

[54] **SEQUENTIAL LOADING SYSTEM HAVING AUXILIARY SWITCHES**

[75] Inventor: **Harold A. McIntosh**, South Pasadena, Calif.

[73] Assignee: **Robertshaw Controls Company**, Richmond, Va.

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[51] Int. Cl. **H02j 3/14**

[58] Field of Search..... 219/486; 337/44, 337/87, 340, 41; 307/41, 141, 141.4, 141.8

[56] **References Cited**

UNITED STATES PATENTS

3,634,801	1/1972	Gould	337/340
2,958,755	11/1960	Miller	219/486 X

Primary Examiner—Herman J. Hohausser
Attorney—Vern Schooley et al.

[57] **ABSTRACT**

A sequential loading control system including a plurality of main switches controlling current flow to respective loads. Respective time delay drive means are provided for controlling the respective main switches and respective auxiliary switches are mechanically coupled with the main switches to form respective units and are closed when the main switches are closed. Circuit means connects the main switches to the respective loads and the auxiliary switches of each unit with the time delay drive of the succeeding unit whereby energization of the system results in the respective time delay drive means being sequentially energized to effect closure of the respective main switches and also the auxiliary switches to energize the time delay means of the succeeding unit to thereby sequentially bring the loads into the circuit.

2 Claims, 7 Drawing Figures

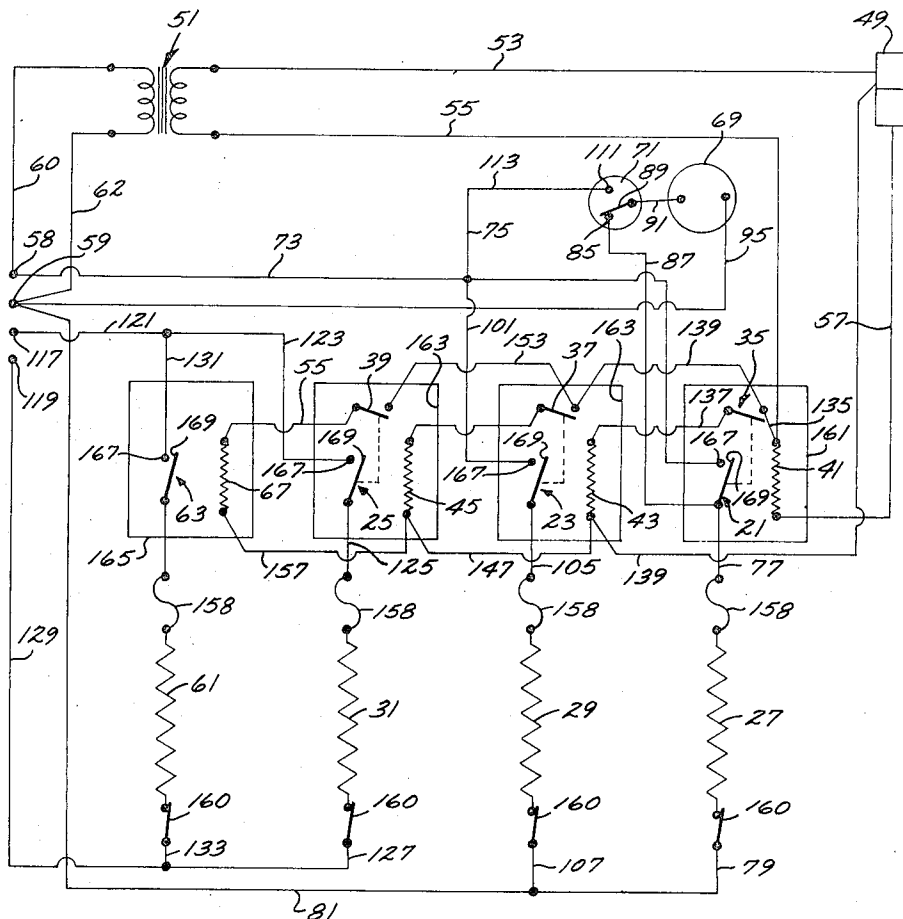


FIG. 1

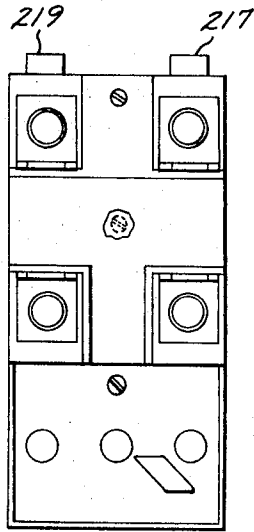


FIG. 2

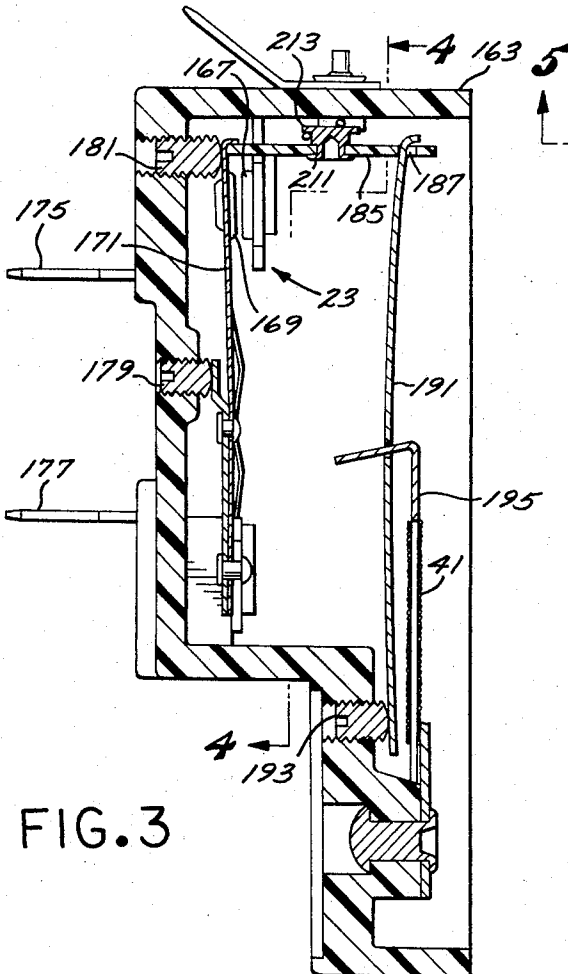
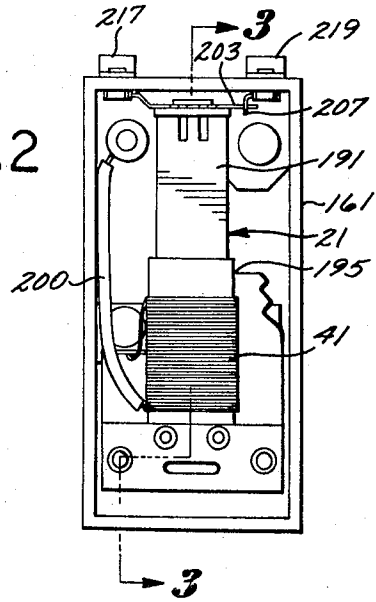


