HICKOK

OPERATING INSTRUCTION
COLOR BAR GENERATOR
MODEL 660

CHOICE OF THE EXPERTS FOR SPEED, ACCURACY and DEPENDABILITY...

OPERATING INSTRUCTIONS

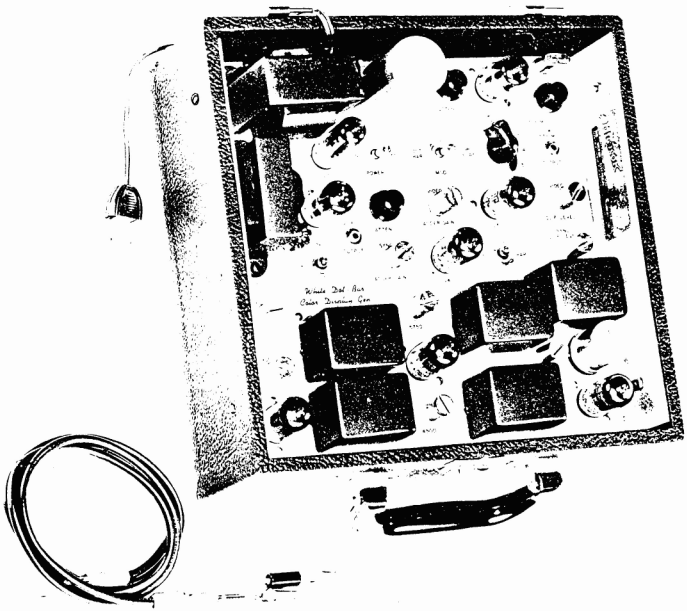
FOR

HICKOK WHITE DOT - BAR, COLOR DISPLAY GENERATOR

MODEL 660

Manufactured by

THE HICKOK ELECTRICAL INSTRUMENT COMPANY
10514 Dupont Avenue
Cleveland 8, Ohio



Model 660

COLOR BAR GENERATOR

MODEL 660

WHITE DOT - BAR, COLOR DISPLAY GENERATOR

TECHNICAL CHARACTERISTICS

Power Supply Required - 105-125V, 50-70 cycles AC.

Power Consumption - 40W.

Video Output - 0-4 Volts p-p.

Output Impedance - 300 ohms
Black Positive or Negative
300 White Dots less those in blanking
Crosshatch, White lines, 20 Vertical and 15 Horizontal, less those in blanking
Sidelock Color Frequency
Xtal 3. 563795 Mc output 1 Volt p-p
Ratio of Sync to Video Variable 10-90%
Dot and Bar size - two lines in both Horizontal and Vertical planes.
All pulses generated are Xtal controlled and locked together.

RF Output Frequency - Channels 2-6, Selected by Selector Switch.

RF Output Voltage - .05 Volts maximum
. 001 Volts minimum

RF Modulated by all Video outputs - 60% Modulation

Housed in Black Leatherette Portable Case - 10-1/2" x 10-1/2" x 5"

Weight - 15 lbs.

Tube Complement:

3 - 5963-	Blocking Oscillator and Xtal Oscillator
1 - 12AV7-	Color Oscillator - RF Oscillator
1 - 6X4 -	Power Rectifier
1 - OA2 -	Voltage Regulator
1 - 12AU7-	Inverter - Cathode Follower
2 - 6U8-	Gates and Adders

STANDARD RETMA GUARANTEE

The Hickok Electrical Instrument Company warrants instruments manufactured by it to be free from defective material or factory workmanship and agrees to repair such instruments which under normal use and service, discloses the defect to be the fault of our manufacturing. Our obligation under this warranty is limited to repairing any instrument or test equipment which proves to be defective, when returned to us, transportation prepaid, within ninety (90) days from the date of original purchase and provided the serial number has been made known to us promptly for our records.

This warranty does not apply to any of our products which have been repaired or altered by unauthorized persons or service stations in any way so as, in our judgement to injure their stability or reliability or which have been subject to misuse, negligence, or accident or which have had the serial number altered, effaced, or removed. Neither does this warranty apply to any of our products which have been connected, installed, or adjusted otherwise than in accordance with the instructions furnished by us. Accessories including all vacuum tubes not of our manufacture used with this product are not covered by this warranty.

This warranty is in lieu of all other warranties expressed or implied and no representatives or person is authorized to assume for us any other liability in connection with the sale of our products.

