Dec. 6, 1949 W. USSLER, JR 2,490,561

TELEVISION PICTURE MIXING CIRCUIT

Filed June 20, 1946 2 Sheets-Sheet 1

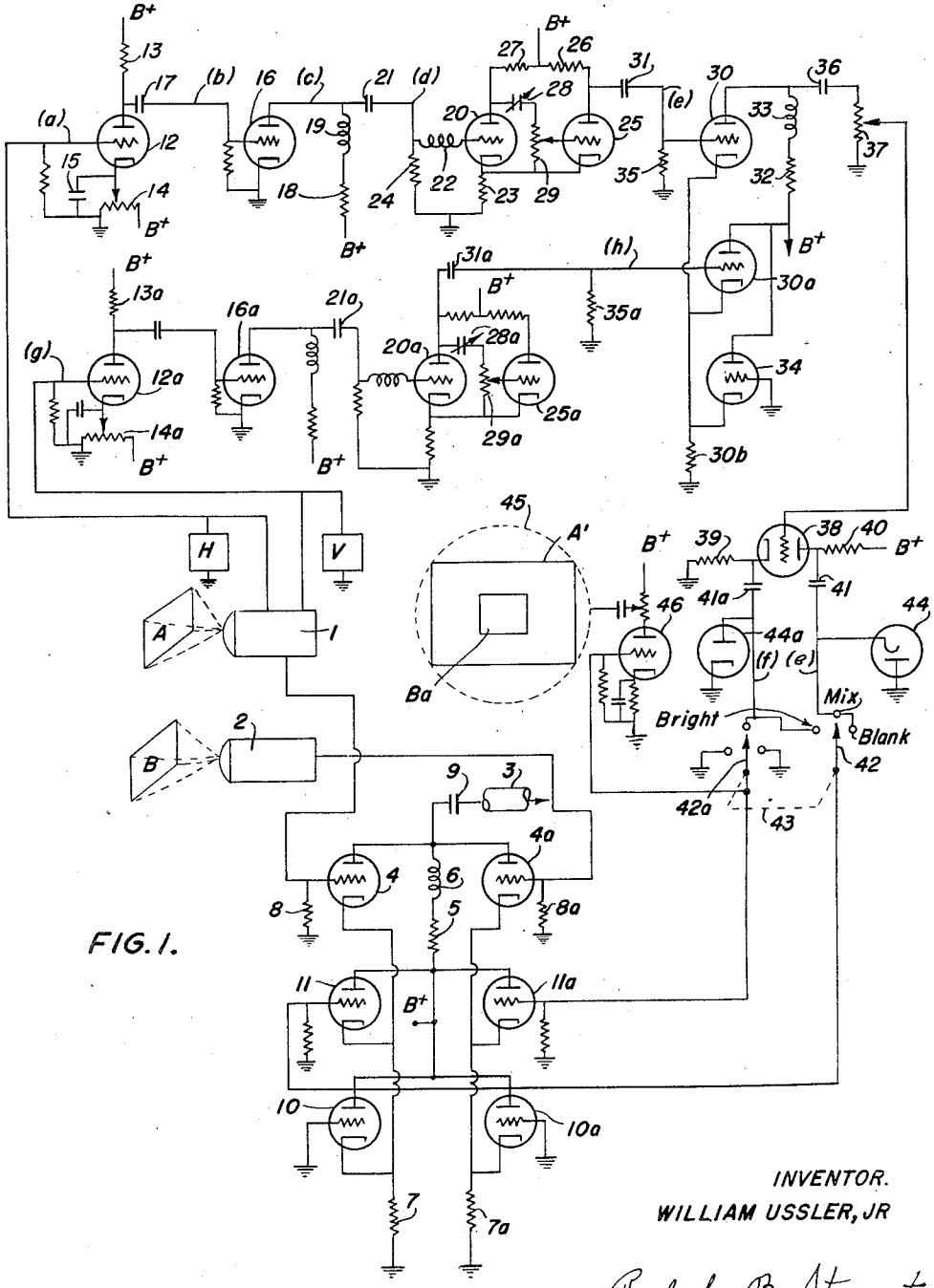


FIG. 1.