FIG. 3

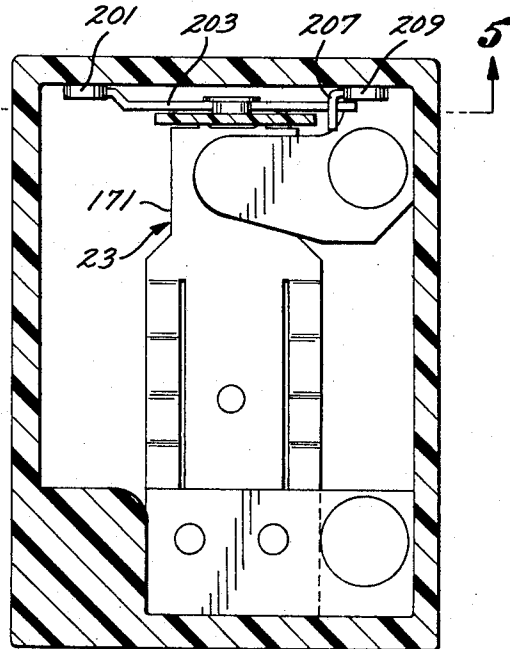


FIG. 4

FIG. 5

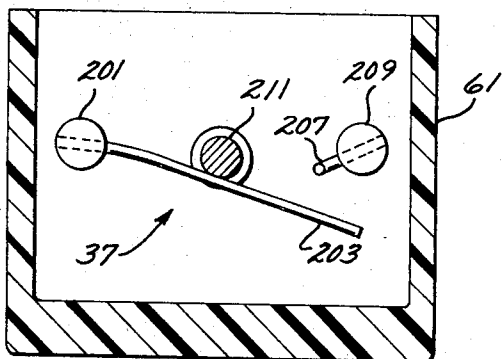


FIG. 6

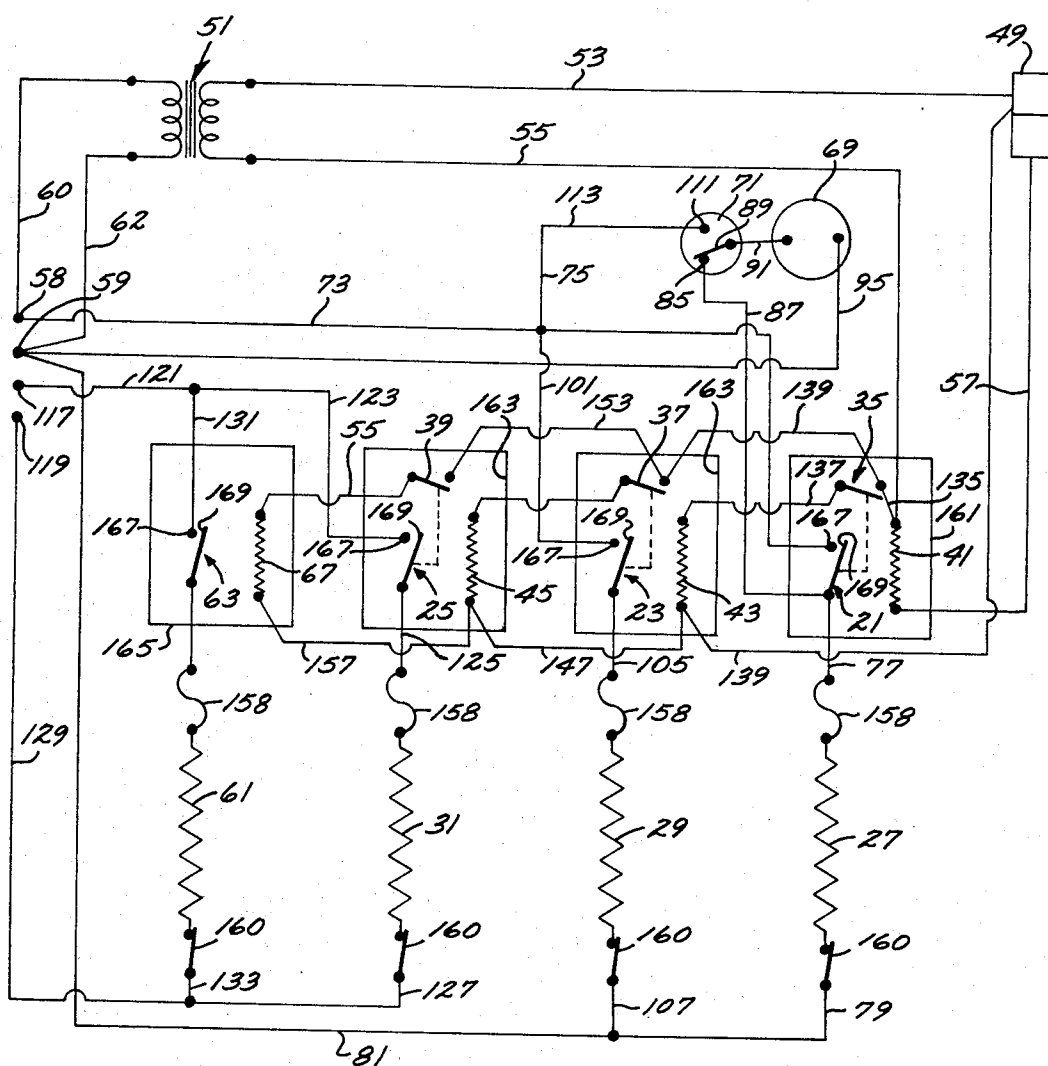
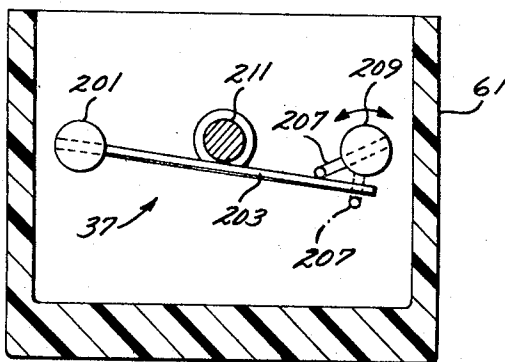


