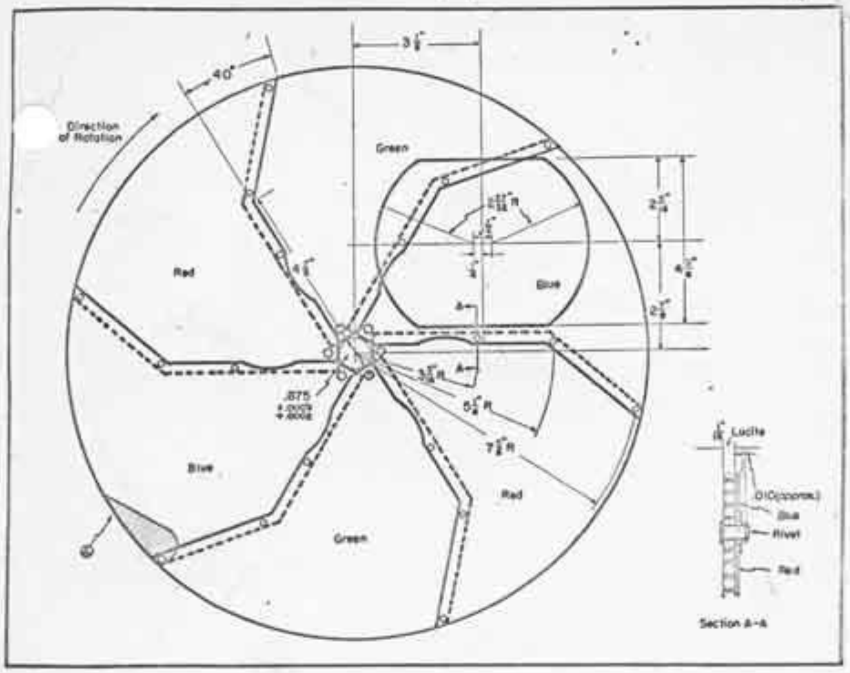
COLOR



Detailed drawing for 15½-inch color disc. Area represented in *A* may be used for counter-weights phased 60° apart near side. Filters are normally mounted on far side, with overlap as shown in *AA*. Two types of plastic filter material are recommended by CBS: 1/16" high-temperature plexiglas or boilable lucite; produced by Monsanto (filter *E* for all colors or 4/3 density No. 61 for green) and Eastman-Kodak (½ density No. 47 for blue and No. 26 for red).

IN CONVERTING a monochrome receiver for CBS color, it is necessary to be familiar with the problems and limitations involved in the alteration. First, it must be remembered that the quality of color pictures at present cannot be compared with black and white reproduction, as far as brightness, size and detail are concerned. In color receivers substantial light is lost by absorption in the color filters. Secondly, the mechanical apparatus used to recombine the various colors is limited in size for mechanical reasons, thus limiting the size of the set to be converted. Third, there is some loss in the detail obtainable with the disc color system, because of the 405-line system involved.

In sets with electromagnetic deflection and flyback transformers there are additional technical problems. The complexity of the entire horizontal sweep circuit requires an altered switching arrangement. The flyback transformers and yokes in the standard monochrome receivers are designed to operate most efficiently at a horizontal frequency of 15750 cps, and will not work as well at the new 29160 cps level.

Conversion Procedure

The smaller electrostatic receivers will be found to be the easiest types to convert. The smaller size screen is more suited to the use of a color wheel. Electrostatic deflection also avoids the problems connected with the horizontal driving circuits, when the horizontal frequency is changed from 15750 to 29160 cps. In most sets, the timing for the vertical and horizontal sweep frequencies is determined by some form of a blocking oscillator or multivibrator. Either one of these two types of circuit runs at a frequency lower than desired, and they are synchron-

Fig. 1 *a* and *b*. Vertical sawtooth generator used in the Belmont 7-inch electrostatic type chassis is shown in *a*. The horizontal sawtooth generator used in this model appears in *b*.

