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W. D. COCKRELL

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PHOTOELECTRIC RELAY APPARATUS

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Fig. 1.

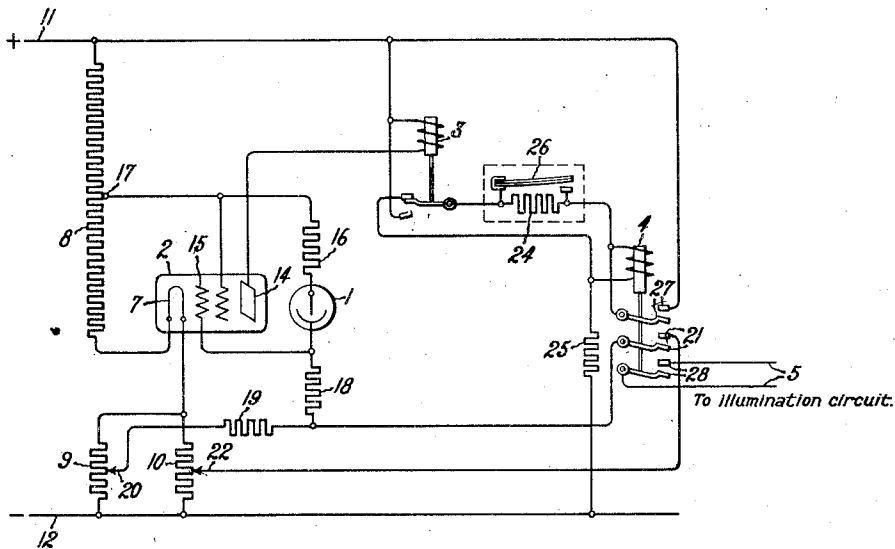
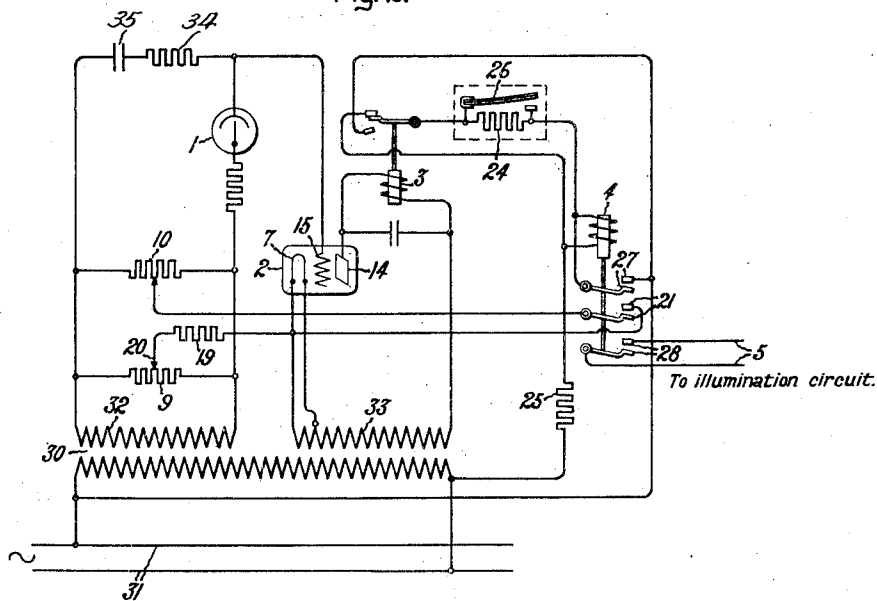


Fig. 2.



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UNITED STATES PATENT OFFICE

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PHOTOELECTRIC RELAY APPARATUS

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Application July 13, 1932, Serial No. 622,274

1 Claim. (Cl. 250—41.5)

My invention relates to photo-electric relay apparatus. With certain forms of such apparatus heretofore constructed and used to control the operation of a circuit controller in accordance with the illumination of a photo-electric device, if the circuit controller is arranged to operate in one sense when the degree of a changing illumination of the photo-electric device reaches a certain point, it will operate in the opposite sense with a return of substantially the same degree of illumination of the device. It is the object of my invention to provide an improved apparatus of this character wherein the operations of the circuit controller in the two opposite senses may be caused to occur at different predetermined degrees of illumination of the photo-electric device. A further object of my invention is the provision of such improved apparatus whereby both operations of the circuit controller may be caused to occur at various selected degrees of illumination of the photo-electric device.

My invention will be better understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claim.

Referring to the drawing, Fig. 1 is a circuit diagram illustrating a form of my invention adapted for use when supplied by direct current; and Fig. 2 is a similar diagram of a form of my invention adapted for use when supplied by alternating current.

