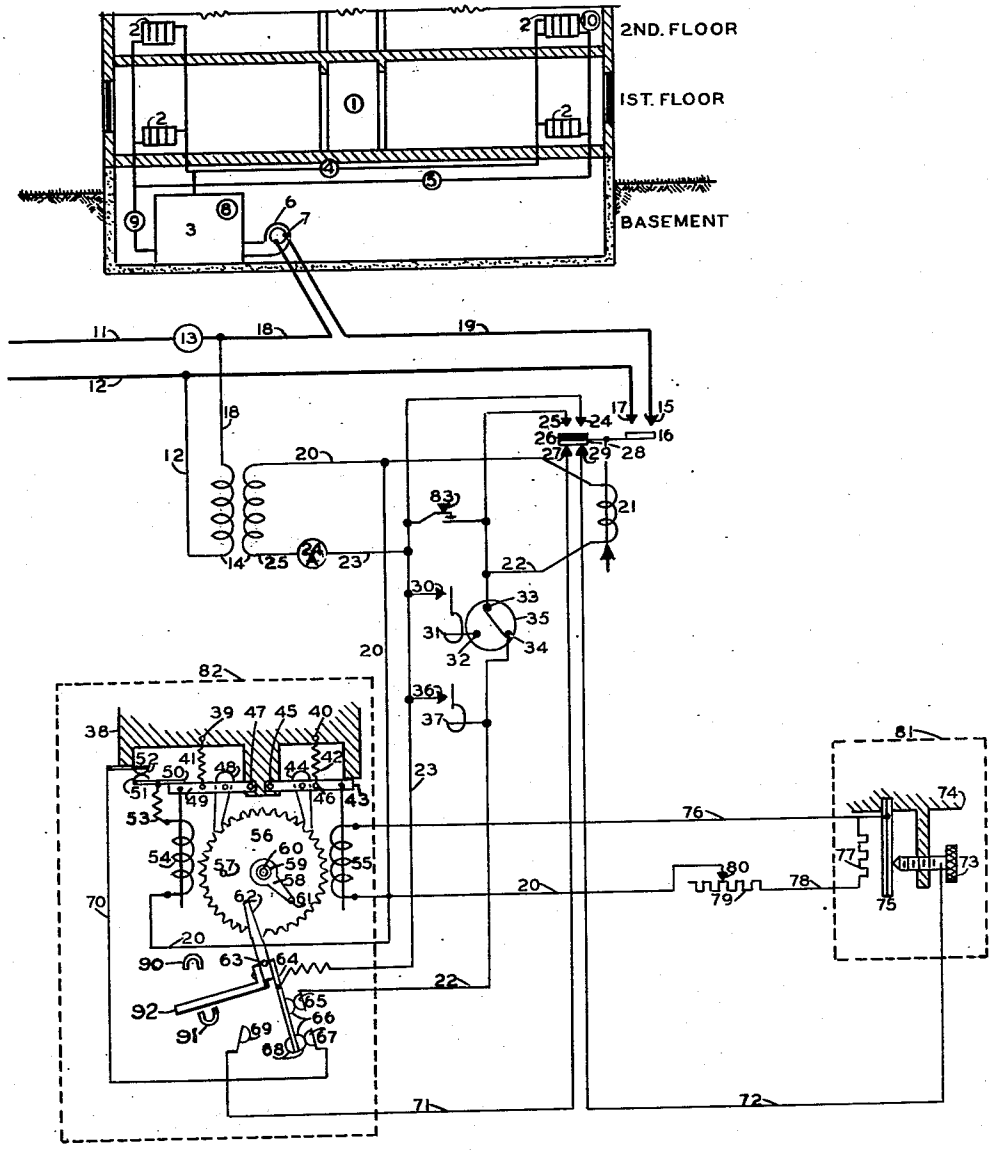
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HEATING SYSTEM CONTROLLED BY OUTSIDE TEMPERATURE

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HEATING SYSTEM CONTROLLED BY OUTSIDE TEMPERATURE

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My invention pertains to heating systems in general and more particularly to a heating system for a multiple occupancy building such as an apartment house or store building.