FIG. 7

SEQUENTIAL LOADING SYSTEM HAVING AUXILIARY SWITCHES

BACKGROUND OF THE INVENTION

1. Field of the Invention

The control system of present invention relates to an apparatus for sequentially bringing loads into a circuit to avoid simultaneously loading the circuit with all such loads and consequent overloading of the power source.

2. Description of the Prior Art

Numerous sequential loading system have been proposed which utilize the time delay devices to delay closing of individual switches connected in series with respective loads. A device of this type incorporating thermostatic blades connected in series with the respective loads is shown in U.S. Pat. No. 3,588,471. This device suffers the shortcoming that each load is connected in series with the time delay resistor of the succeeding unit thereby requiring relatively careful design control for the particular thermostatic blade and heating resistors for various different source voltages and required time delays.

SUMMARY OF THE INVENTION

The present invention is characterized by a sequential loading control system including a plurality of main switches connected in series with respective loads and being driven by electrical time delay means. Respective auxiliary switches are mechanically coupled to each of the main switches and are closed thereby as such main switches are closed to energize the time delay means of the succeeding unit to, after a selected time delay, effect closure of the main switch of such succeeding unit.

The objects and advantages of the present invention will become apparent from a consideration of the following detailed description when taken in conjunction with the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top plan view of a time delay relay device incorporated in a control system embodying the present invention;

FIG. 2 is a bottom view of the time delay device shown in FIG. 1;

FIG. 3 is a longitudinal sectional view, in enlarged scale, taken along the line 3—3 of FIG. 2;

FIG. 4 is a longitudinal sectional view taken along the line 4—4 of FIG. 3;

FIG. 5 is a longitudinal sectional view, taken along line 4—4 of FIG. 3;

FIGS. 5 and 6 are transverse sectional views taken along the line 5—5 of FIG. 4; and

FIG. 7 is a schematic diagram of a sequential loading control system embodying the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 7, the sequential loading control system of present invention includes, generally, a plurality of thermostatic main control switches 21, 23, 25 and 26 for controlling a current to respective resistance heater loads 27, 29, 31 and 32. The respective main control switches 21, 23 and 25 are mechanically coupled with respective auxiliary switches 35, 37 and 39 to form respective units. Respective resistance heat motors 41, 43, 45 and 46 are disposed in heat exchange relationship with the respective thermostatic switches

