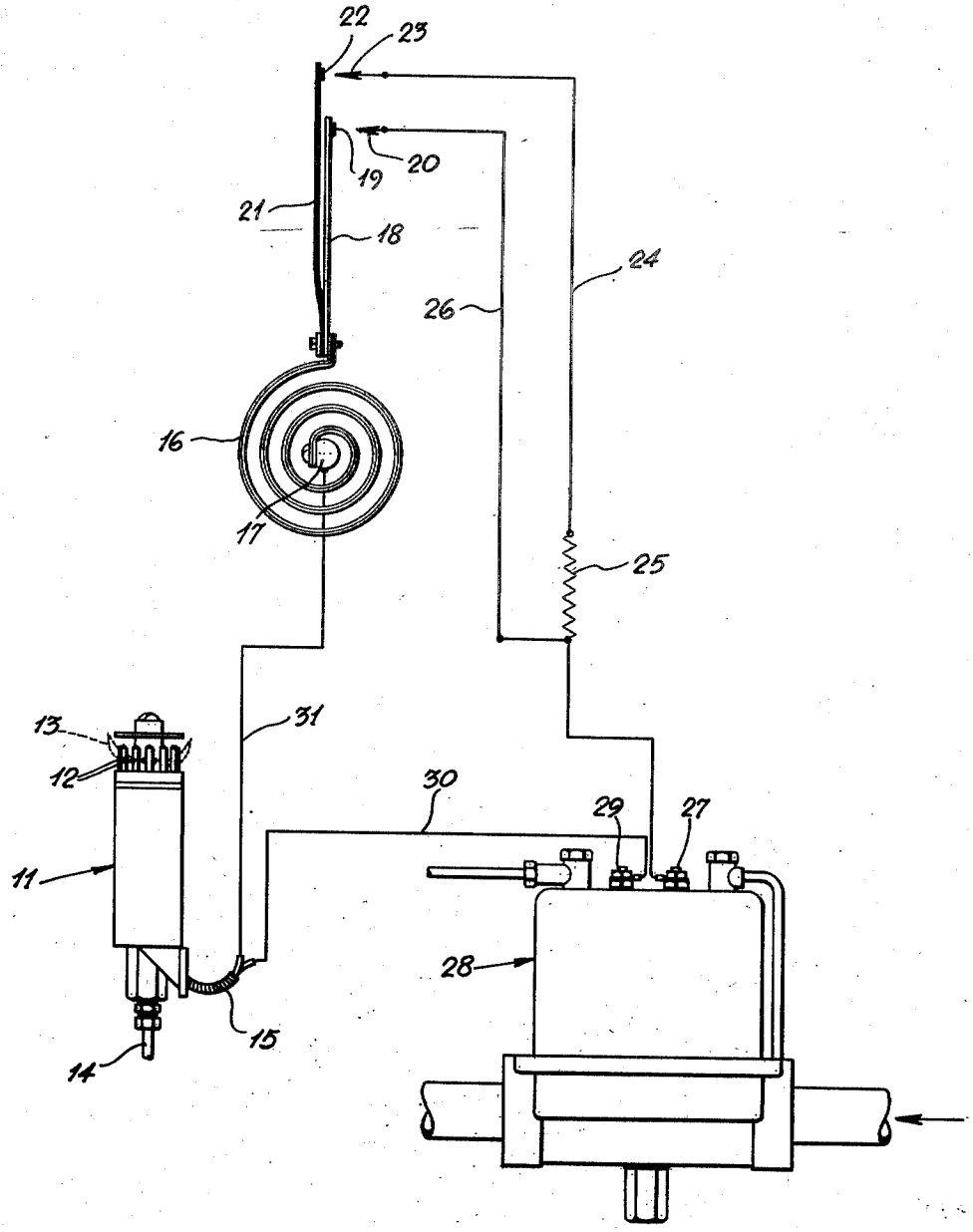
April 8, 1941. W. A. RAY 2,237,578

CONTROL CIRCUIT

Filed Oct. 21, 1938



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Patented Apr. 8, 1941

2,237,578

UNITED STATES PATENT OFFICE

2,237,578

CONTROL CIRCUIT

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Application October 21, 1938, Serial No. 236,258

4 Claims. (Cl. 236—75)

My present invention relates to electrical control circuits and particularly to circuits in which current is controlled by a device which is movable in response to change in a condition, such as, temperature, humidity or pressure.

