May 15, 1934. C. L. HANEL 1,959,205

ELECTRICAL CIRCUIT CONTROLLING MECHANISM

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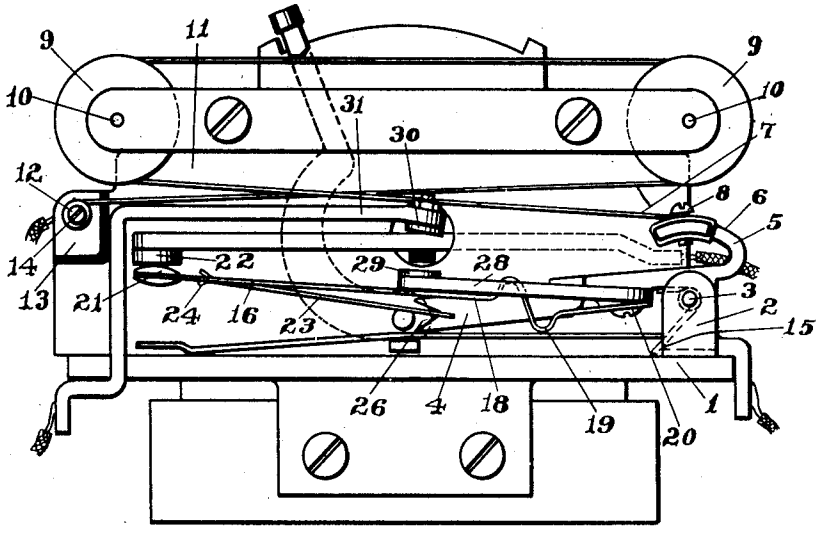


Fig. 1.

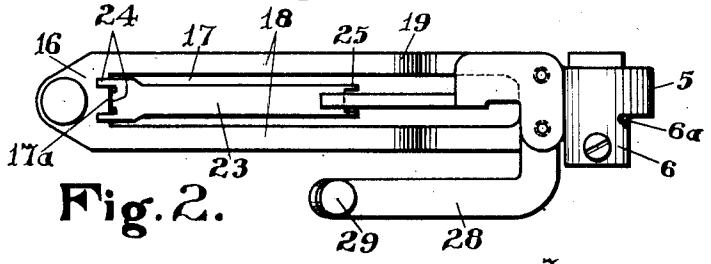


Fig. 2.

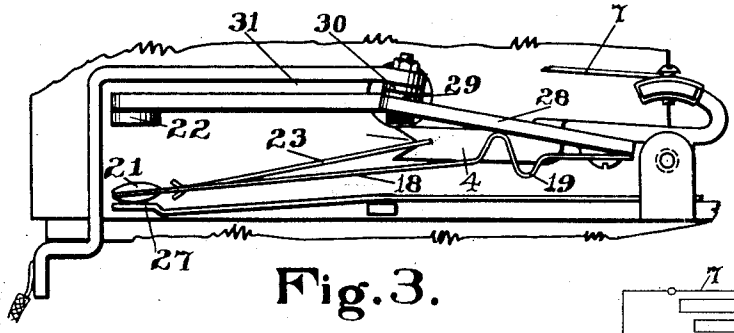


Fig. 3.

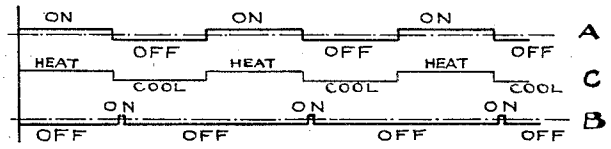


Fig. 4.

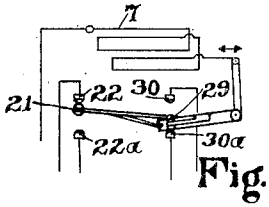


Fig. 5.

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ELECTRICAL CIRCUIT CONTROLLING MECHANISM

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7 Claims. (Cl. 200—113)

The present invention relates to an improved electrical circuit controlling mechanism and has for its object to provide a device of this character that will operate automatically in response to the passage of electrical current therethrough to either control a circuit in which the device itself forms a part, or to control one or more circuits external to the device.

