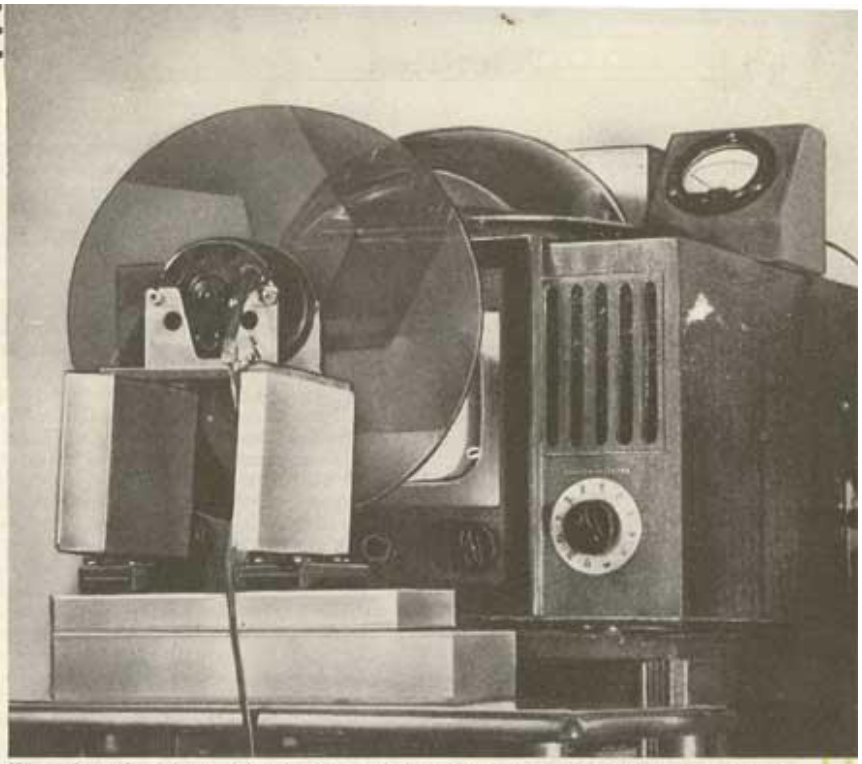
Simple changes in the sweep circuits often suffice to convert to CBS color. Circuits for converting popular makes of receivers are described in this article.



The color wheel in position in front of the video screen. The wheel may be any place between viewer and receiver, but should be near the receiver for best results.

Convert Your TV Set For Color Reception

By NORMAN L. CHALFIN

WHILE the industry makes up its mind whether to go along on color TV as authorized by the FCC, you can still enjoy the CBS broadcasts on your own receiver by making simple changes in the sweep circuits.

Don't misunderstand me . . . you can get an enjoyable picture for your own use, but it may be unwise to offer to convert a customer's set on a commercial basis. To get a picture of exactly the same brightness, size and with the same scanning linearity as the original 525-line picture is an engineering feat of the first order, and may call for replacing important parts in many receivers.

A 7-inch electrostatically deflected set will be easiest to convert. Larger sets with r.f. power supplies are often simple to handle. TV receivers with flyback high-voltage systems will call for complex circuit switching. For a commercially acceptable job, it would probably be necessary to replace the flyback transformer and yoke in many of these.

The frequencies of the deflection oscillators in present black-and-white (monochrome) TV transmissions are 60 cycles per second for vertical and 15,750 cycles for horizontal sweep frequencies. For the CBS field-sequential color TV broadcasts these oscillator frequencies must be changed to 144 cycles for vertical deflection and 29,160 cycles for the horizontal line generator.

The hold control resistance must be adjusted to a smaller value in the multivibrator or blocking oscillator used to generate the sweep frequencies. The ratio of change will be the reciprocal of that between the monochrome and color sweep frequencies. For vertical this will amount to a value of 1/2.4 of the total frequency-determining resistance of the sweep oscillator in the black-and-white receiver. For horizontal the new value for color will be 1/1.851 times the black-and-white value. With these fractions you will be able to determine the values for any receiver different from those in the circuits illustrated.

