

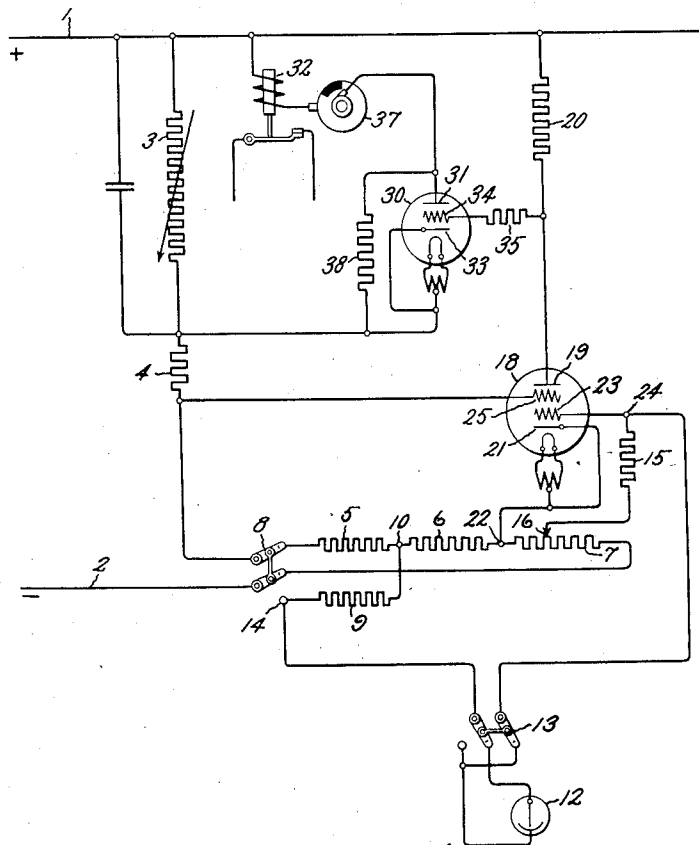
Dec. 4, 1934.

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1,983,345

PHOTO-ELECTRIC RELAY

Original Filed Jan. 21, 1932



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UNITED STATES PATENT OFFICE

1,983,345

PHOTO-ELECTRIC RELAY

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Original application January 21, 1932, Serial No.
587,925. Patent No. 1,957,247, dated May 1,
1934. Divided and this application February
25, 1933, Serial No. 658,566

3 Claims. (Cl. 250-41.5)

My invention relates to photo-electric relays and it has for its object the provision of an improved relay of this type which may be used to respond either to an increase in light or to a decrease thereof with substantially the same sensitivity.

My present invention which is a division of my Patent No. 1,957,247, issued May 1, 1934, 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 claims.

In the single figure of the drawing which illustrates one embodiment of my invention, I have shown at 1 and 2 the positive and negative sides respectively of a direct current source which for example may be a 250 volt source. Connected between the sides 1 and 2 is a voltage divider comprising the adjustable resistor 3 and resistors 4, 5, 6, and 7. In order that the flow of current through resistors 5, 6, and 7 may be reversed for purposes to be hereinafter described I provide the reversing switch 8. When this switch is shifted to a position to reverse the current through resistors 5, 6, and 7, it cuts off resistor 5 and substitutes resistor 9 therefor, which resistor connects at the point 10 with the divider as above described. Resistors 5 and 9 are approximately equal in resistance, the value of which as well as that of resistors 6 and 7 may for example be a few thousand ohms each. The photo-electric tube 12 connects through the reversing switch 13, which is provided for the purpose of reversing the polarity on the tube when reversing switch 8 is operated, with the contact 14 of switch 8 and through resistor 15 whose resistance preferably is of the order of 10 to 50 megohms with the adjustable contact 16 on resistor 7. Electron discharge amplifier 18 has its plate 19 connected through resistor 20 with the positive side of the supply circuit, its cathode 21 connected with the divider at the point 22 and its control grid 23 connected with resistor 15 and photo tube at the point 24. This amplifier is shown provided with the screen grid 25 also connected with the divider but the use of a screen grid tube is not essential to my invention.