In my copending application Serial No. 291,441, filed July 9, 1928, and since issued as Patent No. 1,868,500 July 26, 1932, there is shown and described an electrical circuit controlling mechanism characterized by the utilization of the longitudinal expansion and contraction of an electrical conductor due to the passage of electric current therethrough to automatically operate a device for making and breaking an electrical circuit with a very rapid movement, high contact pressure being maintained up to the point of contact separation. The present invention contemplates certain improvements in the mechanism covered by the aforesaid copending application, so as to obtain better operating characteristics and insure its uniform operation over a long period of time. The device of the present invention also provides additional contacts operating in such a manner as to extend the field of usefulness of the device in the control of associated electrical apparatus. The above and other advantageous features of the invention will hereinafter more fully appear from the following description with reference to the accompanying drawing in which:—

Fig. 1 is a view in front elevation of the improved circuit controlling mechanism.

Fig. 2 is a plan view of the operating lever and associated contact member removed from the mechanism.

Fig. 3 is a fragmentary view showing a portion of the parts shown in Fig. 1 in a different position.

Fig. 4 is a diagram illustrating the functioning of the contacts of the device.

Fig. 5 is a diagram illustrating a contact sequence of the device.

Like reference characters refer to like parts throughout the different figures.

Referring first to Fig. 1, the mechanism consists of a base 1 of insulating material upon which is mounted a U-shaped hinge bracket 2 carrying a pin 3 on which is pivotally supported a lever 4. One end of the lever 4 provides a lug 5 adjacent to the pivot pin 3, which lug is bent upwardly to a point above the pin 3 to provide a curved surface 6 having its center of curvature extending through the axis of the pivot pin 3. The curved surface 6 provides a small groove 6a for receiving a wire or filament 7 which is wrapped around the lug 6 and is secured thereto by a set screw 8.

The filament 7 passes from the lug 5 around grooved pulleys 9, 9 freely mounted on shafts 10, 10 supported by a plate 11 extending upwardly from one side of the insulating base 1. After passing around the right hand pulley 9, the filament 7 extends in the opposite direction to an anchor pin 12 carried by a terminal plate 13 insulated from the rear plate 11. The filament 7 is wrapped for a few turns about the anchor pin 12 and the end of the pin provides a slot 14, whereby the pin 12 may be turned to wind the filament 7 thereon. As previously pointed out, the other end of the filament 7 is secured to the lug 5 on the lever 4, so that when the filament 7 is wound on the anchor pin 12, a tension can be placed on the filament which will tend to turn the lever 4 about its pivotal axis in a counterclockwise direction. Normally the initial tension in the filament 7 is sufficient to hold the lever 4 in the position shown in Fig. 1.

The pivot pin 3 of the lever 4 is surrounded by a spring 15 indicated in dotted lines in Fig. 1, one end of which bears on the lever 4 while the other end bears on the base 1. Therefore, with the parts in the position shown in Fig. 1 the spring 15 opposes the initial tension of the filament 7, so that should the latter be extended longitudinally, the spring 15 will tend to turn the lever 4 on its axis in a clockwise direction into the position shown n Fig. 3.

The lever 4 also carries a resilient contact member 16 which, as best shown in Fig. 2, is preferably formed from a single piece of sheet metal with a central slot 17 extending between spaced arms 18. In forming the contact member 16, the arms 18 are bent into double loops at 19, preferably located near the point of attachment of the member 16 to the lever 4 by the screws 20. The opposite end of the contact member 16 carries a contact tip 21 which is normally maintained in yielding engagement with a stationary contact 22 by the thrust of a tongue 23 extending between the free end of the lever 4 and the junction of the arms 18 of the contact member 16.

