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PHOTOELECTRIC SWITCHING SYSTEM

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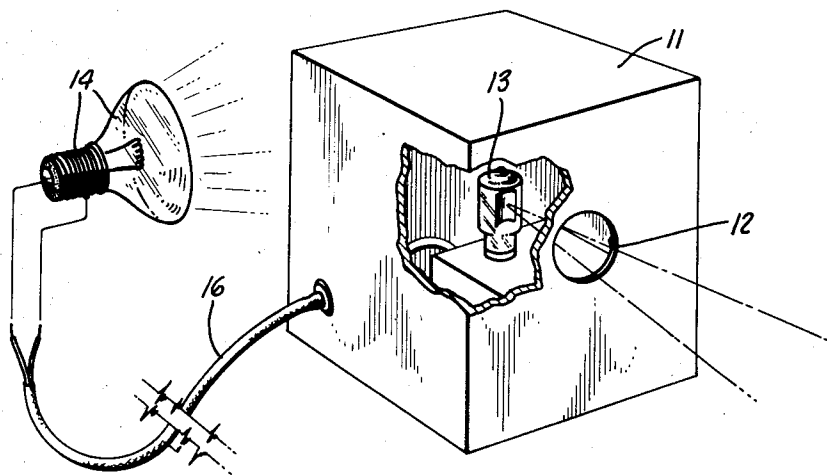


FIG. 1

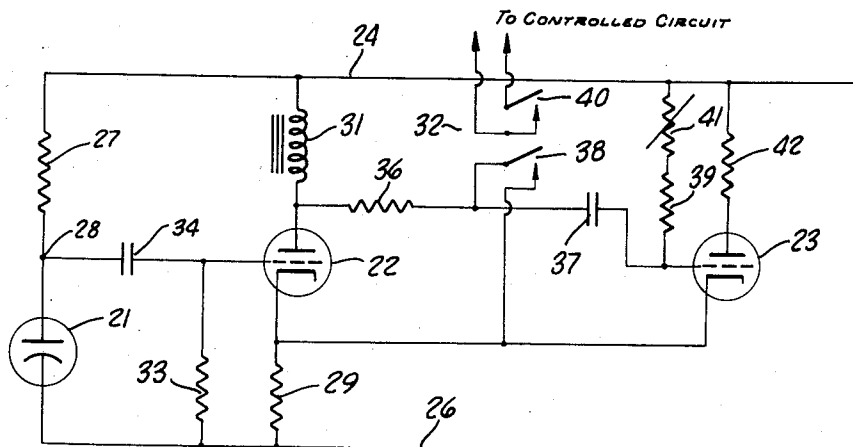


FIG. 2

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PHOTOELECTRIC SWITCHING SYSTEM

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2 Claims. (Cl. 317—130)

This invention relates generally to a photoelectric switching system, and more particularly to a photoelectric switching system responsive to sudden changes in illumination.

There are many applications where it is necessary to have a switch operate for a predetermined period of time. As an example, let us consider a patrolman walking his beat. At each of the various establishments located on his beat, the patrolman walks to the window or door and shines his flashlight through the window and inspects the interior. The illumination provided by the flashlight is low, and, consequently, many portions of the interior cannot be seen. When a person drives into his driveway at night, it is convenient to have the outside lights turn on for a period of time while he walks to the door or opens the garage. When guests arrive at night, outside lighting is desirable.

It may be inconvenient or undesirable to manually operate a switch. It is desirable to provide a photoelectric switching system in which the switch is operated by a sudden change in illumination. For example, the patrolman would shine his flashlight on the switching means and have it turn on the lights automatically. Similarly, the automobile headlights would operate the switching means. The switching system should also include means whereby the switch is turned off after a predetermined period of time. Thus, the interior lights or the outside lights would be extinguished.

In the past, photoelectric switches have been employed to control illumination. These switches have, in general, been responsive to changes in the level of illumination and have served to turn on lights when the level of natural illumination has dropped to a predetermined value, or to turn off lights when the level has reached a predetermined level.

