

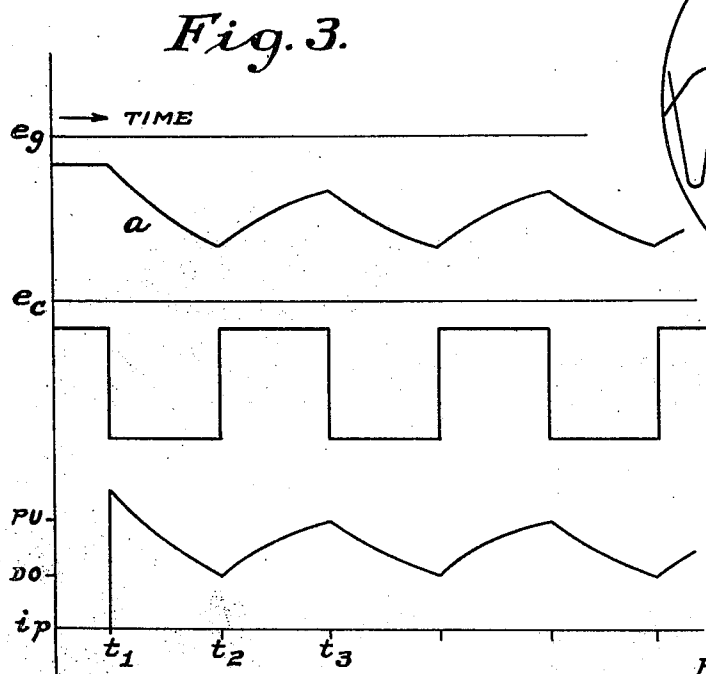
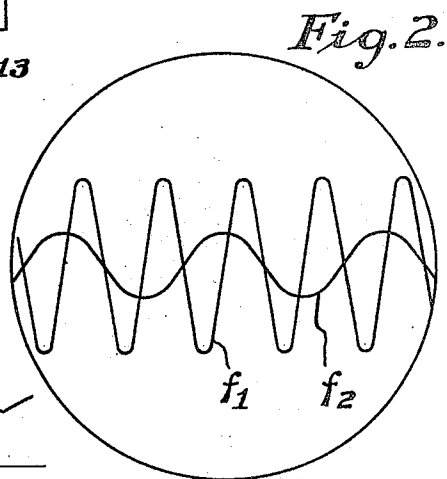
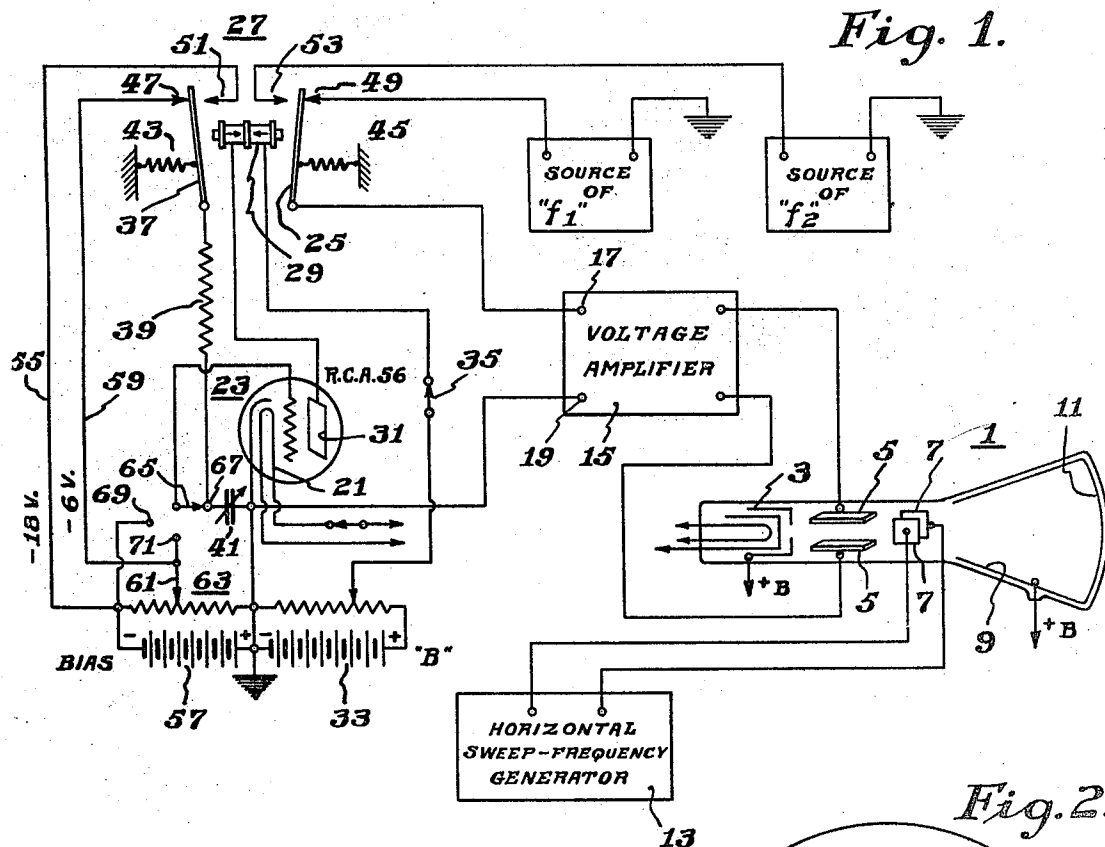
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SWITCHING DEVICE

