ALIGNMENT AND PRODUCTION TESTING OF TELEVISION RECEIVERS

1. AUDIO CIRCUITS

Operation of the audio frequency amplifier may be checked by touching the grid of the 6N7 and noting humming pickup in the speaker. The first video I.F. transformer should be adjusted to give the same characteristics as it affects the sound I.F. characteristic. Next, the I.F. amplifier should be aligned, using an oscillograph connected to the screen of the 2nd I.F. tube (screen by-pass removed) and a wobbulator connected to the proper points to indicate the desired characteristics. The 2nd I.F. transformer should be adjusted first with the wobbulator connected to the grid of the first I.F. tube (1951), and then the first I.F. transformer adjusted with the wobbulator connected to the converter grid. Next the I.R.T. screen by-pass should be put back, the oscillograph shifted to the diode output at the first audio coupling condenser, the 0.001-ohm A.C. condenser opened, and the discriminator transformer adjusted.

The output of the wobbulator should be of the order of 5000 microvolts which may be obtained from the RCA wobbulator using the low tap with a 10-ohm resistor shunting it to ground. A Ferris signal generator may be used as a marker connecting it to the wobbulator output (low tap) through a 5-ohm resistor.

The appearance of the characteristics are indicated by the sketches below. The exact shape of these curves will vary somewhat with individual receivers.

A check on alignment should be made using a Ferris signal generator with about 5000 microvolts output. Tuning the signal generator through the bands to equal peaks (x 10K) and a null point should be observed. The null point should be at 8.25 mc (x 15 K)

Sensitivity should then be checked using the Ferris signal generator connected to the converter grid, and the oscillograph connected to the plate of the 6V6A audio output tube. The input level for an average output for the two peaks of 20 volts p-p (12.5 db on 1200) should be from 30 to 100 microvolts. (At this input the two peaks may not be exactly equal due to the fact that signal level affects the I.P. tuning to some extent.)

2. VIDEO I.F. CIRCUITS

An oscillograph is attached to the deflection plates of the I.F. video detector tube. An I.F. wobbulator is connected successively to the last I.F. stage, next to the last, and so on, back to the mixer grid with adjustment of the corresponding I.F. transformer at each step. In this alignment the overall curve is approximately that shown below. The vertical axis of the oscilloscope is set at 0, the I.F. tuned to the point where the signal is just discernible on the oscilloscope. The time base is set at 50 microseconds per division. The adjustment of the oscillator is made with the front knob trimmer set at 0 capacitance. A final sensitivity measurement is now made using the signal generator on the carrier frequencies for signal and sound for all 4 channels.

is desirable that the video I.F. alignment shall have the 6db attenuation at the carrier frequency successful reception of the single sideband transmission. 4 of the 5 picture I.F. transformers are tuned while the first I.F. transformer is a double tuned unit. Then tuning the video I.F. transformer in the plate of the mixer tube, the R.F. circuits should be disconnected from the grid of the mixer before adjusting the I.F. signal wobbulator to this grid so as to insure last input.

The trap to reject the adjacent channel picture carrier and the traps to reject the associated sound carrier are all pre-tuned and need no further adjustment. These traps are tuned in manufacture using a Q-meter.

3. R.F. CIRCUITS

The R.F. circuits are aligned by using an input wobbulator having relatively high voltage of the order of 1 volt covering the channels as follows:

1 50-55 Mc
2 50-60 Mc
3 70-84 Mc
4 96-108 Mc

To determine the characteristic of those R.F. circuits independent of I.F. response, an oscillograph is connected with the grounded terminal to the B+ power supply (using care not to touch the oscillograph) and with its vertical input amplifier connected to the mixer screen. In this way the mixer screen response represents quite adequately the band pass characteristic of the R.F. circuits. The high level wobbulator is applied to the antenna terminals, following which the R.F. antenna coil and the mixer grid coil are tuned with the corresponding condensers for each band. The response curve for each band is represented by the sketch above, showing the response for all bands which is typical of all of them. The higher channels are somewhat broader than this. During this alignment the oscillator tube has been removed.

