Nov. 7, 1939. W. A. PENNOW 2,179,349

LIGHT-SENSITIVE RELAY CONTROL SYSTEM

Filed April 29, 1936

Fig. 1.

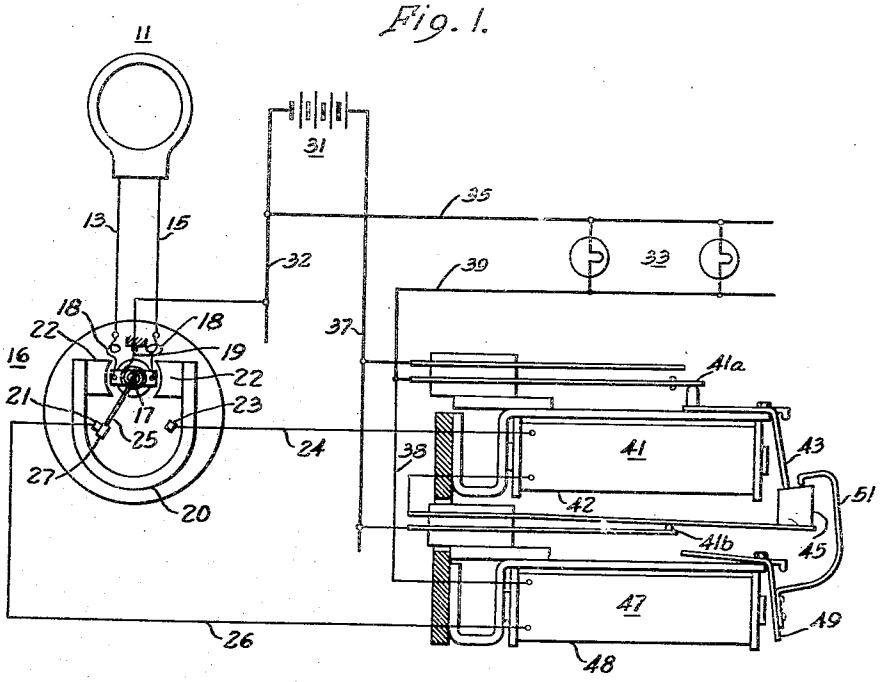
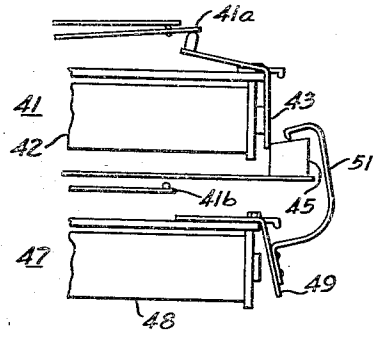


Fig. 2.



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Patented Nov. 7, 1939 2,179,349

UNITED STATES PATENT OFFICE

2,179,349

LIGHT-SENSITIVE RELAY CONTROL SYSTEM

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Application April 29, 1936, Serial No. 76,994

5 Claims. (Cl. 175—320)

This invention relates generally to a photo-voltaic control system for an electric circuit, and has reference in particular to the control of isolated lighting equipment.

In many installations of beacons, markers, channel buoys, and the like, it is desirable to control the operation of the equipment, so that it will function only when the visability has fallen below some predetermined threshold limit. As such a limit may be reached at any hour of the day, owing to fog or heavy clouds, the use of astronomical time devices is prohibited, and photo-sensitive control devices have been resorted to.

As the energy output from a photo-voltaic cell is of the order of micro-watts, any relay operable from such a source must of necessity be very sensitive. This requires a light moving element, very delicately sprung—a construction which does not permit the development of any appreciable contact pressure. Such construction lends itself to the possibility of the contact members opening, if the relay is subject to shock or vibration.

The opening of contact members under load causes arcing, which either pits the surface of the contact members, or causes them to fuse together. The first condition seriously reduces the reliability of subsequent operation, and the second renders the relay entirely inoperative.

