# MODERNISING EARLIER TELEVISION RECEIVERS

**Since the description of our 1964 TV Receiver in December last a number of readers have contacted us concerning the possibility of incorporating recent circuit innovations in our earlier receivers. This article tells how to add horizontal sweep and EHT stabilisation, a picture "sharpness" control, an additional video IF trap to improve definition and a noise-gated synch separator and keyed AGC system.**

**by Jamieson Rowe**

Of the recent improvements to television receiver design probably the most noticeably worthwhile is the incorporation of horizontal-EHT stabilisation into 110-degree receivers. Receivers such as our own 1964 design which feature this development display a picture whose size is notably more stable than that of earlier 110-degree receivers, whether home-constructed or otherwise. The picture is considerably less influenced by scene brightness changes, mains voltage variations and valve emission drop.

The improvement offered by stabilisation involves little if any additional circuit complexity or cost where construction of a new receiver is concerned. In fact, it may well prove less costly, as some of the components formerly used are no longer required.

Adding stabilisation to existing receivers will involve a small amount of labour and some half-dozen components, but is nevertheless a fairly simple and straightforward job. The receivers in which the change will prove to be very worthwhile are those constructed to our 1959 and 1961 designs, and it is in connection with these that we will give modification data. The earlier 70- and 90-degree designs had inherently good picture regulation, and would thus show very little improvement with the addition of stabilisation.

Figure 1 shows the extent of the modifications, which are to the horizontal output circuitry. In (a) is shown the original 1961 output section (including modifications as published), which is very similar to that of the 1959 design, while (b) shows the circuit fitted with stabilisation.

In the space available here it will not be possible to give more than a brief explanation of the principle of stabilisation. Readers requiring a more detailed discussion are referred to the November, 1964, article.

As may be seen from figure 1, stabilisation involves a feedback connection. A 100pF capacitor connected to tap 8 of the horizontal output transformer feeds flyback pulse voltage to a voltage-dependent resistor (VDR), and because of the assymetrical nature of the pulses the VDR conducts substantially in only one direction; as a result the capacitor becomes highly charged with the polarity shown and the VDR develops an average negative voltage with respect to earth. The 30pF capacitor is used simply to limit the pulse voltage across the VDR.

The magnitude of the negative voltage is adjustable by means of the potentiometer marked "width," as this supplies a voltage which opposes the pulse-derived voltage. The resultant VDR voltage is used to bias the horizontal output valve grid.

The bias acts in a fashion similar to the AGC bias applied to an IF or RF stage. Thus if mains voltage increases or picture-tube current falls and the flyback pulse and EHT rise as a result, the bias will increase also and tend to reduce the output valve conduction. If on the other hand mains voltage falls or picture-tube current rises, the bias on the output valve is reduced and its conduction increases.

The sweep output and EHT thus tend to remain constant for variations in mains voltage, picture-tube load changes and drive variations, and the picture size and width are much more stable than otherwise.

The two 47OK resistors and 0.047uF capacitor between the VDR and the 1M output valve grid resistor constitute a filter which smoothes the bias of pulse components. It should be noted that the capacitor value of .047uF is larger than that shown in the 1964 receiver; we have found that the larger value is necessary to prevent oscillation at low settings of the width control. Those who have constructed the 1964 design are advised to replace the original filter capacitor with a .047uF unit.

The addition of the stabilising circuitry involves a few small circuit changes, as may be seen. The cathode of the horizontal output valve is now earthed, and the screen heavily bypassed to chassis via an electrolytic of 2-5uF. The value of the screen supply resistor has been changed; two resistors are now used, connected in parallel.

The drive trimmer is no longer used, as the circuit requires as much drive as possible to provide maximum stabilisation. The AGC action of the stabilisation prevents the output valve from being overdriven.

Note that, as the cathode of the output valve is now earthed, the oscillator discharge capacitor (.0012uF) is taken to earth also.