As best shown in Fig. 1, the tongue 23 is provided at one end with oppositely bent ears 24 which are adapted to receive between them the edge 17a which forms one end of the slot 17 in the contact member 16, (see Fig. 2). The other

end of the tongue 23 is cut away at 25 so as to be received in a notch 26 provided at the free end of the lever 4. With the parts in the position shown in Fig. 1, the end of the tongue 23 received in the notch 26 is disposed below the resilient arms 18 of the contact member 16 so that the tongue 23 exerts an upward thrust on the whole contact member, thereby tending to yieldingly maintain the contact tip 21 in close engagement with the stationary contact 22.

As fully described in my aforesaid copending application Serial No. 291,441, passage of electrical current through the filament 7 results in longitudinal expansion of the filament as it heats up, thereby permitting the spring 15 to slowly turn the lever 4 in a clockwise direction about its pivot pin 3. As this movement progresses, the thrust of the tongue 23 tends to press the contact 21 into engagement with the stationary contact 22, the loops 19 in the arms 18 permitting a certain amount of elongation of the contact member 16 under the thrust of the tongue 23, with resulting sliding of the contact 21 on stationary contact 22. When turning movement of the lever 4 has progressed to the point where the apex of the notch 26 passes above the plane of the arms 16, the tongue 23 immediately exerts a thrust tending to separate the contacts 21 and 22 with a rapid movement, the thrust of the tongue 23 being added to the turning force of the spring 15 in swinging the lever 4 quickly upwardly. In Fig. 3, the lever 4 is shown as having swung to its upper position, with the contact member 21 maintained in yielding engagement with an adjustable stop 27.

Assuming that the flow of electrical current through the filament 7 is interrupted upon separation of the contacts 21 and 22, it is obvious that the filament 7 will start to cool off when the parts have assumed the position of Fig. 3, whereupon the contraction of the filament starts to swing the lever 4 downwardly in a counterclockwise direction. When this movement reaches the point where the apex of the notch 26 passes below the plane of the arms 18, the contact member 16 is snapped back into the position shown in Fig. 1 to reengage the contacts 21 and 22. Obviously, continued energization and deenergization of the filament 7 will impart a measured oscillatory movement to the lever 4, the period of which is determined by the rate of expansion of the filament 7 and the amplitude of which is determined by the spacing between the stationary contact 22 and the stop 27. As the lever 4 oscillates about the pivot pin 3, there is no appreciable flexure of the filament 7 where it is attached to the lug 5, owing to the fact that the surface 6 of the lug 5 is concentric about the axis of the pin 3. Furthermore, repeated flexures of the contact member 16 by the thrust of the tongue 23 results in no appreciable wear of these parts, since the tongue 23 swings on the straight edge 17*a* at the end of the slot. The double loops 19 also serve to absorb flexure of the arm 18 without bending the arms at their points of attachment to the lever 4. As a result of the above noted features of construction, the device is adapted to operate uniformly over long periods without breakage of the filament 7 and without showing appreciable wear of the parts carried by the lever.

As previously pointed out, the invention also contemplates the provision of auxiliary contacts for the purpose of extending its field of application in the control of associated electrical apparatus. To this end, the lever 4 provides an extension 28 provided at its end with a contact 29 adapted to cooperate with a stationary contact 30, that is adjustable by reason of its being threaded into a stationary support 31. The stationary contact 30 is entirely separate from the stationary contact 22 and obviously the contact 29 moves directly with the lever 4 and independently of the resilient contact member 16. As a result, the period of engagement, or of disengagement, of the contacts 29 and 30 is entirely different from the period of engagement, or of disengagement, of the contacts 21 and 22. As indicated in Fig. 3, the contact 29 is adapted to engage the contact 30 just as, or shortly after movement of the lever 4 has snapped the contact member 16 away from the stationary contact 22. Therefore, assuming that the disengagement of contacts 21 and 22 results in interrupting the flow of current through the filament 7, it follows that contraction of the filament 7, due to cooling, will almost immediately move the lever 4 far enough to separate the contact 29 from the stationary contact 30. It is, therefore, evident that the period of engagement between the contacts 29 and 30 is very much less than the period of engagement between the contacts 21 and 22 and in fact the device may be so adjusted, as by screwing the contact 30, so as to permit only momentary engagement between contacts 29 and 30. Various ways of utilizing the measured periods of engagement and disengagement of the contacts 21 and 22, as well as the almost momentary engagements of the contacts 29 and 30, with relatively long periods of disengagement, are too numerous to require detailed description herein.

