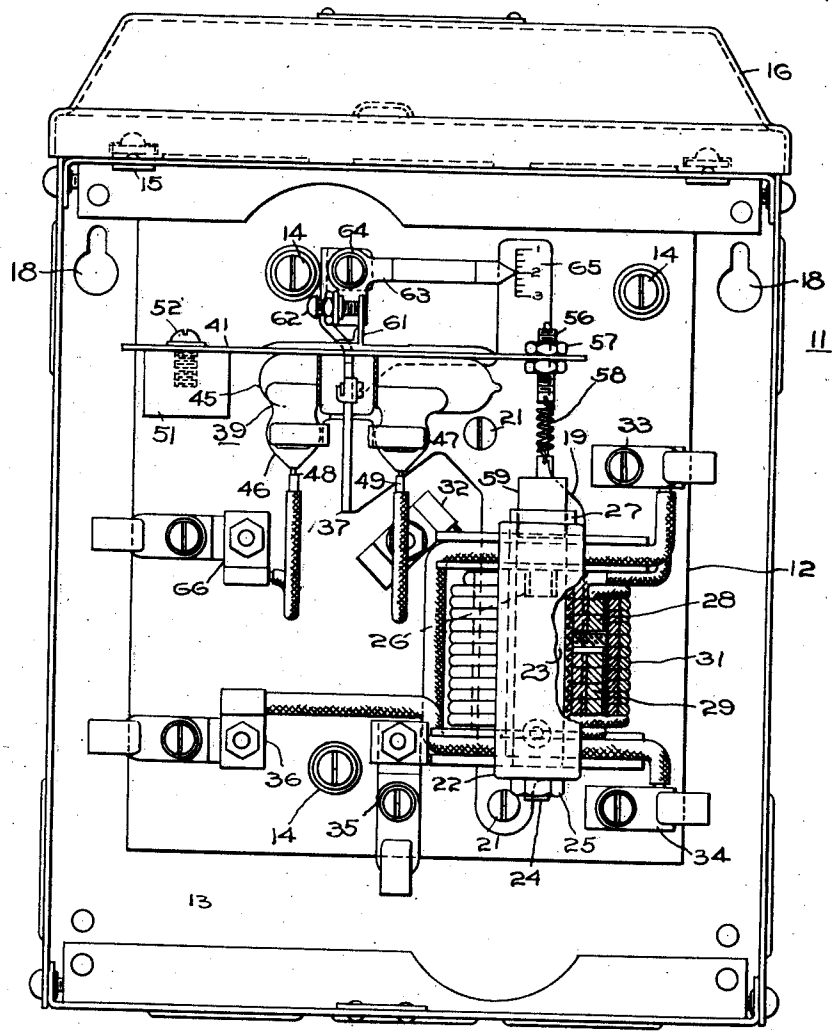
Jan. 14, 1930. E. K. CLARK 1,743,115

MAGNETIC SWITCH

Filed Jan. 19, 1928 2 Sheets-Sheet 1

Fig. 1.



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Fig. 2.

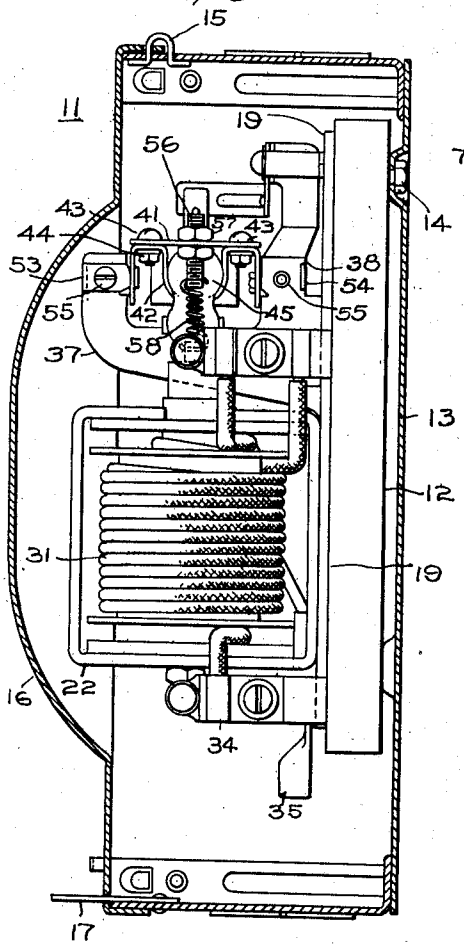


Fig. 3.