Alignment of the oscillator itself is made by using an audio signal generator tuned to the carrier frequency for the sound channel. Then the oscillator trimmers are adjusted for each of the 4 channels mentioned above so that the sound carrier is received as indicated on the loud speaker. To ensure that the oscillator trimmers above the desired carrier the signal generator is then tuned to the picture carrier and a check of received signal is made through the video channel. Another check is to see that the minimum capacity of the oscillator trimmer is used where it is possible to get 2 oscillator frequencies which pass a sound signal. This condition of the oscillator is made with the front knob trimmer set at 0 capacitance.
The picture sensitivity should be approximately 200 micro-
volt levels of noise to yield a sufficient level of signal to peak
at the final video 768 amplifier plate, using an oscillograph for
measurement and using a signal generator with 300kWampere.

**Sweep Rejection**

While an attenuation ratio of 100 at the sound channel
was sufficient, it is not adequate at the high sound.
The signal generator should be tuned through the sound band which is
180 Hz (± 10 kHz) and the attenuation ratio should be at least
100 throughout this band at R.P.S.

**Adjacent Channel Sound Rejection**

Previous rejection ratios of 1000 to 1 at R.P.S. was
attained. Measurements should be made by tuning through the band as
above and the ratio should be at least 100 throughout the band.

The sound sensitivity at R.P.S. should be approximately the
same as at i.f.

4. VIDEO AND SWEEP CIRCUITS

This alignment of the video amplifier and the sweep
 circuits can be made either with an over-the-air test pattern or with a
test pattern from a coaxial line. When an over-the-air trans-
mission is used the signal is applied to the antenna terminals.

However, when a coaxial line signal is used, it is nec-

essary to observe the operation of a suitable input network for
applying the signal to the grid of the 1851 first video amplifier
tube. This tube has a fixed bias within the set to which its grid
bias is returned and its cathode is grounded. It is therefore des-
irable to insert a coupling condenser of at least 0.1 μf from the
coaxial line and supply a grid leak from the 1851 grid lead of
at least 100 μf between the 1851 grid cap and the lead wire from
beneath the chassis which would otherwise normally be connected

The vertical sync impulses should be applied to the tube.

After alignment has been made as outlined above there are
certain tests and precautions that should be followed closely in
order to keep the possibility of shipping either defective
receivers or those that are not up to standard in efficiency and
quality. A coax line carrying a composite video signal to be used
for checking video amplifier and sweep circuits should be monitored
to make sure that the tube voltages are not out of line with the
corrected values.

A vertical blanking should be from 7 to 8μ.

The 1851 tube and 768 tube of the 8 stage video frequency
amplifier have their frequency constants such that the overall re-
sponse to the cathode-ray tube grid is essentially flat from 50
cycles to 30 megacycles with a gradual drop to approximately 44 meg-
cycles at which time the response is down to about 50%. This orig-
inal design was checked with the video frequency oscillator and it has
been found unnecessary to check each receiver individually ex-
cept for general observation of a test pattern which is adequate
to show up any actual mistakes in the circuit wiring of the peak-
ing coils, etc.

The sweep circuits are tuned to determine the adequacy
of amplitude and frequency range. Linearity adjustment is made
with the two linearity controls on the sweep deck. In case these
adjustments do not give a sufficient range small capaci-
tances are placed in parallel with the condenser of the
potential divider which feeds the grid of the sweep amplifier tube.
This added capacitor is actually placed from grid to ground of the
sweep amplifier tube. In this way the ratio of signal from the
oscillator to the grid of the sweep amplifier output which is
exponential and a sweep amplifier output which is not.

Thus correcting the linearity so an overall linear sawtooth
is produced by combination of a sweep oscillator output which is
exponential and a sweep amplifier output which is not.

After linearity has been adjusted the horizontal am-
plitude control should have at least one inch additional amplitude
available. The vertical amplitude control should have several
inches of additional amplitude available.