It is an object of my invention to provide a circuit and condition responsive means for controlling it whereby a definite differential of the controlling condition is required for energization and deenergization of the means controlling the condition producing means.

Other objects and advantages of my invention will be found in the description, the drawing and the appended claims.

For a complete understanding of my invention, reference may be had to the following detailed description and accompanying drawing in which the single figure is a diagrammatic illustration of apparatus embodying my invention.

In the drawing, the numeral 11 denotes a source of electrical energy in the form of a gas consuming thermoelectric generating device comprising thermocouple elements 12 arranged to be heated by flames 13. Fuel is supplied to the device by a pipe 14, and a cable 15 provides means for connecting to the electrical output of the device. This device is fully described in the copending application of William R. Ray, Serial No. 225,075, filed August 15, 1938.

Secured to a bimetallic spiral 16, supported by a member 17, is a rigid arm 18 carrying a contact element 19 cooperable with a relatively fixed contact 20 and a resilient arm 21 carrying a contact element 22 cooperable with a relatively fixed contact 23. The bimetallic spiral and its associated elements constitute a thermostat.

Connected to the contact 23 by wire 24 is an impedance or resistance element 25. A wire 26 connects the other contact 20 and the lower end of resistance element 25 to a terminal 27 of an electrically operated fluid fuel control valve 28. The other terminal 29 of the valve is connected by wires 30 and 31 through the thermoelectric generating device to the bimetallic spiral supporting member 17.

The valve 28, shown by way of example, is fully described in my copending application Serial No. 222,673, filed August 2, 1938, and comprises a fluid pressure operated main valve controlled by an electromagnetically operated pilot valve which includes an armature normally biased to one position and movable to another position upon energization of the device.

Assuming that the valve 28 is adapted to control fuel to a device for heating the space in which the thermostat is located, on drop of temperature in the space the bimetallic member moves in a clockwise direction, bringing the contact element 22 carried by the resilient arm 21 into contact with contact 23, completing a serial circuit through the source 11, the resistance 25 and the valve 28. The contact arrangement is such that, upon initial contact of element 22 with contact 23, there is still a gap between element 19 and contact 20.

The value of the resistance 25 is so arranged that insufficient current is passed thereby to operate the electromagnetic device of the valve. Consequently, temperature in the space continues to drop, with the result that the bimetallic member continues to move, flexing the resilient arm 21, until contact element 19 is brought into contact with contact 20. It will be seen that a short circuit path is now formed across the resistor 25 by the arms 18 and 21 and wires 24 and 26, with the result that sufficient current is permitted to flow in the circuit to operate the valve to open position.

Assuming that heating now occurs, temperature rise will cause the bimetallic spiral to move in counter-clockwise direction with the result that the contact of elements 19 and 20 will be broken, current now flowing through the resistor 25 in series with the source and load.

As is common with many electrically operated devices, particularly electromagnetic devices including an armature normally biased to one position and movable into another upon energization of the device, less current is required to maintain the device in operated condition than is required to operate it. For this reason, with the reduction of current in the circuit the valve remains open.

So heating still continues until the contact of elements 22 and 23 is broken, completely opening the circuit and allowing the valve to close.

It will be seen that thus a definite temperature differential is required for opening and closing the valve with the result that positive operation of the system is effected. Also, neither of the pairs of contacts is ever required to make or break the full load of the valve, thus reducing arcing and wear of the contacts. In practice, the positions of contacts 20 and 23 with respect to their cooperating contact elements are made adjustable so as to vary the differential as desired.

While I have shown and described my invention as applied to the control of a heating system, it is obvious that it is not so limited and that it may as well be embodied in circuits for con-

trolling other conditions, such as humidity or pressure, and which are controlled by a member movable in response to change in such conditions.

