Sept. 25, 1951 C. E. ARMSTRONG 2,568,700

MULTIPLE STEP LINE-SWITCH LOAD LIMITING RELAY

Filed July 19, 1948 3 Sheets-Sheet 1

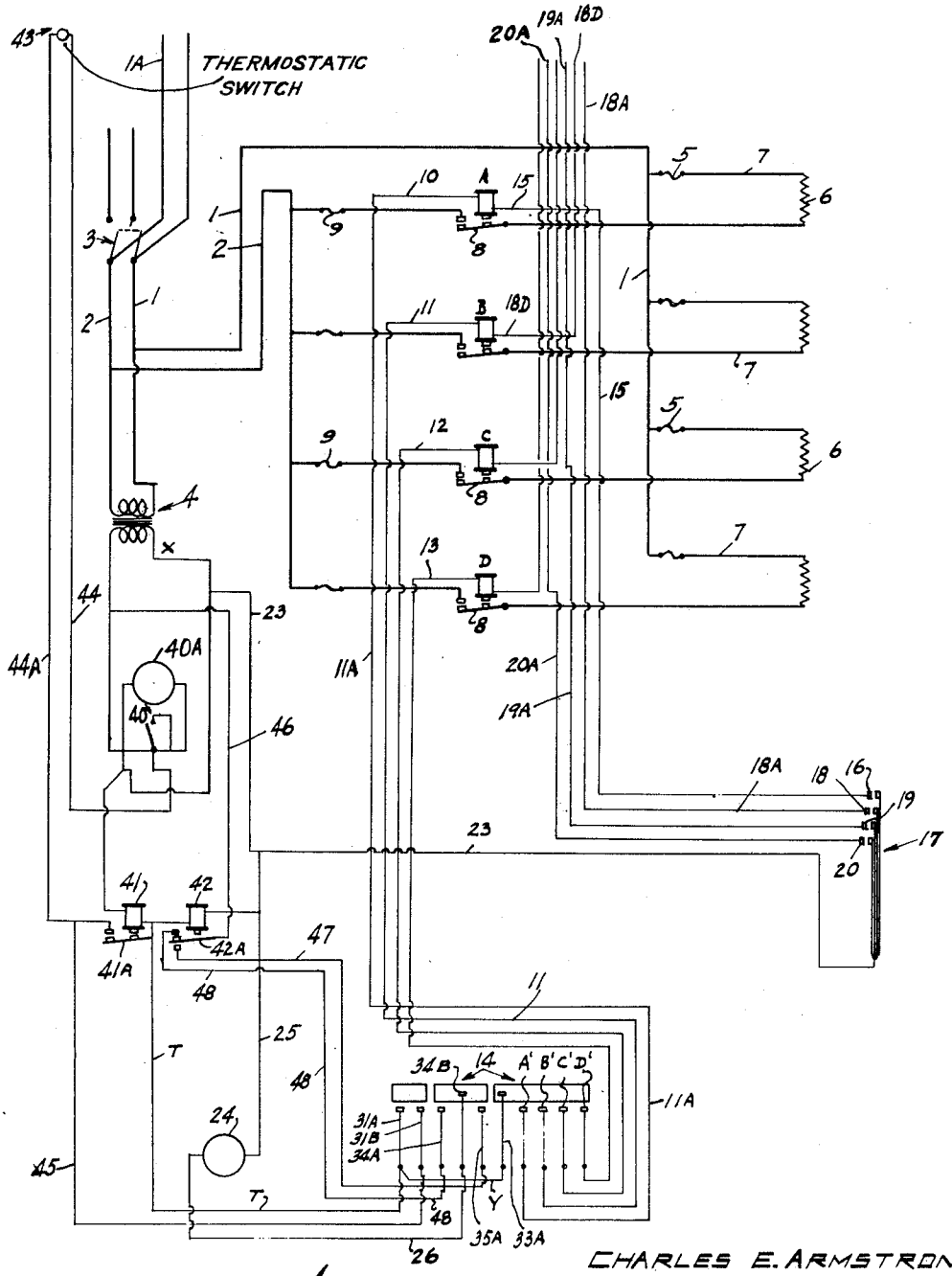


Fig. 1

CHARLES E. ARMSTRONG
INVENTOR.

