

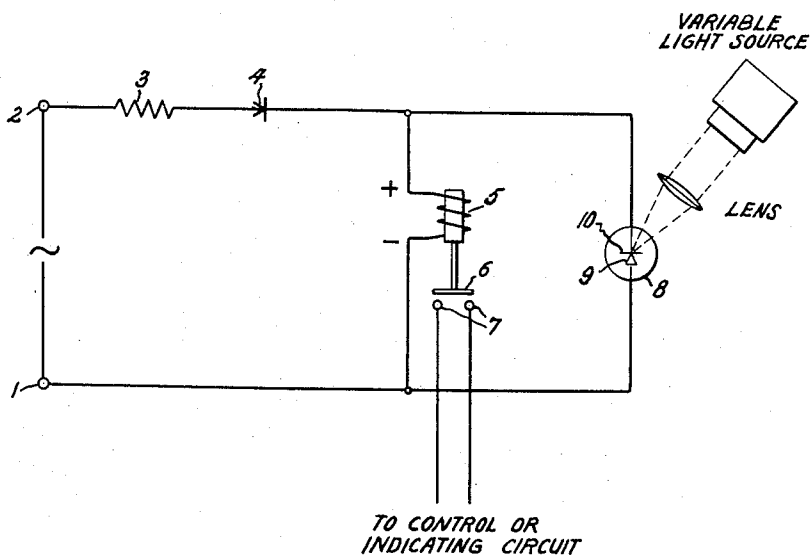
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RADIATION RESPONSIVE SYSTEM

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RADIATION RESPONSIVE SYSTEM

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5 Claims. (Cl. 317-124)

This invention relates to a radiation responsive system and, more particularly, to such a system operable from an alternating current source which provides both photoresponsive control and steady-state maintenance of a current through an inductive relay winding to control an operation.

This application is a continuation of, and is assigned to the same assignee as, my copending application, Serial No. 246,300, filed September 12, 1951, and now abandoned.

As is well known, there are many operations controllable by relay wherein it is expedient to have the control photoresponsive, that is, responsive to the presence or absence of light or to the intensity of light. Further, it is desirable that the control system be operable from a conventional alternating current power supply. Prior systems of such character have generally been complicated as requiring separate external current sources for the photoresponsive element and for the relay or by requiring amplification of the photoresponsive current and filtering for the relay current.

Therefore, it is an object of this invention to provide a photoresponsive system in which a photocell performs the dual function of photoresponsive intensity control of, and smoothing of the current through an inductive relay winding.

In accordance with this invention, a photoconductive photocell which has a low resistance to current flow therethrough in one direction and a higher resistance in the opposite direction, variable as a function of the intensity of incident light, is connected in parallel with inductive relay winding so as to divert from the winding an amount of current which is dependent upon the intensity of the light on the photocell. A unidirectional conducting means is connected in series with the relay winding so as to adapt the circuit for use in conjunction with the alternating current source and the photocell, in parallel therewith, when conducting in the forward direction, acts as a smoothing circuit to convert pulsating direct current output from the unidirectional conducting means into a substantially steady-state direct current supply to the current responsive element. Armature means responsive to variations in the current through the relay winding may be used to effect a control or switching operation.

The features of my invention which I believe to be novel are set forth with particularity in the appended claims. My invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing, in which:

The single figure of the drawing is a schematic representation of the embodiment of the invention in which the current responsive element is in the form of a relay having a movable armature to make or break an independent circuit.

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While my invention is not limited to any particular type of photoconductive photocell, I have found that a germanium diode may be used advantageously, and it is to be understood that the photocell must be of a type which affords a low resistance to the flow of current in one direction and a variable resistance in the opposite direction dependent upon the intensity of radiation to which the photocell is subjected.

Certain photoconductive photocells, such as a germanium diode, are particularly responsive to that portion of the spectrum which extends into the visible light range and also into the infra-red range. It will be understood that the invention in its broader aspects is not limited to any particular wavelength of electromagnetic radiation, and that the principles thereof do not limit the application of the invention to any particular portion of the spectrum. Thus, the term "light" is used in the specification and in the claims as being of a meaning sufficiently broad to incorporate both visible and invisible electromagnetic radiations, the wavelengths of which may be in excess of or less than the wavelengths within the visible spectrum.

In the drawing, the numerals 1 and 2 designate the terminals of a source of alternating current. Connected across the terminals 1 and 2 is a circuit which may include a current limiting resistance 3 and a unidirectional conducting device or half-wave rectifier 4, which may be of any suitable known construction, and an inductive winding 5 which is a part of a relay having a movable armature 6 arranged to bridge the fixed contacts 7 when moved downwardly into engagement therewith.

Thus, with an alternating current voltage of a predetermined magnitude connected across terminals 1 and 2, a current of a given magnitude would be supplied to the winding 5 of the relay. For a given half-cycle when the terminal 2 is positive, a current pulse passes through the unidirectional conducting device 4, whereas when the terminal 2 is negative during the succeeding half-cycle, no current flows through the winding 5 due to the action of rectifier 4.

Photocell 8 is arranged with respect to winding 5 so that current may flow from the negative terminal of winding 5 without encountering appreciable resistance through the photocell to the positive terminal of winding 5. The photocell, in parallel with the inductive winding, is in the inverse mode relative to the supply voltage and, in series with the winding, is in a forward mode relative to the discharge voltage of the inductive winding. In the forward mode, the collector 9 is positive relative to the germanium disc 10 and there is a constant low resistance to current flow in the direction from the collector to the disc. In the inverse mode the collector is negative relative to the disc and for current flowing in the direction from the disc to the collector there is a high resistance which is variable as a function of the light intensity incident upon the photocell. If the photocell 8 is maintained in darkness, there is a high resistance to current flow from the positive terminal of winding 5 downwardly through photocell 8 to the negative terminal of winding 5 due to the inherent characteristics of the photocell.