21, 23, 25 and 26 whereby, upon energization of the resistance heat motor 41 of the first unit, the first thermostatic switch 21 will be closed to energize the resistance heater load 27 and close the associated auxiliary switch 35 to energize the resistance heat motor 43 of the second unit to commence heating of the second thermostatic main switch 23. After a selected time delay, such second thermostatic switch 23 will close to energize the second resistance heater load 29 and close the auxiliary switch 37 thereby energizing the time delay heat motor 45 of the third thermostatic switch 25 to energize the third resistance heater load 31. Consequently, the loads 27, 29 and 31 are brought sequentially into circuit to thereby avoid simultaneous energization of all loads and consequent overloading of the power source.

In the particular embodiment shown the sequential loading control system of present invention is utilized for controlling operation of a forced air furnace in response to temperatures sensed by a thermostat 49. The first unit heat motor 41 is connected across the secondary coil of a source transformer 51 and in series with the thermostat 49 by means of leads 53, 55 and 57. The primary coil of such transformer 51 is connected across a pair of source terminals 58 and 59 by means of leads 60 and 62.

The furnace (not shown) incorporates the four resistance heater loads 27, 29, 31 and 32 and a blower 69 is provided for blowing air thereover. Current to such blower 69 is controlled by a thermostatic blower switch 71 that is disposed in the plenum chamber of such furnace and arranged downstream of such resistance heater loads.

The first time delay switch 21 is connected across the source terminals 58 and 59 and in series with the resistance heating load 27 by means of leads 73, 75, 77, 79 and 81. The thermostatic blade of the time delay switch 21 is connected with one terminal 85 of the fan switch 71 by means of a lead 87, the thermostatic blade 89 of such fan switch being connected with the negative terminal of the fan 69 by means of a lead 91 and the positive terminal of such fan being connected with one of the source terminals 59 by means of a lead 95.

The second heater load 29 is connected between the source terminals 58 and 59 and in series with the second unit thermostatic switch 23 by means of leads 73, 101, 105, 107 and 81. The stationary contact of the second thermostatic switch 23 is connected with the normally open contact 111 of the fan control switch 71 by means of a lead 113.

The resistance heater load 31 of the third unit is connected across a pair of source terminals 117 and 119 and in series with the third thermostatic switch 25 by means of leads 121, 123, 125, 127 and 129.

The fourth resistance heater load 32 is connected across the terminals 117 and 119 and in series with the fourth thermostatic switch 26 by means of leads 121, 131, 133 and 129.

The second resistance delay motor 43 is connected across the secondary coil of the transformer 51 and in series with the first auxiliary switch 35 by means of leads 55, 135, 137, 139 and 53.

The third resistance delay drive motor 45 is also connected across the secondary coil of the transformer 51 and in series with the second auxiliary switch 37 by means of leads 55, 135, 139, 141, 139 and 53.

The fourth resistance delay motor 57 is also connected across the secondary coil of the transformer 51 and in series with the third auxiliary switch 39 by means of leads 55, 135, 139, 153, 155, 157, 147, and 53.

Connected in series with the respective resistance loads 27, 29, 31 and 61 are protective devices in the form of respective fusible links 158 and limit switches 160.

The respective time delay switches 21, 23 and 25 and auxiliary switches 35, 37 and 39 are mounted in respective relay housings 161 (FIG. 2). Referring to FIGS. 2 and 3, the relay housing 161 has a stationary contact 167 mounted thereon and a movable contact 159 disposed in engagable alignment therewith. The movable contact 169 is carried from the free end of a cantileverly mounted tri-snap blade 171. The tri-snap blade 171 is of a character that after the free end thereof has moved downwardly a predetermined distance, it will flex and snap rapidly downwardly to close the movable contact 169 on the stationary contact 167. The stationary contact 167 is connected with a plug prong 175 and the movable contact 169 is electrically connected with a plug prong 177. Respective set screws 179 and 181 are provided for adjusting the action of the tri-snap blade 171.

