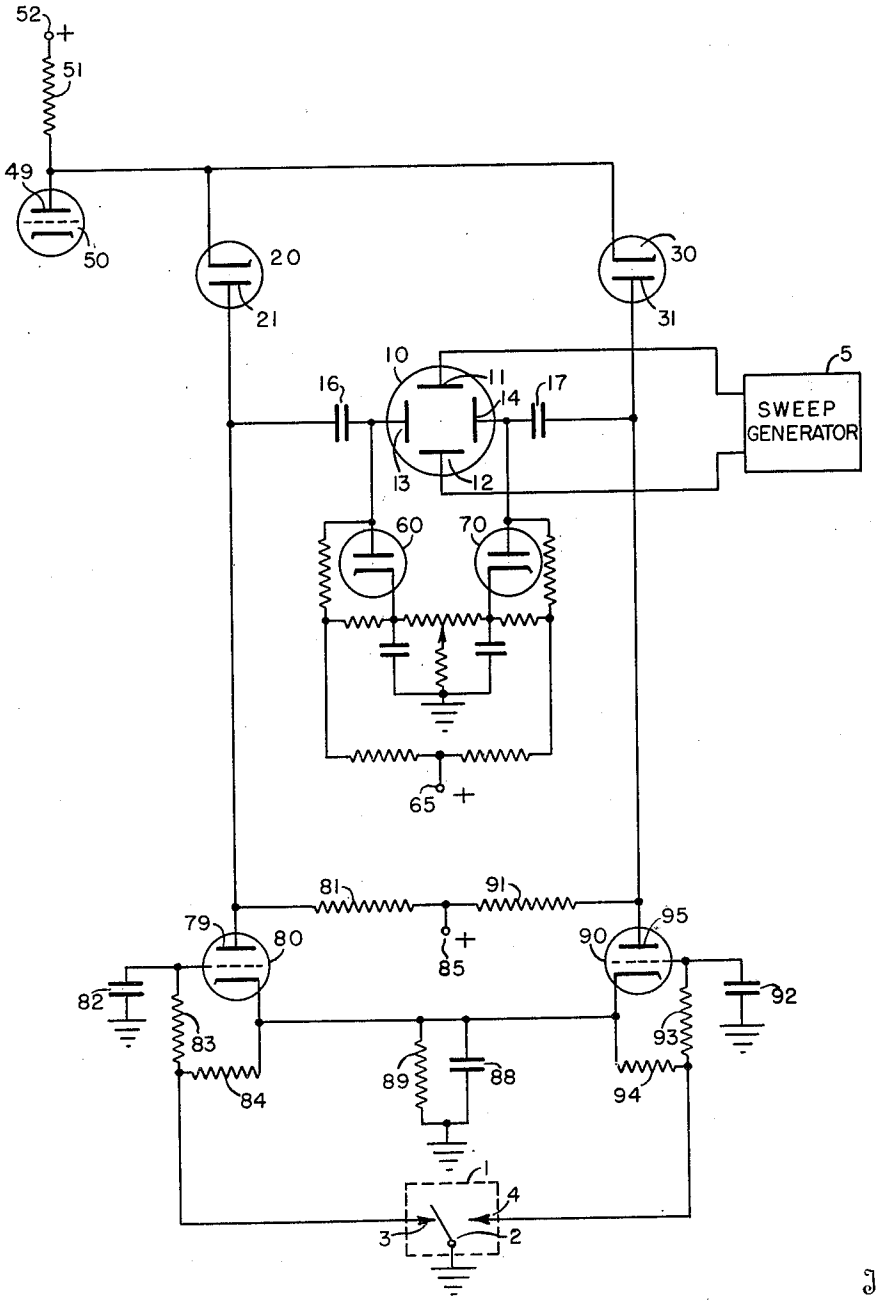
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ELECTRONIC SWITCH

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Inventor

KENNETH BLAKE

By Ralph L. Chappell

Attorney

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ELECTRONIC SWITCH

Kenneth Blake, Washington, D. C., assignor to Minister of Supply in His Majesty's Government of the United Kingdom of Great Britain and Northern Ireland, London, England

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This invention relates to electronic switches and, more particularly, to apparatus for switching video currents from one signal channel to another.