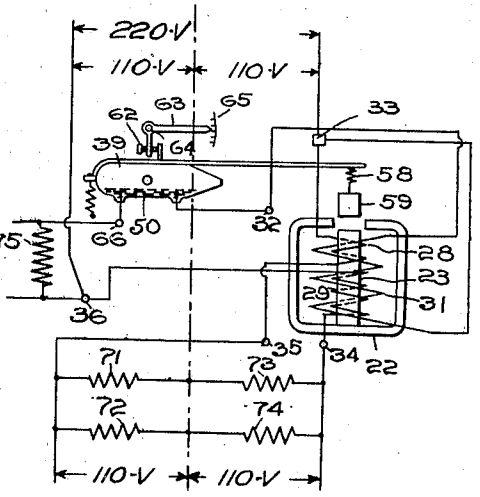
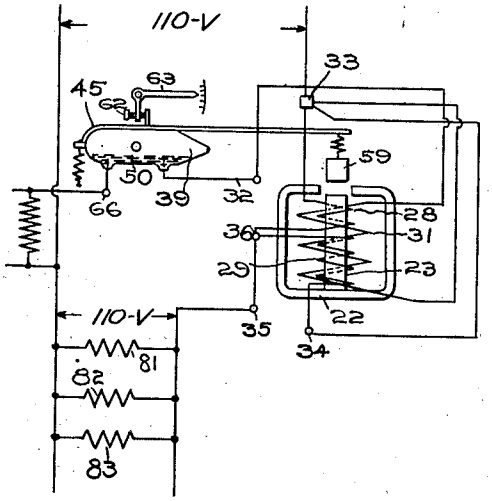


Fig. 4.



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UNITED STATES PATENT OFFICE

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MAGNETIC SWITCH

Application filed January 19, 1928. Serial No. 247,820.

My invention relates to relays and particularly to load-limiting electromagnetic relays.

An object of my invention is to provide a relatively simple multiple-coil relay for limiting the total load on a circuit comprising main and auxiliary resistors.

Another object is to provide a multiple-coil electromagnetic relay that shall be highly sensitive to load changes on the circuit and that shall be easily and quickly adjustable to varying load values at which it is to operate.

A still further object of my invention is to provide a relatively simple, compact and inexpensive electromagnetic relay to be operatively associated with an electric range and an electric water heater to ensure that the total load demand on the circuit shall not exceed a prdetermined value, which value shall be easily and quickly adjustable.

In practicing my invention, I provide a triple coil electromagnet comprising a movable core member yieldingly connected to a mercury switch which is pivotally mounted on a suitable means and is biased to its closed position. A lever is operatively associated with the mercury switch to adjust its initial position to vary the load values at which it is operated.

In the drawings,

Figure 1 is a view, in front elevation, of a device embodying my invention, portions thereof being shown in section, the device being shown as mounted in a suitable box the cover of which is raised,

Fig. 2 is a view of a device embodying my invention, shown in side elevation and mounted in a closed box which is shown in section,

Fig 3 is a diagram of connections showing the device embodying my invention as associated with a three-wire system, and,

Fig. 4 is a diagram of connections showing the device embodying my invention as applied to a two-wire system.

An electromagnetic relay, designated generally by the numeral 11, embodies a base 12 of suitable electric insulating material upon which all of the current-conducting portions of my device are mounted.