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SWITCHING DEVICE

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10 Claims. (Cl. 171-95)

My invention relates to switching devices, and it has particular relation to switching devices adapted for use in connection with cathode-ray oscilloscopes and the like.

5 In utilizing cathode-ray oscilloscopes for the investigation of electrical current and/or potential wave forms it is oftentimes desirable to simultaneously view the traces of waves emanating from a plurality of sources. In other words, assuming, for example, that the output potentials from the horizontal and vertical ray deflection oscillation generators, in a television receiving system or the like, are to be investigated, it is convenient to so arrange the circuits of the oscilloscope that both potentials are represented as luminous traces simultaneously upon the fluorescent screen thereof. In order that this may be accomplished, it has been found desirable to supply the horizontal deflection plates of the oscilloscope with alternating potential at the sweep-frequency, which potential controls the horizontal travel of the cathode ray, and to supply to the vertical deflection plates the several frequencies, rapidly commutating between the frequencies applied at a rate such that the phenomenon of persistence of vision causes the two traces to appear simultaneously upon the screen.

My invention, as will hereinafter be apparent, is also applicable to cathode ray tubes equipped with electromagnetic deflection coils instead of plates.

Various devices such as buzzers vibrating relays and motor driven commutators, and the like have been unsuccessfully tried for commutating potentials from the several oscillation generators at a rate of approximately twenty cycles per second, it being a requirement that no high frequency potentials must exist in the vicinity of the contacts, since they would militate against operation of the system if the commutated frequencies appear at low potentials.

The use of a commutator driven by a remotely located motor was rejected on the basis of cost and vibration. Numerous vibrating relays were also tried, but it was found that inductive surge voltages were developed which, when picked up by the wiring adjacent the contacts, marred the appearance of the wave-traces on the fluorescent screen.

It is, accordingly, an object of my invention to provide switching means substantially devoid of inductive surge-potentials.

Another object of my invention is to provide switching means adapted to commutate poten-

tials or currents from a plurality of alternating potential or alternating current sources without the introduction of spurious electrical surges or the like.

Another object of my invention is to provide switching means, adapted to commutate electric currents or potentials wherein the rate of commutation may be controlled electrically without mechanical adjustment of the relay device per se.

A still further and more specific object of my invention is to provide switching means, adapted to commutate electric currents or potentials from two sources, which may at will be rendered operative or kept in a static condition, with either of the said sources semi-permanently connected to an output circuit, upon the simple manipulation of a switching element.

Yet another and still more specific object of my invention is to provide switching means especially adapted for use in connection with an oscilloscope of the cathode ray type that is potential-responsive.

In a preferred embodiment of my invention I attain the foregoing objects and other objects ancillary thereto through the use of a thermionic device for the purpose of causing the current in the winding of a plural-armature relay to automatically rise to a value at which the armatures are picked up and to fall automatically to a value at which the said armatures are released. Also, when the armatures are picked up the conditions are such that one of the sources is operatively connected to the vertical deflection plates of an oscilloscope or cathode-ray tube, and when the armatures are released the other source is connected thereto thus effecting commutation of the said sources. As will be apparent hereinafter, a single moving element may be utilized, associated with a plurality of contact devices, instead of the plural armature relay shown.

The novel features that I consider characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation together with additional objects and advantages thereof, will best be understood from the following description of a specific embodiment, when read in connection with the accompanying drawing, in which

Figure 1 is a diagrammatic view of a cathode-ray oscilloscope system including a preferred embodiment of my invention;

Fig. 2 is a view in elevation of the fluorescent screen of the cathode-ray tube exemplifying the

apparent simultaneous appearance thereon of a plurality of traces corresponding to potentials derived from a corresponding number of alternating current or potential sources, and

Fig. 3 is a series of curves to which reference will be made in explaining the operation of a system constructed according to my invention.

Referring now to Fig. 1 of the drawing, a cathode-ray oscilloscope system constructed according to my invention includes a cathode-ray tube wherein are disposed an electron gun 3, a plurality of vertical deflection plates 5, a plurality of horizontal deflection plates 7, a ray-focusing anode 9, and a fluorescent screen 11. The horizontal deflection plates are connected to a horizontal sweep-frequency generator 13, the frequency of which is adjustable.

