March 21, 1933. J. E. WILLING 1,902,793

THERMAL RELAY

Filed June 26, 1930

FIG. 1.

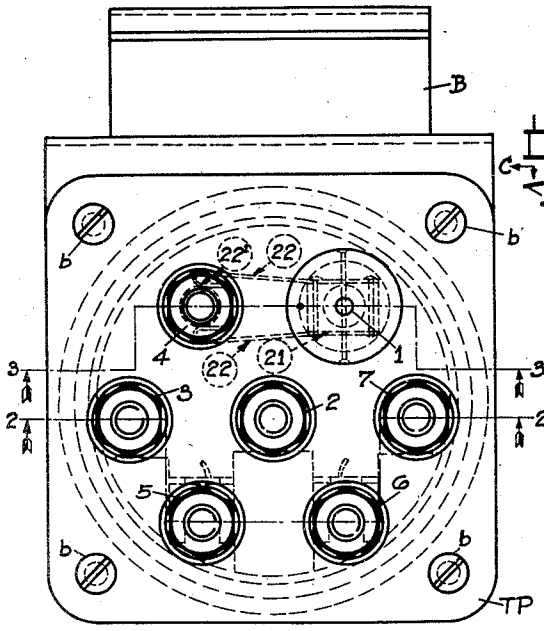


FIG. 5.

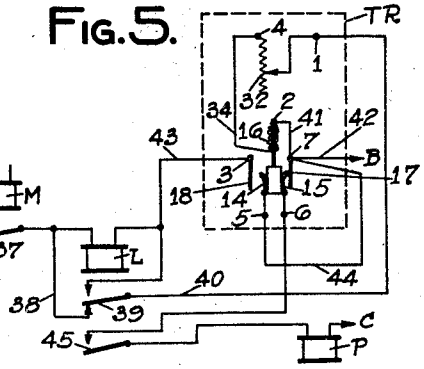


FIG. 4.

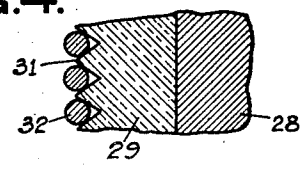


FIG. 2.

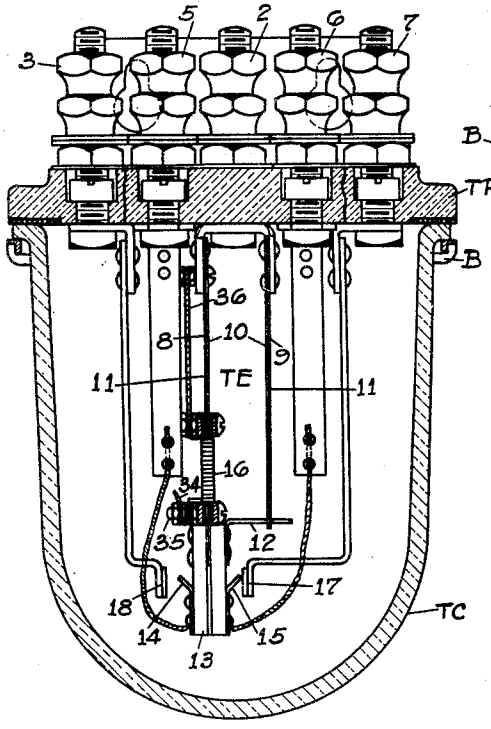
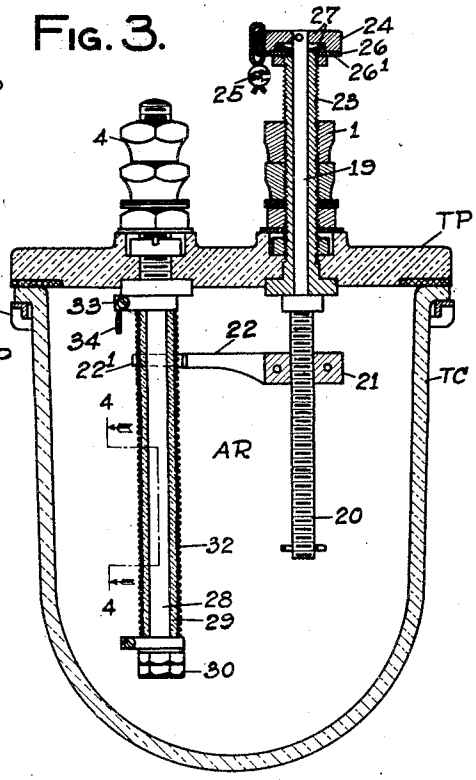


FIG. 3.