Parts will be made available for a minimum period of five (5) years after the manufacture of this equipment has been discontinued. Parts include all materials, charts, instructions, diagrams, accessories, etc., which have been furnished in the standard model.

RETURNING EQUIPMENT FOR REPAIR

Before returning any equipment for service, under warranty or otherwise, the factory must first be contacted giving the nature of the trouble. Instructions will then be given for either correcting the trouble or returning the equipment. Upon authorization, this equipment should be forwarded directly to THE HICKOK factory located at 10636 Leuer Avenue, Cleveland 8, Ohio, or to a designated service station in your locality. All correspondence pertaining to repairs should be directed to HICKOK Electrical Instrument Company, 10514 Dupont Avenue, Cleveland 8, Ohio, or to the authorized service station designated.

REGISTRATION CARD

The above guarantee is contingent upon the attached registration card being returned to the factory immediately upon receipt of the equipment.

THEORY OF OPERATION

GENERAL

A thorough understanding of the theory behind the operation of any instrument will enable the user to obtain greater utility and satisfaction from the instrument. For this reason the following explanation of the circuits of the Model 660 Generator is given. As principles of operation rather than a detailed explanation of operation is intended, the block diagram in Figure 1 has been greatly simplified.

POWER SUPPLY

The power supply consists of transformer, 225 volts each side of center tap. and 6X4 rectifier with pi type filter. An OA2 voltage regulator tube supplied B+ to the timer. This assures stable operation of the timer circuits.

TIMER

The timer which is the heart of the instrument, is Xtal controlled. The Xtal frequency is 315 Kc. This frequency is divided down with blocking oscillators to the desired frequencies which are then gated and mixed together to form the composite video output.

GATES

The 315 Kc pulses are gated by the 900 cycle pulses in the video gate tube V4A to produce the dot information.

The 15750 pulses are gated by the 60 cycle pulses in the sync gate tube V5A to produce the sync information.

ADDERS

The sync and dot information is then fed to the adder tubes V4B, V5B, with their plates tied in parallel, to produce the composite video information.

PHASE SPLITTER

The output of the adder stage is then coupled into the phase splitter, V6A. This stage has equal plate load and cathode resistors. Output is then taken from the cathode or plate, thru the polarity switch.

CATHODE FOLLOWER

The Output of the Phase Splitter is fed to the cathode follower V6B. The function of the follower is to convert the high impedance video signal to low impedance 300 ohms.

RF CHANNEL OSCILLATOR

The RF channel oscillator V7A tunes thru the range of channels 2 to 6 by means of a

selector switch. The oscillator is of the Colpitts type and is modulated 60% by either the composite video or the color display signal.

COLOR DISPLAY OSCILLATOR 3.56 Mc CW

The color oscillator is a crystal oscillator--the frequency is 3.563795. The output is taken from the cathode thru an attenuator control.

OPERATION

Connect power cord to AC-60 cycle, 115 volt line. Turn Power switch on and allow 15 minutes warm up time. This will assure stable operation.

For Video Output - Dots or Bars

Set switches as follows:

1. RF ATTEN - Full counterclockwise to OFF position.
2. Video Polarity + or - as desired, usually negative.
3. Bar - Dot SW as desired.
4. 3.56 CW Attenuator - Fully counterclockwise to OFF position.
5. Video Attenuator to desired level - usually maximum clockwise.
6. Connect output cable to Video Output connector.

For Video Output Color Display

Set switches as follows:

1. RF ATTENUATOR - Fully counterclockwise to OFF position.
2. Video Polarity - Not used.
3. Bar-Dot SW - Not used.
4. Video Attenuator - Not used.
5. 3.56 Mc Attenuator to ON and clockwise to desired level.
6. Connect output cable to 3.56 CW output connector.

RF Output

Set up Video output - Bar - Dot or color display, as described in preceeding instructions.

Set controls as follows:

1. "Mod" to desired function, Dot-Bar or Color Display.
2. RF Channel selector to desired channel.
3. Polarity to + Positive.
4. RF Attenuator to ON position, maximum clockwise.
5. Connect output cable to RF output connector - and Antenna of TV receiver.
6. Bar-Dot switch to desired output.
7. 3.56 Mc CW Attenuator, to OFF position counterclockwise, for Bar-Dot output and ON position maximum clockwise for Color Display output.

