

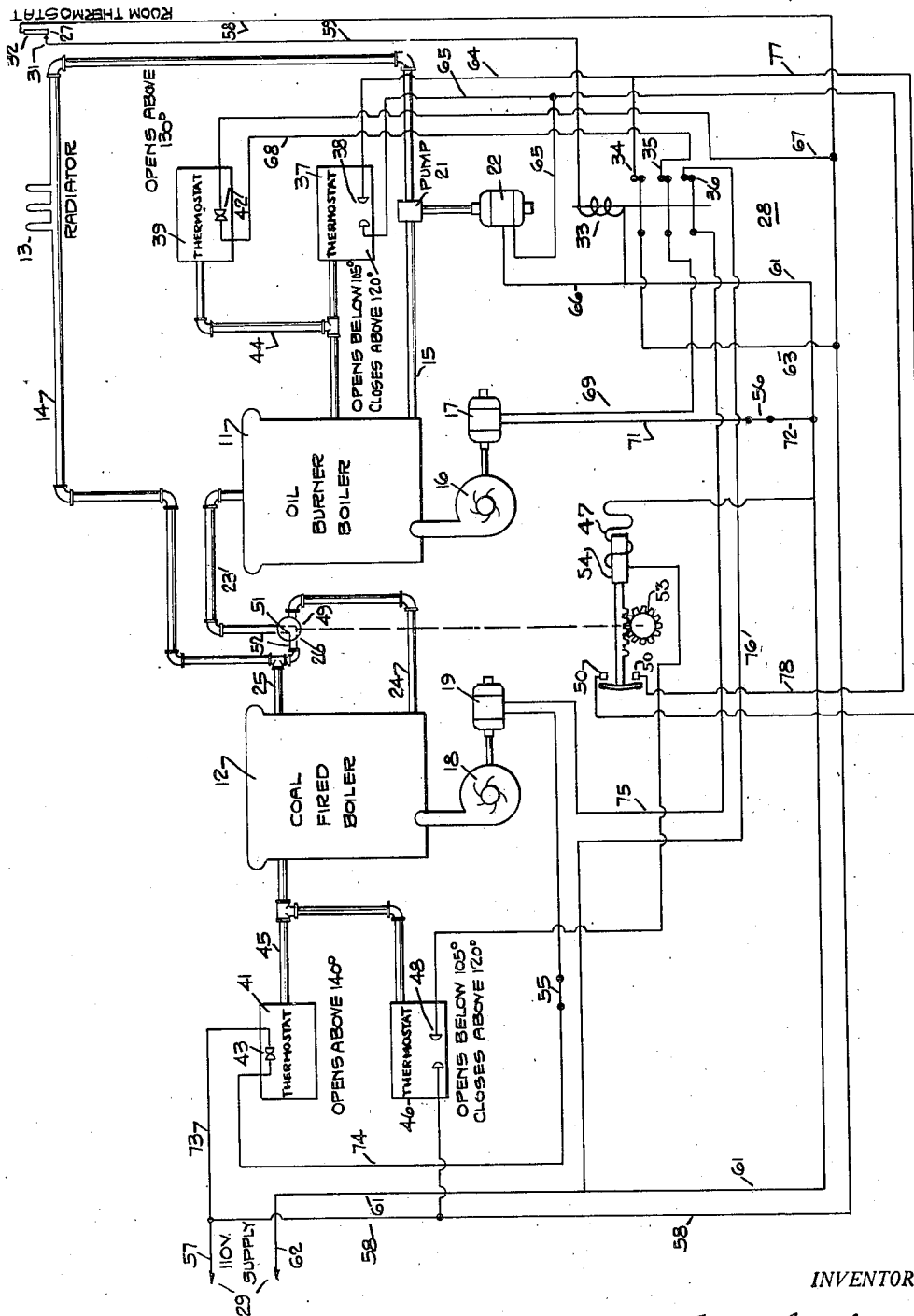
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CONTROL SYSTEM

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CONTROL SYSTEM

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My invention relates to control systems and concerns particularly heat regulating systems and furnace control systems.

