March 3, 1942. W. A. RAY 2,274,938

CONTROL CIRCUIT

Filed Aug. 29, 1938

Fig. 1

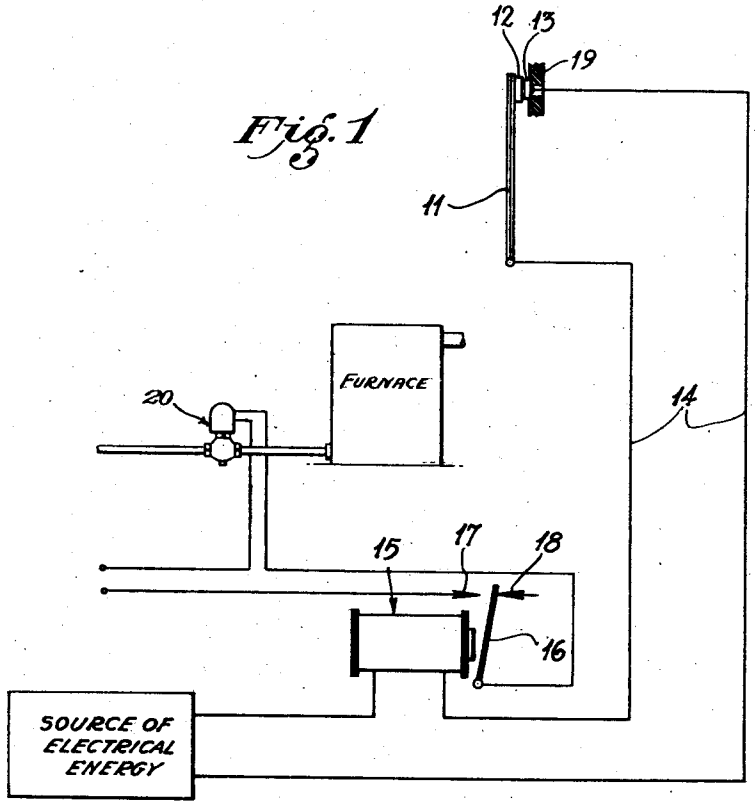
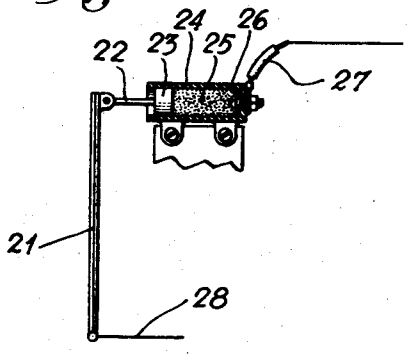


Fig. 2



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CONTROL CIRCUIT

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Application August 29, 1938, Serial No. 227,257

2 Claims. (Cl. 236—78)

My present invention relates to electrical control circuits and has for its chief object the provision of a circuit in which an electrically operated device is controlled by variation of pressure across electrical contact members which are continuously in contact with one another during the operative cycle of the device.

A particular object of this invention is the provision of a circuit in which current flow through an electromagnetic device is substantially constantly varied by variation of pressure across a pair of metallic electrical contact members which are in continuous contact with one another while so varying said current flow as to move a member cooperable with said device between energized and unenergized positions.

The variable controlling pressure employed may be that generated by a temperature responsive bimetallic member, or in a fluid thermostat, or by other devices responsive to changes in conditions.

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

For a more complete understanding of the invention, reference may be had to the following detailed description and accompanying drawing, in which

Figure 1 is a diagrammatic view of apparatus embodying my invention; and

Figure 2 is a more or less diagrammatic view of a device shown only for the purpose of explaining the operation of my invention, and forming no part thereof.

Referring to Fig. 1 of the drawing, the numeral 11 denotes a bimetallic member carrying a contact member 12 cooperable with a relatively fixed contact member 13 mounted in an insulating member 19. The contact members 12 and 13 are connected by means of wires 14 through the coil of an electromagnetic device 15 to a source of electrical energy indicated by the legend. The electromagnetic device 15 is provided with an armature 16 cooperable with contacts 17 and 18 to control an external circuit, which, by way of example, may include an electrically operated valve 20 controlling fuel supply to a furnace, indicated by the legend, for heating the space wherein the bimetallic member is installed.

In Fig. 2, I have shown means, for more readily explaining the effect produced by the contact members 12 and 13 of Fig. 1, which comprise a bimetallic member 21 operatively connected by a pivoted rod 22 to a plunger 23 slidable within a cylinder 24 of insulating material to vary the pressure on carbon granules 25 contained therein in contact with a conductive back plate 26. Electrical connection to the device may be made by means of wires 27 and 28.

In conventional control circuits that include the apparatus diagrammatically shown in Fig. 1, the circuit constants are such that upon initial closing of the contact members the voltage across them drops substantially to zero with respect to that across the electromagnetic device with the result that operation of said device is immediately effected. While the contacts are maintained in closed position, regardless of variation of pressure across them, the voltage across them remains substantially zero. When the contacts actually open, the voltage across them rises to that of the source. It is usual in such a control system to include magnetic or spring actuated "snap action" means for moving the contact members rapidly to and from their closed position so as to prevent arcing and chattering of the contacts.