DEMODULATOR ALIGNMENT WITH THE COLOR DISPLAY SIGNAL

The color display signal is a CW signal generated by a Xtal oscillator. Its frequency is 15750 cycles below color sub-carrier frequency, or 3.563795 Mc.

The fact that the Color display signal frequency is one horizontal line below color sub-carrier, will produce a 360^{o} phase difference in the period of one horizontal scan line, between the reference oscillator in the TV receiver and the color display signal.

This type of signal produces on the face of a color tube in a properly aligned receiver, a color spectrum.

The color sequence is as follows:

> Reddish-Orange at the extreme left side of tube, followed by a gradual transition to red, blue, and green at the right side of tube.

SEE (FIGURE 2)

Figures 3 and 4 illustrate wave forms seen at outputs of demodulators. The vertical input of scope is connected to plate or output of demodulator thru a low capacity probe. Horizontal sweep is set to stop one wave. Ext. horizontal sync is used. This can be had by clipping ext. horizontal sync lead to insulation of horizontal deflection yoke leads. The horizontal sync selector is set to Ext. Sync.

SEE (FIGURE 3) SEE (FIGURE 4)

CIRCLE ALIGNMENT

This type of alignment is simple and quick. The only requirement is that the oscilloscope have equal gain and phase response in the Vertical and Horizontal amplifiers up to 100,000 cycles per second, and a scope polarity such that positive signal will deflect the beam up in the Vertical and to the right on the horizontal. The vertical input of scope is connected to the I or R-Y demodulator and the Horizontal amplifier to the Q or B-Y demodulator. Set Horizontal selector on oscilloscope to Amplifier In. With Generator set up for Color Display signal the following pattern should be seen. (Figure 5). Set Horizontal and Vertical gain controls for circular pattern. If pattern is an ellipse, the quadrature transformer is adjusted along with oscilloscope gain controls for as perfect a circle as possible. This then indicates that the two demodulators are in quadrature. A section of the circle will be cutout. This is due to the flyback gating pulse that is used to gate out horizontal sync and burst. Since there is no color at this time the output of the demodulators drops to Zero, and this is indicated on the circle pattern.

The Hue control then is varied until the circle pattern resembles the ones in Figures 5 and 6.

(FIGURE 5) (FIGURE 6)

The Hue control should operate so that at the center of its range, or mid-position, the proper phase of the circle pattern is achieved. If the proper phase is reached at the end of hue control range, an internal coarse phase adjustment will have to be made. The procedure for this adjustment is described in the manufacturer's alignment instructions.

DOT COVERGENCE - BRIEF OUTLINE

Only a brief outline of dot convergence is intended. The state of the art is changing so rapidly that a more detailed presentation is not possible. Therefore it is recommended that the TV manufacturers alignment instructions be consulted. In no way does this imply that the Model 660 should become obsolete as a result of this manufacturer recommending this alignment procedure.

1. Horizontal-Vertical Amplifier control to Minimum.
2. Tilt controls to medium range.
3. Adjust Beam positioning Magnets on neck of tube to produce White Dots in center of screen.
4. Turn Dot Generator OFF to make purity adjustment.
5. Turn Blue and Green screens to minimum and Red to maximum.
6. Adjust for best red purity in the center of screen by orienting purity magnet and yoke.
7. Advance screen controls for high level white screen.
8. Adjust Field Neutral magnet for best purity on edges.
9. Set background controls Blue and Green to medium range.
10. Set up dot pattern - minimum contrast and full brightness.
11. Adjust screens for high level gray.
12. Advance contrast control and lower brightness, adjust background controls for gray low level.
13. Increase brightness and re-adjust screens, etc., until good color balance is achieved over all positions of contrast and brightness controls.

1. Adjust 3-Red, Blue, Green beam positioning and Blue lateral adjust for white dot in center of screen as shown in Figure 7.

2. Advance Red Vertical Amplifier Maximum clockwise.

3. Adjust Red Vertical tilt for maximum displacement of red dots from cyan dots in center of screen.

4. Advance Green Vertical Amplifier maximum clockwise.

5. Adjust Green Vertical tilt for maximum displacement of green dots from center of screen. Direction of displacement should be opposite red.