The width coil is omitted. This is an important point to note because it was

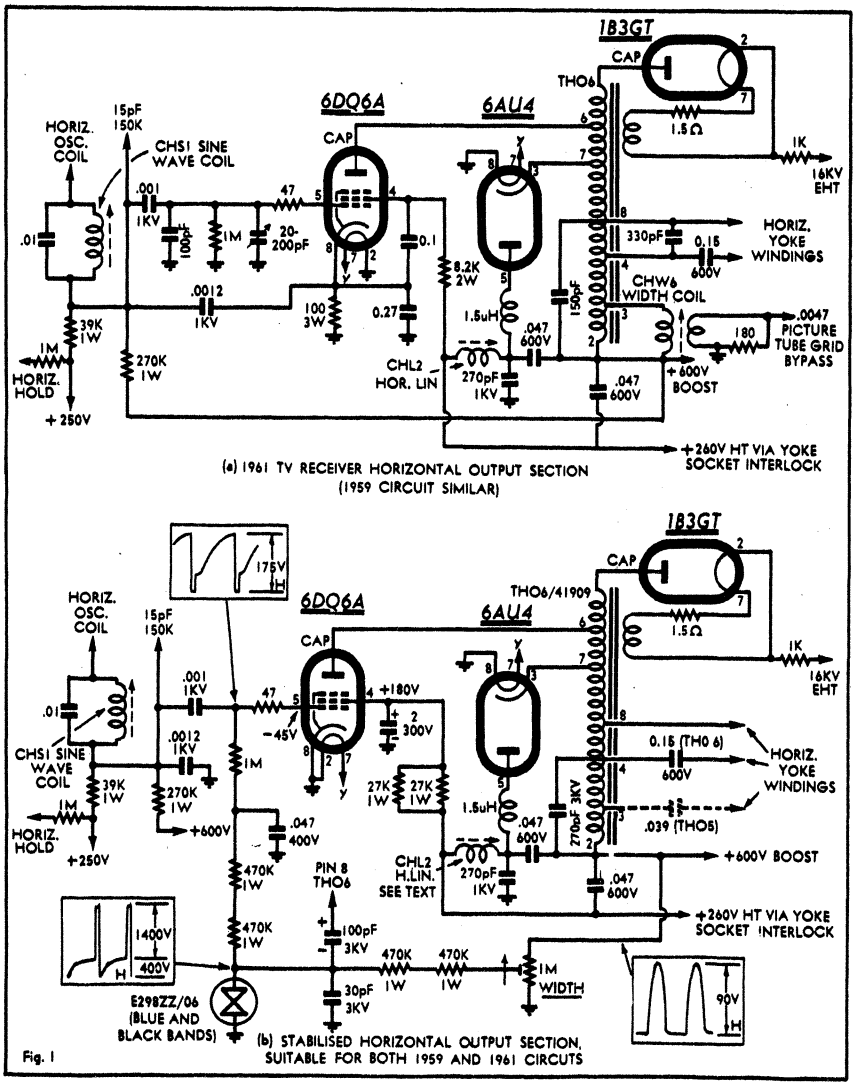



Fig. 1

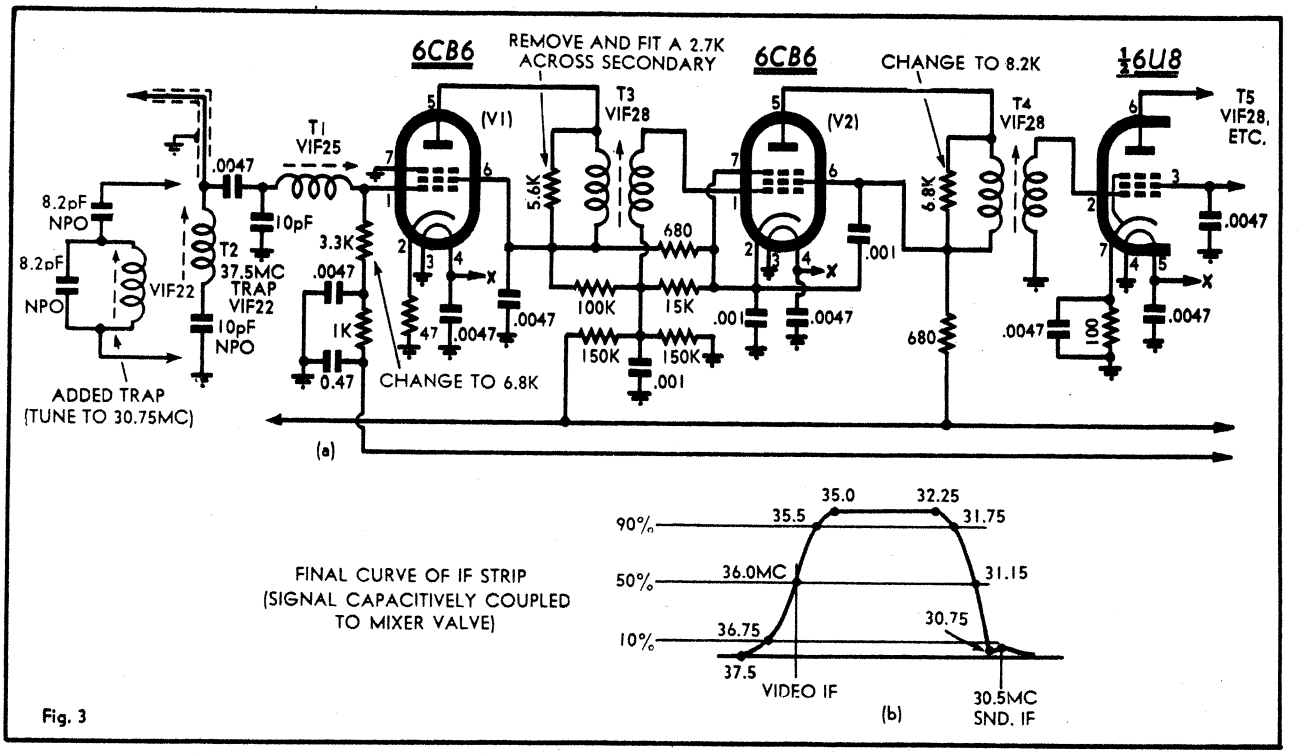



Fig. 3

retained in the 1964 design simply as a transformer for the horizontal flyback blanking pulses. We have verified by observation that the signals currently radiated by the television stations have sufficient correction to make receiver blanking pulses unnecessary, making the width coil redundant. Width is adjusted by the potentiometer, as mentioned above.

Whether or not the linearity coil is necessary in the stabilised circuit is largely a matter of the particu ar set of deflection components involved and the preferences of the builder. In the sets which we have modified, it transpired that the linearity was in fact better with the coil shorted out; we imagine that this will prove to be the case in many instances.

In other words, the linearity coil can probably be omitted also. Simply connect the 1.5 uH parasitic suppressor choke directly to the HT supply line, omit the 270pF capacitor, and use a single O.1uF in place of the two O.047 boost storage capacitors.

The VDR used may be either the E298ZZ/06 shown or the uninsulated type E298ZZ/01. The former is identified by blue and black coding bands.

As there are only a few components involved the physical side of the modification will be relatively simple. The horizontal output valve socket will have to be partially rewired and the drive trimmer removed, along with the width coil and probably the linearity coil.

With rearrangement of the components inside the cage the 100pf capacitor can be accommodated therein; the 30pF capacitor, VDR, 470K resistors and width pot are all easily fitted in the area formerly occupied by the width and linearity coils.

Figure 1 (b) shows the voltages and waveforms of importance concerning the correct operation of the stabilised circuit. The VDR waveform should only be measured with a 100:1 divider probe which gives little circuit loading, otherwise the operation of the circuit may be upset.

One of the less dramatic but nevertheless worthwhile features offered by modern receivers is a video "sharpness" control, which improves definition by providing a small amount of HF boosting to the video signals to compensate for inadequate HF content. Signals which can often be improved by a judicious amount of HF boosting are those originating from poor transmitted program materials such as colour film or telerecordings, those which have suffered due to variations in aerial bandwidth or tuner alignment, and so on.

