This invention relates to electrical signalling and computing apparatus.

An object of this invention is to provide an improved control circuit for use in electrical signalling and computing apparatus.

Another object of this invention is to provide an improved control circuit for controlling any selected electric discharge path of a plurality of such paths and simultaneously interrupting all other such paths.

Still another object of this invention is to provide an improved electron discharge device with an anode, a cathode and a pair of grid electrodes which are constructed to restrain the firing of the electric discharge device during incipient ionization thereof.

A further object of this invention is to provide an improved electrical signalling circuit employing a plurality of sources of radiant energy which are adapted to be individually set into operation and which are connected so that initiating the operation of a selected one thereof stops and restrains the continued operation of any of the others thereof.

Other and further objects of this invention will be apparent to those skilled in the art to which it relates from the following specification and claims.

In accordance with this invention there is provided an electrical circuit arrangement that has application in the signalling and computing arts. As set forth in the objects, this invention relates to a device employing a plurality of electric discharge devices which may function as separate sources of radiant energy that may be visible or invisible.

These devices are constructed so that they may be fired or set into operation selectively by means of a cathode ray tube switching device or by means of other switching devices that may be manually, magnetically, photoelectrically or electrostatically operated and one of the features of this invention resides in the fact that when a selected electric discharge device is fired or set into operation, further operation of any of the other electric discharge devices or sources of radiant energy is to be restrained until another device is fired.

Referring to the drawing briefly;

Fig. 1 is a schematic wiring diagram of an embodiment of this invention; and

Fig. 2 is a sectional view of one of the tubes taken along the line 2—2.

Referring to the drawing in detail, there is illustrated a cathode ray switching tube 10 that is employed for the purpose of selectively transmitting firing pulses to the electric discharge devices 30, 40, 50 and 60. Only four of these devices have been illustrated although it is obvious that a larger number may be employed if desired.

The tube 10 is provided with an electron gun 11 and additional electrodes 12 and 13 together with vertical deflectors 14 and horizontal deflectors 15, all of which are of conventional construction. The tube 10 is in addition provided with an elongated anode or target electrode 16 which may be positioned vertically in said tube and upon which the electron beam from the electron gun 11 may normally impinge. A source of current supply 10a—10b is connected between the gun 11 and the anode 16.

Arranged to one side of the electrode 16 is a row of smaller target electrodes 17, 18—19 and 20. These target electrodes 17, 18—19 and 20 are connected to the upper ends of the high resistance units 21, 22, 23 and 24, respectively. The lower ends of these resistance units are connected to the common line 11a which is also connected to the source of current supply 10a—10b and to the lower ends of the primary windings 36, 46, 56 and 66, the upper ends of these windings being connected to the cathodes 31, 41, 51 and 61, respectively, of the tubes 30, 40, 50 and 60 respectively, which may be gas discharge tubes or glow tubes that are adapted to emit light or other radiation. For this purpose the inner walls or parts thereof of these tubes may be provided with a coating of fluorescent material such as zinc sulphide, scheelite, cadmium sulphide or mixtures of these together with various activators depending upon the spectrum desired.

The tubes 30, 40, 50 and 60 are also provided with electron accelerating grids 34, 44, 54, and 64 respectively, which are connected to the upper ends of the secondary windings 37, 47, 57 and 67 respectively, the lower ends of these windings all being connected to the common line 11a. In addition the tubes 30, 40, 50 and 60 are provided with quenching electrodes 35, 45, 55 and 65 respectively. These electrodes are connected together.

They are also connected to the variable contacts of the potentiometers 39, 49, 59 and 69, the resistances of which are connected across the secondary windings 38, 48, 58 and 68.

From the foregoing it is seen that each of the tubes 30, 40, 50 and 60 is provided with a cathode transformer having a primary winding and two secondary windings which are connected as described above, that is, the cathode transformer of the tube 30 is provided with a primary 36 that is connected in series with the cathode 31, and two secondary windings 37 and 38 which are connected in series with the electrodes 34 and 35 respectively, and the common line 11a. The cathode transformers of the tubes 40, 50 and 60 have corresponding windings that are similarly connected.

The tubes 30, 40, 50 and 60 are also provided with firing electrodes 33, 43, 53 and 63 respectively, which are positioned in the apertures of the quenching electrodes 35, 45, 55 and 65 respectively. These firing electrodes 33, 43, 53 and 63 are connected to the small target electrodes 17, 18, 19 and 20 respectively, of the tube 10. However, these firing electrodes 33, 43, 53 and 63 may be connected to variable wipers or contacts provided to the resistances 21, 22, 23 24 respectively, instead of directly to the electrodes 17, 18, 19 and 20, respectively, which, of course, remain connected to the tops of these resistances 21, 22, 23 and 24 respectively. In addition to the foregoing electrodes, the tubes 30, 40, 50 and 60 are also provided with anodes 32, 42, 52 and 62 respectively, which are connected together and to the positive terminal of the source of current supply 10.

This source of current supply is employed for the purpose of energizing the tubes 30, 40, 50 and 60.