6. Shunt blue grid to ground thru 100 K.

7. Adjust Red and Green Amplifier controls for straight vertical lines along entire screen. Figure 8B

8. Coverge Red and Green dots using Red and Green convergence magnets to produce yellow lines. Re-adjust Red and Green Vertical tilt and amplifier controls if necessary. Figure 8C

9. Remove shunt from Blue grid.

10. Advance blue vertical amplifier control to maximum clockwise.

11. Adjust vertical Blue tilt and amplifier to produce straight blue line parallel to yellow line. Figure 8C and 8D

12. Adjust Blue beam positioning magnets to make blue dots fall on yellow dots to produce a straight vertical row of white dots. Figure 8E

13. Advance Blue horizontal amplifier control to maximum clockwise.

14. Adjust Blue phase control for maximum downward displacement of blue dots in center of screen. Figure 9B

15. Adjust Blue phase and amplifier controls to produce straight horizontal line of blue dots.

16. Shunt Red grid of CRT thru 100 K to ground.

17. Adjust Green phase and Amplifier control to produce a straight horizontal line of green dots.

18. Shunt Blue grid of CRT and remove Red shunt.

19. Adjust Red phase and Amplifier controls to produce a straight horizontal line of Red dots.

20. Remove Red shunt.

21. Shunt Blue grid.

22. Converge Red and Green dots with positioning magnets to produce straight yellow horizontal line of dots.

23. Remove Blue shunt.

24. Converge Blue dots on yellow to produce white with Blue positioning magnets.

Dot pattern should be converged over entire screen.

DOT AND BAR INTENSITY

The Dot and Bar Intensity is variable. This is because the ratio of sync to video information can be varied. The Video adder gain and sync adder gain controls vary this ratio. These controls are factory pre-set at a ratio of 55% Video and 1.8 volts P-P sync, as viewed on a wide band Oscilloscope at the Video output connector with Video Output Attenuator at Maximum.

To increase intensity of Bars and Dots, the Video Adder gain control is increased to 75% Video and the Sync Adder gain control is reduced to 25% sync maintaining a combined 4 volts P-P output or 3 volts P-P Video and 1 volt sync.

To decrease intensity of Dots and Bars and two gain controls are adjusted in reverse for 25% Video and 75% Sync, maintaining 4 volts P-P output.

MAINTENANCE

Simplified Timer Adjustments

a. The time in the Model 660 is the heart of the instrument. If the timer falls out of sync, the instrument becomes unusable. Due to tube age, component changes as a result of heat and humidity, etc., the time may lose sync. Therefore, in most cases a simplified calibration procedure can be followed to restore the instrument to normal operating condition.

b. Determining whether Timer is out of sync.

This check can be made by connecting the video output of the Model 660 to the vertical input of a scope. The 660 should be set up for a bar pattern video output, and the scope for a 60 cycle horizontal sine wave sweep.

If the 660 timer is in sync, a slowly revolving pattern as shown in Figure 10 will be seen on the scope screen. However, if the pattern is revolving rapidly or appears jumbled, this would indicate that the time is out of sync.

Timer Adjustment

a. Equipment required: (1) Oscilloscope, Hickok Model 770 or 675, or equivalent. (2) TV Receiver.

1. Adjust the vertical and horizontal hold controls of the TV receiver with the TV station signal. Then disconnect the antenna.

2. Connect the Model 660 to the antenna of the TV receiver. Turn instrument on and allow a 15 minute warm-up period.

3. Connect the vertical input of the scope to the Video output of the 660. Set the Horizontal Selector of the scope to 60 cycle line frequency.

4. Set the channel selector of the TV receiver to any unused channel, and the Model 660 to the same channel. Set up the 660 for Bar Pattern, RF Output. By viewing both the TV screen and the Video pattern on the scope, the serviceman can make minor adjustment on the timer to bring it back into sync.

NOTE 1: Before making any adjustments, mark the position of each potentiometer with pen and ink, crayon or paint. In this way, if a potentiometer is adjusted and does not bring the timer back in sync, it can be returned to its original position.

NOTE 2: Check all 3 tubes in the timer section one at a time and replace low emission tubes with good aged tubes.

b. The timer adjustments will be split into the following three sections:

1. 31,500 and 15,750 cycles
2. 4500 and 900 cycles
3. 60 cycles

A. (31,500 and 15,750 cycles)
If the 31,500 or 15,750 cycle oscillators are out of sync, the whole timer will be out of sync. This can be recognized by viewing both scope and TV screens. The scope will show a scrambled, rapidly rotating pattern. The TV screen will show a scrambled pattern that is not locked vertically or horizontally.

