Aug. 30, 1949. D. D. GRIEG 2,480,130

LOW IMPEDANCE SWITCH CIRCUIT

Filed April 6, 1946

Fig. 1.

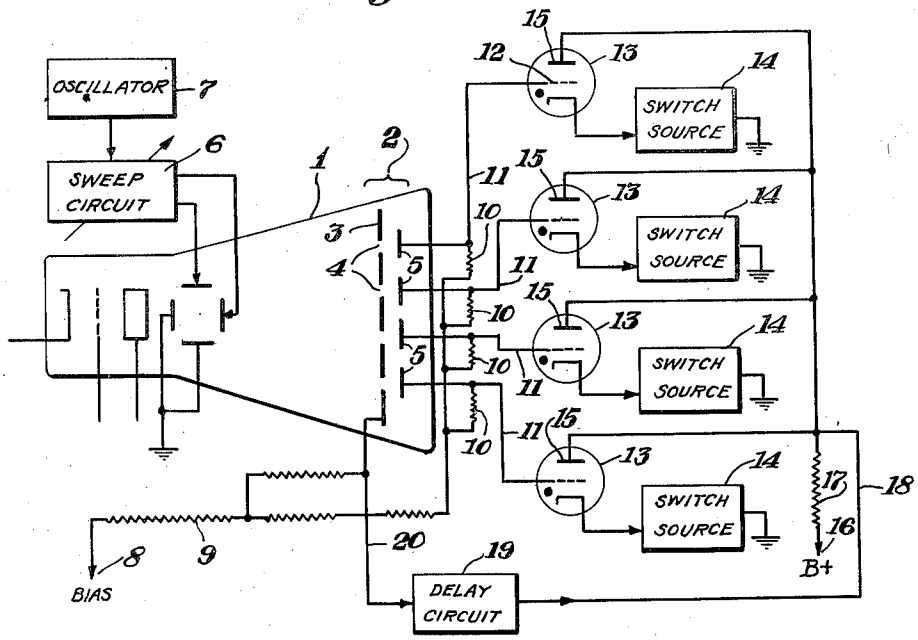
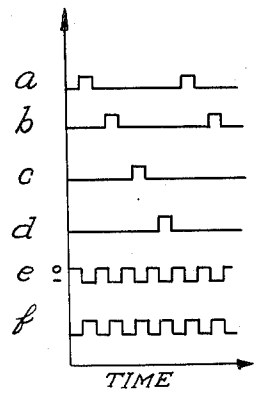



Fig. 2.




INVENTOR.
DONALD D. GRIEG

BY

ATTORNEY

Patented Aug. 30, 1949 2,480,130

# UNITED STATES PATENT OFFICE

2,480,130

## LOW IMPEDANCE SWITCH CIRCUIT

Donald D. Grieg, Forest Hills, N. Y., assignor to Federal Telecommunication Laboratories, Inc., New York, N. Y., a corporation of Delaware

Application April 6, 1946, Serial No. 660,108

7 Claims. (Cl. 250—27)

1

This invention relates to switching circuits and more particularly to electronic switching systems of the type employing a cathode ray tube.

When using switching circuits in connection with a plurality of circuits, particularly circuits which handle comparatively large currents, difficulties arise in providing sufficiently high speed switching from one circuit to another, which, at the same time, permit the use of large currents.

It is an object of the invention to provide a high speed-low impedance switching circuit.

It is another object to provide an electronic switching circuit employing a cathode ray beam for controlling low impedance-high amplitude current switching circuits.

A still further object of the invention is to provide control means for low impedance electronic switches which is dependent on the operation of dynodes or secondary emission producing electrodes in a cathode ray tube.

In accordance with my invention, I provide a series of switch devices which are controlled by individual thyratrons or gaseous electron discharge tubes. For the control of these thyratrons, I provide a cathode ray tube, the electron beam of which is made to act successively on a series of secondary emission producing targets or dynodes. The impact of the beam on the targets produces positive pulses in the output circuits thereof which are employed to control the thyratrons. The pulses produced in the secondary emission targets cause equal and opposite pulses in a barrier plate of the cathode ray tube, which, after suitable phasing, are applied to the plates of the thyratrons for interruption of the operation thereof.

These and other features and objects of the invention will become more apparent and the invention best understood upon consideration of the following detailed description of an embodiment of the invention to be read in connection with the accompanying drawings in which:

Fig. 1 is a diagram in schematic form of a switching circuit of my invention; and

Fig. 2 is a series of graphs illustrating certain operative conditions of the circuit of Fig. 1.

Referring to the schematic in Fig. 1, the switching circuit is seen to comprise a cathode ray tube 1 including, in addition to the usual electron gun equipment, a so-called dynode arrangement 2. The dynodes include a barrier or aperture plate 3 which is provided with a series of apertures 4. Behind each aperture in the line of the cathode ray beam, a number of targets 5 have been provided which are capable of secondary

2

emission upon being impinged upon by the cathode ray beam through the apertures 4. The cathode ray beam of the tube 1 is made to sweep across the apertures 4 at a preselected, desired speed is determined by a suitable sweep circuit 6 energized from an oscillator 7. The aperture plate 3 and the various targets 5 are suitably biased from a source at 8 over a resistance type voltage divider 9 and individual dropping resistances 10. Each of the targets 5, of which four are illustrated, are connected over lines 11 to control grids 12 of respective thyratrons 13 as illustrated, or other gas-filled low impedance electronic relays. Each of the relays 13 includes in their cathode circuits, a high amplitude current switching device indicated at 14. The plate circuits 15 of the relays 13 are connected in parallel to a biasing source at 16 over a common dropping resistance 17. The plate circuits are also connected over a line 18 to a delay circuit 19 which is energized over a line 20 from the aperture plate 3.