More specifically, my invention relates to the control of the heating system for a building and is particularly applicable to buildings where the use of fuel has been excessive and where it is desirable to limit the use of fuel to the essential heating requirements of the building.

In one form of my invention, a boiler in one isolated room of the building is used to supply heat to radiators located in other rooms of the building and the boiler is intermittently supplied with fuel by an electrically driven burner. My invention includes a control system for the electric drive of the burner whereby the interval between operations of the burner is governed by the outside temperature and whereby the end of any intermittent operation of the burner is determined by a limit control which has been located and set to operate when all of the radiators have been supplied with sufficient heat to heat the space in which they are located.

Another object of my invention is to provide a control for a heating system which is not only inexpensive to produce but is also inexpensive to install.

Other objects of my invention will become apparent upon a study of the following specifications referring to the attached diagrammatic drawing of one form of my complete system.

Referring now to the drawing, there is shown a fragmentary section of a multiple occupancy building 1 with a boiler 3 in the basement and radiators 2 in all rooms to be heated. A steam line 4 connects the boiler with all radiators and a return condensate line 5 connects all radiators with the boiler. The automatic fuel supply burner is shown at 6 and the electric motor operating the burner is 7. A pressure limit control for the boiler is indicated as to location on the boiler at 8 while alternate types of limit controls that could be used with my system are shown as to location at 9 and 10. If the limit control were located at position 9, it would be a temperature operated control operating in accordance with the temperature of the return condensate line. If the limit control were located at position 10 it would be a temperature control operating in accordance with the temperature of the hardest-to-heat radiator in the system. It is seen, therefore, that the limit control used to end an operation of my system could be chosen to fit the particular application in which it is used and could be any

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common limit control like a pressure control 8 on the boiler, a temperature 9 on the condensate line, or a temperature control 10 on the farthest radiator. On the schematic wiring diagram of my control system there are shown alternate positions of the limit control. These positions are 13 and 24A. It is seen that any of the limit controls 8, 9 or 10 could be used in positions 13 or 24 in my control circuit without affecting the operation of the circuit.

Proceeding now with a description of control circuit, we have electric power lines 11 and 12 supplying power to the burner motor 7 through elements 11, 13, 18, 7, 19, 15, 16, 17 and 12 where 15 and 17 are stationary contacts on an electromagnetic switch and 16 is the bridging contact of the magnetic switch.

At 14 is shown a transformer to reduce the power line voltage to the control circuit voltage. The primary of this transformer is fed through permanent attachment through lines 12 and 18. The operating coil 21 of the electromagnetic switch used to complete the burner motor circuit is fed from the secondary of the transformer 14 through line 20 and line 25, 24A, 23 and 22 whenever the gap between lines 22 and 23 is bridged by any circuit closing means. Whenever the burner motor circuit is closed by the electromagnetic switch, the auxiliary contacts 24 and 25 of that switch are bridged by the bridging bar 26, therefore, whenever the electromagnetic switch is closed, the auxiliary contacts 24 and 25 being connected to lines 22 and 23 will maintain the electromagnetic switch in closed position until either the main supply circuit or the secondary control circuit is opened respectively by a limit control in position 13 or a limit control in position 24A.

It is understood that a burner operation could be initiated by any means desired and several means are here shown. The simplest form of operation initiating means would be a momentary contact switch manually operated as indicated at 83 where the normally separated contacts of the switch are connected, one to line 22 and the other to line 23. Whenever these contacts touch each other, current from the transformer 14 would energize the coil 21 of the electromagnetic switch, thereby closing the main and auxiliary contacts of the magnetic switch and thereby starting the motor and thereby also energizing the holding circuit which maintains the burner in operation. In my system, manually operated momentary contact switch 83 could be used as desired for a test switch or it could be omitted entirely. Also