1. Adjust the 31,500 cycle potentiometer. The pattern should lock in so that the vertical lines are present on the TV screen. If the pattern does not lock in, return the 31,500 potentiometer to its original position.

2. Adjust the 15,750 cycle potentiometer. The pattern should lock in so that the vertical lines are present on the TV screen. If, however, the vertical bars are locked in but the horizontal bars are not, (this will be indicated by a rapidly revolving pattern on the scope), proceed to the next section.

B. (4500 and 900 cycles)

If the 4500 and 900 cycle oscillators are out of sync, the horizontal bars (900 cycles) and vertical framing frequency (60 cycle pulse) will not be locked in as viewed on the screen of the TV receiver. Also, the scope will show a rapidly revolving pattern.

1. Adjust the 4500 cycle potentiometer. The horizontal bars should fall into sync as viewed on the TV receiver screen. If the pattern does not lock in, return the 4500 potentiometer to its original position and adjust the 900 cycle potentiometer.

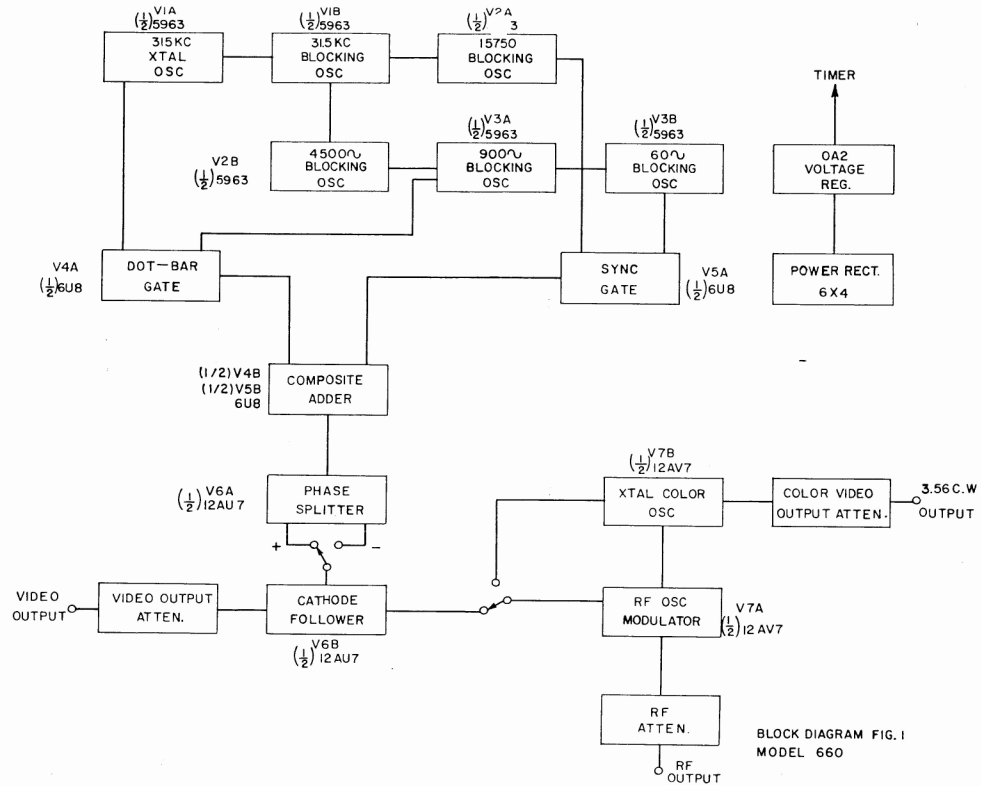
2. View the revolving pattern on the scope screen. If the 900 cycle oscillator is locked in, the 900 cycle pulse as viewed in the revolving composite pattern will be revolving very slowly even though the 60 cycle pulse may be revolving rapidly. This indicates that the 900 cycle oscillator is locked in but the 60 cycle oscillator may not be. Proceed to the next section.

C. (60 cycles)

If the 60 cycle stage is not in sync, the vertical framing frequency (60 cycle pulse) will not be locked in as viewed on the TV receiver screen. Also, on the scope the 60 cycle pulse will be revolving rapidly.

1. Adjust the 60 cycle potentiometer. The revolving pattern should lock in. The timer should hold sync over a variation in line voltage of 90 to 125 volts.