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UNITED STATES PATENT OFFICE

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THERMAL RELAY

Application filed June 26, 1930. Serial No: 463,903.

This invention relates in general to relays, and has more particular reference to a thermal relay with special adjusting features for adjusting for changes of voltage and for varying the timing of operation of the relay.

Among the objects of the present invention is to provide a thermal relay which can be readily adjusted for changes of voltage, so as to maintain the timing of relay operation practically constant.

Another object is to provide a thermal relay which can be readily adjusted to give various times of operation.

A further object is to provide an adjustable resistance element therein which is simple in construction, but is unusually securely maintained in proper operative position, and at the same time is very economical to manufacture.

Further objects include decreasing the cost of production, increasing the efficiency, and prolonging the useful life, of devices of the character in question.

Further objects, purposes and characteristic features will appear as the description progresses, reference being made to the accompanying drawing, showing, solely by way of example, and in no manner in a limiting sense, one form which the invention can assume. In the drawing:—

Fig. 1 is a top plan view of a relay in accordance with this invention.

Fig. 2 is a sectional view on line 2—2 of Fig. 1, viewed in the direction of the arrows.

Fig. 3 is a sectional view on line 3—3 of Fig. 1, viewed in the direction of the arrows.

Fig. 4 is a fragmentary sectional view, on line 4—4 of Fig. 3, viewed in the direction of the arrows.

Fig. 5 is a circuit diagram showing the invention.

The relay forming the subject matter of the present invention is of very general use, and particularly so in railway practice, for insuring a predetermined lapse of time between two operations which bear the relation of cause and effect to each other.

The relay can, for example, be used in controlling switch machines and the like in connection with approach locking.

Referring now to the drawing, in the embodiment shown the relay comprises a transparent case TC, having a top plan TP of insulating material clamped to the case by means of bolts b passing through the top plate and a portion of a suspending bracket B.

Carried on the top plate is a plurality of terminal posts with thumb nuts, in the present instance seven, identified in the drawing by reference characters 1, 2, 3, 4, 5, 6 and 7.

Carried by the post 2, is a thermal element TE, comprising compensated bi-metallic arms, 8 and 9, each of which includes a strip of brass 10 and a strip of invar steel 11, fastened together and anchored at the upper ends to the terminal post 2. The brass strips are positioned to face each other, with the two arms parallel but spaced a short distance from each other as shown, whereby a uniform increase of temperature of the two arms causes them to tend to separate from each other at the lower ends, while a like decrease in temperature causes the lower ends to attempt to draw together. The lower ends are anchored together by means of a plate 12 whereby changes of temperature which affect the two arms equally can have no effect on moving the thermal element TE as a whole.

The thermal element carries an insulating block 13 to which are fastened two contact points 14 and 15, insulated from each other by the block and respectively connected up with the terminal posts 5 and 6.

Carried on one of the arms of the thermal element, as arm 8, is a heating winding 16, which, when energized causes its arm to move the entire thermal element to the left, in the case shown in the drawing, as viewed in Fig. 2, to thereby break the back contact 15 and make the front contact 14, the thermal element being positioned between fixed back and front contacts 17 and 18 respectively, carried by the terminal posts 7 and 3. On de-energizing the heating winding, the thermal element slowly returns to its original position in which it makes up the back contact 15.

In order to adjust the time required for operation of the thermal element, and also to adjust for changes in applied voltage in

the heating coil, an adjustable resistance element AR is provided.