BY James A. Givnan
ATT'Y

Sept. 25, 1951 C. E. ARMSTRONG 2,568,700

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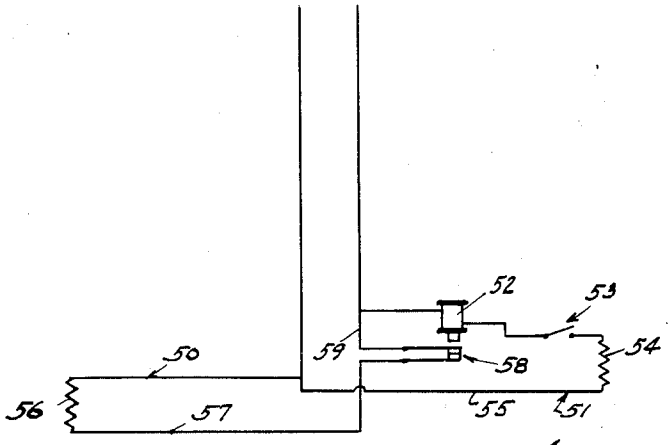


Fig. 4

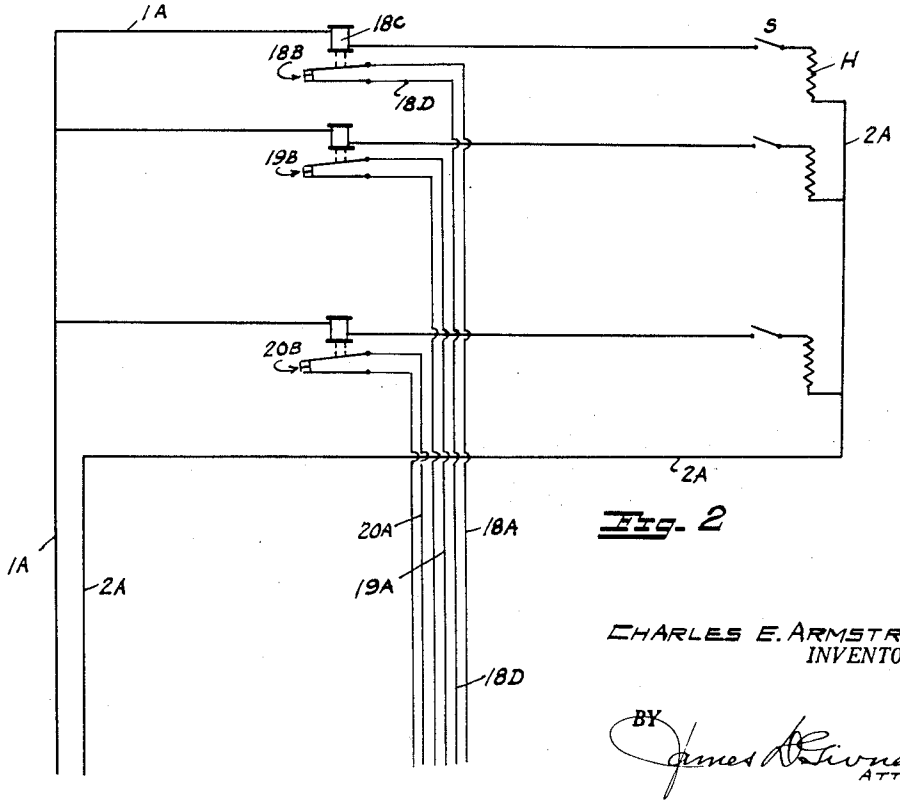


Fig. 2

CHARLES E. ARMSTRONG
INVENTOR.