2. If, after having gone through the simplified timer adjustment, the timer does not lock in properly, it will have to be trouble shot in an effort to locate the intermittent or defective component, then set in again.



BLOCK DIAGRAM FIG. 1
MODEL 660

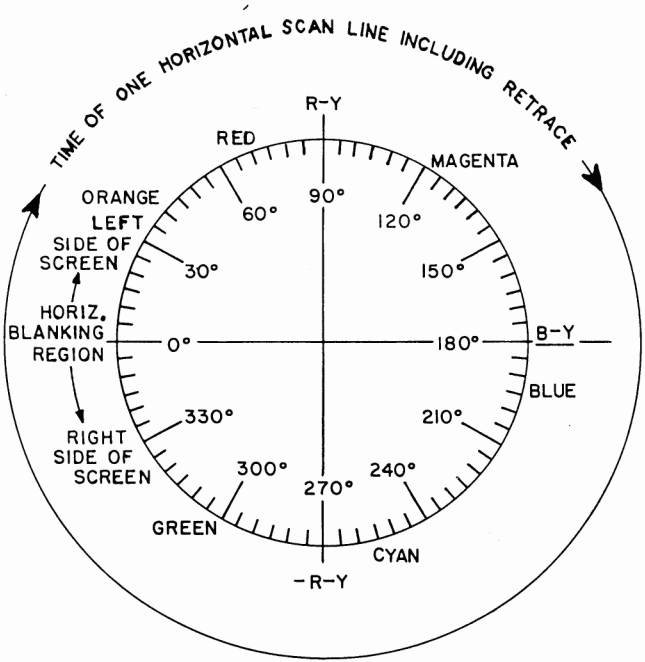

TIME OF ONE HORIZONTAL SCAN LINE INCLUDING RETRACE
R-Y
RED
MAGENTA
ORANGE
LEFT
SIDE OF
SCREEN
60°
90°
120°
30°
150°
HORIZ.
BLANKING
REGION
0°
180°
B-Y
BLUE
330°
210°
RIGHT
SIDE OF
SCREEN
300°
270°
240°
GREEN
CYAN
-R-Y

FIG. 2

TYPICAL WAVE FORMS SEEN IN PROPERLY ALIGNED DEMODULATOR CIRCUITS USING AN OSCILLOSCOPE

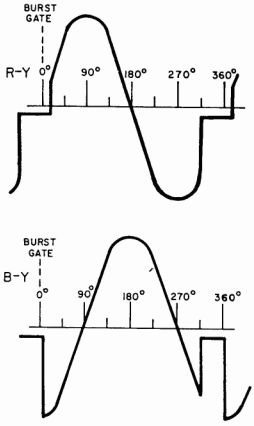


FIG. 3

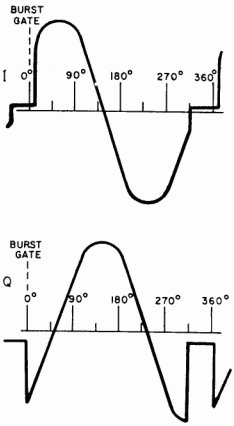
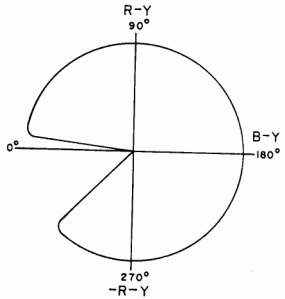
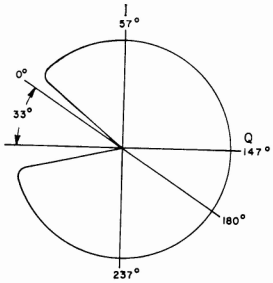