In applications on marine buoys, or markers for emergency airport landing fields, the possibilities of unreliable operation are a hazard to life and must be obviated.

Further, in applications on isolated lighting equipment where a local source of power, such as a battery is used, any control device which requires a constant flow of current to maintain the control circuits is a liability.

The object, therefore, of my invention is to provide for the making and breaking of an electric circuit in response to changes in the surrounding light intensity by energizing the actuating means during the switching period only.

A further object of my invention is to provide a photo-sensitive means of control which shall not be effected in operation by shock or vibration.

A still further object of this invention is to provide a photo-sensitive means of control which shall be durable and reliable.

Other objects will in part be obvious, and will in part appear hereinafter.

My invention, accordingly, is disclosed in the embodiment hereof shown in the accompanying drawing, and comprises the features of construction, combination of elements and arrangements of parts which will be exemplified in the construction hereinafter set forth, and the scope of the application which will be indicated in the appended claims.

For a complete understanding of the nature and scope of my invention, reference may be had to the following detailed description, taken in connection with the accompanying drawing, in which:

Figure 1 is a combined mechanical and diagrammatical view of a photo-voltaic controlled lighting system embodying my invention, and

Fig. 2 is a part view of the switching relays showing the contact members, the latch, and the armature in the energized position, that is, when the load device is connected to the source.

Referring now particularly to Fig. 1, it will be seen that a means of converting solar energy into electrical energy, such as the copper oxide photo-voltaic cell 11, is connected to the moving coil 17 of the d'Arsonval type relay 16, by means of leads 13 and 15. The pointer 25 is secured at one end to the moving coil 17, and has mounted at the other end a moving contact member 27 designed to engage the stationary contact members 21 and 23. Current is carried to the moving coil 17 by means of the spiral springs 18, here shown schematically. A spiral spring 19 completes the circuit to the moving contact member 27. The permanent field for the moving coil 17 is provided by a permanent magnet 20, having field pieces 22. The moving contact member 27 is shown in the energized position—the normal position when the load is deenergized.

The source of power may be of any nature, such as the battery 31, and is connected to the load device, here shown as lamps 33, through the conductors 35, 37, 39 and the contact member 41*a*.

The telephone type relay 41 has an armature 43, operative to engage the contact members 41*a* and at the same time separate contact members 41*b*, when its coil 42 is energized.

A mechanical latch 45 maintains the armature 43 in the closed position when it has once closed.

The related telephone type relay 47 has an armature 49, with an associated arm 51 which is operative, when its coil 48 is energized, to draw down the latch 45, releasing armature 43, opening the contact members 41*a*, and closing the contact members 41*b*.

Each of the relays 41 and 47 are energized through the contact members of the d'Arsonval type relay 16. Relay 41 is energized when the moving contact member 27 engages the stationary contact member 23, and relay 47 is energized when the moving contact member engages the stationary contact member 21.

When the surrounding light intensity is normal, current flows from the photo-voltaic cell 11 through the moving coil 17, and the pointer 25 is deflected, holding the moving contact member 27 against the stationary contact member 21.

As the surrounding light intensity weakens, less current flows from the photo-voltaic cell, and the restraining springs 18 on the moving

coil 17 tend to return the pointer 25 to the zero position. Finally, when the surrounding light intensity reaches a predetermined limit, the moving contact member 27 engages the stationary contact member 23 and completes the circuit for relay 41 from battery 31, through conductor 32, spring 19, moving pointer 25, moving contact member 27, stationary contact member 23, conductor 24, coil 42, contact members 41*b*, and conductor 37 to battery 31. The relay 41 then operates, armature 43 closing contact members 41*a*, and connecting the load 33 to the battery 31. At the same time, the latch 45 is released, and it rises to its free position, opening contact members 41*b* and holding the armature 43 in the closed position. The opening of contact members 41*b* breaks the energizing circuit for the coil 42.