The base 12 is secured against the back wall 13 of a box embodying side walls of the usual type, mounting screws 14 being provided in the usual manner. The upper wall of the box is provided with hinge members 15 to pivotally support a cover 16 which may be locked in its closed position by a suitable lock (not shown) engaging a hasp 17 which projects through the cover member 16 when the cover member is closed, as is shown in Fig. 2 of the drawings. The box there shown is that usually employed in the so-called safety switches, but is here shown for illustrative purposes only. The back wall 13 of the box may be provided with a plurality of openings 18 to permit of mounting it against a suitable vertically extending wall and of locking it thereagainst in a manner well known in the art and constituting no part of my invention.

On the base 12 is mounted a bracket 19 which is secured against the front surface of the base 12 by a plurality of screws or bolts 21. The bracket 19 has secured thereto adjacent to its lower portion a magnetic yoke member 22, shown in front elevation in Fig. 1 of the drawing and in side elevation in Figs. 2, 3 and 4 of the drawings. The yoke 22 has mounted therein a stationary core member 23, the lower end of which is secured to the yoke member by a stud 24 and a nut 25 thereon. The upper end of the stationary core member 23 is provided with a shading coil 26, in order to reduce the noise or rattle when the relay is used on an alternating-current circuit.

The stationary core member is surrounded by a tubular member 27 of electric-insulating material, on which are wound coils 28, 29 and 31. The coil 28 embodies a relatively small number of turns and is located at the upper portion of the electromagnetic structure near to the airgap. Coil 29 is located at the lower portion of the electromagnetic structure and, as it is located farther away from the effective airgap of the electromagnet, it is provided with a somewhat larger number of turns of wire. The coil 31 extends over the entire length of the electromagnet and is provided with a still greater

number of turns. In an actually constructed device, coil 28 is provided with eight turns, coil 29 embodies twelve turns while coil 31 embodies 21 turns.

A plurality of terminal members numbered 32, 33, 34, 35 and 36 are located in spaced relation on the base 12, to which are connected the ends of the respective coils. One end of coil 28 is connected to terminal 33, and the other end is connected to terminal 35. One end of coil 29 is connected to terminal 34 and the other end to terminal 36. One end of coil 31 is connected to terminal 32 and the other end is connected to terminal 33.

The bracket 19 is provided with a forwardly projecting portion 37 which cooperates with a rear portion 38 to provide a pivotal supporting means for a switch 39. The portions 37 and 38 are located in the same plane, this plane extending substantially at right angles to the face of base plate 12.

The mercury switch 39 comprises an upper lever plate or switch arm 41 having secured thereto a depending saddle 42, of substantially U-shape, by screws 43 having nuts 44 associated therewith.

A casing 45 of substantially tubular shape, and of electric insulating material, embodies two depending portions 46 and 47 in which are sealed, in the usual manner, conducting leads 48 and 49. A small quantity of mercury 50 is located within the casing 45 and, normally, operatively engages the inner ends of the leads 48 and 49. A weight 51 is mounted at one end of the lever plate 41 and is secured thereagainst by a screw 52 which extends through an elongated opening in the end of the plate or arm 41 to permit of adjusting the position of the weight relatively to the pivot point of the switch.

The outer ends of the saddle member 42 are bent downwardly, as shown more particularly in Fig. 2 of the drawings, each of these portions being provided with openings to rest upon knife-edge members 53 and 54 which are secured, respectively, against the portions 37 and 38 of the bracket 19. The knife-edge members 53 and 54 are secured by means of screws 55 extending therethrough and into the portions 37 and 38, respectively.

The end of the lever plate 41 opposite to that to which the weight 51 is secured has a small stud 56 extending therethrough, the position of which may be adjusted laterally thereof by means of a plurality of nuts 57. A spring 58 connects the lower end of the stud 56 to the upper end of a movable core member 59 fitting loosely in the upper end of the tubular member 27.

The lever plate 41 is provided with a struck-up portion or lug 61, intermediate its ends, and its outer end is operatively engaged by an adjusting screw 62 which is mounted on the short end of a bell-crank lever 63 pivotally mounted on a screw 64.