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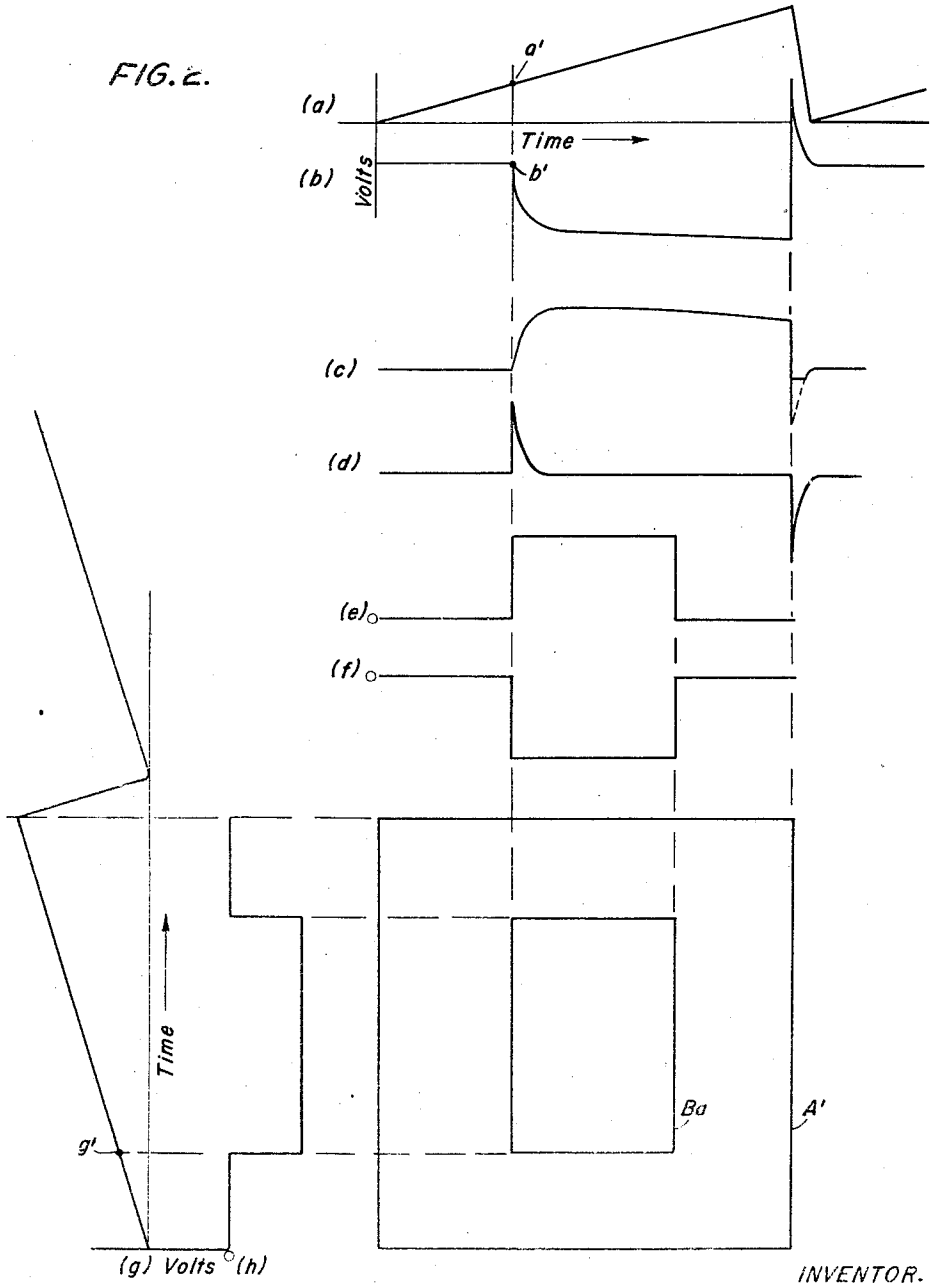
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FIG. 2.



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TELEVISION PICTURE MIXING CIRCUIT

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4 Claims. (Cl. 178—7.1)

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This invention relates to a television system.

An object of the invention is to devise a television system in which a simple adjustment may be made to (1) blank out or remove any desired part of a television picture or scene, (2) brighten or emphasize any desired part of the scene or (3) mix two scenes and produce a composite scene from parts of two scenes. Any of these three conditions may be obtained by the adjustment of a single control element.

A further object of the invention is to devise a television system in which the three conditions of operation listed above may be obtained by control signals derived from the conventional saw-tooth deflection currents supplied to the television transmitter or receiver.

Still another object of the invention is to devise circuit arrangements for producing control signals whereby any desired area of the picture field may be selected by adjustment of simple circuit elements.

My invention may be applied either at the transmitting end of a television system or at the receiving end. The example illustrated in the drawing is applied to the transmitting end.