Referring to FIG. 3, movement to the right of the free end of the tri-snap blade 171 is normally resisted by an electrically insulating coupling bar 185 which is formed in its left extremity with a through slot 187 having the free end of a compensating thermostatic blade 191 projecting therethrough. The opposite extremity of the compensating blade 191 is urged upwardly against an adjustment screw 193 by means of an electrically conductive thermostatic blade 195. The thermostatic compensating blade 191 and thermostatic drive blade 195 are arranged in opposed relationship such that heating of the blade 195 causes the free end thereof to move to the right as viewed in FIG. 3 while the free end of the compensating blade 191 moves an equal distance to the left for equivalent heating to thereby compensate for ambient heating of such blade.

As best seen in FIG. 2, the first heat motor 41 is in the form of a resistance heating coil wound on the thermostatic blade 195, such coil having a lead 200 connecting it with a plug prong.

Still referring to FIG. 3, mounted interiorly at the upper end of the housing 161 is the auxiliary switch 35. Referring to FIGS. 5 and 6, the auxiliary switch 35 is in the form of a pivotable rivet 201 having a resilient electrically conductive arm 203 projecting therefrom. Disposed in alignment with the free end of the arm 203 is an electrically conductive stationary arm 207 which is carried from a second pivotable rivet 209. A drive peg 211 is mounted centrally on the coupling bar 185 and is formed with a head 213 having the intermediate portion of the resilient movable arm 203 engaged therebehind. Consequently, when the switch 35 is assembled, the mounting rivet 209 for the stationary arm 207 may be rotated to orient the stationary arm 207 at the desired angularity for closure of the switch 35 at a specified time with respect to closure of the thermostatic switch 21 and the rivet 209 then riveted over to secure such stationary arm 207 against further pivoting. Likewise, the rivet 201 mounting the movable arm 203 may be rotated or orient the movable arm 203 at the desired angularity for providing the desired switch closing time and contact pressure between the movable

stationary contacts and such rivet 201 then riveted over to be secured against further rotation.

Disposed exteriorly of the housing 153 are a pair of tabs 217 and 219 which are mounted from the respective electrically conductive rivets 209 and 201 and are bent outwardly to form plug prongs as shown in FIG. 3.

In operation the source terminals 58 and 59, 117 and 119 are connected to a power source to energize the system. When the thermostat 49 senses a selected load temperature, it will close a pair of internal contacts to energize the first time delay resistor 41 to commence heating of the first thermostatic switch 21. Referring to FIG. 2, heating of the resistance windings 41 heats the thermostatic blade 191 and flexes the free end thereof to the right as viewed in FIG. 3 thereby enabling the free end of the tri-snap blade 171 to move to the right and also moving the auxiliary drive rivet 211 upwardly as viewed in FIG. 5. When the free end of the tri-snap blade 171 has moved sufficiently far to the right to initiate snapping thereof the movable contact 169 will be snapped downwardly into engagement with the stationary contact 167. Immediately prior to engagement of the movable and stationary contacts 169 and 167, the free end of the movable auxiliary switch arms 203 (FIG. 5) engages the stationary arm 207 to thereby close the auxiliary switch 35. Closure of the switch 37 takes the bias of the auxiliary switch arm off the drive rivet 211 thereby preventing the bias of such arm adding to any tendency of the movable contact 169 to bounce off the stationary contact 167 upon engagement of such contacts to thereby avoid the consequent arcing as the contact 167 and 169 close.

Closure of the thermostatic switch 21 completes a circuit through the leads 73, 75, 77, 79 and 81 to energize the heating resistor load 27 and initiate furnace heating. Also, closure of such thermostatic switch 21 completes a circuit through the leads 73, 75, 87, 91 and 95 to energize the blower 69 to commence blowing air over the resistance heater load 27 to commence forced air heating of the environment as well as to avoid overheating of such heating loads 27.