In most of the circuits there is a limiting resistance connected between the frequency-determining grid of the sweep oscillator and the hold control. This connection is broken and a switch inserted. In some of the very early receivers there is only a hold control and in some cases no change is necessary other than the proper adjustment

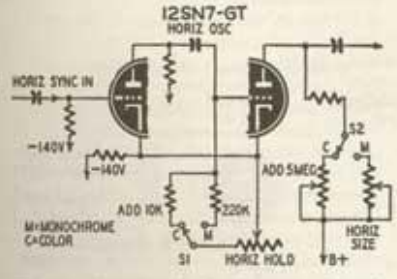


Fig. 1—Converted 7-inch sweep circuit.

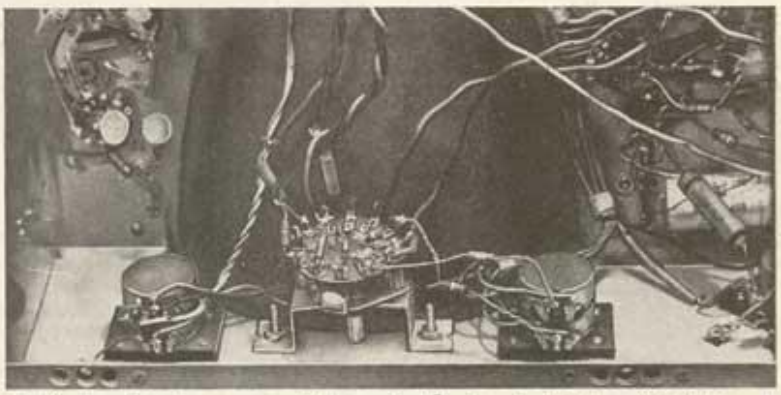


Fig. 2—How the changeover switch was installed on the Teletone TV 149 chassis.

of the hold control. Whether new resistors are switched into the circuit or an adjustment is made directly, the higher sweep frequency usually comes from the oscillator at a lower amplitude than

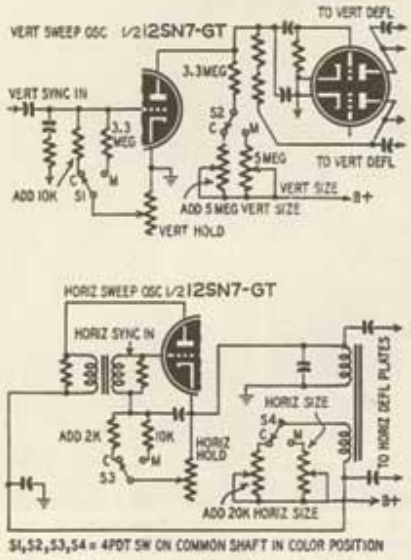


Fig. 3—The sweep circuits of a Motorola VT 71 adapted for color reception.

the original black-and-white sweep frequency. This will result in a smaller image and will require adjustment of the size control each time a change is made from monochrome to color reception, or back again. This problem is overcome by switching separately adjustable size controls (see Fig. 11) at the same time as the hold control values are switched. In some cases it may be advisable also to arrange to switch in separate linearity adjustment controls if they are present in the receiver.

Reference to the several circuits that accompany this article will clearly show the methods that have been developed by the author for making the color images broadcast by CBS visible in black and white on an existing receiver. These, in effect, are circuits the manufacturers would have had to include in sets to meet the bracket standards originally proposed by the FCC last fall.

Several circuits similar

A general similarity in the circuits of the 7-inch TV sets simplifies adaptation for color. Fig. 1 shows the Teletone TV 149 deflection circuit in which the horizontal and vertical oscillator circuits are identical with only the values of some components changed to establish the vertical or horizontal oscillator frequency. For this reason only one of the circuits is shown with the switching data that is required.

