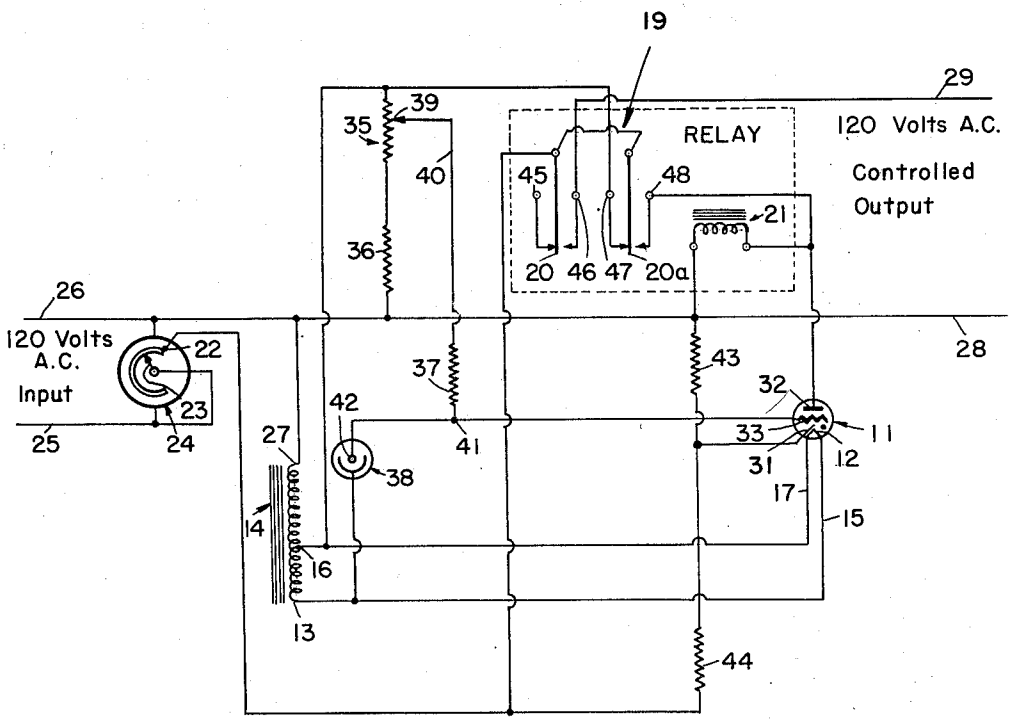
Jan. 16, 1951 R. O. RITCHIE ET AL 2,538,536

PHOTOELECTRIC TIME SWITCHING CONTROL

Filed Aug. 28, 1948



INVENTORS

ROBERT O. RITCHIE

STANLEY MITCHELL

BY

Miner L. Hartmann

ATTORNEY

Patented Jan. 16, 1951 2,538,536

UNITED STATES PATENT OFFICE

2,538,536

PHOTOELECTRIC TIME SWITCHING CONTROL

Robert O. Ritchie, Monterey Park, and Stanley Mitchell, San Gabriel, Calif.

Application August 28, 1948, Serial No. 46,644

5 Claims. (Cl. 175—321)

1

This invention relates to automatic control devices for switching electrical power on and off responsive to combined clock time and light intensity changes.

One object of the invention is to provide an improved light sensitive control for illuminated signs, street lights, and the like. Another object is to provide a light sensitive control means which will be unaffected by transient light intensity decreases and will be completely unaffected by light increases. Another object is to provide a light sensitive control means which is economical to operate and whose parts have long life. A further object is to provide a light sensitive control which closes a relay when there is light of a selected intensity on a decreasing light cycle, and releases the relay at a selected clock time.

These and other objects are attained by our invention which will be understood from the following description, reference being made to the accompanying drawing showing a diagram of the arrangement of the electrical circuits.

In general, this invention is based upon the provision of a time clock as an over-riding control over the remainder of the controlled circuit, i. e., over a light-sensitive device circuit and a power circuit (for lights on streets, billboards, etc., for example). These circuits can receive no power except in the interval set by switches operated by the time clock. The time clock is adjusted to make power available to the rest of the circuit at some selected hour before which it is desired to have the light-sensitive device circuit and the power output circuit non-energized regardless of the prevailing light intensity. In the case of a controlled illuminated sign, for example, this hour would be somewhat before the earliest anticipated hour of dusk for that region. The clock would continue to make power available until some later selected time, at which latter time the clock would shut off power and keep it off until the "turn-on" hour by the clock was again reached.