The operation of this invention may be understood from the following assumption. Assume that tube 30 which is the No. 1 tube, has been fired and is glowing and it is desired to extinguish this tube and fire tube 50 which is the No. 9 tube. The beam of the CR tube 30 is shifted down on the anode 16 to the position opposite the segment anode 19 by application of the proper potential to the deflectors 14 which deflects the beam downward. When the beam is deflected to the position opposite the segment anode 19, a potential is applied to the deflectors.
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15 which deflects the beam laterally to contact the anode 19 thereby placing a firing potential on the firing electrode 53 of the tube 50. This firing potential causes a stream of electrons to be drawn off of the cathode 51 and said electrons are projected toward the anode 52 thereby ionizing some of the gas in the tube 50 sufficiently to start or fire this tube. The ionized gas acts as a conductor and carries the electric current furnished by the source 70 through the tube. The ionized gas glows and emits light as is well known.

When the tube 50 is fired the current through it increases rapidly depending upon the inductance of the primary 56 of the transformer that is connected in series with the cathode 51 of the tube. The secondary windings 57 and 58 are magnetically coupled to the primary 56 and during the interval of current rise through the tube 50 and the primary 56, electromotive forces are induced into these secondary windings. Winding 58 is connected to the grid electrode 55 of the tube 50 and applies a negative quenching voltage to this electrode and also to all the quenching electrodes of the tubes 30, 40 and 60. This quenching voltage is neutralized in the tube 50 at this time by the positive accelerating voltage applied to the grid 54 from the other secondary winding 57 so that this quenching voltage does not have any effect on the build up of the electric discharge through the tube 50. However, the quenching potential from the winding 58 is also applied to the grid 35 of the tube 30 and is of sufficient magnitude to quench the firing of this tube since no potential sufficient to counteract it is simultaneously applied to the grid 34 of the tube 30 at this time.

The discharge through the tube 30 is quenched and when the current through this tube starts to decrease the magnetic field set up by this current through the primary 36 starts to collapse with the result that electromotive forces of polarities opposite to those induced into the secondary windings 37 and 38 during rising magnetic field, are now set up. Consequently, these electromotive forces caused by the collapsing magnetic field assist the quenching of the discharge through the tube 30 even though the E.M.F. set up in the winding 38 is in opposition to the voltage applied to the grid 35 from the secondary winding 58 because at the same time a quenching potential from the winding 37 is applied to the grid 34. This latter potential corresponds to the E.M.F. induced into the winding 37 by the collapsing magnetic field and it is of a polarity opposite to that induced by the rising magnetic field during firing of the tube 30.

The fluorescent materials in the different tubes 30, 40, 50 and 60 may be composed so that the light produced by each of those tubes is in a part of the spectrum, that is, the colors of the light produced by these tubes may be different. In this way the lights produced by these tubes may be used for selective signalling or for controlling color selective devices. Different values or different digits may thus be represented by different light colors.

Photoelectric cells may be connected across the resistance units 21, 22, 23 and 24, respectively, to fire the tubes 30, 40, 50 and 60 respectively, if desired and in that case the light impinging upon these photoelectric cells may be controlled by a card or a tape having holes punched through. The cells connected across the resistance units 21, 22, 23 and 24 may have suitable sources of current supply connected in series therewith so that voltage pulses may be applied to the electrodes 33, 43, 53 and 63, required for firing the respective tubes 30, 40, 50 and 60, when light impinges upon these cells through the perforations of the cards or tape. Magnetically energized or actuated pickup devices such as are employed for reproducing records from magnetic tapes or drums, may also be individually coupled to the electrodes 33, 43, 53 and 63 respectively, through suitable transformers or capacitors for the purpose of firing the tubes 30, 40, 50 and 60 as previously described, and both the photoelectric cells and magnetic pickups may be used in addition to or in place of the CR tube illustrated to initiating the firing of said devices.

Further modifications and applications of this invention will be apparent to those skilled in the art to which it relates and it is not desired to limit this invention to the exact details described and illustrated except insofar as they are defined by the claims.

We claim:

1. An electrical signalling circuit comprising a plurality of electric discharge devices, means for selectively energizing each of said devices for producing an indication thereof, a plurality of transformers each having a plurality of windings, means for connecting a winding of each of said transformers in series with a different one of said electric discharge devices so that an E.M.F. is induced into the other windings of a corresponding transformer when the discharge device connected to said corresponding transformer is energized, and means for connecting selected ones of said transformers so that all of said discharge devices to interrupt energization of any of said previously energized discharge devices when a selected one of said devices is energized through the operation of said first mentioned means.

2. An electrical signalling circuit comprising a plurality of devices each forming a source of radiant energy, electronic current supply means for said devices, each of said devices having means for initiating the production of radiant energy thereby, each of said devices also having means for interrupting the production of radiant energy thereby, means for energizing said second mentioned means for initiating the production of radiant energy by a selected one of said devices and means energized by the current flow through the said selected device for energizing said interrupting means to interrupt the production of radiant energy by any of said devices other than the said selected one of said devices.