An object of the invention is to provide a heating system which operates with high fuel economy and efficiently employs various types of heaters.

Another object is to provide a heating system in which different types of fuel may be employed alone or in conjunction with each other.

Still another object is to provide a system in which a furnace burning one type of fuel may be employed as a stand-by for supplementing or replacing a normally operating furnace burning the same or a different type of fuel.

A further object of the invention is to provide a system for heating a circulating medium by a plurality of sources of heat and cutting out a source whenever the heat supplied thereby is so low as to impair the efficiency of the system.

A further object is to provide a system in which either solid or fluid fuel may be employed according to the supply available and the heat demands of the system.

A further object of the invention is to provide a heating system in which both a coal-fired furnace and a fluid-fuel fired furnace are employed and the controls tend to put the greater load upon the coal-fired furnace in order to save the fluid fuel for periods of light load and times of sudden demand for extra heat. Likewise it is an object to provide a heating system in which furnaces are employed burning different types of fuel and the furnace burning cheaper fuel or operating more efficiently at steady load tends to receive greater load.

A further object of the invention is to provide a heating system having a heater of a type which responds quickly to changes in loading and having another heater which utilizes a more abundant fuel or which supplies heat a minimum of fuel expense for average heater demands.

Other and further objects, features, and advantages of the invention will become apparent as the description proceeds.

In accordance with my invention in its preferred form when used to supply hot water radiators, I employ a fluid-fuel fired boiler such as an oil burner or gas heater, with a second boiler provided with coal grates having combustion control by means of a blower or a damper regulator. Pipe connections are provided for connecting both the fluid-fuel boiler and the solid fuel boiler in a water supply circuit for radiators of the hot water type. Preferably means

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are provided for cutting a boiler out of the hot water circuit whenever such a boiler does not supply adequate heat to the system. For example, means may be provided cutting out a coal-fired boiler except when needed or for cutting out a slowly-heating boiler during its warm up period.

Temperature regulating means such as a room thermostat is provided in connection with relay means for selectively controlling combustion in the boilers and circulating the heat transfer medium, such as hot water in response to variations in room temperature and temperature of the circulating medium. Interlocks may be provided to prevent the hot water from circulating unless its temperature is above a predetermined minimum, and unless heat is being called for.

A better understanding of the invention will be afforded by the followed detailed description considered in conjunction with the accompanying drawing, and its scope will be set forth in the claims. The single figure of the drawing is a circuit diagram schematically representing one embodiment of my invention.

For the sake of illustration a hot water heating system is shown in the drawings comprising boilers 11 and 12 adapted to supply hot water to one or more radiators 13 through a circulating system including piping 14. It will be understood, however, that the invention is not limited to hot water systems and may be employed in connection with heating systems utilizing any desired type of heat transfer medium or heat circulating medium such as hot water, steam or other vapors, hot air or the like. A closed system has been illustrated with a return portion 15 in the piping, but the invention is not limited to such a closed system. In the case of hot air, for example, the heaters 11 and 12 may be arranged to supply the heat transfer medium to a radiator or duct without any similar ducts for air return.

The arrangement is specially adapted to cases where it is desired to employ two different types of heaters or energy transfer devices, for example, where one type of fuel is ordinarily more convenient but is not always accessible, or is more expensive than another type of fuel or when different types of fuel are not equally well adapted to the same type of combustion control. In the arrangement illustrated, the heater 11 may be a type of heater in which the rate of heat transfer to the heat transfer medium may readily and quickly be changed from high to

low rates or completely on and off such as in an electric heater employing current conducting resistors or in a fluid-fired heater utilizing oil, gas, or finely pulverized coal or the like so as to be the equivalent of a fluid fuel-fired heater.