The upper end of the bracket 19 extends sufficiently to be located under the outer end of the long arm of the bell-crank lever 63 and is provided with a suitable scale, indicated at 65, to permit of accurately determining the operative position of the adjusting lever 63, in order to adjust the relay structure to operate at a predetermined load value. This adjustment is, of course, effected by the screw 62 on the short arm of the lever 63 engaging the lug 61 to shift or tilt the mercury switch and the movable core member 59 relatively to the fixed electromagnet structure embodying the yoke 22, the fixed core 23 and the coils associated therewith.

It is apparent that, if the lever 63 and, more particularly, the outer end of the longer arm thereof, be moved upwardly to the scale division indicated by the numeral 1, the core member 59 will be permitted to move downwardly closer to the fixed core member 23 so that a smaller number of total ampere turns provided by the three coils of the electromagnet will cause movement of the switch in a clockwise direction, whereby the circuit therethrough is interrupted.

An additional contact terminal 66 is provided to which is connected the outer end of the lead 48. The lead 49 is electrically connected to the terminal 32.

Referring more particularly to Fig. 3 of the drawings, I have there indicated the diagram of connections when the device embodying my invention is used on a standard three-wire circuit. I have there shown a plurality of main resistors 71 and 72 connected between the neutral and one of the outside wires, and resistors 73 and 74 connected between the neutral and the other outside wire, and an auxiliary resistor 75 which is connected between the outside wires only. Resistors 71 to 74, inclusive, represent the heating elements of an electric range distributed between the oven and the stove portions thereof, which are usually connected in the manner shown in Fig. 3 that is between the neutral and the respective outside wires, in order to balance, as much as possible, the load on the system.

The resistor 75 represents the heating element of an electric water heater and, because of its usually relatively large energy input, is to be connected across the outside wires alone. The mercury switch 39 is connected in series-circuit relation with the resistor 75 and with the coil 31. Coil 28 is connected in series-circuit relation with the resistors 71 and 72 connected between the neutral and one outside wire, and the coil 29 is connected in series-circuit relation with the resistors 73 and 74 connected between the neutral wire and the other outside wire. The terminals are not shown in their actual relative locations in this draw-

ing but the connections illustrated are effected.

Referring more particularly to Fig. 4 of the drawings, I have there illustrated the device embodying my invention as associated with a two-wire system. Resistors 81, 82 and 83 are shown as connected between the two outside wires and represent the heating elements of an electric range. A resistor 84 represents the heating element of an electric water heater. The resistor 84 is again connected in series-circuit relation with the mercury switch 39 and also with the coil 31. Coils 28 and 29 are now connected in parallel and in series with the resistors 81 to 83, inclusive. The changes in the connections from those shown in Fig. 3 may be easily and quickly effected.

The device embodying my invention, as applied to a three-wire circuit shown in Fig. 3 of the drawing, is effective to limit the maximum amount of energy which is permitted to be taken from the circuit in the following manner. Let it be assumed that resistor 75 is energized and that resistors 71 to 74, inclusive, are not energized. This would be the case in the off-peak hours during which the water-heater heating element could be energized, the cost per unit of energy being usually lower than during the peak-load hours. If now, an operator effects energization of any or all of the resistors 71 to 74, inclusive, as is necessary when starting to prepare a meal, it may happen that the total amount of energy taken from the circuit exceeds a predetermined limiting value, this being, of course, particularly true, if all of the resistors 71 to 74, inclusive, are simultaneously energized. The number of ampere turns in the electromagnet will then be sufficiently large to energize the movable core member 59 in spite of a relatively large air gap, whereby the mercury switch is tilted to such position that it interrupts the circuit therethrough and through the resistor 75. As the core member 59 has been drawn downwardly until it operatively engages the upper end of core member 23, it will be held in that position, even though the number of ampere turns provided by the two still energized coils 28 and 29 is much lower than that which caused actuation of the switch. Even though the circuit be an alternating-current circuit, the use of the shading coil 26 provides a means for ensuring that the energizing flux shall not pass through zero value, so that there will always be a magnetic pull on the core 59. Even if this core member 59 vibrates slightly because of dust located on the upper surface of the core member 23 preventing the desirable close engagement of the cooperating faces of the movable stationary core members, any such vibration will be reduced by the spring 58.

