Nov. 26, 1946. J. P. SMITH 2,411,598

KEYING CIRCUIT

Filed Jan. 22, 1943

Fig. 1.

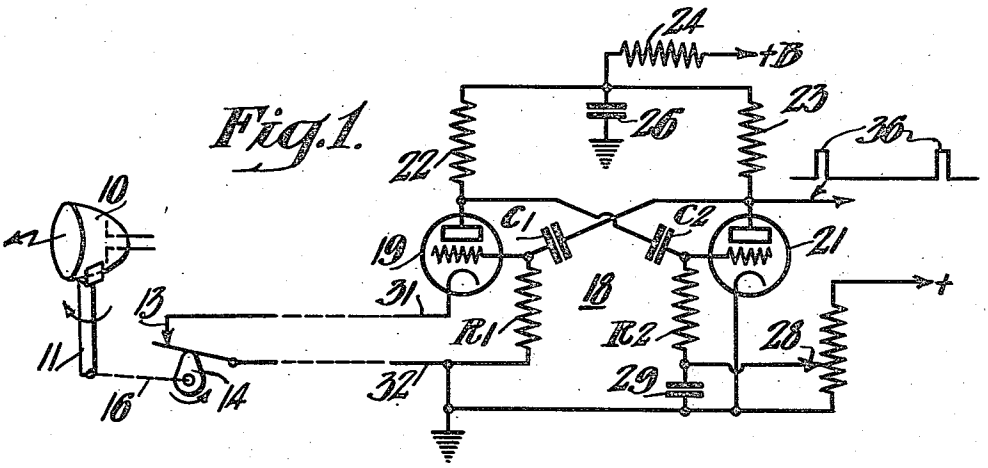


Fig. 2.

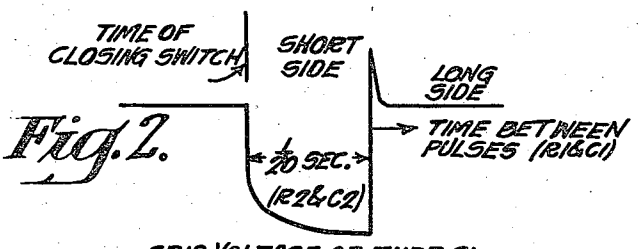


Fig. 3.

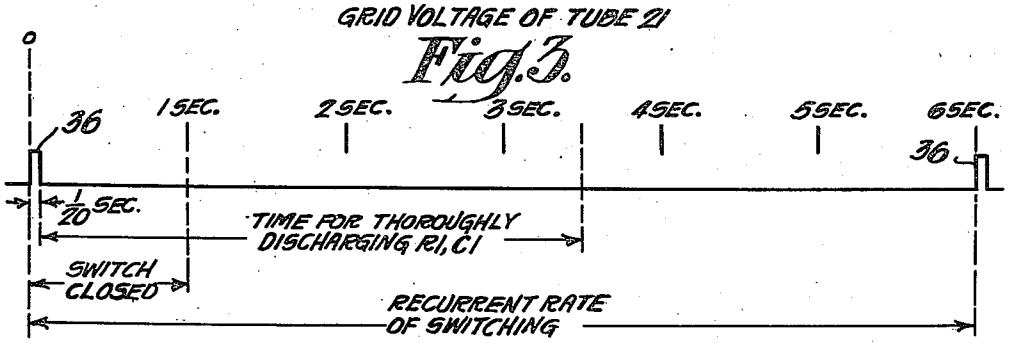
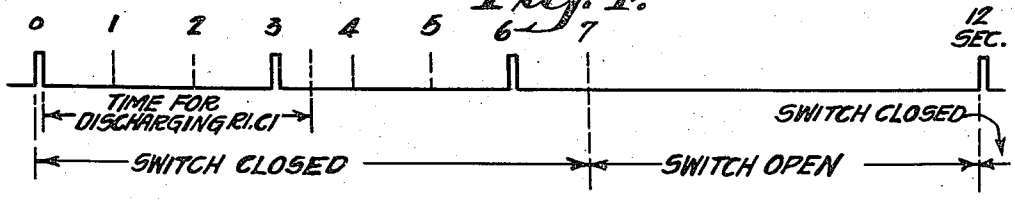


Fig. 4.



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KEYING CIRCUIT

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3 Claims. (Cl. 250—27)

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My invention relates to keying or switching circuits and particularly to an electrical circuit wherein electrical pulses are produced under the control of mechanical switching.

One object of the invention is to provide an improved means for obtaining short electrical pulses in response to the actuation of a mechanical switch.

Another object of the invention is to provide an improved means for obtaining electrical pulses which occur synchronously with the rotation or other motion of a mechanical element.

In a preferred embodiment of the invention, I utilize an asymmetrical multivibrator and connect the mechanical switch in the cathode circuit of the multivibrator tube that has the longer grid capacitor-grid leak resistor time constant. A short electrical pulse is generated in response to closing the cathode circuit by the switch, the pulse ending before the switch is opened. Also, the longer time constant is adjusted so that the grid capacitor of said tube is substantially fully discharged before the switch is again closed.

The invention will be better understood from the following description taken in connection with the accompanying drawing in which

Figure 1 is a circuit diagram illustrating one embodiment of the invention,

Figure 2 is a graph that is referred to in explaining the operation of Fig. 1,

Figure 3 is a graph showing the time relations between the switch operation and the multivibrator output, and

Figure 4 is a graph illustrating another method of practicing the invention.