BY James A. Livingston
ATT'Y

Sept. 25, 1951 C. E. ARMSTRONG 2,568,700

MULTIPLE STEP LINE-SWITCH LOAD LIMITING RELAY

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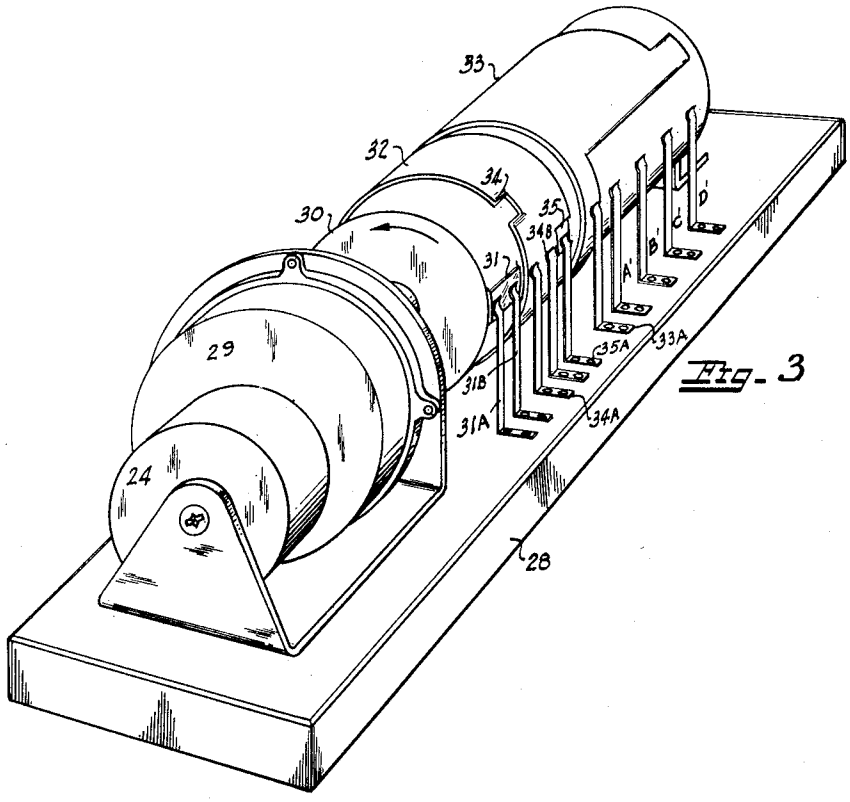


Fig. 3

CHARLES E. ARMSTRONG
INVENTOR.

BY James A. Finnaw
ATT'Y

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MULTIPLE STEP LINE SWITCH LOAD LIMITING RELAY

Charles E. Armstrong, Portland, Oreg., assignor to Electric Controls Inc., Portland, Oreg.

Application July 19, 1948, Serial No. 39,387

2 Claims. (Cl. 171—97)

1

This invention relates to improvements in automatic controls for electrical furnaces, the regulation of electrical loads thereof and of other electrical loads used in various industries.

Ordinarily, an electric furnace employs a plurality of individual heating coils or elements electrically interconnected and adapted to function as a single unit to maintain the temperature within a space to be heated, at a constant desired temperature. The heating elements are also adapted to function individually or collectively for variable periods for raising or lowering the temperature to meet the space requirements.

In instances where a number of such furnaces are used in a district or area and fed by power lines coming from a single source, they collectively impose an excessive load on the power supply line. When, however, the power is accidently cut off from the supply by any of a number of reasons, and when all of said furnaces are thereby cut off they are in most instances set for operation to produce maximum heat. In other words, all of the individual heating elements in each furnace were functioning collectively to produce maximum heat. Then, when the power line has been repaired and power restored to the line, all of said heating elements in all of said furnaces obviously resume operation in their set positions for producing maximum heat. This, of course, produces a dangerous overload on the power supply line resulting in difficulties which not only cause further delay in repairing the power line, but also in time consumed by repair men going about to inspect each individual furnace in said area.