The preferred form of my invention is illustrated in the accompanying drawing in which

Figure 1 is a diagrammatic representation of two television transmitters connected together in accordance with my invention; and

Figure 2 is a series of curves for explaining the operation of Figure 1.

Referring to the drawing, 1 indicates a television transmitter of conventional construction for televising a scene A, and 2 is a second television transmitter for televising a different scene B. 3 indicates an output line or cable leading to a distant receiving station or to a local radio transmitting station. The object of the present invention is to provide an arrangement whereby the two television transmitters 1 and 2 may be associated with the output line 3 to accomplish any of the following conditions of operation:

(1) All of scene A transmitted

(2) All of scene A transmitted with a certain selected area brightened

(3) All of scene A with a certain selected area blanked out

(4) Scene A transmitted with part of scene B inserted in a selected area

(5) All of scene B transmitted

(6) All of scene A transmitted, with a portion or all of scene B superimposed upon scene A.

The output of transmitter 1 is connected to the line 3 by means of an amplifier 4 which is

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supplied with plate current from B+ through resistance 5 and series inductance 6, and a cathode lead resistor 7 supplies a negative biasing potential to the amplifier through grid resistor 8. The output of transmitter 2 is connected to line 3 by means of amplifier 4a which has a cathode lead biasing resistor 7a, and the plate of this amplifier is connected in parallel with the plate of amplifier 4 and receives plate current through resistor 5 and inductance 6. The cable 3 is connected to the plate elements of amplifiers 4 and 4a by condenser 9. A tube 10 has its cathode connected in parallel with the cathode of amplifier 4 and is supplied with plate current from the same source as amplifier 4 but by a connection ahead of resistance 5 and inductance 6. The grid of tube 10 is grounded, and this tube supplies current through biasing resistor 7 to normally bias the grid of amplifier 4 negatively but not below the cutoff point. Another tube 10a is connected in a similar manner to provide a negative biasing potential for amplifier 4a, but in this case the bias is below cutoff. Thus, normally there will be transmission of video signals from television transmitter 1 to the cable 3, but no transmission from transmitter 2. The transmission from transmitter 2 is determined by control signals applied to a pair of switching amplifiers 11 and 11a having their cathode and plate elements connected in parallel with tubes 10 and 10a. Switching amplifiers 11 and 11a are normally conducting and aid in supplying negative biasing potential to amplifiers 4 and 4a. The arrangement for developing the control signals for switching amplifiers 11 and 11a will now be described.

H and V represent saw-tooth generators for supplying the horizontal and vertical saw-tooth sweep waves to transmitter 1. Transmitter 2 may be supplied from the same sources if positioned in the same locality, but separate sources of sweep waves may be employed for transmitter 2. Positive saw-tooth waves from generator H are supplied to tube 12 which will be referred to hereinafter as a "trigger" tube and which is provided with a plate lead resistor 13. A negative biasing potential is supplied by potentiometer 14. A condenser 15 is connected from the variable contact of potentiometer 14 to ground. The signal potential developed across plate resistor 13 is applied to the grid of amplifier 16 through condenser 17. Amplifier 16 is supplied with plate current from B+ through resistor 18 and inductance 19 which form coupling elements for transmitting the signal potential of amplifier 16

to the grid of amplifier 20 through condenser 21. An inductance 22 is connected in the grid lead of amplifier 20 and a cathode lead biasing resistor 23 is provided to bias the grid of tube 20 through grid resistor 24. Tube 25 has its cathode connected in parallel to the cathode of tube 20 and normally is supplied with plate current from B+ through resistor 26 and through biasing resistor 23. This current supplies sufficient biasing potential to normally prevent conduction in tube 20, the plate of which is connected to B+ through resistor 27. A variable condenser 28 and a series resistor 29 are connected across the plate and cathode elements of tube 20, and the grid of tube 25 is connected to a variable contact on the resistor 29. The tubes 20 and 25 connected as shown constitute a "one shot" multivibrator as will be explained more fully hereinafter. The plate of tube 25 is connected to the grid of amplifier 30 through condenser 31. Tube 30 is provided with a cathode lead resistor 30*b* and is supplied with plate current from B+ through series-connected resistor 32 and inductance 33.

Biasing potential for normally rendering tube 30 non-conducting is provided by means of a tube 34 which has its cathode connected to ground through resistor 30*b* and its plate connected directly to B+, the grid of tube 34 being grounded. The plate current of tube 34 provides a biasing voltage across resistance 30*b* which is applied to the grid of tube 30 through grid resistor 35.