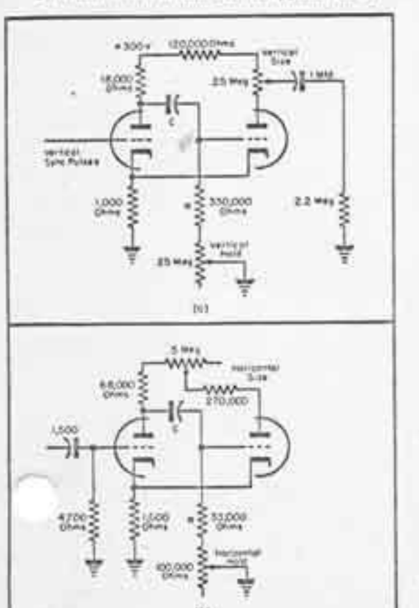


Fig. 1 *c* and *d*. Belmont chassis vertical (*c*) and horizontal (*d*) circuits altered for disc-system pickup.

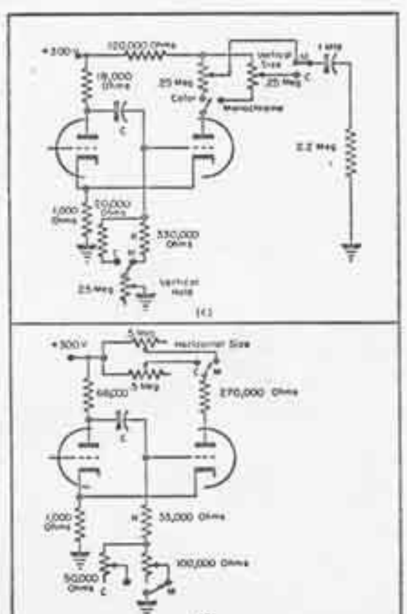
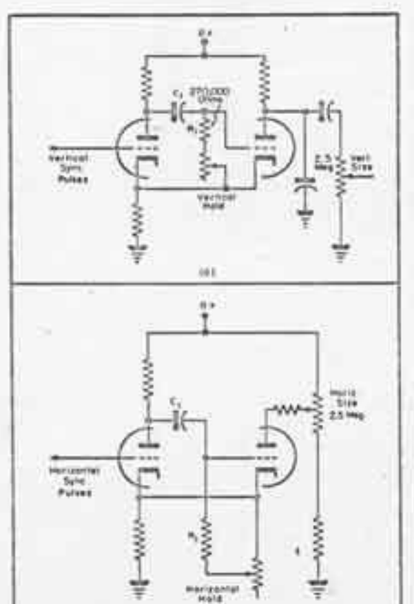


Fig. 2 *a* and *b*. Vertical (*a*) and horizontal sweep (*b*) circuits used in the Hallicrafters T-54 chassis.



TELEVISION

by PHILIP SELVAGGI

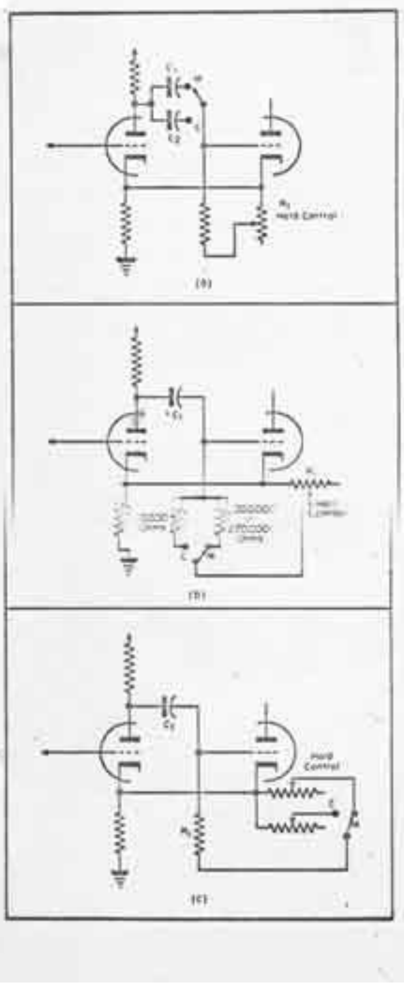
Part II . . . Circuit Changes Involved in Converting Electrostatic and Electromagnetic-Type Receivers to Color-Wheel System for Black and White, and Color Pickup.

ized by the incoming vertical or horizontal sync pulses.