The photograph (Fig. 2) shows the placement of the switch on the chassis of the TV 149. It is a four-pole, double-throw unit which in one position retains the original circuit components and in the second position gives the color values their place in the circuits.

Fig. 3 shows the wiring arrangement for adapting the Motorola VT 71 7-inch TV sets so that they can receive the CBS color transmissions in black and white. Note, here, that there is no deflection amplifier in the horizontal sweep circuit. The horizontal blocking oscillator is very cleverly arranged to deliver push-pull deflection voltages directly to the cathode-ray tube plates. The vertical system resembles the Teletone previously described. The hold control is in the grid as in the Teletone circuit. The size control is in the plate load circuit. A four-pole, double-throw switch will cover this adaptation as for the Teletone.

In case insufficient horizontal voltage is supplied, however, it may be necessary also to switch the output transformer (Motorola No. T-6) with one that will tend to resonate with the two 900-μμf capacitors at the new frequency. The daring experimenter might even consider switching another pair of coils in parallel with the present ones to cut down the inductance.

The Hallicrafters T54 deflection oscillator circuits as shown in Fig. 4, are basically identical with the Teletone. There is a slight variation from the Teletone in size control placement. Horizontal size control in the T54 is connected in potentiometer fashion instead of as a rheostat. It is part of a B-supply bleeder system. The vertical size control is in the grid of the vertical deflection amplifier. The latter connection necessitates an extra switch position, as can be seen in the circuit diagram (Fig. 4) thus requiring a 5-pole, double-throw switch. The horizontal color size control is connected in parallel across the original control and is equal in resistance to it. No serious change in operation takes place as a result of halving the total resistance value. For those who prefer to retain the original operation, a sixth position can be added to the switch. With it, the connections for switching of the horizontal size controls can be made in similar manner to the vertical, by breaking two of the connections to the controls.

The circuit shown in Fig. 5 is the type of blocking oscillator used in the vertical deflection system of many receivers. The commercial variations of the RCA 630 TS use this circuit. RCA's own 630 uses a 6J5, and the discharge action is accomplished in the cathode circuit instead of a second triode, as shown. The 9T246, a similar arrangement, is seen in Fig. 6.

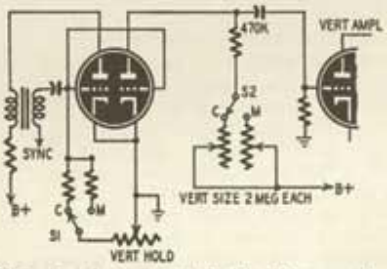


Fig. 5—A converted blocking oscillator of the type used in 630 chassis.

Other receivers

As previously indicated, the 7-inch sets and those with r.f. power supplies are easily adapted to meet the requirements of receiving the CBS color programs in black and white. Sets that have the flyback type of high voltage supply working from the horizontal deflection system will require more complex switching arrangements. Particularly, sets with horizontal a.f.c. systems fall into the more-difficult-to-convert category.

There is shown in Fig. 7 the switch-

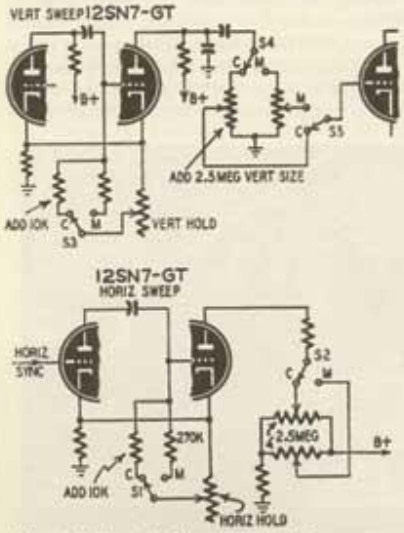


Fig. 4—The Hallicrafters T54 sweeps with alterations for receiving color.