## ADJUSTABLE BOOST

An adjustable control over such boosting is preferable to a fixed amount of boost because permanent boosting can produce visible ringing and outline accentuation on signals which have adequate HF content, such as "live" studio programs or video tape recordings. A variable control allows the viewer to set the compensation for optimum observed clarity and definition.

In the 1964 receiver the sharpness control took the form of a potentiometer controlling HF bypassing of a cathode resistor. This type of control was possible because of the use of a screen-voltage contrast control.

Earlier receivers did not have this tvpe of contrast control, but had a cathode-degeneration contrast control. It is thus not possible to fit a cathode-circuit sharpness control to those receivers, unless the video output stage is rewired to give screen contrast control. This is not recommended, however. Screen contrast control is less linear in its action than cathode control, and can upset picture stability in designs similar to our receivers prior to the 1964 unit, which use the video output valve as a sync. amplifier.

As it happens there is a simple way in which the earlier designs may be fitted with a sharpness control. The circuit of the modification is shown in figure 2.

A small amount of screen degeneration is produced by fitting a 22K resistor in series with the 8uF screen bypass electrolytic. A potentiometer and 220pF capacitor are then used to produce a variable amount of HF bypassing, to restore the gain at the upper end of the spectrum. With the pot turned fully clockwise (minimum resistance) full HF bypassing is produced and HF video components are effectively boosted by some 5-6dB.

The inevitable low and mid-frequency loss in video gain introduced by a sharpness control of this type (and also by the cathode type) will typically cause no embarrassment due to lack of available contrast, as sufficient gain reserve is normally present. In the 1959 and 1961 designs the use of a 6EB8 video valve instead of the 6AW8 originally specified can increase this gain reserve slightly. The 6EB8 is a plug-in replacement having higher gain.

The mechanical aspect of this modification is again simple and relatively straightforward. The main task will be to fit in an additional front-panel minor control, and this may mean drilling four new holes in the centre of the chassis front. The three original minor controls and the new sharpness control can then be arranged in a symmetrical fashion.

Alternatively you may consider it reasonable to shift the horizontal hold control to the rear of the chassis.

The two additional components involved may be fitted to the original video output resistor panel, or mounted on an additional tagstrip mounted nearby. The lead to the sharpness pot should be run in shielded cable to prevent pick-up of sweep information.

## IF CHANGES, ALIGNMENT

To obtain optimum picture definition, the tuner and IF sections of a receiver must have adequate bandwidth and phase characteristics. The question therefore arises as to whether earlier receivers can be improved in regard to these sections.

In general the tuner as a commercially made unit is not suitable for home modification; in any case, with the exception of very early types, the performance is usually quite adequate. Those which prove unsatisfactory are best sent

back to the manufacturer for either service or replacement—possibly replacement with a more modern type. This applies equally to those which perform well but do not have provision for the reception of the newer channels.

The IF strips used in the 1957 and 1958 "R, TV and H" receivers were multi-trap types which, even today, are regarded as excellent performers. No modification is required to such strips, although realignment may be worthwhile as coil slugs may have drifted in position over the years. When properly aligned the bandwidth and phase response of these early strips is virtually beyond reproach.

However experience has shown that the performance of the IF strip used in the 1959 and 1961 receivers can often be improved by adding a second trap coil and altering the damping resistor values slightly. These changes make the strip easier to align and also make it possible to achieve an improved bandwidth characteristic.

The additional trap and altered damping resistor values were used in 1964 design. However, it should be noted that the 1964 IF strip alignment curve SHOULD NOT BE USED to align modified earlier IF strips unless it is desired to use them with the latest tuner types. The reason for this is that the 1964 strip is aligned 0.75MC higher in frequency than previous strips, to make it compatible with tuners manufactured to recently revised standards.

Figure 3 (a) shows the circuit of the 1959-1961 strip, and indicates the changes to be made. The additional trap is a series-parallel type, used to give a sharp fall adjacent to the sound IF. This allows the sound IF to be kept suitably low in amplitude without the necessity of attenuating the upper video components.

As with the 1964 receiver the additional VIF22 coil used in the trap can be fitted to the main receiver chassis adjacent to the original T1 and T2 coils of the strip. Note that all capacitors used to resonate traps should be NPO ceramic types. Other types will cause trap drift.

