voltage measurements are shown on these diagrams as the important information is shown by the shapes. Fig. 4 is the voltage wave from a normally operating supply of the type shown in Fig. 2. Fig. 5 was obtained by substituting a buffer condenser, CB in the diagrams, of too low a value. A vibrator with worn or bouncing contacts will also cause a waveform similar to Fig. 5 and often can be identified by the fact that the positive and negative shapes will be different due to the difference in vibrator action on one side and the other.

Fig. 6 shows a normal current wave as obtained from the circuit shown in Fig. 3. Fig. 7 indicates either that one side of the vibrator is not making contact or that one side of the transformer primary is open. This wave differs from a normal wave in that there is a distance between successive peaks somewhat in excess of the length of one of the peaks. Fig. 8 illustrates, by virtue of the unequal height of the peaks, the effect of unequal emission to the plates of the rectifier tube or of unequal contact resistance in the vibrator.

Fig. 9 was obtained by substituting a buffer condenser of a larger value than normal, and shows quite clearly the high peak currents at the start of the wave which will soon burn the vibrator contacts.

The value of using an oscillograph is plainly seen in the above illustrations as it enables one to check the entire operation of a circuit and the conditions of the components by making only a few connections to the set while it is operating, and so eliminates a lot of extra work involved in checking and substituting each individual component. Get to know your scope better, it will be one of your most valuable time savers and money makers. In the next issue additional uses for your oscillograph will be discussed.

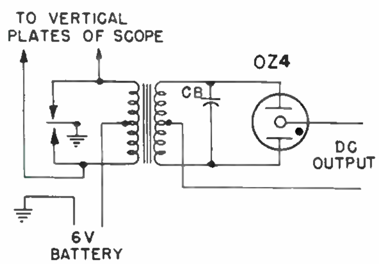


Fig. 2. Non-synchronous vibrator power supply illustrating the oscillograph connections necessary to obtain voltage waveforms.

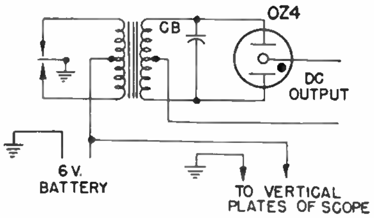
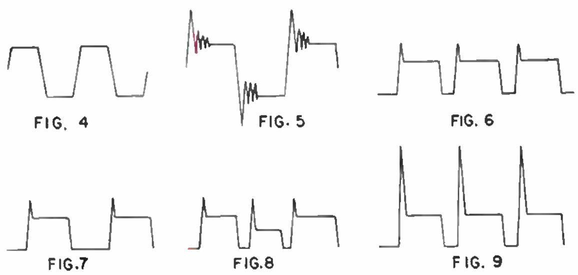


Fig. 3. Non-synchronous vibrator power supply illustrating the oscillograph connections necessary to obtain current waveforms.



Figs. 4 through 9. Voltage and current waveforms illustrating defects in vibrator type power supplies.

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 Editior, Techni-Talk, Tube Division, General Electric Company, Schenectady 5, New York.

SOLDERING AID

The pipe cleaner has been used a lot in radio work but I find it unbeatable when used to clean solder from holes on tie terminals, socket terminals and on battery plugs. It does an excellent job in cleaning out the prongs. Just apply the soldering iron and run pipe cleaner through the hole and all solder is cleaned out. But the best of all is the fact that you can remove the pipe cleaner as it won't get stuck by the solder.

Meile Nelson
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TAPE RECORDER HEAD ALIGNMENT

A serviceman may spend hours to correctly align the record head of a tape recorder: especially if a single head is used to record both edges of the tape. Of course the record head must be properly aligned to give maximum performance on either "track." Manufacturers' aligning procedure should of course be used, using an aligning tape. Often however, it is rather difficult to determine whether or not the record head is positioned right. The tracks on the tape must not overlap, neither should they be allowed to run off the tape. To determine the right positioning of the record head on the tape, simply record a piece of tape, either on one track or both, whichever is desired. The tape is then drawn through a solution of powdered iron and a cigarette lighter fluid mixture. When the tape is removed it will dry in seconds. The powdered iron will cling to the recorded portions of the tape and reveal the exact placement of the recording on the tape. The head can then be moved for correction.

Rolland Pearce
517 Pleasant Avenue
Michigan City, Indiana

QUICK TEST FOR LEAKAGE

Here is a quick method for testing coupling condensers in the audio circuit of most receivers for leakage. This can be done without unsoldering any wires. Connect a milliammeter across the primary of the output transformer and short the plate of the driver tube to ground or B minus. If the plate current of the output tube decreases when the plate of the driver is shorted, the coupling condenser should be replaced. No damage will occur to the rectifier tube of a-c/d-c sets due to this procedure, since the load resistor of the driver tube is very large.

William L. Alford
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TUBE CHANGER OR TECHNICIAN

If a tube in the i-f strip is changed, the alignment may be affected. The alignment of these circuits depends to some extent upon the interelectrode capacity plus the gm of each tube. In an i-f strip that is capacitively tuned a new tube may not make a noticeable difference, but in an i-f strip inductively tuned, another tube may make a very noticeable difference in over-all performance.

Therefore, each time a tube is changed in the i-f strip the transformers should be re-aligned. This *must* be done for slug tuned transformers and it should be done for capacitively tuned transformers. We have made it a practice to do this and we don't think any of our customers are saying, "I don't understand it. The serviceman put in a new tube and the set is worse than it was before." We know it can be worse if the transformers or coils are not properly aligned for the new tube. We do what we can to make the new tube perform as well or better than the old.

Moreover, when the customer knows you have to make some adjustments in addition to replacing a tube he has a little more respect for you and is a little more tolerant about the charge. You're doing something he can't do.

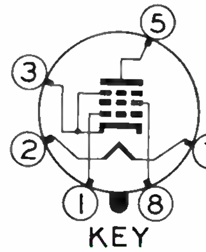
David T. Armstrong
221 Angelique St.
Weehawken, New Jersey

What's new!

6AV5-GT

The 6AV5-GT is a beam-power amplifier designed for use as a horizontal-deflection amplifier in television receivers. It is capable of withstanding the high pulse voltages normally encountered in this application. Features include high perveance, high plate current at low plate and screen voltages, and high ratio of plate to screen current. When used with suitable high-efficiency components one 6AV5-GT is capable of deflecting fully any picture tube having a deflection angle up to 70° and operating with an anode voltage up to 13 kilovolts.

Heater Voltage	6.3 Volts
Heater Current	1.2 Amperes

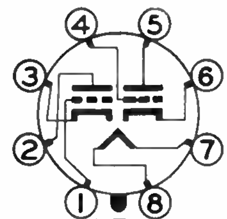


KEY

6SN7-GTA

The 6SN7-GTA is a medium-mu twin triode intended for use as a combined vertical oscillator and vertical-deflection amplifier in television receivers. The 6SN7-GTA is electrically and physically a replacement for the 6SN7-GT. The plate dissipation and operating voltages are in accordance with the requirements of vertical sweep applications. Like the 6SN7-GT, it is also suitable for use in general-purpose applications such as resistance-coupled amplifiers, phase inverters, and multivibrators.

Heater Voltage	6.3 Volts
Heater Current	0.6 Ampere



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