FIG. 4



CIRCLE WAVEFORM AS SEEN WITH OSCILLOSCOPE IN PROPERLY ADJUSTED R-Y, B-Y DEMODULATORS

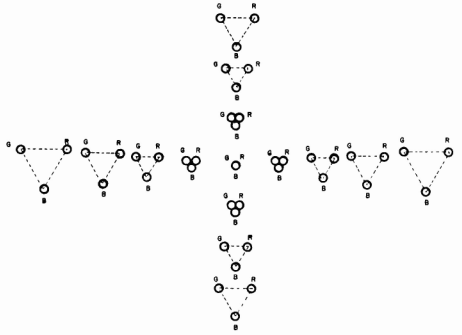
FIG. 5

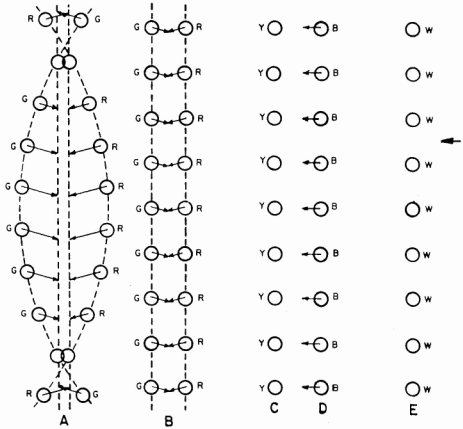


CIRCLE WAVEFORM AS SEEN WITH OSCILLOSCOPE IN PROPERLY ADJUSTED I, Q DEMODULATORS

FIG. 6

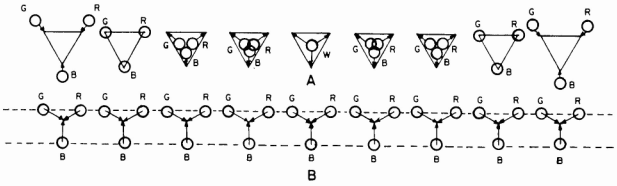
CENTER STATIC
CONVERGENCE PATTERN
FIG. 7 →

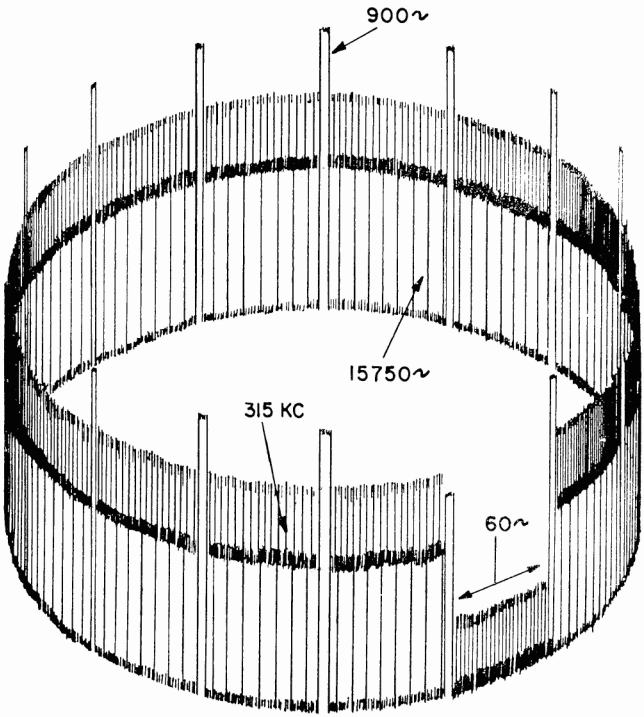




← FIG. 8
VERTICAL DYNAMIC
CONVERGENCE PATTERN

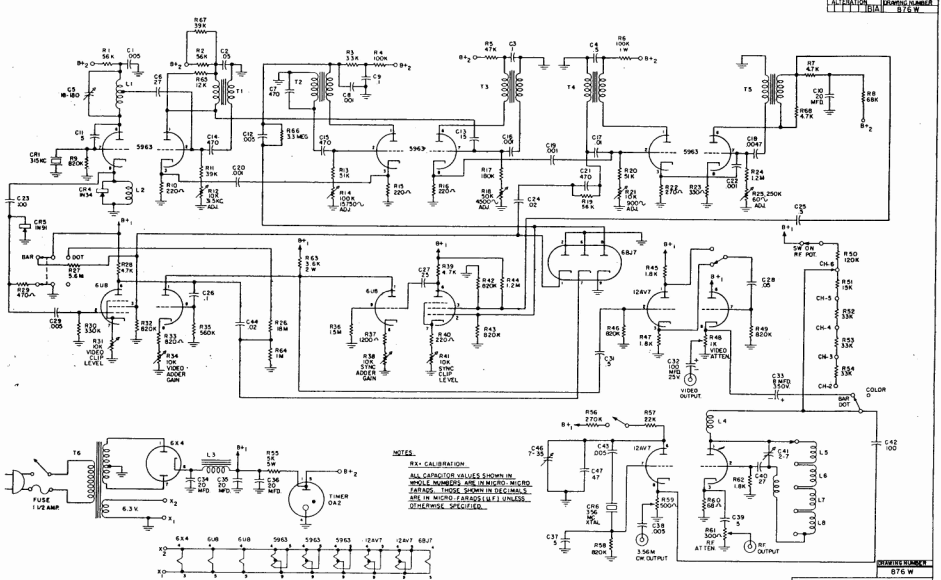
HORIZONTAL DYNAMIC
CONVERGENCE PATTERN
FIG. 9