In both of these circuits the circuit element which controls the frequency is usually a combination of resistor and capacitor. An increase in the resistor-capacitor combination will decrease the sweep rate, while a decrease in the values of this *rc* combination will result in an increase in the sweep rates. In the color-wheel scheme the vertical sweep has to be brought from 60 cps to 144 cps, an increase of 2.4 times. The *rc* combination in the vertical circuit for black and white reception thus becomes 2.4 times the value of the *rc* combination required for color. In the horizontal sweep circuit this *rc* value has to change by approximately $29160/15750 = 1.85$, when switching from color to black and white.

In making a conversion it will be necessary to provide a separate switching arrangement.

Then, a new set of *rc* time constants will have to be installed. The ratio of the black and white time constants to the color time constants should be approximately 2.4 for the vertical and 1.85 for the horizontal. The size controls usually have sufficient range for color and monochrome presentation, so that it will be sufficient to duplicate the existing size control. Fortunately, there is a great deal of similarity in many of the timing circuits which do not used *afc* circuitry.



Examples of Electrostatic Conversions

A typical horizontal and vertical oscillator, used in a Belmont 7″ receiver, is illustrated in Fig. 1. In this case the frequency determining *rc* combination consists of a 1-mfd capacitor and potentiometers. For conversion a switch with dual hold and size controls must be incorporated. Resistors limit the highest frequency obtainable from this circuit. In the color position the resistor's value becomes much smaller so that the multivibrator can operate at the higher frequencies required by color.

Whenever a change is made from the lower to the higher sweep frequency the amplitude of the sweep voltage usually decreases. Under these circumstances the picture will be smaller and the size control will have to be adjusted. To avoid the inconvenience of adjusting the size control with program selection, dual size controls must be provided with a switch. A trouble which may arise, when changing amplitude in this fashion is that of non-linearity. If a set has a linearity control it would be wise to incorporate dual linearity controls operated by a third part of a ganged switch.

Another conversion example appears in Fig. 2; vertical and horizontal sweep circuits of a Hallicrafters T54. In this chassis the timing of the vertical and horizontal sweeps is deter-

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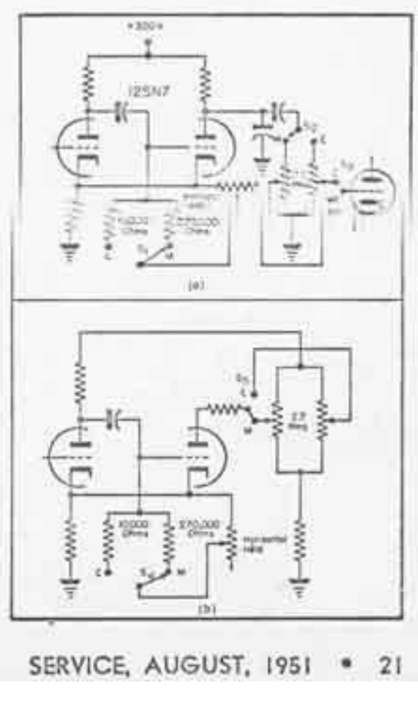
(*Left*)

Fig. 3 *a*, *b* and *c*. Circuits illustrating color-system changes required: In *a*, capacitor value has been altered to change sweep frequency; sweep frequency modification appears in *b*, with frequency-limiting resistance being changed; hold-control alteration to change sweep frequency appears in circuit in *c*.

(*Below*)

Fig. 4. Suggested changes in Hallicrafters T-54 vertical (*a*) and horizontal circuits (*b*) for color-wheel operation.