Applications often arise in echo-ranging and other electronic apparatus wherein a video or an audio signal is to be switched from one signal channel to another responsively to the action of a mechanical switch. An example is in systems employing antenna-lobe switching, in which the video output of the receiver should be switched from one indicator component to another simultaneously with the operation of the lobing switch in the antenna apparatus. Switching a video or an audio signal by mechanical means often is unsatisfactory in such applications because of distortion of the video signal caused by large shunt capacitances in the mechanical switch and the cables leading thereto. It is accordingly one object of this invention to obviate the aforementioned difficulties and to provide electronic means for effecting rapid signal-current switching in response to the action of a mechanical switch, without distortion of the waveform.

The invention will be better understood by reference to the following specification taken in connection with the accompanying drawing in which the single figure shows schematically one embodiment of the invention as incorporated in the cathode-ray tube indicator device of an echo-ranging and object detecting system.

Referring more specifically to the drawing, a cathode ray tube 10 is indicated schematically by the circular outline within which only the beam deflection plates are shown. Thus, the plates producing vertical beam deflection are denoted respectively 11 and 12 while the plates producing horizontal beam deflection are numbered 13 and 14. The vertical beam deflection plates 11 and 12 are connected to a sweep generator 5, shown in block form, which produces systematic vertical deflection of the electron beam. A conventional D.-C. restoration and positioning circuit, comprising diode tubes 60 and 70, D.-C. source 65, and the resistors and condensers associated therewith, is connected to the deflection plates 13 and 14; this circuit maintains a stable horizontal beam position except when signals are fed to one of the horizontally-deflecting plates 13 and 14.

Tube 50 is the final video amplifier tube of a receiver (not shown), the plate 49 of this tube being connected to D.-C. source 52 through load resistor 51 and also connected to the cathodes of

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diode tubes 20 and 30. The plate 21 of diode 20 is connected through coupling condenser 16 to deflection plate 13; the plate 31 of diode 30 is connected through coupling condenser 17 to deflection plate 14. The plate 79 of triode tube 80 is connected to the plate 21 of diode 20; load resistor 81 is connected between the plate 79 of tube 80 and positive D.-C. voltage source 85. The plate 95 of tube 90 is connected to the plate 31 of diode 30; and load resistor 91 is connected between the plate 95 of tube 90 and positive D.-C. source 85.

The cathodes of tubes 80 and 90 are connected together and are connected to ground through biasing resistor 89. By-pass condenser 88 is connected in parallel with resistor 89. Resistors 83 and 84 are connected in series between the control grid of tube 80 and its cathode. The grid of tube 80 is by-passed to ground by condenser 82. Resistors 93 and 94 are connected in series between the control grid and cathode of tube 90; the grid of tube 90 is by-passed to ground by condenser 92.

Switch 1 within the block shown in broken lines is a mechanical switch. In this apparatus the switch 1 normally would be mechanically coupled to and operated synchronously with an antenna-lobing switch (not shown). Switch 1 has a pair of stationary contact elements 3 and 4 and a movable switch arm 2. Switch arm 2 makes contact with these contacts alternately; it engages contact 3 while the ranging system is operating on one antenna lobe, and with contact 4 while the system is operative on the other lobe. Contact 3 is connected to the junction of resistors 83 and 84. Contact 4 is connected to the junction of resistors 93 and 94. Contact 2 is grounded.

The negative sides of all the D.-C. sources shown may be considered grounded. The potential of positive source 85 should be substantially greater than the D.-C. potential at the plate 49 of tube 50. Typical values employed in a practical construction were 300 volts at the plate of tube 50 and 400 volts at D.C. source 85.