indicated on the drawing is a single pole double throw switch 35 which can be considered as the switching mechanism of a time operated program clock. The common point and blade 33 of this time switch is connected to line 22 and when the blade is switched to connect line 22 with contact 32, then a thermostat shown conventionally as 30 and 31 could initiate an operation of the burner since the blade 31 of the thermostat is connected to contact 32 of the time switch and the stationary contact 30 and the thermostat is connected to line 23. For purposes of illustration, we will call the thermostat 30, 31, a night thermostat and another thermostat shown as 36, 37, a day thermostat. The blade of this second thermostat 37 is connected to contact 34 of time switch 35 by line 22 and the stationary contact 36 is connected to line 23. When the blade 33 of time switch 35 connects with contact 34 the day thermostat can start an operation of the burner.

It is understood that the use of either a day thermostat or a night thermostat or both thermostats and a time clock is possible with my system but that they also may be omitted if desired.

At 82 is indicated a time delay mechanism which also is connected to lines 23 and 22 to initiate a burner operation and at 81 is indicated a thermostat which would preferably be located outdoors and which is used to control the amount of time delay elapsing before a new operation of the burner is to be initiated by the mechanism 82.

Returning now to the timing mechanism 82, we have a notched ratchet wheel 56 which can be rotated on a shaft 60 by either a movement of the ratchet arm 43 or a movement of the ratchet arm 49. Ratchet arm 43 is pivoted to fixed support 38 by a pin 45 and is yieldingly held in an upward position by spring 42 attached to ratchet arm 43 at 46 and to fixed support 38 at 40. A ratchet dog 44 is pivoted to ratchet arm 43 and on a downward motion of ratchet arm 43, dog 44 will engage ratchet wheel 56 and move ratchet wheel 56 in a right hand direction an angular distance equal to one notch on wheel 56. An electromagnetic operator is also connected to a ratchet arm 43 so that whenever the coil 55 of this operator is energized, ratchet arm 43 will be pulled downward and through dog 44 will operate ratchet 56 as above noted.

In a similar way magnetic coil 54 through its armature attached to ratchet bar 49 and dog 48 will operate the ratchet wheel in a left hand direction whenever coil 54 is energized. Loose on shaft 60 and held in place against ratchet wheel 56 by a fractional spring nut 59 is a lever arm 58 having a pin 61 at its outer end positioned to engage lever arm 62 when ratchet wheel 56 has advanced far enough in a clockwise direction. Pin 57 extends forwardly from ratchet wheel 56 to which it is firmly attached and will engage lever arm 62 when ratchet wheel 56 advances far enough in the counterclockwise direction. Lever arm 62 is pivoted at 63 and has firmly attached to it a spring conducting bar 64 which is attached by a flexible lead to wire 23. On one side of bar 64 are two contacts 66 and on the other side one contact 68, all of which are connected through the bar to wire 23. Stationary contact 65 is connected to wire 22 and therefore, whenever contact 65 contacts with contact 66, wires 22 and 23 are connected and burner operation is initiated. Lever arm 62 is assumed to be so constructed as to be biased either in the right or left hand direction by stationary permanent magnets 91 and 92 respectively so that it will not move from one of its contact positions until it will make a complete motion and will move to the other contact position. Permanent magnets 91 and 92 are positioned as shown to influence the magnetic armature 92 secured to lever 62.

At 81 is shown an outside thermostat having elements shown as a rigid insulating support 74 with an adjusting conducting screw 73 supported therein and also bimetal strip 75 anchored to support 74. Bimetal strip 75 is so placed as to move toward contact with screw 73 as it gets colder and to move away from contact 73 as it gets warmer. Adjacent to bimetal strip 75 is an electric heater 77 arranged to supply heat to bimetal 75 to urge bimetal 75 in a direction away from contact screw 73. One end of electric heater 77 is connected to bimetal strip 75 and also by wire 76 to one end of operating coil 55. The other end of electric heater 77 is connected to line 78 electric resistor 79 contact 80 and line 20 to the other end of operating coil 55. Adjusting screw 73 is connected by line 72 to stationary contact 29 of a reverse acting auxiliary switch attached to the operator of the electromagnetic switch which starts the motor. This reverse acting auxiliary switch has bridging bar 28 and second contact 27 which is connected by line 71 to stationary contact 69.