In Fig. 4 there is illustrated, graphically, the functioning of the contacts of the device, graph A representing the periods during which contacts 21 and 22 are "on" and "off", graph B representing the corresponding periods for contacts 29 and 30 and graph C representing the heating and cooling periods of filament 7. From this, it is apparent that the periods of the contacts 21 and 22 are, generally, coincident with the heating and cooling periods of the element 7, while the periods of the contacts 29 and 30 are, generally, determined by the complete heating and cooling cycle of filament 7.

A further extension of the use of the device can readily be obtained by employing additional stationary contacts 22*a* and 30*a* adapted to be engaged by the contacts 21 and 29, respectively, as indicated diagrammatically in Fig. 5. In this arrangement, contact 22*a* is engaged by contact 21, when the filament 7 is cooling, while the contact 30*a* is engaged by contact 29, momentarily, at the end of the cooling period. With the disposition of contacts indicated in Fig. 5, the contact sequence during a complete heating and cooling cycle is substantially as follows: contacts 22 and 30*a* on; contact 30*a* off; contact 22 off; contacts 22*a* and 30 on; contact 30 off; and finally contact 22*a* off.

I claim,

1. In a device of the class described, a pivotally mounted member carrying a flexible contact providing spaced arms each having a loop formed therein to permit of longitudinal extension of said contact in response to a thrust exerted at an angle to the plane of said arms.

2. In a device of the class described, a pivotally mounted member carrying a flexible contact providing spaced arms joined together at the free end of said contact and a separate thrust exert-

ing tongue extending between said arms from the free end of said pivotally mounted member, with the other end of said tongue in pivotal engagement with said contact adjacent the juncture of its arms.

3. In a device of the class described, a pivotally mounted member carrying a flexible contact providing spaced arms joined together at the free end of said contact and a separate thrust exerting tongue extending between said arms from the free end of said pivotally mounted member, with the other end of said tongue providing offset portions adapted to embrace an edge forming the juncture of said arms to provide a pivotal connection therebetween.

4. In a device of the class described, a pivotally mounted contact carrying member and a filamentary element having one end fixed and the other end connected to said pivotally mounted member to exert a pull thereon, the said element passing around a surface on said member having a center of curvature coinciding with the pivotal axis of said member.

5. In an electrical circuit controlling device, separate stationary contacts, a pivotally mounted member and a filamentary element having one end fixed and the other end connected to said pivotally mounted member, expansion and contraction of said element causing separate contacts carried by said pivotally mounted member to engage or disengage said stationary contacts for different periods.

6. In an electrical circuit controlling device, separate stationary contacts, a pivotally mounted member carrying separate contacts and a filamentary electrical conductor having one end fixed and the other end connected to said pivotally mounted member, heating and cooling of said conductor due to the passage, or non-passage, of electrical current therethrough causing the contacts carried by said member to engage or disengage said stationary contacts for different periods determined by the heating or cooling of said conductor, alone, as regards one pair of contacts or by the heating and cooling of said conductor, combined, as regards the other pair of contacts.

7. In an electrical circuit controlling device, separate stationary contacts, a pivotally mounted member carrying separate contacts and a filamentary electrical conductor having one end fixed and the other end connected to said pivotally mounted member to cause it to maintain one of its contacts in engagement with one of said stationary contacts, with the other pair of said contacts disengaged, passage of current through said conductor causing heating and expansion of same and the measured turning of said member to first separate said engaged contacts, after a predetermined period of engagement, and then to engage the other pair of contacts after a predetermined period of disengagement, the said second pair of contacts being adapted to be disengaged immediately upon the cooling and contraction of said conductor, while the first pair of contacts are still disengaged.

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