In describing the operation of the invention, it will be first assumed that switch 1 is in the position wherein contact 3 is grounded and contact 4 is open. Under these circumstances tube 90, having its grid at cathode potential, will conduct and tube 80, the grid of which is at ground potential, will be cut off. (The current drawn by tube 90 flows through resistor 89 and raises the cathode of tube 80 sufficiently above ground to cut off current in tube 80.) Since tube 90 is con-

ducting, a large voltage drop occurs in resistor 91, and the plates 95 and 31 of tube 90 and diode 30, respectively, are at a low voltage, i. e., much less positive than the voltage at the cathode of diode 30. In consequence, therefore, no current flows in diode 30 and no video signals reach deflection plate 14 of cathode-ray tube 10. Tube 80 being nonconducting on the other hand, its plate voltage rises to a value more positive than that of the cathode of diode 20. In consequence, a direct current flows from D.-C. source 85 through load resistor 81, and diode 20 to the plate 49 of tube 50. The magnitude of this current, and the resulting potential at the plates 21 and 79 of tubes 20 and 80, respectively, is proportional to the instantaneous plate voltage of tube 50. Thus video signals appearing at the plate of tube 50 are reproduced at the plate of diode 20 and applied through condenser 16 to deflection plate 13. If the video signal consists of negative pulses, the application of the video voltage to deflection plate 13 would result in beam deflection away from that plate or to the right as the cathode ray tube is viewed in the drawing.

Now suppose the antenna lobe switch shifts to its other position, and in synchronism therewith contact 2 of switch 1 is shifted so as to ground contact 4 and leave contact 3 open. The tubes 80 and 90, in this instance, interchange roles; tube 80 conducts heavily and tube 90 is cut off. The plate voltage of tube 80 drops sharply and blocks any further transmission of signals through diode 20. The plate voltage of tube 90 meanwhile rises, at a rapid rate. When it reaches the potential of the cathode of diode 30, that diode starts to conduct and signal transmission proceeds as before, except that signals are now applied to deflection plate 14, where they cause beam deflection in tube 10 in the opposite direction. The result is the type of ranging data presentation commonly called "L-scan," wherein range is indicated on the face of tube by the vertical position of a signal pip and the relative strength of reception on the two lobes is indicated by the relative amplitude of the deflections to left and right.

The great advantage of a system employing the principles of this invention is that the leads running to the mechanical switch 1 carry only direct currents and therefore can be made as long as necessary without distorting the waveform of the video currents which are switched electronically from deflection plate 13 to deflection plate 14. In practical installations switch 1 must usually be situated near the antenna of the ranging system at a considerable distance from cathode ray tube 10, and cable capacitances would seriously attenuate the high frequency components of the video currents were those currents carried to and from switch 1.

The advantage of this system over a mechanical relay system is that the capacitances inherent in this invention are very small and switching transients are ended within one or two milliseconds after a switching operation, a much shorter time than can reliably be achieved by a mechanical relay.

It will be understood that the embodiment of the invention herein shown and described is exemplary only, and that the scope of the invention is to be determined by reference to the appended claims.

What is claimed is:

1. In combination, a signal source; first and second signal channels; a first unidirectional electronic means for coupling the signal source to the first channel; a second unidirectional electronic means for coupling the signal source to the second channel; switching means having first and second alternative operating positions; and control means responsive to said switching means operative when the switching means is in one operating position to apply a blocking bias voltage to the second unidirectional electronic means and to allow the first unidirectional electronic means to pass signals through to the first channel, said control means being operative when the switching means is in another operating position to apply a blocking bias voltage to the first unidirectional electronic means and to allow the second unidirectional electronic means to pass signals through to the second channel.

2. In combination, a signal source; first and second signal channels; a first diode means coupling the signal source to the first channel; a second diode means coupling the signal source to the second channel; a switch having first and second states; and control means responsive to the switch operative when the switch is in the first state to apply a blocking bias voltage to the second diode means and to allow the first diode means to pass signals through to the first channel, and operative when the switch is in the second state to apply a blocking bias voltage to the first diode means and to allow the second diode means to pass signals through to the second channel.