In Fig. 1 of the drawing the photo-electric device 1, which for example may be a photo-electric tube, is connected to the input side of the electron discharge amplifier 2 whose output operates through the relay 3 to cause operation of the electromagnetic switch 4. This switch may, for example, be used to control the closing and opening of an artificial illumination circuit 5, and may be automatically operated in response to variations in the amount of daylight. In this case the photo-electric device 1 will be arranged so as to be subjected to the daylight which is to control the artificial illumination. The amplifier 2 is shown having the cathode 7 connected in series with the voltage divider comprising the resistor 8 and the potentiometers 9 and 10, which, for example, may be 60 ohms each, the divider being connected across the source of direct current supply 11 and 12, which, for example, may be a 110 volt circuit. The anode 14 is shown connected through the winding of relay 3 with the positive side of the line and the control grid 15 is shown connected with the cathode of the photo-

electric device 1. The anode of device 1 connects through resistance 16 with an intermediate point 17 of resistor 8, and the cathode connects through the control resistor 18, which for example, may be 20 megohms, and resistor 19, which for example, may be 5000 ohms with the adjustable arm 20 of potentiometer 9. When switch 4 is in closed circuit position the cathode of the photo device 1 also connects through contacts 21 of the switch with the adjustable arm 22 of potentiometer 10.

Relay 3 when in operated position as illustrated short circuits the winding of switch 4 through resistance 24. When relay 3 is in released position it completes a circuit from the supply line 11 through resistance 24, the winding of switch 4 and resistance 25 to the other supply line 12. Resistor 24 is arranged to heat the bimetallic strip 26 which in response thereto bends and short circuits the resistor 24. Current which passes the resistor 24 alone is insufficient to cause the operation of switch 4 but when this resistor is short circuited by the bimetallic strip 26 the increased current supplied to switch 4 is sufficient to cause its operation. The time delay mechanism thus provided is useful in preventing an opening of switch 4 due to flashes of light such as a flash of lightning. The switch 4 is provided with cooperating contacts 27 which complete a holding or sealing-in circuit for the switch. Contacts 28 of switch 4 are shown controlling the circuit 5 which in the aforesaid example is the circuit of the artificial illumination.

The operation of the apparatus is as follows. Assuming a condition of daylight, the photo-electric device 1 will have its resistance reduced to such an extent that the control grid 15 tends to be positive and the amplifier 2 is passing sufficient current to hold relay 3 in its operated position as illustrated. The potentiometer arm 20 has previously been adjusted to cause this operation of the amplifier and relay with a predetermined degree of light falling upon the photo-electric device 1. Since relay 3 is operated, the switch 4 is open; hence the illumination circuit 5 is open circuited. As darkness approaches, the point is reached which in response to the setting of potentiometer 9 causes a decrease in the energization of relay 3 such that this relay drops open. This operation of relay 3 closes the circuit through the heating resistor 24 but the current passing therethrough is insufficient to operate switch 4. When the bimetallic strip 26 in response to the heat from resistor 24 bends sufficiently to short circuit the resistor, the switch 4

is operated to closed circuit position. This turns on the artificial illumination provided in circuit 5 and also closes the holding circuit for the winding of the switch and through contacts 21 connects potentiometer arm 22 with the resistance 18. This in effect transfers the control from potentiometer 9 to potentiometer 10 since the resistor 19 is of such a value that only a small current passes it.

However, the resistance 19 is so small compared with the extremely high resistance of 18 that its elimination from the bridge circuit has only a very slight effect. With the return of daylight the consequent decrease in resistance of the photo-electric device 1 again causes through the amplifier 2 the energization of relay 3. Thus it will be seen that the two potentiometers 9 and 10 may be separately adjusted, the former governing the closing of switch 4 in accordance with one degree of illumination of the photo-electric device and the other governing the opening of switch 4 in accordance with a higher degree of illumination of the photo-electric device, both settings being practically separate and independent.

In the modified form shown in Fig. 2 where the apparatus is adapted to be supplied with alternating current the corresponding parts are indicated by the same reference numbers. In this case a transformer 30 is used, the primary of which connects across the source of alternating current supply 31 which, for example, may be a 60 cycle, 110 volt source. Two separate secondary windings 32 and 33 are shown, the former supplying current to the photo-electric device and input circuit of the amplifier 2, and the latter supplying current to the output or load circuit of the amplifier. In this case the grid 15 connects with one end of the secondary winding 32 through the photo-electric device 1 and with

the other end thereof through the resistor 34 and the capacitor 35. Inasmuch as this modified form operates in a manner similar to that described above in connection with the form shown in Fig. 1, a detailed description of the operation is thought to be unnecessary. It should be pointed out, however, that the potentiometers 9 and 10 by which the grid potential of the amplifier 2 is controlled are in this case connected across the secondary winding 32. The heating circuit for the cathode of the amplifier 2 is in this case taken from a portion of the secondary 33.

I have chosen the particular embodiments described above as illustrative of my invention and it will be apparent that various other modifications may be made without departing from the spirit and scope of my invention which modifications I aim to cover by the appended claim.

What I claim as new and desire to secure by Letters Patent of the United States is:

Photo-electric relay apparatus comprising a source of supply of alternating current including a transformer having a plurality of separate and independent secondary windings, a grid controlled amplifier having an anode-cathode circuit supplied by one of said windings, a switch controlled by said circuit, a photo-electric device connected between said grid and one end of another of said windings, a capacitor connected between said grid and the other end of said other winding, a plurality of potentiometers connected across said other winding each having an adjustable arm, a resistance connected between the arm of one of said potentiometers and said cathode and cooperating switch contacts controlled by said switch connected between the arm of another of said potentiometers and said cathode.

WILLIAM D. COCKRELL.