It is an object of the present invention to provide a novel photoelectric switching system.

It is another object of the present invention to provide a photoelectric switching system which is responsive to sudden changes in light.

It is another object of the present invention to provide a photoelectric switching means which is operated by a sudden change in illumination and which remains in its operating position for a predetermined period of time.

These and other objects of the invention will be more clearly apparent from the following drawings and description showing by way of example a preferred embodiment of the invention.

Referring to the drawings:

Figure 1 shows a perspective view of a switch housing including the photosensitive device; and

Figure 2 is a circuit diagram of a photoelectric switching system constructed in accordance with our invention.

Referring particularly to Figure 1, a housing 11 is shown which includes an aperture 12. The housing 11 serves to mount the electronic components and the photosensitive device 13. The photo-sensitive device may be

any suitable photoelectric device. For example, the device 13 may be a phototube.

For purposes of illustration, the apparatus is shown connected to a floodlight 14 through the cable 16.

When the illumination falling on the photo-sensitive device 13, through the opening 12, is suddenly decreased, the switching means is operated and remains in this position for a predetermined time. The circuit then returns to its normal position. Thus the floodlight is energized for a predetermined time. A power relay may be connected to the switching system and serve to control associated power circuits.

In Figure 2, we have shown a switching circuit which can be employed to carry out the invention which includes a phototube 21 and first and second amplifier tubes 22 and 23. A D.-C. supply voltage is connected between lines 24 and 26. The phototube 21 is connected in series with resistor 27 across the lines 24 and 26. The point 28 is at a potential which is determined by the value of the resistor 27 and the light-impinging upon the phototube 21. The value of the resistor 27 is chosen such that the tube 22 is normally biased beyond cut-off. The cathode resistor 29 is connected to the cathodes of the amplifier tubes 22 and 23. The plate of tube 22 is connected to line 24 through relay coil 31. The relay 31 may be of the double pole type shown, or any other relay suitable for controlling associated circuits.

The grid of tube 22 is connected to line 26 through the grid leak resistor 33. The grid of tube 22 is also coupled to the point 28 through capacitor 34. Resistor 36 and capacitor 37 are connected in series between the plate of tube 22 and the grid of tube 23. One set of contacts 38 of the double pole switch is connected between the common junction of resistor 36 and capacitor 37 and the cathodes of the tubes. The grid of tube 23 is resistively connected to line 24 through the series combination of fixed resistor 39 and variable resistor 41. The plate of tube 23 is connected to line 24 through plate resistance 42.

Operation of the circuit described is as follows: The grid of the tube 23 is biased positively by the series combination of resistors 39 and 41 connected to line 24. Under normal operating conditions, the tube 23 is conducting a high plate current. Since tubes 22 and 23 have a common cathode resistor 29, the grid of the tube 22 is biased beyond cut-off. Thus tube 22 is non-conducting and tube 23 is conducting.

The action of capacitor 34 is to prevent slow changes in the phototube illumination, such as those resulting from an accumulation of dirt on the light source, aging of the light source, or changes in the general background illumination, from causing the switching system to operate. A sudden decrease in the illumination on the phototube acts differently. When the illumination on phototube 21 is instantly decreased, the voltage drop across the tube increases instantly. There is an equal voltage rise across the resistor 33 since the voltage across the capacitor 34 can not change instantaneously. As a result, the tube 22 starts to conduct current. This energizes relay 32. When relay 32 is energized, the contact 40 which controls the associated circuit and the contact 38 are closed. Closing of the contact 38 applies a negative potential to the grid of tube 23, thereby cutting off the tube. Thus, only tube 22 is conducting, and the bias across the resistor 29 due to current flow through the tube 22 is not sufficient to cut it out. The capacitor 37 slowly discharges through the resistors 39 and 41 until the voltage on the grid of tube 23 is raised sufficiently to cause the tube to conduct. When tube 23 conducts, the bias across the resistor 29 is sufficient to cause the tube

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22 to cut off. Thus, by proper selection of the value of the capacitor 37, resistors 39 and 41, the time during which the tube 22 is conducting, and consequently the time during which the relay 32 is energized, can be accurately controlled.