Accordingly, it is one of the principal objects of my invention to eliminate all of such contingencies by providing new and novel and automatic control means in each furnace to automatically direct the restored power progressively through each individual heating element in timed intervals until they are all put back into operation, thus gradually applying the load on the source instead of applying it abruptly and in its entirety as heretofore.

A further object of my invention resides in a new and novel hook-up with electrically actuated appliances, such as electric ranges, water heaters, and the like, which impose a considerable load on the power supply line and which when functionally combined with the electric furnace or heating system impose an even greater load upon the supply line which increases to an even more dangerous degree the conditions above pointed out. To overcome these difficulties I incorporate within the system automatic means for opening the circuit to, and thereby rendering inoperative, the major portion of the heating elements of the furnace or heating system. For example, when current is applied to one or more of the heating elements in an electric range, corresponding elements of the same or nearly the same capacity within the furnace or heating system are cut out and rendered inoperative during the time that said heating element or elements in the range are functioning. Other electrically actuated elements in the system are similarly connected with the elements in the heating system. In other words functioning of the various electrical appliances predominates that of the furnace, so that at no time will all of the elements in the heating system and all of the elements in the various appliances be put into operation at the same time. By this arrangement a safe and economical load of electrical energy is distributed to the various elements as aforesaid in proportion to their needs without sacrificing proper operation of any.

2

These and other objects will appear as my invention is more fully hereinafter described in the following specification, illustrated in the accompanying drawings and finally pointed out in the appended claims.

In the drawings:

Figure 1 is a wiring diagram of the various electrical circuits employed in operatively connecting the various elements of the invention.

Figure 2 is a continuation of Figure 1.

Figure 3 is a perspective view of a motor driven timing mechanism.

Figure 4 is a wiring diagram of a modified form of the invention.

Referring now more particularly to the drawings:

In Figures 1 and 2 a circuit which will hereinafter be referred to as the power circuit consists of wires 1 and 2 connected with a main switch 3 connected with a source of electrical energy. Said circuit is also connected with a step-down transformer 4 to supply electrical energy to an operating circuit for actuating the timing mechanism, motors, and relays in the system.

The wire 1 of the power circuit connects through fuses 5 with one side of heating elements 6 whose opposite sides are connected by wires 7 through relays 8 and fuses 9 with the other wire 2 of the power circuit. Thus when the relays are closed the heating elements are energized by the power circuit.

The relay switches are of course actuated by

their coils indicated at A, B, C and D, are energized by the operating circuit by having one of their sides connected by wires 10, 11, 12, and 13, respectively, with spring-contact bars A', B', C', and D', adapted for selective contact with a timing mechanism generally indicated at 14, and to be more fully hereinafter described in Figure 3. The opposite side of the relay A is connected by wire 15 with one contact 16 of a room thermostat generally indicated at 17 which closes on a decrease or drop in temperature by progressively closing its contacts 16, 18, 19, and 20 as its bi-metallic blades move to the left as viewed in Figure 1. The contact 16 is connected by wire 18A with a relay switch 18B actuated by its coil 18C whose one side is connected by wire 1A with one side of the power supply circuit. The opposite side of the coil 18C is connected through a manual or automatic switch S with one side of a heating element H whose opposite side is connected by wire 2A with the opposite side of the power supply line. The opposite side of the relay switch 18B is connected by wire 18D with one side of the relay B whose opposite side is connected as aforesaid by wire 11 with contact bar B' of the timing mechanism 14. Thus when the operating circuit is closed, closing of the relay B will close the power circuit through wire 7 to one of the heating elements 6 of the heating system. This circuit can only be closed, however, when the heating element H in the kitchen range or other electrical appliance is de-energized or inoperative, since current flowing through relay coil 18C as a result of closing the switch S will cause the contacts of switch 18B to be drawn apart and thereby open the circuit to relay coil B which upon de-energization will allow its switch arms to drop open to thereby break the circuit to the heating element 6 of the heating system. The contacts 19 and 20 are similarly connected through wires 19A and 20A, respectively, with one side of relays 19B and 20B whose opposite sides are connected, respectively, with one side of relay coils C and D, respectively. These relays 19B and 20B are similarly actuated by their coils which are connected as shown with their respective heating elements also connected by wire 2A with the source of supply. From the foregoing it will be seen that any number of heating elements in a heating system may be dependent on their supply of energy determined by the actuation of the predominating elements used in the various heating appliances as aforesaid.