The damping resistor changes are marked on the circuit. The first resistor is changed from 3.3K to 6.8K, while the second is changed to 2.7K and fitted to the secondary of T3 rather than to the primary. The damping resistor for T4 is changed from 6.8K to 8.2K. No change is made to T5.

After modifications the strip will have to be realigned to compensate for changes in wiring capacitance and ensure that the additional trap is correctly adjusted. If this is not done results may well be poorer than before.

Figure 3 (b) shows the final curve of the modified strip, as it will be aligned to suit earlier tuners. For the curve required for the latest type tuners readers can either add 0.75MC to all frequencies shown, or refer to the December, 1964, article.

The latter article should also be used as a reference if the reader requires a more detailed description of re-alignment than can be given here.

Very briefly, alignment should be carried out as follows:

Connect the sweep and marker generator to the grid of the 6U8 and adjust the slug of T5 for a peak at 32.25MC. Then reduce generator output, connect via a blocking capacitor to the grid of V2, and adjust the slug of T4 for a peak at 35.25. Again reduce the output of the generator, and connect to the grid of V1. The slug of T3 should then be adjusted for a peak at 33.25MC.

Finally capacitively couple the generator to the mixer valve in the tuner (use a wire loop around the envelope, or a split-shield can matching device) and adjust the slugs of the two traps for dips at the appropriate frequencies. Produce the final response curve shown by adjusting the slugs of T1 and the tuner output coil, possibly with slight additional touching-up of T3, T4 and T5.

The modification and re-alignment of the IF strip should result in a noticeable improvement in picture quality, and usually proves well worthwhile.

## CORRECTIONS TO 1961, 1964 TELEVISION RECEIVERS

*Developmental work carried out since we described the 1964 television receiver has shown that the signals currently radiated by the television stations are such that horizontal flyback blanking is no longer necessary. This means that the width coil of the 1964 receiver can be omitted, as with its original function negated by the stabilisation it was retained solely as a blanking pulse transformer. Simply disconnect it from the circuit and discard it.*

*The linearity coil may also be omitted or removed, as discussed in this article; linearity is usually better without it.*

*Tests have also shown that for output stage stability when the width pot is turned down the bias smoothing capacitor bypassing the lower end of the 1M grid resistor should be increased to .047uF. Those who constructed the 1964 receiver are advised to make this change.*

*Readers who constructed the 1961 receiver are advised to make the following circuit change to improve vertical sync. The final integration capacitor which was shown as 0.1uF should be reduced to .0047uF, while its shunt resistor (originally 2.7K) should be increased to 27K. This will make a considerable improvement.*

## KEYED AGC, NOISE GATING

The final modication to be described, while of a more drastic nature than those already discussed, will have a somewhat more subtle effect upon receiver performance. It involves the fitting of a noise-gated sync. separator and keyed AGC system, which makes the receiver better equipped to cope with large variations in signal strength and heavy noise.

Space unfortunately prevents us from discussing the detailed operation of this circuitry in the present article. For a fairly comprehensive discussion of this readers should refer to the relevant section of the November, 1964, article. Here we will restrict ourselves to a brief description of the way in which such circuitry is added to earlier receivers.

Specific details regarding the modification will only be given for the 1961 receiver. The 1959 receiver may be modified according to the circuitry given in December, 1964, with the exception that the OA91 tuner AGC delaying diode and its 3.3M resistor to HT should both be omitted. Note that the lead from C1 and C3 to the AGC valve plate should be in shielded cable.

No specific details are available for modifying the 1957 or 1958 designs, nor is it likely that we shall be able to supply this information. However, in general these designs should be treated in a similar fashion to the 1959 design, with changes dictated by valve types, etc. It should be possible for experienced constructors to modify such earlier sets using the information given in this article and the 1964 articles as a guide; constructors with insufficient experience to do this would be well advised to leave this section of their set as originally described.