Positive saw-tooth pulses from generator V are supplied to a series of amplifier tubes like the tubes 12, 16, 20, 25 and 30, and this series of amplifier circuits is identified by the same reference numerals with the added letter, *a*. For example, tube 12*a* corresponds in function to tube 12 and resistor 13*a* corresponds in function to resistor 13. One difference between these two series of amplifiers is that the plate of tube 30*a* is connected directly to B+ and this tube is normally conducting heavily so that the tube 30 is normally biased considerably below cutoff.

The signal waves developed in the two series of amplifier circuits are combined in tubes 30 and 30*a* and are supplied through condenser 36 to an output potentiometer 37. The variable contact of this potentiometer is connected to the grid of an amplifier 38 which is provided with a cathode lead resistor 39 and is supplied with plate current from B+ through a resistor 40. The purpose of tube 38 is to derive two signal waves of equal amplitude but of opposite polarities, which are to be applied to the grids of switching amplifiers 11 and 11*a*. A signal wave of positive polarity is taken from the plate of tube 38 through condenser 41 and is applied to the center and right contacts of a three-point switch 42, the switch arm of which is connected to the grid of switching amplifier 11. The signal wave of negative polarity is taken from the cathode of tube 38 through condenser 41*a* and applied to the center contact of a second three-position switch 42*a* and to the left contact of the switch 42. The arm of switch 42*a* is connected to the grid of switching amplifier 11*a* and the other contacts of switch 42*a* are grounded. The two three-point switches 42 and 42*a* are mechanically coupled together for simultaneous operation as represented by the dotted connection 43. A diode rectifier 44 is provided to prevent the transmission of negative pulses to the switch 42 and a similar rectifier 44*a* is provided to prevent the transmission of positive pulses to switch 42*a*.

For operation of the system it is convenient to provide a monitoring scope at the transmitting station in order to monitor the waves being transmitted. For this purpose, a cathode ray oscilloscope 45 is provided and is supplied with a beam modulating potential from the signal wave supplied to the switching amplifier 11*a*. This modulating potential is supplied by means of an amplifier 46 which has its grid connected to the contact arm of switch 42*a*. The rectangle A' on the scope 45 represents the outline of the scene A if it were reproduced on the scope. The rectangle B*a* represents the outline of a selected part of the scene B which is to be inserted within the area of the scene A represented by the rectangle A'. The picture area B*a* will always be rectangular in form but it may be varied in size and its position within the rectangle A' may be varied to any point within the area.

The operation of the system will be described by reference to Figure 2. In this figure the rectangle A' represents the outline of the scene A transmitted by transmitter 1, and the rectangle B*a* represents the outline of the portion of scene B which is to be inserted in the area A'. It will be understood that the biasing potential normally impressed upon amplifier 4 is such as to allow transmitter 1 to transmit video signals to the output line 3, and the switching signals supplied to switching tubes 11 and 11*a* must be of such wave form as to blank out the signal from transmitter 1 within the area B*a* and to transmit signals from transmitter 2 within this area.

The positive saw-tooth pulses which produce the horizontal scanning are shown in curve *a* of Figure 2. It will be noted that the duration of the scanning portion of the pulse corresponds to the width of the area A'. When this scanning pulse is applied to the grid of trigger tube 12, the tube does not conduct immediately because of the negative bias impressed on the tube from potentiometer 14, but conduction will start at the point *a'*, and the signal wave produced at the input of tube 16 will be represented by the wave *b* of Figure 2. This wave is formed of a negative pulse beginning at the instant *b'* corresponding to the instant *a'* and is followed by a sharp positive pulse at the end of the scanning traverse. After being amplified by tube 16, the signal wave has the form shown in curve *c*, the negative pip of the wave *c* being clipped by the grid current flow in tube 16. After passing through condenser 21 the differentiated signal current is represented by curve D, and this signal is supplied to the input of the "one shot" multivibrator 20—25 which produces a single positive pulse shown by the curve *e*. It will be noted that the pulse *e* is initiated by the positive pulse of wave *d* and it is automatically terminated by the multivibrator circuit. The negative pulse of wave *d* has no influence on the multivibrator.

The duration of the positive pulse of curve *e* is controlled by varying the condenser 28. This controls the width of the insert area B*a*. The instant at which trigger tube 12 becomes conductive, as shown by the point *a'* in wave *a* is controlled by varying the potentiometer 14. This varies the position of the insert area B*a* with respect to the left boundary of the area A'.