The vertical deflection plates 5 are connected to the output terminals of a voltage amplifier 15 the input terminals 19 and 17 of which are connected, respectively to the grounded cathode 21 of a thermionic tube 23 and to an armature 25 of a relay device 27 such as Western Electric type 221-CB, the winding 29 of which is included between the anode 31 of the tube and a potential source exemplified in the drawing by a battery 33. A switch 35 may be included in the anode circuit. The relay device is provided with an additional armature 37 which is connected to the cathode of the tube through a resistor 39 and a capacitor 41. This capacitor may, if desired, be variable, as shown in the drawing.

In the absence of current in the winding 29 the armatures 37 and 35 of the relay device are biased by springs 43 and 45 against outer contacts 47 and 49, respectively. The armatures are also provided with inner fixed contacts 51 and 53, respectively.

The outer contact 49, associated with the armature 25, is connected to the output terminal of an alternating potential source f_1 , and the inner contact 53 is connected to an output terminal of another alternating potential source, f_2 . The other output terminal of each source is connected to ground and, thence, to the cathode 21 of the thermionic tube. Vibration of the armature 25, therefore, between the inner and outer contacts results in alternate connection of the output terminals of the several sources to the input terminals of the voltage amplifier from which amplified potentials are applied to the vertical deflection plates 5 in the cathode ray tube.

In order that the armature 25 may be caused to vibrate, it is necessary that the space current in the thermionic tube, flowing in the relay winding, shall fluctuate. Furthermore, for the desired purpose, it is desirable that the armature shall dwell for a sufficient length of time against each contact to permit a plurality of complete cycles of potential from each source to be impressed upon the vertical deflection plates during each half-cycle of potential from the sweep-frequency source.

To this end, a conductor 55 extends from the inner contact 51, associated with the armature 37, to the negative end of a bias potential source, such as a battery 57, and another conductor 59 extends from the outer contact 47 to the movable element 61 of a potentiometer 63 connected across the said source, while the grid of the tube is connected to a movable switch-element 65 which may be placed in engagement with a switch-point 67 connected to the junction between the resistor 39 and the capacitor 41. Naturally, the potentiometer may be omitted, if de-

sired, and the conductor 59 may lead directly to an appropriate point on the source 57. Using the potentiometer enables finer adjustment, however. Movement of the armature 37, therefore, between the said inner and outer contacts, causes the application of bias potentials to the grid of the tube which alternate between the most negative potential supplied by the source 61 and a potential determined by the position of the potentiometer contact element. These potentials are so chosen that when the armature is against the inner contact 51 the space current is substantially cut off and when it is against the outer contact 47 sufficient current flows to cause both armatures to be drawn up.

Assuming now that the thermionic tube has been energized by the application of alternating potential to the cathode heater and that the several relay armatures are in the position shown, at which time the source of fluctuating potential f_1 is connected across the input terminals of the voltage amplifier 15.

Referring to Fig. 3, if no plate potential has as yet been applied, the potential across the capacitor 41, e_c , equals the grid-biasing potential, e_g , applied to the grid of the tube from the source 57. This potential is so chosen that it permits the flow of space current in the tube. If anode potential is now applied, for example by closing the switch 35 in the anode supply lead, the space current will rise immediately to the value at which the relay armatures are picked up, indicated by the symbols PU and t_1 in Fig. 3. As soon as the relay armatures are picked up a connection is established from the grid of the thermionic tube through the resistor 39 to the negative terminal of the bias potential source 57 and the application of highly negative biasing potential to the grid begins. By reason of the fact, however, that the condenser 41, interposed between the resistor 39 and the cathode, must receive an additional charge before the grid can be biased to the full negative potential of the source, the grid bias, e_g , does not change instantaneously but relatively slowly, as indicated by the curve a in Fig. 3.

At a later time, indicated by t_2 in the drawing, the grid has received a charge sufficiently negative to diminish the plate current, i_p , to a value indicated by DO in the drawing, which permits the armatures to release or drop out, and the sequence of operation continues just so long as the tube is supplied with cathode heating and plate potential. The "dwell" in each position is represented by the successive time-intervals t_1-t_2 , t_2-t_3 , etc.

Referring again to the drawing, it will be noted that the source f_1 is connected across the horizontal deflection plates in the cathode-ray tube during the time the armatures are released and that the source f_2 is connected thereacross during the time when the armatures are pulled up. If, therefore, it is desirable to separately examine the output from the frequency source f_1 , the switch 65 interposed in the grid circuit of the thermionic tube is moved to a switch point 69, connected permanently to the negative terminal of the bias source, thus cutting the plate current down to a value insufficient to hold in the armatures. On the other hand, if it is desired to individually examine the output of the second source f_2 , the switch 65 is moved into engagement with a switch point 71 connected to the movable element 61 of the potentiometer to therefore supply just sufficient bias potential to the tube to per-

mit enough space current to flow therein to maintain the armatures pulled up.