If now, one or more of the resistors 71 to 74, inclusive, are deenergized by the operator during the preparation of the meal or at the end thereof, the ampere turns that are effective to hold the movable core member 54 are reduced and the weight member 51 will cause a movement of the mercury switch in a counter-clockwise direction to reclose the circuit through the resistor 75, this reclosing action being dependent upon the position of the bell-crank lever 63.

Substantially the same method of operation will be effective when the device embodying my invention is used on a two-wire circuit of the type shown generally in Fig. 4 of the drawings and it is considered unnecessary to describe, in detail, the various steps in the operation of the device and system.

The device embodying my invention thus provides a relatively simple, multiple-coil electromagnetic relay to be operatively associated with main and auxiliary resistors, in which all of the coils of the electromagnet are operative to effect actuation of the switch to its open position, whereby the circuit through the auxiliary resistor is deenergized and in which one portion of the coils are effective to permit reclosing of the switch to reenergize the auxiliary resistor.

While I have illustrated and described a specific embodiment of a device embodying my invention, as applied to a predetermined number of main and auxiliary resistors, and have described the same in connection with an electric range and an electric water heater, it is obvious that the device embodying my invention is not limited to such uses, but is applicable to other uses not described in detail. I desire, therefore, that only such limitations shall be placed thereon as are imposed by the prior art or are set forth in the appended claims.

I claim as my invention:

1. An electromagnetic relay for a load circuit comprising main resistors and an auxiliary resistor, said relay comprising a switch for controlling the energization of the auxiliary resistor, a counterweight therefor and an electromagnet for actuating said switch and embodying a plurality of coils, all of said coils being operative to cause said switch to interrupt the circuit of the auxiliary resistor and a portion only of said coils being effective to permit the counterweight to actuate the switch to effect reenergization of the auxiliary resistor.

2. An electromagnetic relay for a load circuit comprising main resistors and an auxiliary resistor, said relay comprising a switch for controlling the energization of the auxiliary resistor, an electromagnet for actuating said switch and embodying a plurality of coils, and a counterweight operatively associated with the switch and electromagnet, one of said coils being connected in series-circuit relation with the auxiliary resistor, the pull

of all of the coils being additive to effect movement of the switch to interrupt the circuit of the auxiliary resistor, and a portion of the coils being effective to permit the counterweight to effect closing of the switch.

3. An electromagnetic relay for a load circuit comprising main resistors and an auxiliary resistor, said relay comprising a switch for controlling the energization of the auxiliary resistor, and a triple-coil electromagnet for actuating said switch, one of said coils being connected in series circuit with the switch and the auxiliary resistor and the other coils being connected in series circuit with the main resistors, the pull of all of the coils being additive to effect movement of the switch to interrupt the circuit of the auxiliary resistor.

4. An electromagnetic relay for a load circuit embodying main and auxiliary resistors, said relay comprising a switch connected in series circuit with the auxiliary resistor and a triple coil electromagnet for controlling the switch, one of the coils being connected in series with the auxiliary resistor and the other coils being connected in series with the main resistors, the pull of all of the coils being additive to effect movement of the switch to interrupt the circuit of the auxiliary resistor, and that coil connected in series circuit with the auxiliary resistor being inoperative during the closing movement of the switch.

5. An electromagnetic relay for a load circuit comprising main resistors and an auxiliary resistor, said relay comprising a switch biased to its closed position and connected in series circuit with the auxiliary resistor, a triple-coil electromagnet, one of the coils thereof being connected in series circuit with the auxiliary resistor and the switch and the other coils being connected in series circuit with the main resistors, the pull of all of the coils being additive to effect movement of the switch to interrupt its circuit at a predetermined total load on the relay, and means operatively engaging said switch for varying the value of the total load at which the switch is moved to its open position.

In testimony whereof, I have hereunto subscribed my name this 12th day of January, 1928.

EARL K. CLARK.