As the electron beam of the cathode ray tube 1 sweeps past the apertures 4 in the plate 3 and successively impinges on the targets 5, secondary emission drawn from the targets to the plate 3 due to the relative biasing conditions renders such targets more positive and the plate somewhat more negative than they were before and between the intervals when the electron beam impinges on the targets. In consequence, positive pulses are set up in the respective output lines 11 which are connected to the control grids 12 of the thyratrons 13, thus enabling the latter to become conductive and thereby to permit the operation of the respective switching device 14. Graphs *a*, *b*, *c* and *d* in Fig. 2 indicate the character of the positive pulses transmitted to the various control grids as a consequence of the passage of the electron ray thereacross. The thyratron tubes 13 characteristically continue to function, that is, remain conductive after cessation of the positive enabling pulses. In order to control the operation of the thyratrons, that is, in this case to interrupt their operation, as the electron beam leaves each target, the negative pulses simultaneously available on the aperture plate 3 are made use of. This is accomplished by applying the negative pulses from the plate 3 as shown in graph *e* in Fig. 2 after a suitable delay in the delay circuit 19 to the respective plates of the tubes 13. It will be seen that the negative pulses of graph *e* are coincident with the positive pulses obtainable from the various targets 5. In graph *f* the negative pulses are

shown to have been delayed exactly by the width of the positive pulses so that a negative pulse is applied to the respective plate immediately following the application of a positive pulse to the grids. This has the effect of interrupting the conductivity of the thyratrons. The delay circuit 19 may suitably comprise any network of conductances and capacities to simulate a transmission line to provide the necessary delay in accordance with graphs *e* and *f*.

It is thus seen that I have provided a high speed switching apparatus of low impedance able to handle comparatively large currents at a speed determined only by the frequency of the sweep circuit.

While the above is a description of the principles of this invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation of the scope of this invention.

I claim:

1. An electronic switching system, comprising a switching device, low impedance relay means for controlling the operation of said device, and electron gun means having electrodes energized by the movement of the electron ray of said gun, and connections from said electrodes to said relay whereby said relay is energized from one said electrode and deenergized from the other said electrode.

2. An electronic switching system according to claim 1, including a delay circuit device for determining the time interval between said relay energization and deenergization.

3. An electronic switching system, comprising at least one switching device, low impedance relay means for controlling the operation of said device, and electron gun means including at least one dynode corresponding to said one relay means for controlling separately the on-and-off operation of said relay means.

4. A system according to claim 3, wherein said relay means comprises a gaseous electron discharge device.

5. A system according to claim 3, wherein said dynode includes a secondary emission producing target for the electron ray and an apertured barrier plate, connections whereby said target becomes a source of a positive polarity impulse for initiating the operation of said relay means and connections whereby said plate becomes the source of a negative impulse for interrupting the operating of said relay means following the initiation thereof.



6. A system according to claim 3, wherein said dynode includes a secondary emission producing target for the electron ray and an apertured barrier plate, connections whereby said target becomes a source of a positive polarity impulse for initiating the operation of said relay means and connections whereby said plate becomes the source of a negative impulse for interrupting the operating of said relay means following the initiation thereof, further including delay circuit means in circuit with said barrier for delaying the negative impulse therefrom in respect to the positive pulse from the target.

7. An electronic switching system, comprising a plurality of switching devices of the type requiring a comparatively large current for the operation thereof, gaseous electron discharge tubes one for controlling the operation of each of said devices operatively associated therewith having an anode and a grid; an electron gun device including a dynode corresponding to each of said discharge tubes, said dynodes including a barrier plate and targets for said electron gun, said barrier plate being apertured in line with said targets; means connecting said targets to corresponding grids, means connecting said barrier plate to each of said anodes; and delay circuit means in said means connecting said barrier plate and said anodes.

DONALD D. GRIEG.


REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

| Number | Name | Date |
|---|---|---|
| 2,097,392 | Finch | Oct. 26, 1937 |
| 2,173,193 | Zworykin | Sept. 19, 1939 |
| 2,185,693 | Mertz | Jan. 2, 1940 |
| 2,212,645 | Morton | Aug. 27, 1940 |
| 2,223,001 | Farnsworth | Nov. 26, 1940 |
| 2,224,677 | Hanscom | Dec. 10, 1940 |
| 2,243,158 | Banks | Feb. 18, 1941 |
| 2,250,527 | Gray | July 29, 1941 |
| 2,250,528 | Gray | July 29, 1941 |
| 2,267,557 | Espenschield et al. | Dec. 23, 1941 |
| 2,310,883 | Thom | Feb. 9, 1943 |
| 2,311,021 | Blumlein | Feb. 16, 1943 |