The black sweep control knobs, which are connected by
turning the sweep selector switch on the front panel counter-
clockwise, should be checked to insure that the
vertical frequency range includes 30 and 60 field per second
with adequate overlap, and that the horizontal frequency range in-
cudes 1800 and 1870 lines per second with adequate overlap.

The blank knobs should be set at the standard 825
lines 30 frames.

The red sweep control knobs, which are connected by
turning the sweep selector switch clockwise (to position 1) should
be capable of being adjusted to the following color combinations:

(a) CBS color pictures use 375 lines per frame at 60 frames
   per second which requires a horizontal scanning rate of 29,500
   lines per second, and a vertical scanning rate of 120 field scans
   per second.

(b) NBC has transmitted color with 441 lines per frame and
   60 frames per second, requiring 24,460 scanning lines per
   second and 160 vertical fields per second.

The Du Mont sync transformer should be adjusted as
follows:

A Du Mont picture signal should be applied to the 1851
first video grid in accordance with the previous instruction,
or received over the air. A diode rectifier with its output con-
ected to an oscillograph should be very loosely coupled to the
grid of the horizontal oscillator (green lead on Du Mont sync trans-
former). This may be done by clipping a battery clip around an
insulated portion of the ground lead. The oscillograph sweep should
be synchronized to the 60 cycle power line, the beam of the
CRT should be off, and the sweep oscillator tubes of the television
receiver removed. The Du Mont sync transformer should then be ad-
justed for maximum amplitude of the envelope of the R.F. out-
put pulse as indicated on the oscillograph.

The test pattern should be clean and crisp with no signs of
any broken vertical lines. Breakdown will cause intermittent hori-
izontal lines which jump back and forth vertically or horizontally tear out
similar to that produced by noise, which is partially noticeable
at the black circle of the test pattern.

Very often faulty coupling condensers in the deflection
circuits will cause this trouble and tapping them with an insulated
red will help locate the faulty part.
7. No control of focus or intensity
   (a) Fibre tongue is usually broken on controls. The fibre tongue
       insulates the intensity and focus control pots from ground as
       they are 4000 volts above ground. If no fibre tongues are
       available, turn controls with an insulated screwdriver to the
       proper intensity and focus.
   (b) The 90V and a meg. bleeder resistors mounted on the front panel
       between the focus and intensity pots may be open.

8. Breakdown in raster or test pattern
   (a) Check for leakage at CRT socket and base.
   (b) If breakdown is due to leakage at CRT socket, you will hear a
       misaligned noise at base of CRT socket. If socket hasn’t arced
       across causing complete breakdown, you can put a 40watt lamp
       in tube socket to dry out moisture. If that doesn’t do it,
       replace CRT socket and if CRT base is badly burned from arcing
       need CRT to be rebased.
   (c) Breakdown is noticed on the raster by the separation of the
       line structure.

9. Microphonic
   (a) Check the 6J5 oscillator, 165a mixer and the 15a1 first audio
       tubes for microphonic conditions.

10. Sound in picture
    (a) Check 1651 first video amplifier tube.
    (b) Check 669C video amplifier tube.
    (c) R.F. and detector circuits being off, frequency due to drift
        or misalignment. Realignment will be necessary.

11. Vertical or horizontal lines on screen
    (a) Caused by no plate voltage on 6AD6 horizontal or vertical sweep
        oscillator, due to open plate supply resistors. On the vertical
        side there are four 100k plate resistors. Always turn down
        the intensity control if there is a bright horizontal or verti-
        cal line on screen or it will become burned.

12. Intermittance sound or picture
    (a) Due to shorted antenna line.

13. Poor linearity
    (a) Due to defective 6BQ6 horizontal or vertical amplifier tube.
    On the right side of the sweep deck, you will find the hori-
    zontal linearity control. On the left side you will find the
    vertical linearity control. By adjusting controls, poor
    linearity can be corrected.

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