The forced air from the blower 69 passing over the heater load 27 will be heated to heat the fan switch 71 to flex the thermostatic blade 89 upwardly to the broken line position to engage the contact 111 connected with the source terminal by means of the leads 73 and 113. Thus, the fan 69 will remain energized until all the heating loads 27, 29, 31 and 61 are de-energized and the thermostatic switch 71 allowed to cool.

Closure of the first auxiliary switch 35 commences current flow through the heat motor 43 of the second delay switch 23 and, after a predetermined time, the thermostatic blade 191 thereof will be heated sufficiently to flex and close the second time delay switch 23 to energize the second heater resistance load 29.

Referring to FIG. 1, closure of the second auxiliary switch 37 (FIG. 7) commences current flow there-through and through the heat motor 41 of the third time delay switch 25 to initiate heating of the thermostatic blade 191 and consequent flexure to close the third auxiliary switch 39 and main switch 25 to energize the fourth heat motor 46 and third resistance heater load 31.

After a fourth time delay, the resistance motor 46 will heat the fourth time delay switch 26 sufficiently to

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effect closure thereof and consequent energization of the fourth resistance load 32.

The resistance heater loads 27, 29, 21 and 32 will then remain energized until the environment is warmed sufficiently to warm the thermostat 49 above the target temperature to open the internal contacts to de-energize the first resistance delay motor 41 to enable the first time delay switch 21 to cool and open thereby opening the first auxiliary switch 35 and de-energizing the first resistance load 27. Opening of the first auxiliary switch 25 will enable the second time delay motor 43 to cool to cause the second time delay switch 23 to open thereby opening the second auxiliary switch 37 and also de-energizing the second resistance load 29. Opening of the second auxiliary switch 37 will enable the third time delay resistance motor 45 to cool thereby enabling the third time delay switch 25 to open thereby opening the third auxiliary switch 39 and also de-energizing the third resistance load 31.

Opening of the third auxiliary switch 39 will enable the fourth time delay resistance 46 to cool thereby causing the fourth time delay switch 26 to open to de-energize the fourth resistance load 32.

The fan motor 69 will remain energized until all the resistance loads 27, 29, 31 and 32 have cooled thereby enabling the fan switch 71 to cool to flex the free end of the thermostatic blade 89 downwardly to thereby open the circuit to the fan 69 to discontinue operation thereof.

From the foregoing, it will be apparent that the sequential loading control system of present invention provides a convenient means for sequentially bringing a plurality of loads into circuit to thereby avoid simultaneously loading the circuit with all such loads and reducing the risk of overloading the electrical source.

Various modifications and changes may be made with regard to the foregoing detailed description without departing from the spirit of the invention.

What is claimed is:

1. Sequential loading control system comprising:
 - a plurality of loads;
 - a plurality of relay housings;

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respective main switches mounted in the respective housings and including respective first and second contacts, thermostatic blade means mounted on one end to said respective housings and carrying said respective second contacts on the free ends thereof for travel through a path into engagement with said respective first contacts upon flexure of said respective blade means;

respective auxiliary switches mounted in the respective housings and including respective stationary contacts and elongated resilient and electrically conductive arms mounted on one end from the respective housings and having the free ends thereof formed to define respective housings and having the free ends thereof formed to define respective movable contacts disposed for engagement with the respective stationary contacts upon flexure of said respective arms, said arms being mechanically coupled with the respective thermostatic blades to form respective units;

respective time delay drive means including heat motors disposed adjacent each thermostatic blade; actuating means connected with one of said time delay drive means for actuating said system; and circuit means connecting said loads to the respective main switches to form units and the auxiliary switch of each unit with the time delay drive means of the succeeding unit whereby when said system is actuated, the time delay drive means of the first unit will be energized to, after a time delay, close the main and auxiliary switches of the first unit to energize the load of the first unit and the time delay means of the succeeding unit.

2. Sequential loading control system as set forth in claim 1 that includes:

pivot means mounting said respective arms to said housings whereby the angular settings of said arms may be adjusted to set the contact force between set movable and stationary contacts at different selected settings.

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