Figure 4 shows the section of the 1961 circuit concerned in this modification. Briefly the modification involves removing the original simple AGC, rewiring the detector load circuit, rewiring the triode section of the 6EB8 (or 6AW8) video valve as a sync./AGC preamp instead of a sync. clipper, and the addition of a noise-gated combination AGC amplifier/sync. clipper valve.

Removing the simple AGC circuitry is straightforward, as is rewiring the video detector to the circuit shown in figure 4. The rewiring does not involve new tagstrips or realignment of the IF strip, apart from a possible touch-up to T5.

The triode section of the video 6EB8 or 6AW8 is rewired as shown, so that it acts as a simple triode preamp for the signals used to drive the sync. clipper and AGC amplifier sections. The double divider load network is simply used to provide a low output impedance for the AGC valve drive signal.

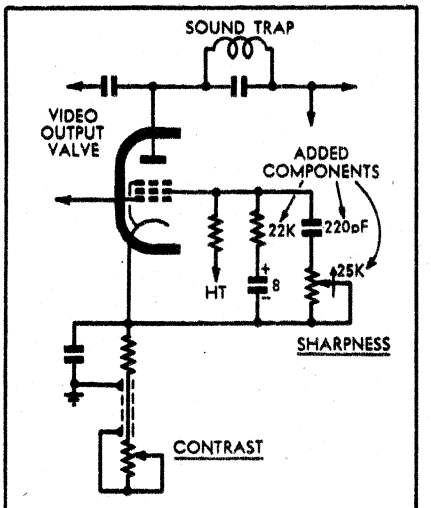
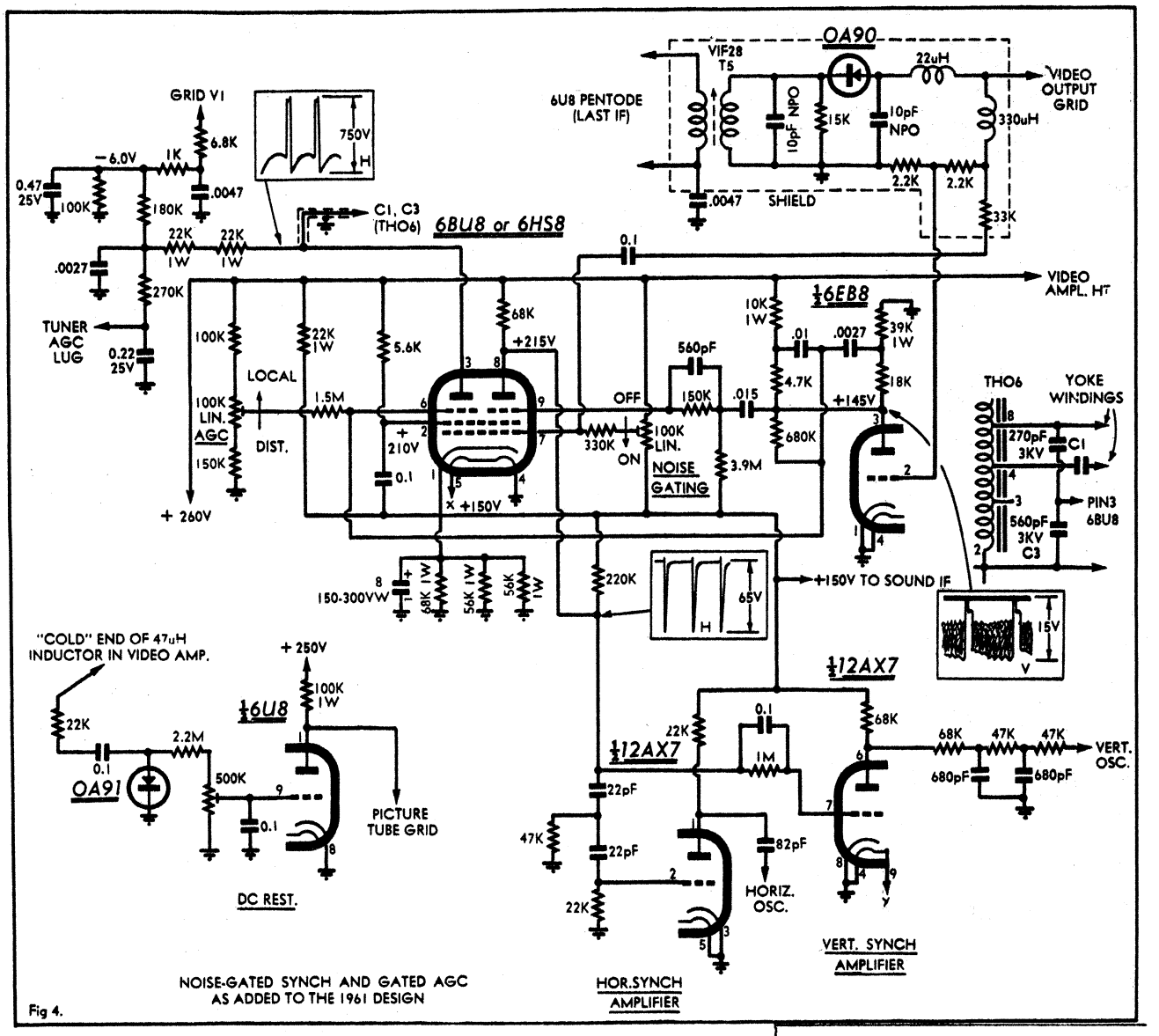