The thermostat 17 is disposed in any desired location within a room or space to be heated and is connected by wire 23 with one side of the transformer 4. With particular reference to Figure 1 it will be noted that contacts A', B', C', and D' correspond with contact blades similarly marked in Figure 3 and which periodically contact the collar 33 as it is rotated by the motor 24.

The timing mechanism is driven by the motor 24 whose one side is connected by wire 25 with one side of the transformer 4. The opposite side of the motor is connected by wire 26 with a permanent contact 34B in the timing mechanism. The timing mechanism as illustrated in Figure 3 is mounted upon any approved type of base 28 of insulating material and includes the motor 24 connected, through speed reducing power transmission means disposed within a housing 29, with a drum 30 of insulating material. Se-

cured to the periphery of the drum at one of its ends is a contact plate 31. Spaced apart from this plate is a metallic collar 32 and spaced from the collar 32 is another metallic collar 33. The collar 32 is cut out as at 34 and 35, and the collar 33 is cut out as at 36, 37, 38, and 39. Mounted upon the base 28 of the timing mechanism is a pair of spring contact fingers 31A and 31B adapted to simultaneously contact the plate 31 on the drum 30 for closing a circuit between them. The spring finger 34A is normally in contact with the collar 32 except when it drops into the cut out 34 and against the drum 30 of insulating material at which time the circuit through said contact finger is broken. The spring finger 34B is in contact with the collar 32 at all times. The spring finger 35A intermittently contacts the drum 30 through the cutout 35 for breaking the circuit through it in the same manner as the spring finger 34A. The spring finger 33A is in contact with the collar 33 at all times.

When the main switch 3 is closed, current flows through the load circuit represented by wires 1 and 2 to the heating elements 6 of the heating system and also through the load circuit represented by wires 1A and 2A extending through the relay coils 18C and their respective heating elements as shown in the continuation of Figure 1. The operating circuit extending from the transformer 4 embraces a clock actuated time switch generally indicated at 40 and operated by a Telecron motor or the like as at 40A which runs continuously in the usual manner. Connected in with the clock circuit is a normally closed high limit thermostatic switch 43 by means of wires 44, and 44A one of which connects to one side of a relay switch 41 as shown and extends on through wire 45 to connect with spring finger 31B for intermittent contact with the plate 31 carried by the drum 30. The other side of the clock circuit, on wire 46, connects with one contact of the relay switch 42 whose said one contact connects by wire 47 with spring finger 35A in contact with the collar 32. The opposite contact of the relay switch 42 connects by wire 48 with the spring finger 34A also adapted for interrupted contact with the collar 32. It will be remembered that the center spring finger 34B is in constant contact with the collar 32 so that as the collar is rotated, current passes from either contact 34A—35A through the collar, through contact 34B, through wire 26, into one side of the motor 24 whose opposite side is connected, as aforesaid, by wire 25 through wire 23 with the operating circuit.

Thus it will be seen when clock mechanism closes switch 40, current will flow through wire 44, through high-limit thermostatic switch 43, down through wire 44A, and continue on through wire 45, up through finger 31B, across bridge contact plate 31, down through finger 31A, up through wire T, and into one side of relay coil 41, thus energizing coil 41, closing switch 41A, to enable current from wire 44A to flow through closed contact 41 into coil 41 and also into coil 42, thus also energizing coil 42 to cause switch 42A to close. Current then flows down through wire 48, up through finger 34A, and onto contact collar 32, down through 34B to wire 26 and back to one side of motor 24. Motor will continue to rotate and in turn rotate timing mechanism 14 until finger 34A drops into notch 34, thus breaking the motor circuit. While timing mechanism