One end of operating coil 54 is connected to line 20. The other end of operating coil 54 is connected by flexible lead 53 to a conducting bar 50 attached to ratchet lever arm 49. Bar 50 has at its end contact 51 which when lever arm 49 is held in the upward position by spring 41, makes contact with stationary contact 52 supported on insulator 38 and connected to stationary contact 67 through wire 70.

It is seen that the ratchet timing mechanism 82 and the outdoor thermostat mechanism 81 are actuated by power supplied by transformer 14 through lines 20 and 23. Thus when contacts 66 and 67 are closed, a power circuit is established between line 23, contact 66, 67, line 70, contacts 52, 51, line 53, and operating coil 54 to line 20 and coil 54 is energized thereby pulling lever arm 49 downward and operating the ratchet wheel one notch in the left hand direction. At the same time contacts 51, 52 open this circuit, de-energizing coil 54, and ratchet arm 49 is again pulled upward by spring 41 and contacts 51 and 52 are again closed. This operation will repeat until ratchet wheel 56 has proceeded far enough in a reverse direction for pin 57 to contact lever 62 with sufficient force to throw lever 62 to the right and thereby open contacts 65, 66, and 67 and close contacts 68 and 69. When contacts 68 and 69 are closed and if the burner is not in operation it is seen that a circuit is made from transformer 14 through line 23 to bar 64, contacts 68, 69, wire 71 reverse auxiliary switch 27, 28, 29 line 72 adjusting screw 73 bimetal strip 75 to line 76. From line 76 there are two parallel paths which complete the circuit to line 20 and the other side of transformer 14. These two parallel paths are seen to be through operating coil 55 on the one hand, and through heater 77, line 78, adjusting resistor 79, 80 and line 20 on the other end. It is, therefore, seen that under these circumstances that when contact 68 and 69 are closed, operating coil 55 will be energized and heater 77 will be energized at the same time. Because of this, ratchet arm 43 will be pulled downward and ratchet wheel 56 will be advanced one notch in the right hand direction and the

ratchet arm will be held down until such time as heater 77 has sufficiently influenced bimetal strip 75 to open the contact between bimetal 75 and screw 73. When the contact between screw 73 and bimetal 75 is broken bimetal strip 75 will start to cool off and operating coil 55 will release ratchet arm 43 which under the influence of spring 42 will return to its upward position. When bimetal 75 has cooled sufficiently to again contact with screw 73 this operation will be again repeated until pin 61 on arm 58 which travels with ratchet wheel 56 has rotated far enough in the right hand direction to contact lever 62 with sufficient force to return it to the burner starting position of contacts 65 and 66.

It should be noted that when the equipment is not supplying heat to the space to be heated, contacts 68, 69 of the stepping relay will be in engagement, and whenever blade 75 of remote condition responsive device 81 cools and contacts screw 73, stepping coil 55 and heater 77 will be energized and the stepping relay will make a step in the forward direction. Blade 75 will be quickly heated and open the 75, 73 contact, whereupon the stepping relay coil will be de-energized and ready for a new step when the 75, 73 contact is again closed. In the meantime blade 75 will cool slowly or quickly in proportion to the depression of the ambient temperature at that point and it is the cooling time after its quick heating which is the major timing period (variable) in the cycle of operation. The colder the ambient temperature the more rapid the cooling, the more frequent the cycling, and the more frequent the resulting cycling of the heat supply means.