When arranged as shown, the photocell acts as a so-called discharge rectifier and tends to smooth out the pulsating direct current supplied through the winding 5 so that such current approaches a steady-state condition. Following conduction through the winding 5 during a predetermined half-cycle of the alternating current source such as a positive half-cycle with respect to half-wave rectifier 4, the discharge current will flow from the lower terminal of coil 5 upwardly through the photocell 8 to the upper terminal of coil 5, which phenomena tends

to maintain a current through coil 5 during the intervals between the positive current pulses, so that a current approaching a steady-state direct current is supplied through the winding 5 even though a source of half-wave alternating current is connected to the terminals thereof.

Photocell 8 is rendered conductive from the positive terminal of winding 5 to the negative terminal thereof in accordance with the intensity of light which is allowed to shine on the photocell 8. Stated otherwise, the photocell becomes conductive in what is normally the difficult direction of current flow, i.e., from base to contact point. Thus, if photocell 8 is maintained in darkness very little current flows through the photocell, but substantial current flows through relay winding 5 which is arranged to maintain the armature bridging member 6 out of engagement with the contacts 7 under such conditions. If the intensity of light allowed to shine on photocell 8 is increased, then the amount of current diverted from the positive terminal of winding 5 to the photocell 8 and to the negative terminal of winding 5 is increased in proportion to the intensity of light allowed to shine on the photocell. Thus, it will be understood that if light on the photocell 8 is in excess of a predetermined intensity the current through the winding 5 is so small that the armature of bridging member 6 is allowed to descend and engage fixed contacts 7. When such an operation occurs, the circuit connected to contacts 7 is completed so that a protective or control operation is performed. No additional elements, such as a biasing D.-C. supply for the collector, or an amplifier for a photoconductive current, are required for the operation of this device.

From the above description, it will be understood that the invention may be used to perform an operation in response to an interruption of a fixed source of light normally allowed to shine on the photocell. In such an arrangement, the circuit may function as a counting device or as a control device, of which many examples are known. Further, the arrangement may be used as a control in conjunction with heating devices, such as oil burners, or furnaces in general.

While this invention has been described by reference to particular embodiments thereof, it will be understood that numerous changes can be made by those skilled in the art without actually departing from the invention, and it is the aim of the appended claims to cover all such equivalent variations as come within the true spirit and scope of the foregoing disclosure.

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

1. A photoresponsive system comprising a unidirectional conducting element for connection in series with a source of alternating current to provide a pulsating unidirectional current, an inductive relay winding connected in series with said element, and a photoconducting photocell connected in parallel with said winding in the inverse mode relative to the supply current of said winding and in the forward mode relative to the discharge current of said winding to provide both a photosensitive control of and a smoothing action upon the current through said winding.

2. A photoresponsive system comprising a unidirectional conducting element for connection in series with a source of alternating current to provide a pulsating unidirectional current, a relay having an inductive winding and an armature movable relative to said winding, said winding being connected in series with said element, and a photoconducting photocell connected in parallel with said winding in the inverse mode relative to the supply current of said winding and in the forward mode relative to the discharge current of said winding to pro-

vide both a photosensitive control of and a smoothing action upon the current through said winding.

3. A photoresponsive device system comprising a source of alternating current, a relay having an inductive winding, a unidirectional conducting element connected in series with said source and said winding to provide a pulsating unidirectional current, and a photoconductive photocell having low resistance to current flow therethrough in one direction and having in the opposite direction a higher resistance which varies as a function of the intensity of light on said photocell, said photocell being connected in parallel with said inductive winding and in a direction presenting its higher light-variable resistance to said pulsating unidirectional current and presenting its low resistance to current discharged by said winding and means coupled to the inductive winding responsive to changes in the magnitude of energizing current through said winding.

4. An alternating current photoresponsive device system comprising a relay having an inductive winding, a unidirectional conducting element in series with said winding for connection to a source of alternating current to provide a pulsating unidirectional current, a rectifying photoconductive photocell having low resistance to current flow therethrough in one direction and having in the opposite direction a high resistance which varies as a function of the intensity of light on said photocell, said photocell being connected in parallel with said winding and with a polarity presenting its higher light-variable resistance to said pulsating unidirectional current and presenting its low resistance to current discharged by said winding so as to effect both a photoresponsive intensity control of and a smoothing action upon the current through said winding, and means coupled to the winding responsive to changes in the magnitude of the current in said winding for performing an operation.

5. A photoresponsive relay system comprising a circuit including a relay having an inductive winding connected in series with unidirectional conducting means, said circuit being adapted for energization from a source of alternating current to provide a pulsating unidirectional current, a rectifying germanium photocell having low resistance to current flow therethrough in one direction and having in the opposite direction a higher resistance which varies as a function of the intensity of light on said photocell, said photocell being connected in parallel with said winding and with a polarity presenting its higher light-variable resistance to the rectified current in said circuit and presenting its low resistance to current discharged by said winding so as to effect both a photoresponsive intensity control of and a smoothing action upon the current through said winding, and said relay having an armature movable from a normal position to an operated position in response to a predetermined reduction in the magnitude of current through said winding.

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