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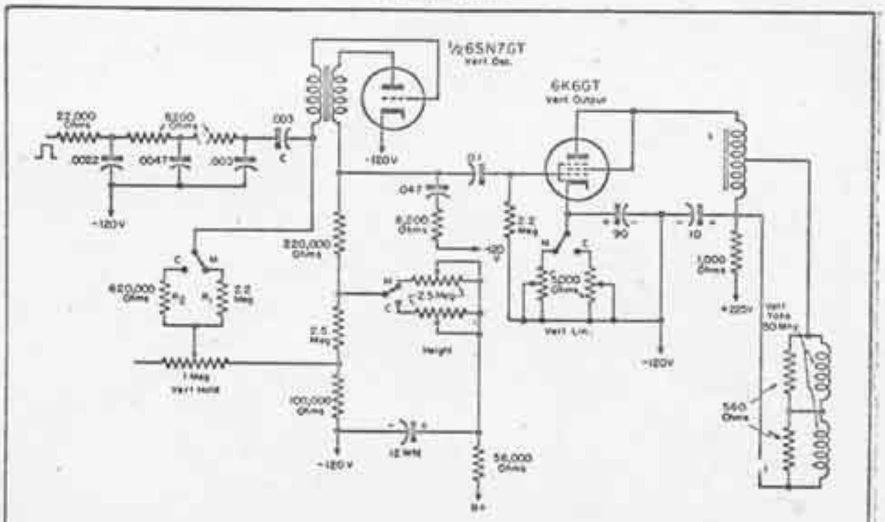
mined by the capacitor C_1, the fixed resistor R_1, and the potentiometer in series with R_1; The sweep rate depends upon the *rc* product of the grid circuit where $C = C_1$ and $R = R_1$, plus the resistance of the pot. To change the vertical frequency this *rc* product must be divided by 2.4. Either the R or the C could be divided by this value. For the horizontal sweep the *rc* product must be divided by 1.85. Fig. 3 (p. 21) shows three different ways of obtaining this division. In *a* is illustrated the method used to switch a capacitor in or out, as the set is switched from color to black and white. For monochrome the vertical capacitor must be 2.4 times the color capacitor and the horizontal capacitor 1.85 times the color capacitor. The disadvantage of this method is that it may not be easy to find capacitors with the values to satisfy the necessary ratios. The basic principle is illustrated, however, and the method can be used when the right capacitors are available.

Fig. *3b* shows a method in which the value of the resistance is reduced by the right factor. In this case, the frequency limiting resistor has been changed: If we call the pot resistance, R_1, then the ratio of $R_1 + 220{,}000$ ohms$/R_1 + 10{,}000$ ohms $= 2.4$ for the vertical frequency and $R_1 + 270{,}000$ $/R_1 + 10{,}000 = 1.85$ for the horizontal frequency. This circuit is the simplest and the cheapest to install.

Circuit Defects

The circuits in *a* and *b* do have one defect. They both have just one adjustment for both color and monochrome. If, as the set ages, this setting changes for one presentation or the other, it will be necessary to adjust the potentiometer each time the receiver is switched from color to monochrome. One way to solve this difficulty is illustrated in *c*. The resistance is again changed by the right ratio, but instead of changing the fixed re-

Fig. 5. Vertical-deflection circuit of RCA 9T246 modified to provide correct scanning for field-sequential color.



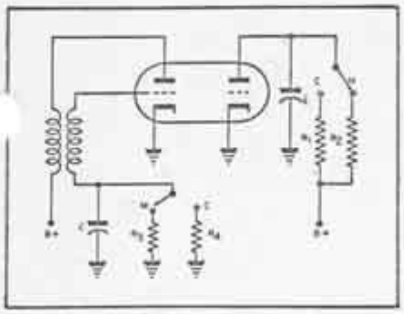


Fig. 6. Blocking oscillator with switch for color and black and white reception.

sistor, an additional potentiometer is inserted in the color position. Thus, there can be adjustments for either color or monochrome without interfering with the other operating conditions. This method is expensive, requires more space, and demands more effort to install.

Hallicrafter Set Conversion

A method which can be used to convert the vertical and horizontal size control for color appears in Fig. 4. (p. 21). In both cases 2.5-megohm potentiometers have been placed into the circuit in suitable positions to be switched into operation as the color switch is operated. In these two instances the existing pots were duplicated for the color section. In any case, where a potentiometer which is used as a frequency or size control can cover the range required for color and monochrome, it is only necessary to duplicate the pot in the color scheme and adjust it for proper size in each position of the color monochrome switch. It should be noted that only a *dpdt* switch is required to change the sweep circuits.

Blocking Oscillator Circuit

A blocking oscillator circuit, of the type used in the RCA 9T246, appears in Fig. 5. In this case the capacitor C, in conjunction with resistors, R_1 or R_2, determine the frequency of the blocking oscillator. A 2.2-megohm resistor can be used for the 60-cps vertical sweep of black and white, while a 620,000-ohm resistor will serve for the 144 cps required for color. In one alteration, the vertical size of the original potentiometer was duplicated as it had enough range. Fig. 6 shows another type of blocking oscillator where the *rc* combination in the grid circuit