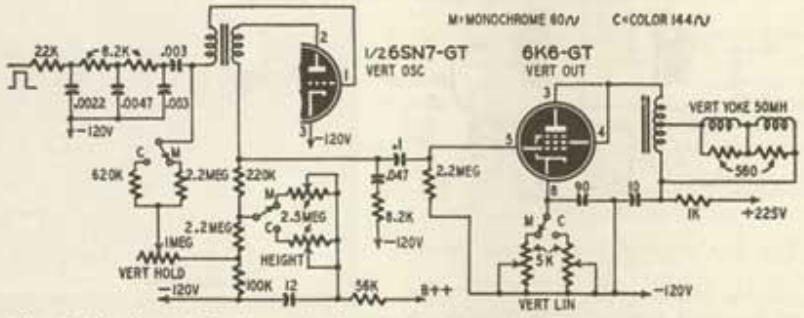


Fig. 6—Vertical deflection circuit of the RCA 9T246. To receive color, the vertical sweep frequency must be 144 cycles and the horizontal 29,160 cycles.

ing of components of the horizontal a.f.c. system employed in the 630 TS type of set. For this alone, three switch points are required: discriminator frequency adjusting capacitance is changed, horizontal oscillator reactance-tube frequency adjusting capacitance is changed, and the values of horizontal drive R-C network are changed. The right side of Fig. 8 shows the rest of the horizontal system changes that will be required for the 6BG6-G and flyback-output transformer system. Fig. 8 shows a typical Synchroguide system as adapted to the 29,160-cycle sweep frequency switching for color from the black-and-white 15,750-cycle sweep. Fig. 9 is a new horizontal output transformer with separate taps for the monochrome and color horizontal output connections to the deflection coils. The changes are necessary because, when the original system is used, there is a deterioration in horizontal output linearity and sweep amplitude in the color position. The new transformer has more turns for the color secondary connection to the horizontal deflection yoke than for the monochrome connection.

The transformer is wound on a square ferrite horizontal output transformer core, with a gap of .015 inch in each leg. The primary (1-2) is wound with 800 turns of No. 28 single-silk enamel insulated wire. The high-voltage winding in series with it consists of another 800 turns of 10-44 litz or No. 36 single-silk or single nylon enamel wire. The secondary is also wound with this wire. Position of the windings is the same as on the transformer it replaces, as is the method of winding. It will be practically impossible to wind such a transformer by hand, but they may become available commercially in the near future.

The modifications indicated in Figs. 6, 7, 8 and 9 were worked out by CBS engineers, to whom thanks are due for supplying the information.

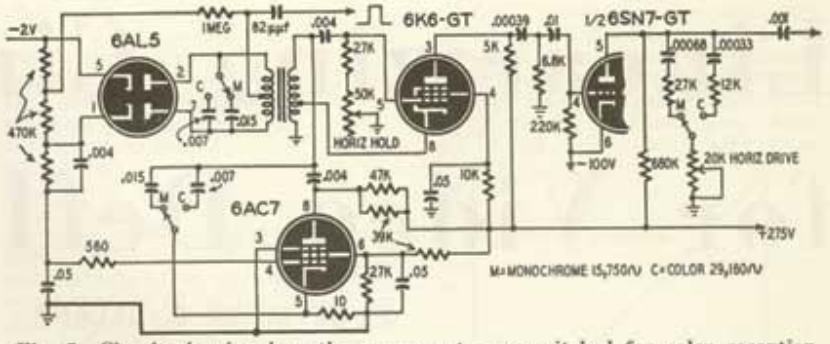


Fig. 7—Circuit showing how the components are switched for color reception in the 630 type receiver. This is the horizontal a.f.c. section of the set.