3. In combination, a signal source; first and second signal channels; a first diode means coupling the signal source to the first channel; a second diode means coupling the signal source to the second channel; a first control tube having a cathode, an anode and a grid; a second control tube having a cathode, an anode and a grid; means coupling the anode of the first control tube to the first diode; means coupling the anode of the second control tube to the second diode; a switch having first and second states; and means coupling the grids of the control tubes to the switch means operative when the switch is in the first state to bias the grid of the first control tube to render the first diode means conducting and to bias the grid of the second control tube to block the second diode means, and operative when the switch is in the second state to bias the grid of the second control tube to render the second diode means conducting and to bias the grid of the first control tube to block the first diode means.

4. In combination, a signal source; first and second signal channels; a first diode means coupling the signal source to the first channel; a second diode means coupling the signal source to the second channel; a first control tube having a cathode, an anode, and a grid; a second control tube having a cathode, an anode, and a grid; means coupling the anode of the first control tube to the first diode means; means coupling the anode of the second control tube to the second diode means; a voltage source; impedance means connecting the anode of the first control tube to the voltage source; impedance means connecting the anode of the second tube to the voltage source; impedance means coupling the grid of the first tube to its cathode; impedance means coupling the grid of the second tube to its cathode; means biasing the cathodes of both control tubes at a bias voltage relative to ground; a switch means having first and second states; and means operative to place the grid of the first

control tube at ground potential when the switch is in the first state and operative to place the grid of the second control tube at ground potential when the switch is in the second state.

5. In combination, a signal source, a plurality of signal channels, diode means coupled between said source and each of said channels, each of said diode means responsive to an unblocking bias to establish a circuit between said source and the channel coupled thereto and responsive to a blocking bias to isolate said source from the channel coupled thereto, electronic control means operative to apply an unblocking bias to any one of said diode means and to simultaneously apply a blocking bias to the remainder of said diode means and switch means controlling said control means so that a circuit may be established between said source and any preselected one of said channels.

6. In an apparatus for selectively controlling application of a signal source to any one of a plurality of signal channels, electronic coupling means positioned between said source and each of said channels, each of said electronic coupling means responsive to an unblocking bias to establish a circuit between said source and the channel associated therewith, control means operable to apply an unblocking bias to any one of said electronic coupling means and selectively operable switch means to control said control means so that an unblocking bias may be applied to a preselected one of said electronic coupling means.

7. In an apparatus for selectively controlling application of a signal source to any one of a plurality of signal channels, electronic coupling means positioned between said source and each of said channels, each of said electronic coupling means responsive to an unblocking bias to establish a circuit between said source and the channel associated therewith and responsive to a blocking bias to isolate said source from said associated channel, control means operable to apply an unblocking bias to any one of said electronic coupling means and to simultaneously apply a blocking bias to the remainder of said electronic coupling means and selectively operable switch means to control said control means so that a circuit may be established between said source and any preselected one of said signal channels.

8. In an apparatus for selectively controlling the application of a signal source to either of two signal channels, electronic coupling means positioned between said source and each of said channels responsive to an unblocking bias to establish a circuit between said source and the channel associated therewith and responsive to a blocking bias for isolating said source from said associated channel, control means operable to apply an unblocking bias to either of said coupling means and to simultaneously apply a blocking bias to the other of said coupling means and selectively operable switch means to control said control means so that a circuit may be established between said source and a preselected one of said signal channels.

9. In combination, a signal source, a plurality of signal channels, a plurality of uni-directional discharge devices each including a cathode and an anode connecting said source to said channels with the cathode of each of said devices connected to said source and with the anodes thereof connected to separate channels of said channels, means applying positive bias to the cathodes of said devices, and selectively operable means applying positive bias greater than the positive bias applied to said cathodes to any one of said anodes for selectively coupling said signal source to any one of said signal channels.

KENNETH BLAKE.

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