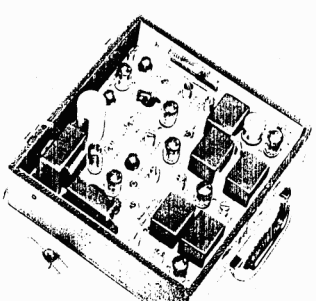


COMPOSITE VIDEO CROSSHATCH PATTERN

FIG. 9


ALTERATION
DRAWING NUMBER
876 W
NOTES
RX- CALIBRATION
ALL CAPACITOR VALUES SHOWN IN WHOLE NUMBERS ARE IN MICRO-MICRO FARADS. THOSE SHOWN IN DECIMALS ARE IN MICRO-FARADS UNLESS OTHERWISE SPECIFIED.
FUSE 1/2 AMP
6.3 V.
TIMER DA2
3.56 M CW. OUTPUT
VIDEO OUTPUT
RF ATTEN.
RF OUTPUT
SW ON RF POT
BAR DOT
COLOR
CH-6
CH-5
CH-4
CH-3
CH-2
DRAWING NUMBER
876 W
WHITE DOT-BAR COLOR DISPLAY GEN.
SCHEMATIC WIRING DIAGRAM MODEL 882 EC
DRAWN&TRACED
CHECKED
APP'D
DATE
ROH
11-1-55
THE HICKOK ELECTRICAL INSTRUMENT CO.
CLEVELAND, OHIO

WHITE-DOT-BAR COLOR DISPLAY TELEVISION GENERATOR

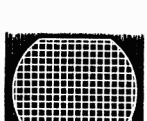


- *All Frequencies Crystal-Controlled and Locked Together*
- *Circuitry Completely Compatible with New Design Receivers*
- *Lightweight, Portable for In-The-Home Servicing*

This generator was designed for use in fast, in-the-home servicing of color TV receivers or on-site servicing of industrial color TV closed circuit installations. It features a high order of stability not provided by externally synchronized white-dot generators. In the Model 660, all frequencies generated are crystal-controlled and locked together for maximum stability. In addition, the frequency of the chrominance (color) signal is crystal-controlled to insure reliable evaluation of chroma circuit performance. This feature assures an accurate standard of reference not found in color display generators employing a free-running oscillator.

RF output frequency is in pre-set channels 2 through 6, permitting easy selection by means of a built-in switching arrangement. The circuit of the Model 660 has been developed to be completely compatible with future color TV receiver designs. The precise timer circuit will hold synchronization over the wide range of line voltages that may be encountered in "on-location" servicing.

Small size white dot pattern. 300 white dots, less those in blanking.



White line cross-hatch pattern. 20 vertical and 15 horizontal, less those in blanking.

Technical Specifications

COLOR DISPLAY PATTERN: In the following sequence; orange, red, magenta, blue, cyan and green—all crystal controlled.

SIDELOCK COLOR FREQUENCY CRYSTAL: 3.563795 MC output, 1 volt peak-to-peak

DOT AND CROSSHATCH SIZE: As small as 2 lines in both horizontal and vertical planes. Approximately 300 dots total.

CROSSHATCH WHITE LINES: 20 vertical and 15 horizontal, less those in blanking

RATIO OF SYNC TO VIDEO: Variable from 10 to 90%

VIDEO OUTPUT: 0-4 volts, peak-to-peak; across 300 ohms, black positive or negative

RF OUTPUT VOLTAGE: 0.05 volts maximum, 0.001 volts minimum RF modulated by all video outputs (60% modulation)

CASE SPECIFICATIONS: Furnished in sturdy black leatherette portable case with detachable cover, 10½" W, 10½" H, 5¼" D. 15 pounds net weight

POWER SPECIFICATIONS: 105-125 volts, 50-60 cycles, 40 watts Furnished complete with instructions book, with color channel alignment waveforms, 2 crystals and output cable.