When the surrounding light intensity increases, more current flows from the photo-voltaic cell 11, deflecting the moving pointer 25, so that when the light intensity reaches a predetermined value, contact member 27 engages stationary contact member 21, completing the circuit for relay 47 which extends from battery 31, through conductor 32, spring 19, moving pointer 25, moving contact member 27, stationary contact member 21, conductor 26, coil 48, conductor 38, contact members 41*a*, and conductor 37 to battery 31. Relay 47 operates, the arm 51 drawing down the latch 45, releasing armature 43, which opens contact members 41*a* and disconnects the load 33 from the battery 31. At the same time the circuit for coil 48 is broken as it passes through contact members 41*a*. Contact members 41*b* are closed when the arm 51 draws the latch 45 down, thus providing for the next sequence of operation.

It will be seen from the above, that the switching relays 41 and 47 draw current during the switching period only. The mechanical latch 45 obviates the necessity of any holding circuit, which makes the control system economical in its current requirements.

Another point of importance lies in the fact that the contact members of relay 16 do not carry the load current, thus lessening the possibility of becoming damaged through burning or pitting. Further, as only a momentary engagement of the moving and stationary contact members is necessary to complete the switching operation, any repeated opening and closing of the contact members, such as from shock or vibration, will do no harm, as there will be no circuit to break or current to interrupt.

This photo-voltaic control system has then embodied in it not only the features of reliability and durability, owing to the elimination of the fault of contact pitting or welding, but also economy of operation, as the switching means require energy during the switching period only. It, therefore, lends itself admirably to the control of isolated equipment such as beacons, buoys, markers or the like where both reliability and economy are both prime factors in performance.

Since further changes may be made in the above construction, and different embodiments of the invention may be made without departing from the scope thereof, it is intended that all matter contained in the above description, or shown in the accompanying drawing, shall be interpreted as illustrative, and not in a limiting sense.

I claim as my invention:

1. The combination with a power source, load circuit and a relatively sensitive control relay, of relay means for connecting the load circuit to and disconnecting it from the power source in response to predetermined successive operations of the control relay, said relay means comprising two relays, the first of which is provided with a switch element disposed in the load circuit and also in the operating circuit of the second relay, said second relay having a switch element disposed in the operating circuit of the first relay, said switch element carrying a latch member operable to hold the first relay in its operated position when the second relay is in a deenergized condition.

2. In a control system, the combination with a reltively sensitive control relay, of a source of power, a load, switching means operable under the control of the control relay to connect the load to the source, a latch member operable in response to the operation of the switching means to disconnect said switching means from the source and retain it in the closed position, control means operable from the source to release the latch member, and circuit means associated with the switching means for energizing the control means only when the switching means is in the closed position.

3. In a control system, the combination with a relatively sensitive control relay, of a source of power, a load, switching means operable from the power source in response to the operation of the control relay to connect the load to the source, latch means effective in response to the operation of said switching means to deenergize the switching means and mechanically retain it in the energized position, and electro-responsive control means effective upon energization to disconnect the load and the control means from the source by actuating the latch means to restore the switching means to the deenergized position.

4. The combination with a relatively sensitive control switch, of a load, a source of power, relay means for connecting the load to the source under the control of the control switch, a latch member for mechanically retaining the relay means in the energized position and interrupting the energizing circuit thereof in response to its operation, and additional relay means energizable only when the load and the source are connected for actuating the latch member to effect disconnection of the load from the source and return of the first-mentioned relay means to the deenergized position.

5. The combination with a sensitive control switch, of a source of power, a load circuit, switching means controlled by the control switch for connecting the load circuit to the power source, auxiliary control means associated with the switching means for effecting disconection of the load circuit from the source, circuit means associated with the switching means for providing an energizing circuit for the control means only when the load circuit is connected to the source, and a common latching member actuated by the switching means and the control means for retaining the switching means in the actuated position and effecting immediate deenergization thereof after operation.

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