The adjustable resistance element AR includes a rod extended within and without the case TC, with the lower end threaded as at 20 and receiving threaded thereon a traveler comprising a threaded nut and two spaced spring arms 22—22 extending from the nut. The upper end of the rod 19 is rotatably received in a threaded tubular member 23 which is clamped in fixed position to the top plate as by means of nuts on binding post 1. Pinned to the rod 19 is a thumb nut 24 for turning the rod within its tubular member, and thereby causing the traveler nut and arms to move along the threaded portion 20, the thumb nut having a seal 25 for fastening it to a stop plate 26, in any desired position by means of a series of apertures 26^1 in plate 26. Plate 26 is keyed to the tubular member 23 and held in its keyed position by means of a dished spring washer 27 received in a socket in the thumb nut. With this arrangement of parts, when the thumb nut 24 and lock plate 26 are interconnected, it is impossible to turn the threaded rod and hence it is impossible to move the traveler.

Carried by the post 4 is a rod 28, with a porcelain sleeve 29 received thereon and held in place by nuts 30. The porcelain sleeve has its outer surface threaded to form teeth 31 for receiving a resistance wire 32 which is wound in the teeth, as shown best in Fig. 4. This construction insures that the resistance winding, even though it expands on being heated by current traversing it, will remain securely in place, and also facilitates the operation of winding the resistance wire and hence decreases the cost of manufacture very materially. The resistance wire is fastened at its upper end to a clamp 33 which is electrically connected by a wire 34 to the binding post 35 at the lower end of the heating coil 16, with the upper end of the heating coil 16 connected by wire 36 to the terminal post 2.

The spring arms 22 on the traveler embrace the resistance winding 32 on opposite sides by means of their inturned spring fingers 22^1 whereby to vary the resistance inserted in the energizing circuit for the heating winding 16, the resistance increasing or decreasing according as the fingers move away or toward the clamp 33.

With the structure described above, it is seen that a thermal relay has been provided which has a thermal element comprising two spaced parallel bi-metallic arms anchored at their upper ends to a fixed support, and having their lower free ends connected together to prevent relative movement therebetween, whereby to compensate for changes in room temperature, together with readily adjustable means for varying the energization of a heating winding on one of the two bi-metallic arms, the thermal element, on operation, moving between two fixed contact posts.

In order to illustrate one application of the thermal relay described above, there is shown, in a manner similar to an application of R. M. Phinney, filed of even date herewith, and entitled Traffic control system for railroads, in Fig. 5, in a wholly diagrammatic manner, a thermal relay of the construction just described, this relay being represented as enclosed within a dashed line rectangular.

Together with the thermal relay TR, is a relay M, which can be operated either manually or automatically in any desired manner to pick up its contact finger when so energized, a stick relay L, and a device P, which can be a relay or any desired device which it is desired to energize a predetermined time after the operation of relay M. Relay M, for example, can be automatically controlled in accordance with traffic conditions, while the device P can be a relay which controls the operation of a switch machine or like mechanism.

In the arrangement of parts shown in Fig. 5, on energization of relay M, its contact finger is picked up to thereby energize the heating winding of the thermal relay, through a circuit including C, contact finger 37 and front point of relay M, wire 38, contact finger 39 and back point of L, wire 40, resistance 32, wire 34, heating winding 16, wires 41 and 42, to B. On energization of the heating winding 16, the thermal element moves to open its back contact 15 and close its front contact 14 whereupon the stick relay L is energized through a circuit including C, contact finger 37 and front point of M, relay L, wire 43, contact finger 14 and front point of TR, and wire 44 to B. On being picked up, the stick relay L is stuck up through a circuit including, C, contact finger 37 and front point, relay L, contact finger 39 and front point, wire 40, etc., as above, through the heating winding 16 to B.

It should be noted that on relay L picking up, the energizing circuit for the heating element through a back point of L, previously referred to, is broken, and a new one is established which includes the winding of relay L, and this winding is of such high resistance as to so decrease the current passing through the heating winding as to allow the heating winding to cool down substantially as though its energizing circuit had been broken.