Trigger tube 12 and the other elements connecting this tube to the multivibrator tube 20 constitutes a gate device energized by the saw-

tooth scanning waves and operating to generate a triggering impulse for the multivibrator when the saw-tooth wave causes the tube 12 to become conductive. The aperture of the gate device, that is, the value of the saw-tooth voltage required to render the tube 12 conductive is varied by varying the potentiometer 14 and thereby varying the negative bias applied to the tube.

Curve *g* shows the positive saw-tooth wave supplied to the input of tube 12*a* This wave produces the vertical scanning, and its scanning portion has a duration corresponding to the time required to scan an entire frame of the area A'. Tube 12*a* functions in the same manner as tube 12 and becomes conductive at the instant *g'* determined by the adjustment of the potentiometer 14*a*. The tube 16*a* and the multivibrator 20*a*—25*a* function in the same way as tube 16 and multivibrator 20—25 to produce a negative wave pulse at the grid of tube 30*a* as shown in the curve *h*. The duration of the negative pulse *h* is controlled by adjustment of the variable condenser 28*a*. This determines the vertical dimension of the insert area B*a*. The position of the bottom boundary of the insert area B*a* with respect to the bottom boundary of the area A' is determined by adjustment of the potentiometer 14*a*.

As previously explained, tube 30 is normally biased considerably below cutoff. During the time when negative pulse *h* is applied to the grid of tube 30*a* the current through biasing resistor 30*b* is reduced so as to bring the tube 30 approximately to the cutoff point, and so long as negative pulse *h* continues, the positive pulses *e* supplied to the grid of tube 30 will be transmitted. Thus, positive signal pulses are transmitted to output potentiometer 37 only within the insert area B*a*. Only one negative pulse *h* occurs during each scanning of the entire frame area A', and during the period of the pulse *h*, a series of positive pulses are transmitted by the tube 30 to potentiometer 37, there being one positive pulse for each horizontal scanning traverse within the interval of flow of pulse *h*. This block or group of positive pulses is transmitted from potentiometer 37 to tube 38 where two corresponding sets of pulses are derived, one being negative and the other positive as previously explained. The group of positive pulses represented by the curve *e* in Figure 2 passes through condenser 41 to switch 42 and the group of negative pulses represented by the curve *f* passes through condenser 41*a* to the switch 42*a*. These two switches are shown in the center position which is the "mixing" position where the positive series of pulses is applied to the grid of switching tube 11 and the negative series is applied to the grid of switching tube 11*a*.

As previously explained, video signals from transmitter 1 are normally being transmitted to the line 3 by tube 4. When a positive signal pulse is received by tube 11, the current through biasing resistance 7 is increased so that the negative biasing potential applied to the tube 4 is at the cutoff point. At the same time, a negative pulse is being supplied to switching tube 11*a*, and this reduces the current flowing through biasing resistor 7*a* which raises the biasing potential of amplifier 4*a* above the cutoff point and allows video signals to be transmitted from transmitter 2 to line 3. Thus, scene A will be transmitted within the entire area A' in Figure 2 except for the insert area B*a* which contains a portion of scene B.

By turning switches 42 and 42*a* to the right-hand position, positive pulses continue to be supplied to switching tube 11 and the video signals from transmitter 1 are blanked out within the area B*a*, but the grid of switching tube 11*a* is connected to ground and no signals are transmitted from transmitter 2. Thus, the area B*a* will remain blank in this position of the switches.

In the lefthand position of switches 42 and 42*a*, no signals will be transmitted from transmitter 2, and negative signal pulses will be applied to the grid of switching tube 11. These pulses will decrease the current flowing through biasing resistor 7 and will accordingly decrease the negative bias on amplifier 4 and will increase the brightness of the video signals from transmitter 1 within the area B*a*. Thus, by a simple adjustment of the switch control 43, it is possible to obtain three conditions of transmission corresponding to "mix," "blank" and "bright."

The degree of brightening, blanking or mixing may be controlled by varying the potentiometer 37.

By using the monitor scope 45, the operator of the television transmitter 1 can see the position and the extent of the inserted area B*a* at all times. The signals supplied to the beam modulating electrode of the monitor scope will serve to brighten the area B*a* relative to the remaining parts of the area enclosed within the rectangle A'. Signals from transmitter 2 may be supplied to the monitor scope 45, so that the operator may change the position and extent of the insert area B*a* to follow the points of interest in the scene B.