14 is rotating, as just described, current will flow down through wire T, across through wire Y, up through finger 33A, to energize drum collar 33 while it is rotating in the direction shown by the arrow. It will be seen that spring finger A' will come into contact with rotating drum 33, and so also will spring fingers B', C', and D' contact the drum progressively as it rotates. In turn, as spring finger A' is energized by drum 33, current will then flow through wire 11A and wire 10 to one side of relay coil A. At the same time the opposite side of the operating circuit, shown at the transformer and indicated at X, flows down through wire 23 and connects to a terminal on thermostat 17, upon which the four contacts are mounted for cooperation with contacts 16, 18, 19, and 20, heretofore referred to. If contacts 16, 18, 19, and 20 are standing in a closed position due to low temperature existing at the thermostat, current will continue through wire 15 up to the opposite side of said relay coil A, thus energizing relay coil A, causing switch 8 to close and permit current to flow through wire 7, through heating element 6, back through fuse 5 to the line 1. As the drum 30 continues to rotate the next step in collar 33 contacts spring finger B' thus permitting current to flow through wire 11 and into one side of relay coil B. At the same time, the other side of the circuit from the transformer 4 closes through wire 23, through thermostat 17, through contact 18, up through wire 18A, through switch 18B and back through wire 18D to one side of relay coil B, as aforesaid. Coil B now being energized closes its contacts causing the power circuit to flow through wire 7 into the next heating element 6 and back into power line 1. The operation of relays C and D is the same as that of relays A and B.

In the case of an interruption or failure out on the supply line, all relay switches drop open and remain so until the power supply is restored. Upon restoration of the power to the system, current will be directed through wire 46 through switch 42A, through wire 47 and into spring finger 35A which at this time is contacting collar 32. Current will then flow through contact finger 34B (also in contact with collar 32) through wire 26 to one side of motor 24, through the motor up through wire 25, wire 23, and into the transformer 4 which has now been re-energized by the restoration of the power. The circuit is thus completed through motor 24 which will commence to rotate the drum 30 and the collars carried thereby. Rotation of the drum will bring bridge contact 31 across spring fingers 31A and 31B, thus setting the system to operate as heretofore described.

In the modified form of the invention illustrated in Figure 4 the two load circuits are indicated generally by reference numerals 50 and

51 and connected with a source of supply. One wire of the load circuit 51 extends through a relay coil 52, and a manual or thermostatically actuated switch 53 to one side of a heating element or other electric load indicated at 54 whose other side is connected by wire 55 back to the source. The other load circuit 50 connects to one side of a heating element or other electric load 56 whose opposite side connects by wire 57 with a relay switch 58 and by wire 59 to the source. From the foregoing it will be apparent that as long as current is flowing into the load circuit 51 and the coil 52 is energized thereby, the contacts of switch 58 will be held apart to maintain the circuit open to the load circuit 50. At any time however the switch 53 is opened and the circuit through the coil 52 is broken the contacts of the switch 58 will be allowed to close to restore current to the load circuit 50.

While I have shown a particular form of embodiment of my invention, I am aware that many minor changes therein will readily suggest themselves to others skilled in the art, without departing from the spirit and scope of the invention. Having thus described the invention, what I claim as new and desire to protect by Letters Patent is:

1. A heat control system comprising in combination a source of electrical energy divided into two load circuits each directed to operate separate groups of heating elements, one group being connected with one of said load circuits through relay coils embraced within said load circuit, the heating elements of the other of said groups adapted to be energized through relay switches operable only upon de-energization of said relay coils.

2. A heat control system comprising in combination a source of electrical energy divided into two load circuits each directed to two separate heating elements, one heating element being connected with one of said load circuits through a relay coil embraced within said load circuit, the other heating element adapted to be energized through a relay switch operable only upon de-energization of said relay coil.

CHARLES E. ARMSTRONG.

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