By reason of the presence of the resistor 39 and the capacitor 41 the rate at which the space current in the thermionic tube rises and falls may be quite easily adjusted, this rate obviously depending upon the time constant of the circuit so formed.

Since, in the operation of my improved relay circuit the space current in the thermionic device is never entirely broken, high potential surges do not appear across the winding of the relay and the possibility of such surges causing inductive disturbance in the remainder of the system is thus obviated. Furthermore, since the function of the movable armature is merely to commutate the several frequency sources with respect to the cathode-ray tube and since it plays no part in the operation of the system other than that, sparking does not occur and the inductive surges characteristic of a buzzer, in which the coil current is broken by an armature contact, are obviously missing. It should also be especially noted that, in my improved system, the current in the relay winding changes in value at a relatively slow rate, as compared with analogous devices of the prior art. This is an especially valuable feature of my invention, since it permits the armature to "dwell" for appreciable time in both the open and the closed positions.

Other advantages of my improved system will at once be apparent to those familiar with the art to which it pertains. Also, many modifications will be obvious and my invention therefore is not to be limited except in so far as is necessitated by the prior art and by the spirit of the appended claims.

I claim as my invention:

1. In combination, a thermionic tube having a relay winding in its output circuit, a grid circuit for said tube, a source of biasing potential and means whereby relatively slowly fluctuating negative potential, derived from said source, is introduced into said grid circuit to thereby cause the relay to be periodically actuated.

2. In combination, a thermionic tube having a control-electrode, an output electrode and a cathode, a relay winding connected between the output electrode and the cathode, a connection including a capacitor between the control-electrode and the cathode, a source of biasing potential the positive terminal of which is connected to the cathode, a resistor one end of which is connected to the control-electrode and means under control of said relay winding for connecting the other end of said resistor sequentially and repeatedly to points of differing potential on said source.

3. The invention set forth in claim 2, characterized in that the time-constant of the resistor and the capacitor is of the order of one twentieth of a second.

4. The invention set forth in claim 2, characterized in that the last mentioned means is constituted by a movable armature and a plurality of contact devices associated with the relay winding.

5. In combination with a cathode-ray tube, a relay device having a winding and a movable armature, and means whereby unidirectional

current from any appropriate source may be caused to flow in said winding and to fluctuate at approximately the rate of persistence of vision between a magnitude at which the armature pulls in and a magnitude at which the armature drops out, whereby inductive surges are obviated during the operation of the device, and means for controlling the deflection of the cathode ray in accordance with the movement of said armature.

6. The invention set forth in claim 5, characterized in that the first named means includes a thermionic tube provided with a grid biasing circuit having a relatively low time-constant.

7. In combination, a cathode ray tube having deflecting devices and a fluorescent screen, a relay having a winding, a thermionic tube having a grid and a plate circuit, said winding being connected in said plate circuit whereby plate current flows therethrough, means for applying a slowly fluctuating bias to said grid, and means including said relay for connecting said deflecting devices to one or the other of two alternating voltage sources depending upon the value of said plate current, the frequency of said fluctuations being high enough for causing two curves to be seen simultaneously on said fluorescent screen.

8. In combination with an indicating device for indicating characteristics of the output of alternating voltage sources, an electric discharge tube having a cathode, a control grid and a plate circuit, a relay having a winding included in said plate circuit, a condenser connected between said cathode and said control electrode, a resistor, means including said relay winding for sequentially and periodically connecting said grid through said resistor to points of differing potential whereby a fluctuating current is produced in said plate circuit, and means for sequentially and periodically connecting said sources to said indicating device in accordance with the fluctuations of said plate current.

9. In combination, a cathode ray oscilloscope provided with both horizontal and vertical ray deflecting devices, a plurality of sources of alternating potential, connections for continuously applying potential from one of said sources to one of said ray deflecting devices, commutating means including a thermionic tube for sequentially and repeatedly applying to another of said ray deflecting devices potentials from the remaining sources, a relay actuated by the space current in said tube and means controlled by said relay for causing the bias on the grid of said tube to periodically change relatively slowly from one negative value to another negative value.

10. In combination, a thermionic tube having a relay in its output circuit, a grid circuit for said tube including a resistor and a capacitor serially connected, a source of biasing potential in said grid circuit and means for periodically connecting said resistor and capacitor in shunt to different portions of the biasing potential source whereby relatively slowly fluctuating negative potential is introduced into said grid circuit to thereby cause the relay to be periodically actuated.

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