The heater 12 on the other hand may be one which operates well under a static condition of heat transfer but which is not so rapidly transferred from higher to lower rates of heat supply or fuel consumption, for example, as in the case of a heater utilizing solid fuel such as coal, briquets or the like having either a blower control, stoker, or a damper regulator control for varying the rate of heat transfer in accordance with the demands of the heating system. As will be explained hereinafter, means are provided whereby one or the other of the heaters 11 or 12 may have its combustion control disconnected during periods when the fuel for such a heater is not available or is unduly expensive. For the sake of illustration it is assumed that the fuel for the heater 12 is the less expensive and that the heater 11 is to be utilized when heat demands are greater than those which can be met by the heater 12, and means to be described hereinafter are provided for causing the heater 12 to be brought up to a full load before the heater 11 is caused to operate substantially continuously.

The oil burner boiler 11 is provided with a conventional combustion control schematically represented by a blower 16 driven by an electric motor 17, and the coal-fired boiler 12 is similarly provided with a suitable combustion control such as a damper regulator, or a stoker system or a simple blower represented schematically by a blower 18 and an electric driving motor 19 for the blower 18.

For causing the heat transfer medium, in this case hot water, to be transferred quickly from the boilers 11 and 12 to the radiator or radiators 13, a circulating pump 21 is provided driven by an electric motor 22. In the arrangement illustrated in which a return portion 15 is provided for, the heat transfer medium piping or ducts, the pump 21 may if desired be connected in the return portion 15 of the water circulating piping.

The heaters 11 and 12 are both connected to the outgoing and return circulating pipes 14 and 15 in any desired manner either in series or parallel as desired, and means are provided for cutting out one of the heaters when it is not to be operated for the sake of increasing the efficiency of the other heater. For example, in the arrangement illustrated, the boilers 11 and 12 are adapted to be connected in series. A portion of the circulating piping represented by a pipe 23 leaves the upper portion of the boiler 11, joining a return length of piping 24 at the lower portion of the boiler 12 which in turn has an outlet 25 connected to the pipe 14. For disconnecting one of the boilers, in this case the boiler 12, a by-pass valve 26 is provided which is adapted to short out the boiler 12 and connect the outlet pipe 23 of the boiler 11 directly to the pipe 14.

In order that the temperature or energy intensity level in the space occupied by the radiator or energy consumer 13 may be maintained substantially uniform, a suitable temperature control or regulating system is provided including a thermostat 27 and a thermostat relay 28. A suitable source of electric current 29 is provided for energizing the motors 17, 19 and 22, and the ther-

mostat relay 28 together with any other relays or controls which may be provided.

The thermostat 27 includes a pair of contacts 31 and 32 which are adapted to close when the temperature in the space occupied by the radiator 13 falls below a predetermined level and to open when the temperature rises above that level. The thermostat relay 28 comprises an operating winding 33 connected in series with the current supply 24 and the contacts 31 and 32 of the thermostat 27, and also includes pairs of contacts 34, 35 and 36 adapted to remain open until the relay winding 33 is energized.

The contacts 34 are interposed in a circuit joining the circulating pump driving motor 22 to the current source 29; the contacts 35 are interposed in a circuit connecting the combustion control device, in this case the blower driving motor 17 of the oil burner 11, to the current source 29; and the contacts 36 are interposed in a circuit joining the combustion control device for the coal-fired boiler 12, in this case the motor 19, to the current source 29. It will be understood that the combustion control devices for the boilers 11 and 12, or the heat output control devices therefore have two or more settings, in this case two settings which may be called a "high rate setting" or a "high fuel consumption setting" and a "low rate setting" or a "low fuel consumption setting" represented respectively by the conditions when the motors 17 and 19 are connected to the current source 29 and the conditions when these motors are disconnected. However, it will be understood that in case a different type of combustion control device or heat output control device for the heaters is employed, contacts 35 and 36 will be so arranged as to transfer the control devices to the "high rate setting" when the contacts 35 and 36 are respectively closed and to transfer the control devices to the "low rate setting" when these contacts are respectively open.