On picking up and sticking up of relay L, as just described, the heating winding 16 is substantially deenergized, whereby after a predetermined interval of time, the thermal element returns to its initial position to thereby make up its back contact 15 again.

It should be noted that the device P, which it is desired to control, has an energizing circuit including a contact finger 45 and front point of relay L, and the back point 15 of the

thermal relay TR, whereby it requires, for energization, that the thermal relay pass through a complete cycle of operation and returns to its initial position. The thermal relay must close its front point 14 to pick up relay L, and thus close, and stick closed, contact finger 45, and then return to its initial position to close its back contact 15, before the energizing circuit for device P is completed.

On de-energization of relay M, stick relay L returns to its initial position, as likewise does the device P and the energizing circuit for the heating coil 16 is opened.

By arranging the various parts as just described, so that the time interval elapsing between the operation of an operating member, as M, and that of an operated member, as P, is equal to the time required for the thermal relay to move from its back point to its front point, and back again to its back point, it is assured that the thermal relay shall always be ready for a successive operation, no matter how closely the successive operations follow each other. This is not the case where the time interval is determined only by the movement of a thermal element from one position to an opposite position, as a considerable time is required for the element to return to its initial position so that an attempted successive operation during the return period of the thermal element, necessarily fails.

The above rather specific description of one form of the present invention is given solely by way of illustration, and is not intended, in any manner whatsoever, in a limiting sense. Obviously, the invention can assume many different physical forms, and is susceptible of numerous modifications, and all such forms and modifications are intended to be included in this application, as come within the scope of the appended claims.

Having described my invention, I now claim:—

1. In a thermal relay, in combination, fixed front and back points, and a thermal element positioned to move between said points and including, spaced, bi-metallic arms, a heating coil on but one of said arms, and a rheostat for regulating flow of current through the heating coil.

2. In a thermal relay, in combination, fixed front and back points, a thermal element positioned to move between said points and including, spaced, bi-metallic arms, a top plate for the relay, one end of each arm being anchored to the top plate, means restraining the other ends of the arms to move together, a heating coil on the unanchored end of but one of said arms, and a rheostat for regulating flow of current through the heating coil.

3. In a thermal relay, in combination, fixed front and back points, a thermal element positioned to move between said points, and including, spaced, bi-metallic arms, a heating coil on but one of said arms, and a rheostat for regulating flow of current through the heating coil, said rheostat including a threaded spindle of insulating material, and a resistance wire wound in the threads of the spindle.

4. In a thermal relay, in combination, fixed front and back points, and a thermal element positioned to move between said points, and including, spaced, bi-metallic arms, a heating coil on but one of said arms, and a rheostat for regulating flow of current through the heating coil, said rheostat including a threaded spindle of insulating material, a resistance wire wound in the threads of the spindle, a threaded carrier slidable along the resistance wire, and a screw for moving said carrier.

5. In a thermal relay, in combination, fixed front and back points, a thermal element positioned to move between said points, and including, spaced, bi-metallic arms, a heating coil on but one of said arms, and a rheostat for regulating flow of current through the heating coil, said rheostat including a threaded spindle of insulating material, a resistance wire wound in the threads of the spindle, a threaded carrier slidable along the resistance wire, a screw for moving said carrier, and apertured members fixed respectively to the top plate and the screw for locking the screw in any one of a plurality of adjusted positions.

6. In a thermal relay, in combination; a top plate, fixed front and back contacts, a thermal element having contacts movable between the fixed contacts and including spaced bi-metallic arms anchored at one end to the top plate and positioned to move in opposite directions upon changes in temperature, means restraining the unanchored ends of the arms to move together, a heating coil on one of the arms, a circuit for energizing the heating coil, and a variable resistance in said circuit comprising a fixed stud, a threaded insulating sleeve on the stud, resistance wire in the threads of the sleeve, and a contact slidable over the resistance wire.

In testimony whereof I affix my signature.

JOSEPH E. WILLING.