With the reversing switches 8 and 13 each in the position illustrated, the photo tube is adapted to cause the operation of the amplifier in response to an increase in light while with these switches shifted to their opposite positions the tube is adapted to cause the operation of the amplifier in response to a decrease in light. With little or no light falling upon the tube 12 the potential

of the grid 23 of amplifier 18 is negative with respect to its cathode since the point 16 on the divider is more negative than the point 22. When light is thrown upon the tube 12 or the illumination thereof is increased to a predetermined amount the resulting lowered resistance of the tube causes the grid 23 to become positive with respect to its cathode since tube 12 connects through resistor 9 with the divider at the point 10 which is positive with respect to point 22. Thus the amplifier 18 becomes operative. It will be noted that the potential applied to the photo tube in this case and when it is dark is substantially that which exists on the divider between the points 10 and 16, the effect of resistors 9 and 15 which are in series with the photo tube being so small that it may be neglected. Inasmuch as the photo tubes of the gas-filled type which are the most sensitive thus far developed operate with the greatest efficiency when supplied with the maximum voltage for which they are designed but which may be ruined if the applied voltage exceeds a certain amount, for example, 90 volts, the voltage divider is so constructed that the voltage supplied to the tube 12, namely, that between the points 10 and 16, is approximately the maximum which may be safely used on the tube.

When it is desired to have the photo tube cause the amplifier to operate in response to a decreasing light, the switch 8 is thrown to its down position and switch 13 thrown to the left, thus reversing the direction of current flow through the resistors 6 and 7. Resistor 9 is now included in the divider instead of resistor 5, the two resistors being approximately equal. With no light on the photo tube the charge on the grid 23 of the amplifier is positive with respect to the cathode since now the point 16 is positive with respect to the point 22. However, since grid 23 is positive with respect to the its cathode a small grid current will pass and there will be a resulting small IR drop across the resistor 15. Hence the voltage applied to the photo tube 12 will equal that produced by the divider between the point 16 and the point 14, instead of point 10 as before, minus the voltage drop due to the grid current in resistor 15. By a proper proportioning of the resistors this net voltage which is now applied to the photo tube may be made approximately equal to that which was applied when the reversing switch was in its original or upper position. Thus it will be seen that although the IR drop in resistor 15 of the grid current in the lowered position of switch 8 subtracts from the voltage applied to the tube, the circuit connec-

tions of the tube have been changed to include resistor 9 whereas formerly it excluded the equal resistor 5. It hardly needs to be explained that when tube 12 is illuminated with the switch 8 in its lower position the grid 23 is charged negatively with respect to its cathode and the amplifier 18 is rendered inoperative until the light on the tube 12 is cut off or reduced to a predetermined value. As a result of this arrangement the single photo tube 12 may cause the operation of the amplifier 18 either in response to an increase in light when the switch is in its upper position or in response to a decrease in light when the switch is in its lower position, the photo tube in either case operating with a maximum efficiency and without danger of its being subjected to an injuriously high voltage. Amplifier 18 may be used to control any desired apparatus such, for example, as the vapor electric discharge device 30.

In accordance with another feature of my invention which is claimed in my aforesaid application the current flow in the anode circuit of amplifier 18 controls the operation of the vapor device 30 which in turn controls the current flow in the electromagnetic relay 32. The vapor device 30 is shown having the anode 31, the cathode 33, and the grid 34 which connects through the resistor 35 with the anode 19 of device 18. Inserted in the anode circuit of the vapor device 30 is the rotatable circuit interrupter 37 which at each rotation interrupts the anode circuit. As long as the current flow in the anode circuit of device 18 is below a predetermined value the grid of device 30 is maintained positive and the device is conducting to energize the relay 32. As soon as the current flow in the anode circuit of device 18 rises to a predetermined value the potential drop through resistor 20 makes the grid voltage of device 30 sufficiently negative to prevent the tripping of the device 30 and the relay 32 remains deenergized.

I have chosen the particular embodiment 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 claims.

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

1. A photo-electric relay comprising a photo-electric device and a resistor adapted to be connected in series with a source of current, an electron discharge amplifier having its grid-cathode circuit connected across said resistor and a device operative to reverse the polarity of the voltage applied to said circuit and simultaneously to change the value of said voltage to compensate for the voltage drop in said resistor due to grid current.

2. A photo-electric relay comprising a voltage divider adapted to be connected with a source of current, a photo-electric device and a resistor connected to be supplied in series from said divider, an electron discharge amplifier having a grid and cathode connected to respond to voltage variations across said resistor, switching means for reversing the direction of current flow through said divider and for simultaneously changing the point of connection of the photo-electric device with the divider.

3. A photo-electric relay comprising a source of current supply, a photo-electric device and a resistor connected in series with said source, a grid controlled electron discharge amplifier connected to respond to variations in voltage across said resistor and means operative simultaneously to reverse the connections of said device and resistor with said source and to compensate for the effect of grid current on the response of said device.

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