In order to avoid supplying cold air or water or other heat transfer medium to the radiator 13 when for any reason the heaters 11 and 12 are not in operation or before the heat transfer medium has acquired a sufficient temperature for effective operation, suitable means are preferably provided for preventing the operation of the circulating motor 22 until the heat transfer medium has reached a predetermined temperature. For example, a liquid temperature-responsive thermostat 37 such as one of the type sold under the trade name "Aqua-stat", may be provided which is responsive to the temperature of the heat transfer medium, namely the water in the boiler 11, and has a pair of contacts 38 which are arranged to open when the temperature of the medium in the boiler 11 falls below a setting such as 105 degrees Fahrenheit for example, and which are adapted to close again when the temperature rises above this value, for example when it rises to a temperature such as 120 degrees Fahrenheit. It will be understood that the temperatures mentioned are merely illustrative and that the invention is not limited to any of the specific temperature settings mentioned in connection with the thermostat 37 or the other temperature control devices to be mentioned hereinafter. In view of the structural necessities of devices such as the thermostat 37, it will be understood that the contacts 38 cannot be expected to open and close at exactly the same temperature level, and furthermore, it is desirable to have a range such as the 15 degree range mentioned between the opening and closing temperatures in order to avoid un-

duly frequent starting and stopping of the pump 21 which will obviously lower the temperature of the water in the boiler 11 whenever it starts circulating.

For safety purposes and in order to prevent the unnecessary consumption of fuel when the temperature of the heat transfer medium has risen to such a value that sufficient heat is stored therein to supply the radiator 13 without further consumption of fuel, upper limit temperature responsive devices such as liquid temperature-responsive thermostats of the type sold as "Aquastats" 39 and 41 for example are provided which are responsive respectively to the temperatures of the heat transfer medium, in this case hot water, in the boilers 11 and 12 respectively. In cases where for any reason one of the heaters 11 or 12 is of such a type or nature, or it burns such a fuel, that it is preferred to operate one of the heaters most of the time, the thermostats 39 and 41 are preferably arranged to operate at somewhat different maximum temperatures. Such an arrangement may be desirable, for example where one of the heaters is capable of carrying the entire load until the outside temperature falls below a certain value when the standby heater is brought into operation or when one of the heaters is not readily adapted to sudden changes in heat demands and the other heater is brought into operation for short periods of time when additional sudden demands for heat must be met. For the sake of illustration it is assumed that the heater 12 is the one which operates with the cheaper fuel or which is less well adapted for sudden variations in combustion control so that the load is ordinarily to be carried by the heater 12 so far as possible. Under these circumstances the liquid temperature-responsive thermostat 41 may be set to open its contacts at a temperature slightly higher than the temperature at which the thermostat 39 opens. For example, the thermostats 39 and 41 may be arranged to cut-off the combustion control devices for the heaters 11 and 12 at temperatures of 130 degrees Fahrenheit and 140 degrees Fahrenheit respectively.

The thermostats include pairs of relatively movable contacts 42 and 43 respectively arranged to be opened by mechanism, not shown, responsive to the temperatures of the waters in the boilers 11 and 12 through connecting pipes 44 and 45 respectively. The contacts 42 are connected in series with the circuit to the combustion control motor 17, and the contacts 43 are connected in series with the circuit to the combustion control motor 19 of the boiler 12.

It has been assumed for the sake of illustration that the boiler 12 is of the type which is well adapted for steady operation or a continued operation at a substantially uniform rate, and may not be so well adapted for sudden changes in temperature requirements. Accordingly, means may be provided for preventing the boiler 12 from cooling the circulating circuit of the faster operating boiler 11 when the heating system is turned on by the thermostat 27 unless the temperature of the water in the boiler 12 has attained an adequate value. For this purpose an additional liquid temperature-responsive thermostat 45 may be provided adapted to control an operating winding 47 for the by-pass valve 26. The thermostat 46 may include a pair of contacts 48 adapted to open below a predetermined temperature and to close above a predetermined temperature for energizing the valve operating winding 47. For example,

the operating temperatures may be 105° and 120° respectively.