The horizontal dimension of the insert area B*a* is determined by adjustment of the condenser 28, and the vertical dimension of this area is determined by adjustment of condenser 28*a*. The position of the left boundary of the area B*a* is determined by adjustment of potentiometer 14, and the position of one of the horizontal boundaries is determined by adjustment of potentiometer 14*a*. By properly adjusting these four controls, it is possible to vary the size, position and shape of the area B*a*. This area may be reduced to zero or it may be made to entirely cover the area A' by proper adjustment of the controls.

While my invention has been described and illustrated as applied to a television transmitting station, it will be obvious that it may be applied to control the receiver at a television receiving station. In this case the generators H and V would supply the horizontal and vertical scanning waves for the receiving scope, and the two television signals received from a distant transmitting station or stations would be applied to the grids of tubes 4 and 4*a*. The line 3 would be connected to the beam controlling electrode of the receiving scope.

I claim:

1. In a television system, an arrangement for producing control signal waves comprising, in combination, a source of positive saw-tooth waves for horizontal scanning, a one-shot multivibrator to produce a square-wave positive pulse of adjustable duration, means for triggering said multivibrator comprising a grid-controlled trigger tube, a source of biasing voltage normally biasing said trigger tube below cut-off, means applying said positive saw-tooth waves to the grid of said trigger tube to generate a triggering impulse when said saw-tooth waves reach a value to cause conduction in said trigger tube, a sec-

ond source of positive saw-tooth waves for vertical scanning, a second one-shot multivibrator for producing a square-wave pulse of adjustable duration, means for triggering said second multivibrator comprising a second grid-controlled trigger tube, a source of biasing voltage normally biasing said second trigger tube below cut-off, means applying said second saw-tooth waves to the grid of said second trigger tube to generate a triggering impulse when said second saw-tooth waves reach a value to cause conduction in said second trigger tube, an amplifier controlled by said first mentioned multivibrator and being normally biased below cutoff, and means controlled by said second mentioned multivibrator for shifting the bias on said amplifier to the cut-off point during each pulse of the second multivibrator.

2. In a television system, an arrangement for producing control signal waves comprising, in combination, a source of saw-tooth waves for horizontal scanning, a one-shot multivibrator to produce a square-wave pulse of adjustable duration, a gate device energized by said saw-tooth waves and being responsive to a predetermined value thereof for generating a triggering impulse in each horizontal scanning cycle, means applying said triggering impulses to trigger said multivibrator, means for adjusting the aperture of said gate device and thereby varying the time of triggering of said multivibrator in the cycle of horizontal scanning, a second source of saw-tooth waves for vertical scanning, a second one-shot multivibrator for producing a square-wave pulse of adjustable duration, a second gate device energized by said second saw-tooth waves and being responsive to a predetermined value thereof for generating a triggering impulse in each vertical scanning cycle, means applying said triggering impulses to said second multivibrator, means for adjusting the aperture of said second gate device and thereby varying the time of triggering of said second multivibrator in the cycle of vertical scanning, an output circuit, and means controlled jointly by said multivibrators for transmitting pulses from said first multivibrator to said output circuit only during intervals of pulses from said second multivibrator.

3. A combination according to claim 2 and including two sources of video signals representing different scenes, a video output circuit, normally operative transmission means for transmitting video signals from one of said sources to said video output circuit, normally inoperative transmission means for transmitting video signals from the second video source to said video output circuit, and means controlled by the pulses in said control output circuit for disabling said normally operative transmission means and activating said normally inoperative transmission means.

4. In a television system, an arrangement for producing a control signal wave comprising, in combination, a source of saw-tooth sweep wave for horizontal scanning, a gate device including a normally non-conductive amplifier tube controlled by said saw-tooth wave and rendered conductive at a predetermined value of each saw-tooth pulse and thereby producing a sharp positive pulse at a predetermined point in each horizontal scanning cycle, a one-shot multivibrator triggered by each of said positive pulses and producing a pulse of predetermined duration, a source of saw-tooth sweep wave for vertical scanning, a second gate device including a normally non-conductive amplifier tube controlled by said vertical scanning saw-tooth wave and rendered conductive at a predetermined value of each saw-tooth pulse and thereby producing a sharp positive pulse at a predetermined point in each vertical scanning cycle, a second one-shot multivibrator triggered by the positive pulses produced by said vertical scanning wave, an output circuit, means controlled jointly by said multivibrators for transmitting pulses from said first multivibrator to said output circuit only during intervals of pulses from said second multivibrator, and means for varying the bias of said amplifier tubes to vary the times at which said tubes become conductive.

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