It is of course apparent that tube 22 can be cut off by suddenly increasing the illumination on tube 21, thus opening the relay 32.

Apparatus was constructed in accordance with the above in which the various components had the following values:

Resistors:

- 27=12 meg Ω
- 29=1000 Ω
- 33=3.9 meg Ω
- 36=330 kilo Ω
- 39=470 kilo Ω
- 42=1000 Ω ; and
- 41 was a 10 meg Ω variable resistor

Capacitors:

- C2=.005 microfarad; and
- C3=4 microfarads

Tubes 22 and 23 were a dual triode known by manufacturer's specifications as a 12AU7. Phototube 21 was of the type known by manufacturer's specification as #930. The D.-C. coil 31 of the relay had a resistance of 5000 Ω .

Apparatus constructed with the components specified above was tested and found to be insensitive to changes in light varying from nighttime to daylight conditions. The photoelectric switching system was responsive to sudden changes in illumination such as afforded by flashing light from a flashlight on the phototube 21. The time during which the circuit operated the relay could be varied between 2 and 70 seconds by varying the resistance 41.

It is apparent that if the positions of the phototube 21 and resistor 27 are interchanged the tube 22 will become conductive when the illumination is suddenly increased. This might be desirable when employing the switch to turn on lights in response to automobile headlights.

Thus it is seen that we have provided a novel photoelectric switching system which is operated by sudden changes in illumination and which remains in its operating position for a controllable period of time.

We claim:

1. A photoelectric system comprising first and second voltage supply lines, first and second tubes, each having at least plate, grid and cathode elements, a relay means having a coil and plurality of contacts, said coil connected in the plate circuit of the first tube, serially connected resistance and capacitance elements connected between the plate of the first tube and the grid of the second tube, resistance means connected between the grid of the second tube and the first supply line serving to bias said tube whereby the same is normally conducting, a

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resistor and photoelectric means connected between the supply lines, a capacitor serving to couple the grid of the first tube to the common junction of the resistor and photoelectric means, said last resistor having a value whereby said first tube is normally non-conductive and said last capacitor serving to make said first tube insensitive to gradual changes in illumination, one set of said relay contacts connected between the cathode lead of said second tube and the grid capacitor, said relay contacts closing to cut off said second tube when the first tube is rendered conducting in response to a sudden change in illumination, said bias resistor and capacitor serving to form a delay circuit which maintains the second tube cut-off for a predetermined time.

2. A photoelectric system comprising first and second voltage supply lines, first and second tubes each having at least cathode, grid and plate elements, a common cathode resistor connected in the cathode path of said tubes and the second voltage supply line, relay means having a coil and a plurality of contacts, said coil connected between the plate of the first tube and the first supply line, serially connected resistance and capacitance elements connected between the plate of the first tube and the grid of the second tube, a variable resistance connected between the grid of the second tube and the first supply line, said resistor serving to bias the grid of said tube whereby the tube is normally conducting, a serially connected photoelectric tube and resistor connected between said supply lines, a coupling capacitor serving to couple the grid of the first tube to the common junction of the serially connected resistance and photoelectric tube, said resistor being chosen whereby the first tube is biased to be non-conducting under normal conditions of illumination, said capacitor serving to make said tube insensitive to gradual changes in illumination but triggering said tube into a conductive stage upon sudden changes in illumination, one set of the relay contacts connected between the cathode lead of said second tube and the common junction of the capacitor and resistor connected to the grid, said contact closing when the first tube becomes conducting and serving to cut off the second tube, said capacitor then discharging through the grid resistor of the second tube, said tube becoming conducting after a predetermined controllable time delay, said second tube serving to conduct a high plate current whereby the first tube is biased to cut off by the common cathode resistor.

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