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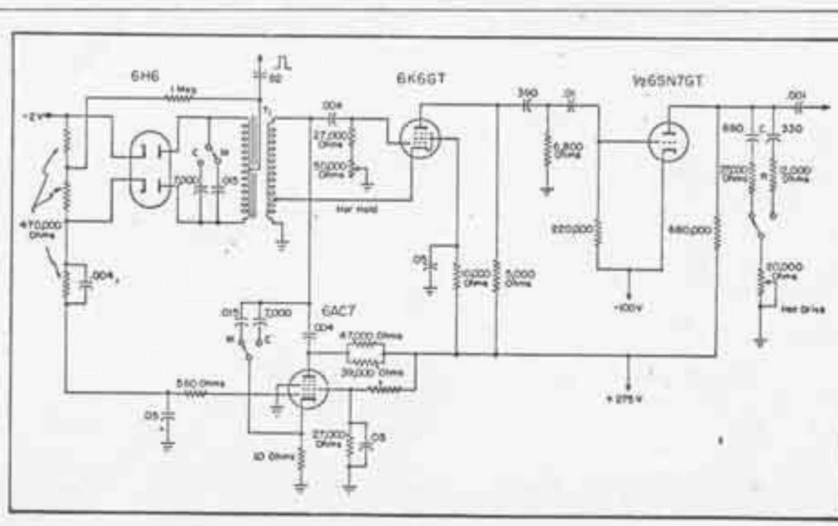

Fig. 7. Typical dual-frequency synchrolock horizontal-scan circuit applied to RCA 630TS.

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determines the frequency. Again a smaller resistor and a switch were incorporated to make the circuit adaptable for color.

Flyback Conversion Problems

Receivers which employ flyback transformers for the high-voltage supply and those that use horizontal *afc* systems are not as easy to convert, as the smaller electrostatic types.

AFC Circuit Difficulties

The *afc* circuit has been found to make the conversion process somewhat

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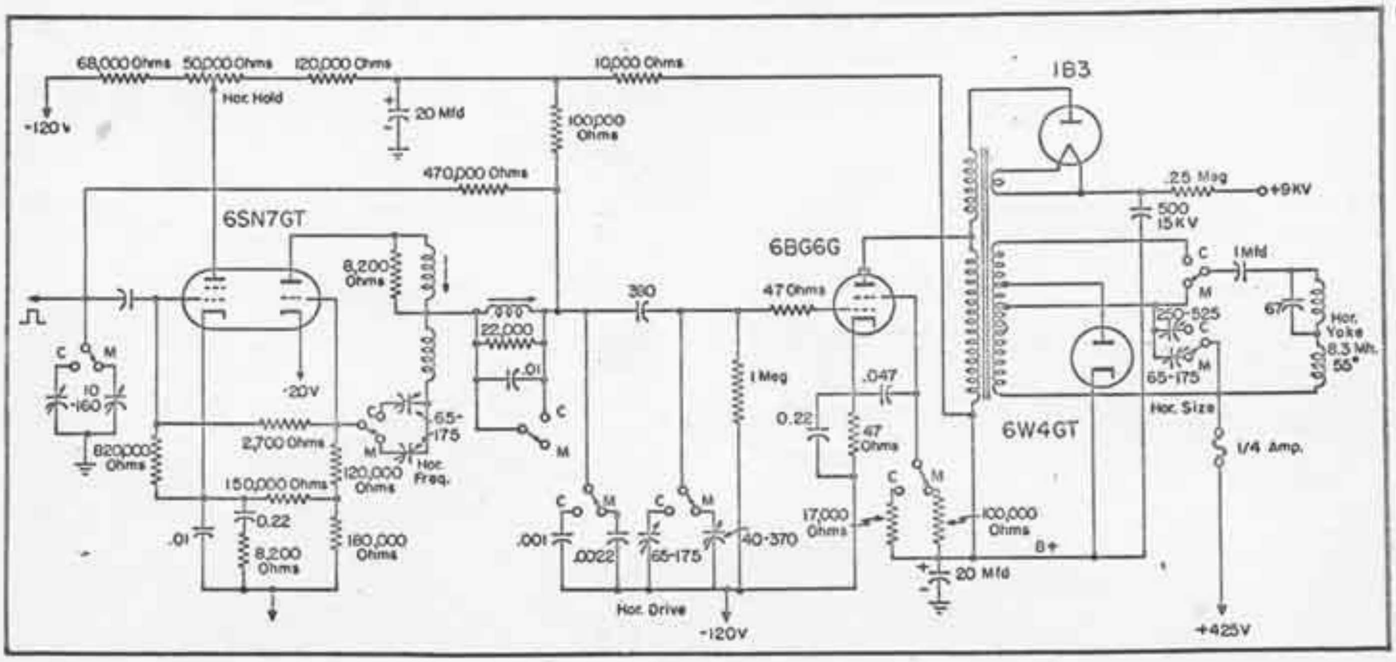
Color wheels for field-sequential colorcasts announced by Deitz Sales Co., 120 South Orange Ave., Newark, N. J. Available for 7-, 10- and 12-inch sets. Solid one-piece product, 1/100" in thickness, that is said to be balanced to prevent vibration. Supplied with pre-drilled mounting holes for assembly to either spindle or hub.