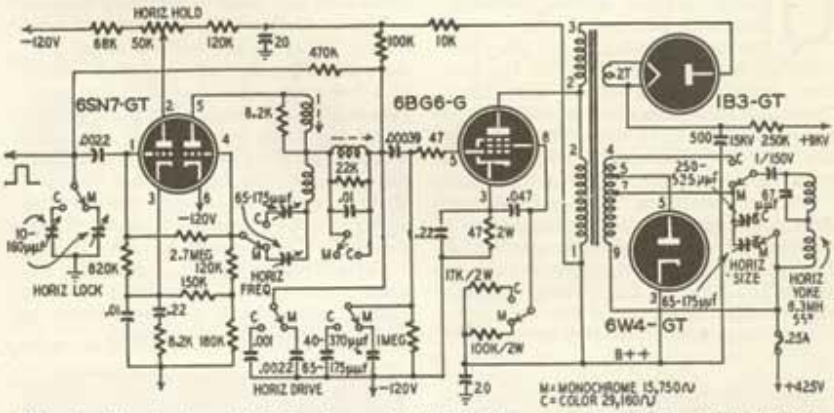


Fig. 8—The horizontal deflection and high-voltage circuit of the RCA 9T-246 type receiver showing the modifications that are made to receive color.

The color converter

If the above changes are made, you will be able to receive color broadcasts in black and white. To see them in color you will need a rotating disc. The most effective disc diameter should be a little more than double the width of the picture to be received. Six sectors are arranged on the disc with the three colors in this order: Red, Blue, Green, Red, Blue, Green. This is shown in Fig. 10. This disc must rotate at a speed of 1,440 r.p.m. before the screen of your set. For three segments (120° each) motor speed would be 2,880 r.p.m. A standard 1,800-r.p.m. phonograph motor would have to be geared or friction-driven to lower the speed. Several methods of synchronization are possible. One of these would be to drive the motor with a 48-cycle oscillator synchronized by some frequency-dividing circuit deriving its sync pulses from the 144-cycle vertical sweep system of the receiver when set for color TV.

When observing the test pattern transmitted by CBS in New York, you will find it moving in a circular path at a rate of about one revolution in 20 seconds. This was done to prevent the test pattern from burning into the image orthicon on the color camera.

Several plastics suppliers make available colored sheet plastic suitable for color discs. Eastman Kodak is expected to put out a set of color television filters in the near future.

Good results can be obtained with Wratten No. 26 for the red; No. 47 for the blue, and No. 58 for the green. Approximately equivalent Plexiglas numbers are: No. 159 or 160, red; 263, blue; and 260 or 2004, green; and Lucite: No. 10539, red; No. 7456, blue; and No. 3526, green.

A commercial disc is on the market at a cost under $20. This is the Celomat unit and has a manual speed adjustment. It will hold synchronization for reasonable periods but does require frequent re-adjustment. It is intended that you look at the screen of your adapted TV set through this device where it is nearer to you than to the set. The larger the screen, the further away you will be. Used in this way the color disc has a particularly humorous deficiency. After getting the Celomat device into synchronization, so that flesh tones are of the proper hue, if you move to the left or right of the viewing position in which you first adjusted synchronism these tones turn to a predominantly blue or green tint. Possibly this effect can be used to add proper eeriness to mystery shows.

Fig. 9—Horizontal output transformer tapped for black-and-white and color.

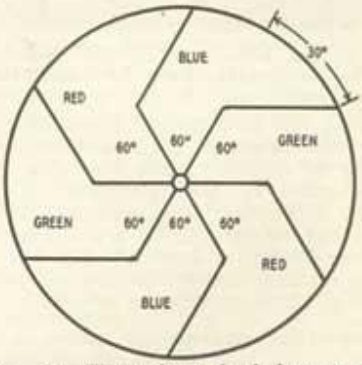


Fig. 10—The color wheel layout. It must rotate at a speed of 1,440 r.p.m.

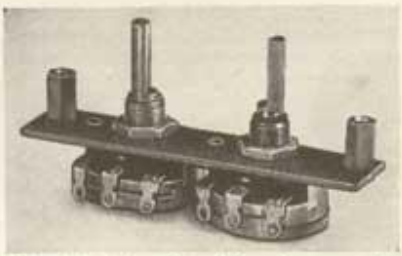


Fig. 11—The adjustable size controls.

Radio Electronics, January 1951

Courtesy of Cliff Benham