A preferred arrangement is shown in the diagram. In the control circuit which receives power is a light-sensitive unit and a unit for translating a signal from the light-sensitive unit into a switching action. In the circuit illustrated, the switching unit is an electromagnetic relay, whose action is controlled by a triode gas discharge tube with indirectly heated cathode (thyratron) which in turn is controlled by a phototube or light-sensitive device. The thyratron tube 11 is provided with an indirect heating element 12 which is connected by the conductor 15 to one end 13

2

of the transformer 14 and by the conductor 17 connected to the tap 16 of said transformer, which in turn is connected through the double pole double throw switch 19 through the switch contacts 22 and 23 of the time clock 24 to one input alternating current power line 25. The other input power line 26 is connected to the other end 27 of the transformer 14, and is also connected in as one side 28 of the controlled power output. The time clock 24 is electrically operated across the input lines 25 and 26. The cathode 31 of the thyratron tube 11 is maintained at a fixed voltage relationship to the plate 32 by means of the voltage divider network of the two resistors 43 and 44, these resistors being connected in series across the input power lines 25 and 26, the connection to line 25 being through the time clock switch points 22 and 23. A suppressor grid may be provided between the plate 32 and the grid 33 connected to the cathode 31 and maintained at the same potential.

A second voltage divider network consisting of the potentiometer 35 and the fixed resistor 36, is connected between the power input line 26 and the tap 16 of the transformer 14, and permits the application of the adjustable voltage to a third voltage dividing system consisting of the resistor 37 and the photo-tube 38. The potentiometer contact 39 is connected by the wire 40 to one end of the resistor 37, whose other end is connected to the junction 41 with the terminal 42 of the photo-tube 38, the other terminal of the photo-tube being connected by the wire 15 to the transformer 14. The junction 41 is connected to the control grid 33, and establishes a relationship between the instantaneous voltages at the cathode 31 and the control grid 33. This relationship is dependent upon two variable resistances, the effective resistance of the potentiometer 35, adjustable by the moving contact 39; and the variable resistance of the photo-tube 38. The resistance of the photo-tube is lowered by increasing intensity of light. Thus, for one setting of the contact 39, as the light striking the photo-tube 38 decreases in intensity, the electrical resistance increases, changing the voltage relationship between the control grid 33 and the cathode 31 of the thyratron tube 11, until plate current is conducted during a portion of the voltage half cycle of the applied alternating current, when the plate 32 is positive with respect to its cathode 31. When this occurs, current is applied to the coils of the electromagnet 21 and the two movable electrically and mechanically connected

arms 20 and 20A of the relay are pulled into the closed position (to the right as shown).

In a typical application of our invention, at a predetermined hour approaching sundown, the time clock movable arm 23 makes contact at 22 and thus applies voltage from the input line 25 (which is, for example, standard 120 volt, 60 cycle, alternating current) to the photo-sensitive circuit, including the photo-tube 38 (photo-tube No. 929), the resistors 36 (6,000 ohms) and 37 (5 megohms), the potentiometer 35 (3,000 ohms maximum), resistors 43 (6,000 ohms) and 44 (350 ohms), and the cathode 31. The element 12 of the gas discharge tube 11 (thyratron 2050 or GL 502A) is energized and heats the cathode 31. The light striking the photo-tube 38 gradually decreases with the passing time of day and with it the resistance of the photo-tube increases, until the voltage on the grid 33 allows plate current to pass. When the required current passes through the plate circuit and through the electromagnetic coil 21 of the relay to overcome its inertia, the movable arms 20 and 20A are moved to the opposite positions from those shown in the diagram (i. e. to the right). This movement of the relay switches causes three changes in the system: (1) the output circuit line 29 is connected through the arm 20 and the contact 46, through the time clock arm 23 and the contact 22 to the input circuit line 25, thus applying voltage to the controlled circuit; (2) the coil 21 of the relay is connected to the input circuit line 25 through the arm 20A and switch contact 48 so that it no longer depends on the plate current from the thyratron gas discharge tube 11 and any further changes in light intensity either short flashes or of longer duration have no effect on the relay or on the photo-cell circuit until the time clock has again turned over control of the photoelectric cell; (3) current to the heater element 12 of the tube 11 and photo-cell circuit is disconnected by the arm 20A at the switch contact 47.

When the time clock reaches the "turn off" position, moving off the contact 22, voltage is shut off from the relay coil circuit, the relay opens, and the output circuit is de-energized. The relay, electronic components and output circuit will remain de-energized until the time clock again reaches the selected "turn-on" position, and contact is made again between the movable arm 23 and the contact 22. The power output circuit will remain de-energized after the clock has "turned on" until the incident light intensity on the photo cell 38 has decreased beyond the pre-selected intensity, which is controlled by the setting of the potentiometer contact 39.