Fig. 2 VIDEO SCREEN SHARPNESS CONTROL

One section of the 6BU8 (or 6HS8) becomes the sync. clipper, and feeds clipped sync. pulses to the two halves of the 12AX7 sync. amplifier valve as before. The only changes here are changes in the loads of the 12AX7 sections to allow operation from the 150V available from the 6BU8 cathode, and reduction of the horizontal section grid resistor (from 2.2M to 22K) to improve horizontal sync. waveform.

An associated change is the provision of an additional OA91 as a peak detector for the DC restorer valve, as the latter previously made use of the voltage developed at the grid of the sync. clipper. Due to the elevated DC poten-




NOISE-GATED SYNCH AND GATED AGC AS ADDED TO THE 1961 DESIGN

Fig 4.

tial of the grid of the noise-grated clipper this is no longer possible, and the separate detector is required.

The AGC amplifier is quite conventional, being keyed by pulses obtained by a capacitive divider across a section of the horizontal output transformer TH06. The developed AGC voltage is filtered by two 22K resistors and the .0027uF capacitor and fed to the tuner and IF strip in the usual manner.

Note that in contrast with the 1964 circuit there is no tuner delaying diode. We have found that the GW4500 tuner used in the 1961 receiver gives best performance without such delay, and thus delay has not been shown. Readers using other tuners may care to experiment with delay, using the 1964 circuit as a guide.

The waveforms and voltages relevant to circuit operation are shown in figure 4. As usual with these voltage figures, the values shown should be regarded as typical only. Component variations may cause voltage variations of up to about 10 per cent.

The mechanical aspects of this modification will vary according to the receiver concerned. The 1959 and 1961 receivers may be rewired in a fashion similar to the 1964 design, with the new valve fitted between the 6EB8 (6AW8) and the 12AX7 (6CG7). The original resistor panel mounted in that position may be replaced with two smaller resistor panels (miniature type) to fit the additional minor components, while the AGC and noise gating pots are mounted on the rear of the chassis.

For more detail regarding this readers are referred to the underchassis photograph of the 1964 receiver, given in November 1964.

The mechanical aspect of the modification as adapted to the 1957 and 1958 receivers is left to the individual constructor. The circuitry is not particularly critical and; providing reasonable care is taken to ensure that induction of line pulses is kept to a minimum, considerable latitude is permissible.

Adjustment of the two additional controls is a relatively simple matter. With the noise gating control fully anticlockwise (off) set the AGC control for no overload on the strongest local channel. Then advance the noise gating control until sync. on the weakest channel is lost, and retard it from this point sufficient to restore reliable sync. Check on all channels, and touch up the noise gating control if necessary.

The main point to bear in mind is that if the AGC control is adjusted the noise gating control will always have to be reset. With both correctly set the receiver should give very stable reception.