In contradistinction to the above, by my invention, the circuit constants are so arranged that upon initial closing of the contact members 12 and 13 the voltage across them is still substantially that of the source, or very high with respect to that across the electromagnetic device 15, with the result that said device remains unoperated.

Upon increase of pressure being produced across the contact members by flexing of the bimetallic member 11 in response to drop in temperature, the voltage across the contact members is substantially constantly reduced with the result that a point is reached at which sufficient current flows in the circuit to operate the electromagnetic device. Upon decrease in pressure across the contacts, the voltage across them substantially constantly increases, with the result that a point is reached at which the electromagnetic device returns to unoperated condition while the contact members are still in mechanical contact.

Upon further possible movement of the contact members they may actually separate, but without any effect upon the operation of the control circuit.

For a clear understanding of the operation described above, reference may be had to Fig. 2 of the drawing the device shown therein being effective to vary the pressure between carbon granules, with the well known result that the voltage across the device would be substantially constantly varied if it were connected in a cir-

cuit including a source of electrical energy and a load or resistance.

For the purpose of my invention, I prefer to employ solid contact members made of such metals as platinum or silver. I also employ a source of voltage that is very low with respect to that commonly employed in control circuits. It may preferably be in the order of 0.25 volt or less for best results with platinum or silver contact members. This source may conveniently be in the form of a thermoelectric generating device of low internal resistance, a D. C. or A. C. source provided with a potentiometer, or an A. C. transformer wound for such low voltage. The electrically operated device that I employ has low resistance or impedance, preferably in the order of one or two ohms, depending mainly upon the resistance or impedance of the source.

I have found that a control circuit employing the apparatus described in the previous paragraph operates by variation of pressure across the contact members, with the result that the contact members are continuously closed during the operative control cycle. The effective variation of contact resistance with variation of pressure is seemingly due to the microscopic change in area of contact. This effect is produced, for example, between fresh clean surfaces of platinum or silver. The surface of at least one of the contact members is preferably of spherical form as shown.

An outstanding advantage of the control circuit of my invention resides in the small differential of the condition controlling the contact pressure required for operation of the controlled device. For example, I have found, by means of accurate recording instruments, that a consistent 0.25° F. differential was maintained in the control of heating apparatus by a bimetallic member so arranged as to move 0.0004 inch per degree Fahrenheit. A sensitive millivoltmeter connected across the contacts showed a substantially constant change throughout the variation of pressure across the contacts.

A further advantage is in the absence of arcing at the contacts which obviously cannot occur under the constant variation of current which occurs in my control circuit.

The harmful effect of vibration of the contacts is also minimized, as it has been shown that the initial making of contact has no effect on the operation of the controlled device.

The load device of my circuit may be any form of sensitive electrically operated device having the required resistance characteristics.

The circuit of my invention has been found to have particular utility in connection with the fluid pressure operated valve disclosed in my copending application, Serial No. 222,673, filed August 2, 1938, along with the thermoelectric generating device disclosed in the patent of William R. Ray, No. 2,236,609, dated April 1, 1941. When such a valve is employed, no relay is required as the sensitive electrically operated pilot valve of this valve may be connected directly in the thermostatically controlled circuit.

While I have shown the contact members arranged in series with the source and electromagnetic device, it is obvious that control might also be effected by arranging the source and load in a complete series circuit and shunting the contacts across the load and source, especially in connection with a thermoelectric generating device.

I do not claim any particular means for varying the pressure across the contacts, as there are many well known means, in particular, condition responsive means, for effecting such variation.

No limitations upon my invention are intended other than are imposed by the scope of the appended claims.

I claim as my invention:

1. In a system whereby the degree of a condition is automatically controlled, in response to variations of said degree, in a narrow range: means for changing the degree of said condition; a pair of smooth-faced, rigid, metallic contact members normally in engagement within said narrow range; a circuit, including a source of electrical energy having an E. M. F. of a fraction of a volt, controlled by said contact members; a device, electrically operable between two controlling positions dependent on the degree of energization thereof and biased to one of said positions, for controlling the means for changing the degree of said condition and connected in said circuit; and means, movable in response to changes in said condition, for varying the pressure between the contact members; the constants of the components of said circuit having such values, with respect to the variation of the contact resistance of said members due to the variation in pressure between them produced in said narrow range, that when said pressure has a low value the current flow in the circuit is insufficient to operate said device into the other of said positions and only becomes sufficient when the pressure exceeds said low value.

2. In a system whereby the temperature of a space is automatically controlled in a narrow range in response to variation of said temperature: means for changing the temperature of said space; a pair of smooth-faced, rigid, metallic contact members normally in engagement within said narrow range of temperature; a circuit, including a source of electrical energy having an E. M. F. of a fraction of a volt, controlled by said contact members; a device, electrically operable between two controlling positions dependent on the degree of energization thereof and biased to one of said positions, for controlling said temperature changing means and connected in said circuit; and means, movable in response to changes in the temperature of said space, for varying the pressure between the contact members; the constants of the components of said circuit having such values, with respect to the variation of the contact resistance of said members due to the variation in pressure between them produced in said narrow range, that when said pressure has a low value the current flow in the circuit is insufficient to operate said device into the other of said positions and only becomes sufficient when the pressure exceeds said low value.

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