It will be noted that the electronic circuit is in operation only in the interval between the "turn-on" time by the time clock and the attainment of sufficiently decreased light intensity so that the plate current through the thyratron gas discharge tube closes the relay, as described. This is advantageous in reducing current consumption and in the longer effective life of the elements in the circuit.

The advantages of the invention will be apparent. The time clock "turn-on" point may be set far enough ahead so that the system will be ready to turn on the power output circuit when the light intensity has decreased to the selected level where output is desired. The output is shut off at a selected clock time, regardless of the length of time it has been turned on. The sensitive instruments in the circuit are in use for only a short period of time each day, and therefore have long life and require little servicing. This is most important in controlling sign lighting, etc. The arrangement is simple, relatively inexpensive, and its use conserves electrical energy by turning on the power output circuit only when needed, and turning it off when a selected time by the clock has been reached.

While particular embodiments have been used to illustrate the invention, it will be understood that various modifications may be made without departing from the spirit and scope of this invention as defined in the following claims.

We claim:

1. In combination with an input power circuit and an output power circuit, a light sensitive electrical device control circuit, a relay switch controlled by said control circuit, a holding circuit for said relay switch, said holding circuit being kept closed by said relay switch, and a time clock switch, said time clock switch being set to allow current to flow from said input circuit only during a selected interval of time, said relay switch being closed at times by said light sensitive electrical device control circuit and for the succeeding time being held closed by said holding circuit energized by said input power circuit, flowing through said time clock switch during said selected interval of time.

2. In combination with an input power circuit and an output power circuit, a light sensitive control circuit comprising a triode gas conduction cell having a control grid and a photo-cell circuit adapted to control the flow of current through said triode cell by the variable voltage impressed upon said grid in response to varying light intensities on the photo-cell of said photo-cell circuit; a relay switch adapted to be closed at times by said current through said triode cell; a relay switch holding circuit, said holding circuit being kept closed by said relay switch; and a time clock switch, said clock switch being set to allow current to flow from said input circuit only during a selected interval of time, said relay switch being held in closed position by said holding circuit after initial energization by said current through said triode cell until released by the shutting off of said input power circuit by said time clock switch.

3. In combination with an input power circuit and an output power circuit a light sensitive control circuit comprising a triode gas conduction cell having a control grid and a photo-cell circuit adapted to control the flow of current through said triode cell by the variable voltage impressed upon said grid in response to varying light intensities on the photo-cell of said photo-cell circuit, a relay switch adapted to be closed at times by said current through said triode cell; a holding circuit for said relay, said holding circuit being kept closed by said relay switch and a time clock switch providing over-riding control over said photo-cell circuit and said output power circuit, said clock switch being set to allow current to flow from said input circuit only during a selected interval of time, said relay switch being held in closed position by said holding circuit after initial energization by said current through said triode cell until released by the shutting off of said input power circuit by said time clock switch, said relay switch in closed position shutting off energizing current to said triode cell and said photo-cell circuit, and applying voltage to said output circuit.

4. Automatic electric output circuit switching control means comprising a photosensitive electrical device, a triode gas conduction tube, a double pole electromagnetic relay switch, a time clock switch, and an input electrical circuit, said photo-sensitive electrical device being adapted to be subjected to light of varying intensity, said device under a seletced light intensity being adapted to impress an electrical charge on the grid controlling the flow of current between the heated cathode and the plate of said triode gas conduction tube, said flow of current arranged in a circuit adapted to close said double-pole electromagnetic relay switch, said relay switch when closed connecting the coil of said electromagnetic relay to said input circuit independent of said triode tube circuit, and said relay switch also connecting said output circuit to said input circuit, said input circuit being connected and disconnected at selected time intervals by said time clock switch.

5. Automatic electric output circuit switching control means comprising a photosensitive electrical device, a triode gas conduction tube, a double-pole electromagnetic relay switch, an input electrical circuit, and a time clock switch, said photosensitive electrical device being adapted to be subjected to light of varying intensity under

a selected light intensity being adapted to impress an electrical charge on the grid controlling the flow of current between the heated cathode and the plate of said triode gas conduction tube, said flow of current being arranged in a circuit adapted to close said double pole electromagnetic relay switch, said relay switch when closed connecting the coil of said electromagnetic relay to said input circuit independent of said triode tube circuit, and disconnecting said photoelectric device including the heating circuit of said triode cell, and said relay switch also connecting and disconnecting said output circuit, said input circuit being connected and disconnected at selected time intervals by said time clock switch.

ROBERT O. RITCHIE.
STANLEY MITCHELL.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,140,387	Juchter	Dec. 13, 1938
2,295,894	Dewan	Sept. 15, 1942
2,446,450	Ziegler	Aug. 3, 1948