In Fig. 1, one embodiment of the invention is shown applied to a system wherein a directional antenna 10 is rotated about a vertical shaft or axis 11 at a constant speed. It is desired to produce a short electrical pulse each time the antenna 10 reaches a certain position, for example, each time the antenna radiation pattern is pointing north.

A switch 13 located near the antenna 10 is closed periodically by a cam 14 as the antenna is rotated. The cam 14 may be mechanically coupled to the shaft 11 as indicated by the broken line 16 so that the switch 13 closes once for each rotation of the antenna.

A multivibrator 18, which may be located at a point remote from the antenna 10, comprises two three-element vacuum tubes 19 and 21. Plate voltage is applied to the tubes through plate resistors 22 and 23. The resistor 24 and capacitor 26 are filter elements.

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Tube 19 has a grid resistor R1 and a grid capacitor C1 having comparatively large resistance and/or capacity, respectively, whereby the time constant of the circuit R1—C1 is comparatively large. The tube 21 has a grid leak resistor R2 and a grid capacitor C2 having comparatively small values so that the time constant of circuit R2—C2 is comparatively small. The cathode end of resistor R2 may be connected to a variable tap 28 on a source of positive biasing voltage for controlling the width of the multivibrator pulses. A bypass capacitor 29 may be provided.

The cathode circuit of the tube 19 includes the switch 13 so that the cathode of tube 19 is connected to ground through the conductors 31 and 32 and the switch 13 when the switch 13 is closed. When switch 13 is closed, plate current flows through tube 19 to cause a voltage pulse 36 of short duration to appear on the plate of tube 21. The action of the circuit in producing the desired short pulse is illustrated by the graph in Fig. 2 showing the voltage on the grid of tube 21 and by the diagram in Fig. 3 showing the different time relations. The action is substantially as follows: When the switch 13 closes there is an increase of current flow through the tube 19 which causes its plate to go more negative and drive the grid of tube 21 more negative. This decreases the plate current through tube 21 to make its plate more positive whereby the grid of tube 19 is made more positive, thus further increasing the current flow in tube 19 and reinforcing the negative charge on grid capacitor C2. As a result, the tube 21 is almost instantly driven to plate current cutoff to produce the front edge of the short pulse 36. This cutoff condition is held until the charge of the capacitor C2 leaks off through resistor R2 enough to let the grid of tube 21 go positive. The plate of tube 21 now goes negative, whereby the capacitor C1 is charged to block the tube 19, thus producing the back edge of the said short pulse 36. Because of the comparatively long time constant of the circuit C1—R1, the tube 19 remains blocked for a comparatively long period and as a result the interval between the successive short pulses is long compared to the width or duration of these pulses.

The width of the pulses 36 may be controlled by adjusting the tap 28 to change the positive bias on the grid of tube 21, this bias adjustment having the same effect as changing the values of the elements C2 and R2. In one specific embodiment of the invention the circuit time constants and the bias for tube 21 were so adjusted

that the short pulse was approximately 1/20 seconds long while the time for complete discharge of the capacitor C1 was three and one-half seconds, this being the condition illustrated in Figs. 2 and 3.

As indicated in Fig. 3, the capacitor C1 is substantially completely discharged between the time the antenna switch 13 opens and the time it is again closed. In the example illustrated the switch 13 has an "on" time of one second and a recurrent closing rate of six seconds.

If desired, the invention may be utilized to provide more than one short pulse for each actuation of the mechanical switch. In this case the widths of the short pulses would be determined by the time constant of the circuit C2—R2 and the intervals between pulses would be determined by the time constant of the circuit C1—R1. Thus, if instead of the arrangement illustrated in Fig. 3, the switch 13 remains closed for seven seconds, as indicated in Fig. 4, three short pulses would be generated with an accuracy of timing depending on the multivibrator constants. By reducing the time constant of the circuit R1—C1 the natural period of the multivibrator may be decreased so that for seven seconds "on" time for switch 13 more than two short pulses may be generated.

I claim as my invention:

1. In combination, an asymmetrical multivibrator comprising a pair of tubes each having a cathode circuit, an anode and a control grid and further comprising a grid capacitor and a grid leak resistor connected to the control grids of said tubes, respectively, one of said tubes having a grid capacitor and a grid leak resistor that have a substantially longer time constant than the grid capacitor and grid leak resistor of the other tube, a switch connected in the circuit of said one tube to break the flow of plate current therethrough when the switch is open, and means for periodically closing said switch for a length of time that exceeds the duration of the shorter duration voltage pulses produced at the plate of said other tube.

2. In combination, an asymmetrical multivibrator comprising a pair of tubes each having a cathode circuit, an anode and a control grid and further comprising a grid capacitor and a grid leak resistor connected to the control grids of said tubes, respectively, one of said tubes having a grid capacitor and a grid leak resistor that have a substantially longer time constant than the grid capacitor and grid leak resistor of the other tube, a switch connected in the cathode circuit of said one tube, and means for periodically closing said switch for a length of time that exceeds the duration of the shorter duration voltage pulses produced at the plate of said other tube.

3. In combination, an asymmetrical multivibrator comprising a pair of tubes each having a cathode circuit, an anode and a control grid and further comprising a grid capacitor and a grid leak resistor connected to the control grids of said tubes, respectively, one of said tubes having a grid capacitor and a grid leak resistor that have a substantially longer time constant than the grid capacitor and grid leak resistor of the other tube, a switch connected in the cathode circuit of said one tube, and means for periodically closing said switch for a length of time that exceeds the duration of the shorter duration voltage pulses produced at the plate of said other tube but which is less than the natural period of the multivibrator.

JOHN P. SMITH.