3. An electrical signalling circuit comprising a plurality of electric discharge devices for producing luminous radiation, each of said devices having an anode, a cathode, a firing electrode and a plurality of discharge controlling electrodes, a plurality of voltage pulses produced in series with said electrodes of said electric discharge devices, means for connecting a source of potential across said discharge devices, means for selectively applying voltage pulses to the firing electrodes of said discharge devices for firing a selected one of said devices, the firing of said selected device producing a pair of voltage pulses in the pulse producing means connected in series therewith, means for applying one of said pair of voltage pulses to one of the discharge controlling electrodes of all of said discharge devices so that discharges in said devices other than said selected device may be restrained thereby and means for applying the other of said pair of pulses to the other of said controlling electrodes in said selected device so that electric discharge is stimulated in said selected device.

4. An electric signalling circuit as set forth in claim 1 further characterized in that each of said devices is adapted to emit visible radiations in a different part of the light spectrum.

5. An electric signalling circuit as set forth in claim 2 further characterized in that each of said devices forming sources of radiant energy is adapted to produce visible radiations in a different part of the light spectrum.

6. An electric signalling circuit as set forth in claim 3 further comprising a cathode ray switching device having a plurality of target electrodes and control means for connecting said target electrodes to different ones of said devices forming sources of radiant energy for
selecting the one of said devices to produce radiant energy.

7. An electric signalling circuit as set forth in claim 6 further characterized in that different ones of said target electrodes are connected to different ones of the means for initiating the production of radiant energy of different ones of said devices.

8. An electric signalling circuit comprising a plurality of devices each forming a source of radiant energy, electric current supply means for said devices, each of said devices having an electrode for initiating the production of radiant energy thereby, each of said devices also having electrode means for interrupting the production of radiant energy thereby, means for energizing said first mentioned electrode for initiating the production of radiant energy by selected one of said devices and inductive means energized by the current flow through the selected one of said devices for applying a pulse to said electrode means for interrupting the production of radiant energy by any device other than the selected device.

9. An electric signalling circuit comprising a plurality of discharge devices each forming a source of radiant energy, electric current supply means for said devices, each of said devices having means for initiating the production of radiant energy thereby, a light sensitive device connected to control each of said last mentioned means, each of said devices also having means for interrupting the production of radiant energy thereby, means for energizing said second mentioned means for initiating the production of radiant energy by a selected one of said devices and means energized by the current flow through said selected one of said devices for interrupting the production of radiant energy by any of said devices other than said selected one of said devices.

10. An electrical signalling circuit comprising a plurality of electric discharge devices, means for selectively energizing each of said devices for producing an indication thereby, a plurality of light sensitive devices connected to said means, a plurality of transformers each having a plurality of windings, means for connecting a winding of one of said transformers in series with one of said electric discharge devices so that an E.M.F. is induced into the other windings of said one transformer when the one of said devices connected to said one transformer is energized, and means for connecting selected ones of said windings to all of said devices to interrupt energization of any of said devices other than the said selected devices.

11. An electric signalling circuit comprising a plurality of indicators, each of said indicators comprising a gas discharge tube, each of said tubes having a plurality of control electrodes, means for selectively controlling said indicators, electric current supply for said indicators, each of said indicators having means connected to selected ones of said control electrodes for initiating and for interrupting the production of an indication thereby, means for energizing said second mentioned means for initiating the production of an indication by a selected one of said indicators and means responsive to the current flow through said selected indicator for controlling said second mentioned means to interrupt the production of an indication by any of said indicators other than the said selected indicator.

12. An electric signalling circuit comprising a plurality of signal devices, each of said devices comprising a gas discharge tube, each of said tubes comprising a plurality of control electrodes, electric current supply for said devices, each of said devices having means connected to one of the said control electrodes for initiating the production of a signal thereby, each of said devices also having means connected to other said selected ones of the said control electrodes for interrupting the production of a signal thereby, means for energizing said first mentioned means for initiating the production of a signal by a selected one of said devices and means responsive to the current flow through said selected device for interrupting the production of a signal by any of said devices other than the said selected device.

13. An electric signalling circuit comprising a plurality of visual devices, each of said devices comprising a gas discharge tube, each of said tubes having a plurality of control electrodes, electric current supply for said devices, each of said devices having means connected to one of said control electrodes for initiating the production of a visual signal indication thereby, each of said devices also having means connected to another one of said control electrodes for interrupting the production of a visual signal indication by a selected one of said devices and means responsive to the current flow through the said selected device for interrupting the production of a visual signal indication by any of said devices other than the said selected device.

References Cited in the file of this patent

UNITED STATES PATENTS

1,979,602 Knowles Nov. 6, 1934
2,315,286 Olofsson Mar. 9, 1943
2,478,901 Edgerton Aug. 16, 1949
2,565,103 Toulon Aug. 21, 1951
2,598,420 Onksen May 27, 1952
2,749,480 Ruderfer June 5, 1956