Having thus illustrated in a schematic way the mechanism of my invention, I can describe the daily operation of my system as follows:

The time clock 35 can be set so that at some-time in the early morning the switch blade 33 will be switched from contact 32 to contact 34 thus putting the control of my system under day thermostat 36, 37 and my outside timer mechanism 81 and 82. Day thermostat 36, 37 will be located somewhere in one of the spaces to be heated and will keep the burner in operation subject only to a limit control until the temperature of the building has been raised to a little less than that desired for day time operation. At the same time timer 82 and outside thermostat 81 will start to measure out a time delay period before starting up the burner, each time the burner shuts down due to the operation of the limit control or due finally to the opening of day thermostat 36 and 37. Thus when day thermostat 36, 37 opens the control, the heating system goes over to the combination of the outside thermostat 81 and the timer 82. Repeated heating and cooling of thermostat 81 and operating of actuating coil 55 causes pin 61 to throw lever arm 62 in a time which has been previously determined by the manual setting of arm 58 with respect to its position on ratchet wheel 56 which determines the number of notches which the wheel must advance before tripping lever 62. Also the length of time required to advance wheel 56 each notch is determined by the rapidity of cooling bimetal 75 which is determined by the outside temperature. Whenever the burner is started by the closing of contact 65, 66 the burner will be held in operation by auxiliary switch 24, 25 and 26 until the operation is stopped by a limit control. At the same time the contacts 65, 66 are closed contacts 66, 67 are closed and through

the operation above explained the ratchet wheel is immediately returned to its starting position where pin 57 has operated lever 62 to open contacts 65, 66 and 67 and close contacts 68 and 69. The time delay mechanism is then again ready to start another time delay timing period whenever the limit control opens the cicuit, operating coil 21 is de-energized and reverse auxiliary switch 27, 28 and 29 is closed.

Thus it is seen that as time switch 35 takes the control in the early morning from the night thermostat and transfers this control to the day thermostat and the outside timing control, the first operation is by the day thermostat which keeps the burner in operation limited only by the limit control until the space temperature is nearly up to the day temperature desired. At this time the day thermostat is satisfied and the combination of outside thermostat 81 and timer 82 carries on to bring the day temperature up to that desired. After the morning warm up period, it is seen that the complete control of the heating system is from the outside control to supply whatever heat is required in accordance with the outside temperature.

In the evening when the use of the building changes from average day use to average night use the setting of the time clock has been made so that the time clock switches blade 33 from contact 34 to contact 32, thereby taking control away from either the outside controller or the day thermostat and giving control to night thermostat 30, 31. The night thermostat located in some part of the space to be heated will have a setting lower than the day thermostat in accordance with the usage of the building and will maintain in the space to be heated only this lower night temperature until the morning warm up period again starts in the morning.

It is, therefore, seen that I have provided a system giving a complete and desirable day round operation which results in sufficient burner operation to satisfy the requirements of the building but which limits the use of fuel to the standard requirements of the building for the particular weather being experienced.

Having thus completely described the construction of one form of the system of my invention and explained its operation, I claim:

1. The combination of means defining a space to be heated, means for heating said space, and electrical means for controlling said heating means, said electrical means comprising a power circuit for supplying power to said heating means, means for closing said power circuit and additional means for opening said power circuit, said circuit closing means including an aperiodic pulse delay means comprising manually operated means for setting the number of pulses to elapse before closing said circuit and means responsive to the outside temperature remote from said circuit closing means to control the time length of each pulse, said opening means including a limit control so pre-set and located as to initiate the opening of said circuit when a condition has been established whereby it is probable that heat has been supplied to all parts of the space to be heated.

2. The combination of means defining a space to be heated, means for heating said space, and electrical means for controlling said heating means, said electrical means comprising a power circuit for supplying power to said heating means, means for closing said power circuit, and additional means for opening said circuit, said clos-

ing means comprising a ratchet operated aperiodic delay means and means responsive to the ambient temperature at a remote location to control said delay means whereby said power circuit is closed with a time delay which varies as a function of said ambient temperature.

3. The combination of an electric circuit to be closed, with a variable time delay means for closing said circuit, said delay means comprising an aperiodic pulse delay means having a manually operated means for setting the number of pulses included in the time delay and means for controlling the time length of each pulse cycle, said controlling means being responsive to the ambient temperature at a location remote from said setting means.

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