remains the same. The complexity of the problem for sets with *afc* and flyback transformers are quite obvious from this schematic, there being eight points which have to be changed and switched over, in addition to the replacement of the flyback transformer.

(In the next discussion, there will appear an analysis of the color wheel, and its phasing problems with manual and automatic systems. There will also appear a review of the tricolor tubes and a description of the latest color receivers.)

Fig. 8. Dual-frequency synchroguide scanning circuit as applied to RCA 9T246 chassis. Horizontal output transformer required for modified system features a primary with 800 turns of No. 10 or 14 litz; a *hv* winding, also with 800 turns of No. 10 or 14 litz, and a secondary with three sections of 100, 200 and 250 turns, respectively, using No. 28 *bse* wire. According to CBS, secondary should be wound first; second, primary for 6BG6G; and third, *hv* primary for 1B3, all being wound on a square-type ferrite core with a 15-mil gap in each leg. A ferrite-type yoke is also recommended for use with the circuit.



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involved because the number of points to be switched over are more numerous. It does have circuit constants which can be altered for color; the tuning elements of the oscillator circuit can be changed to permit horizontal synchronization at 29160 cps.

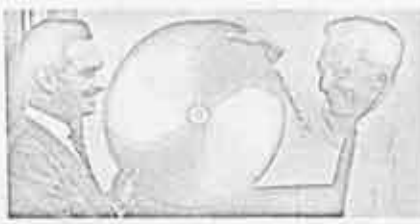
Synchrolock Adaption

Fig 7 (p. 69) shows the changes that are required to adapt a synchrolock *afc* circuit for color. The 6K6 with a transformer comprises a Hartley oscillator which is tuned close to 15750 cps by means of the capacitor across the secondary winding. This capacitor must be changed from .015 to .007 to make the oscillator operate close to 29160 cps. The same change is required in the frequency-controlling capacitor in the reactance tube. Since the correct timing is obtained from the tuning of the oscillator in conjunction with the proper setting of the reactance tube, it is not necessary to modify the hold circuit in this case. It was found necessary, however, to modify the *rc* circuit in the horizontal-drive circuit.

Dual-Type Transformer Use

These modifications indicate that a total of three switching points are required in the *afc* circuit alone. If no more switching points were required, the situation would not be so bad. As was mentioned previously, however, the flyback transformer, designed to operate with best efficiency at 15750 cps, must be replaced with one providing sufficient drive and linearity at 29160 cps. A dual-type transformer has been designed to supply sufficient drive for the color picture. This transformer, together with the necessary changes in the driving circuit, are shown in Fig. 8. In the color position there are additional turns on the secondary winding to obtain more drive. In addition, it was found necessary to reduce the screen dropping resistor in the 6BG6GT from 100,000 to 17,000 ohms, thereby increasing the screen voltage and the gain of the 6BG6GT. In one arrangement the transformer has been mounted on a conventional square ferrite output transformer core, with the winding positions placed similar to those of an ordinary flyback transformer.

Myron J. Greenwald (left), vice-president of Celomat, describing Celomat color wheel to Leopold M. Kay, vice-president in charge of engineering of CBS-Columbia, Inc.



Circuit Changes Required

The changes necessary to adopt the synchroguide *afc* circuit for dual reception are also illustrated in Fig. 8. The synchroguide circuit has more adjustments and tuning elements, the total number of switching points adding up to five. The values of new variable capacitors, for use with color, are indicated in the horizontal lock and the horizontal frequency controls. The horizontal drive has to be converted again while the horizontal hold