The particular electrically operated valve and source of current shown and described are by way of example only. Other forms of electrically operated devices and sources of current, A. C. or D. C., may be substituted without departing from the spirit of my invention.

My invention therefore is to be limited only by the scope of the appended claims.

I claim as my invention:

1. In a system wherein a condition changing device is controlled by an electromagnet comprising an armature movable between two controlling positions and biased to one of said positions, a predetermined amount of current operating said armature into the other of said positions and a predetermined less amount of current sufficing then to retain said armature in that position against said bias; the combination therewith of a source of electrical energy; an electrical impedance; a member subjected to, and movable in response to change in, said condition; resilient means connected to said movable member so as to move therewith; first switching means operable by movement of said resilient means; and second switching means operable by movement of said movable member; said first switching means being effective to interconnect said source, said electromagnet, and said impedance upon initial movement of said movable member in one direction; said second switching means being effective to shunt said impedance upon further movement of said movable member in said one direction, whereby said armature is operated into said other position; said impedance having a value such that, when said impedance is again introduced into circuit by subsequent movement of said movable member in the opposite direction, said armature is retained in said other position.

2. In a system wherein a condition changing device is controlled by an electromagnet comprising an armature movable between two controlling positions and biased to one of said positions, a predetermined amount of current operating said armature into the other of said positions and a predetermined less amount of current sufficing then to retain said armature in that position against said bias; the combination therewith of a source of electrical energy; an electrical impedance; a member subjected to, and movable in response to change in, said condition; a resilient member connected to said movable member so as to move therewith; first contact means carried by said resilient member; and second contact means carried by said movable member; said first contact means being effective to interconnect said source, said electromagnet, and said impedance upon initial movement of said movable member in one direction; said second contact means being effective to shunt said impedance upon further movement of said movable member in said one direction, whereby said armature is operated into said other position; said impedance having a value such that, when said impedance is again introduced into circuit by subsequent movement of said movable member in the opposite direction, said armature is retained in said other position.

3. In a system wherein a condition changing device is controlled by an electromagnet comprising an armature movable between two controlling positions and biased to one of said positions, a predetermined amount of current operating said armature into the other of said positions and a predetermined less amount of current sufficing then to retain said armature in that position against said bias; the combination therewith of a source of electrical energy; an electrical impedance; a member subjected to, and movable in response to change in, said condition; a resilient member connected to said movable member so as to move therewith; a first contact element carried by said resilient member; a second contact element carried by said movable member; and a pair of relatively fixed contact elements engageable respectively and consecutively with said first and said second movable contact elements when said movable member is moved in one direction; said first contact element being effective to interconnect said source, said electromagnet, and said impedance upon initial movement of said movable member in said one direction; said second contact element being effective by additional engagement thereof with its corresponding fixed contact element to short out said impedance upon further movement of said movable member in the same direction, whereby said armature is operated into said other position; said impedance having a value such that, when said impedance is again introduced into circuit by subsequent movement of said movable member in the opposite direction, said armature is retained in said other position.

4. In a system wherein a temperature changing device is controlled by an electromagnet comprising an armature movable between two controlling positions and biased to one of said positions, a predetermined amount of current operating said armature into the other of said positions and a predetermined less amount of current sufficing then to retain said armature in that position against said bias; the combination therewith of a source of electrical energy; an electrical impedance; a bimetallic member subjected to, and movable in response to change in, said temperature; a resilient member connected to said bimetallic member so as to move therewith; a first contact element carried by said resilient member; a second contact element carried by said bimetallic member; and a pair of relatively fixed contact elements engageable respectively and consecutively with said first and said second movable contact elements when said bimetallic member is moved in one direction; said first contact element being effective to interconnect said source, said electromagnet, and said impedance upon initial movement of said bimetallic member in said one direction; said second contact element being effective, by additional engagement thereof with its corresponding fixed contact element, to short out said impedance upon further movement of said bimetallic member in the same direction, whereby said armature is operated into said other position; said impedance having a value such that, when said impedance is again introduced into circuit by subsequent movement of said bimetallic member in the opposite direction, said armature is retained in said other position.

WILLIAM A. RAY.