The by-pass valve 26 may be of any suitable type. For the sake of illustration, it is represented as a gate valve of the two position type having a rotatable member 49 containing a right angle passage-way 51 adapted to make connections between pipes 25 and 23 or between pipes 23 and 24 according to the angular position of the member 49. For rotating the member 49 suitable mechanism such as a rack and pinion linkage 53 may be provided controlled by the operating winding 47 through the medium of a magnetic plunger 54. For reasons to be explained hereinafter the plunger 54 may also be arranged for operation of normally open contacts 50.

The passage-way 51 is adapted to communicate between the pipes 23 and an end 52 of the pipe 14 when the operating winding 47 is de-energized, and the passage-way 51 is adapted to communicate between the pipes 23 and 24 when the valve operating winding 47 is energized. The pipe 25 may make a T connection with the pipe 14.

If desired means may be provided for suspending the operation of either of the heaters 11 or 12 when fuel therefor is not available. For example, cut-out switches 55 and 56 may be included in the combustion control circuits, namely in circuits of the motors 19 and 17 respectively.

It will be observed that when the by-pass valve 26 is in the position shown with the operating winding 47 de-energized, a water circulating circuit is formed from the circulating pump 21 through the return pipe 14, the oil burner boiler 11, the pipe 23, the valve passage-way 51, the pipe-end 52, the supply pipe 14 and the radiator 13 back to the circulating pump 21. On the other hand when the valve operating winding 47 is energized which may be considered the normal condition, when the temperature of the water in the boiler 12 is above a temperature of 120 degrees, for example, the valve passage-way 51 connects the pipes 24 and 23, and the circulating system includes the boiler 12 continuing from the boiler 11 through the pipes 23 and 24, through the boiler 12, the pipe 25 to the radiator supply pipe 14. The thermostat 46 may be so designed for example as to open its contacts 48 at temperatures below 105 degrees and to close the contacts at temperatures above 120 degrees.

It is assumed for the sake of illustration that the temperature in the space containing the radiator 13 is such that heat is called for, and accordingly the contacts 31 and 32 of the thermostat 27 are closed energizing the thermostat relay winding 33 and closing the contacts 34, 35, and 36.

An energizing circuit for the relay 28 may be traced from the upper terminal 57 of the current supply source 29 through a conductor 58 to the thermostat blade 32, thermostat contact 31, a conductor 59, the relay winding 33, and a conductor 61 back to the second terminal 62 of the current supply source 29. The closing of the contacts 34 forms a circuit from the terminal 57 to the conductor 58 and a conductor 63 through the contact 34, a conductor 64, the contacts 38 of the thermostat 37, provided the temperature of the water in the boiler 11 is high enough, through a conductor 65, the motor 22, a conductor 66 and the conductor 61 back to the terminal 62 of the current supply 29.

The closing of the contacts 35 forms a circuit from the terminal 57 through the conductor 58, a conductor 67, the normally closed contacts 42

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of the thermostat 39, a conductor 68, the relay contacts 35, a conductor 69, the combustion control motor 17 for the boiler 11, a conductor 71, the cut-out switch 56, a conductor 72 and the conductor 61 back to the terminal 62 of the current source 29. Similarly, the closing of the contacts 36 forms a circuit from the terminal 57 through a conductor 73, the normally closed contacts 43 of the thermostat 41, a conductor 74, the control cut-out switch 55, the combustion control motor 19 of the boiler 12, a conductor 75, the contacts 36, a conductor 76 back to the conductor 61 and the terminal 62 of the current source 29.

As soon as the motor 17 has run long enough to bring the temperature of the heat transfer medium in the boiler 11 to the proper value, the contacts 38 of the thermostat 37 close permitting the operation to take place as described. If the oil burner 11 is not in use, assuming the switch 56 is open for example, the thermostat contacts 38 remain open until the temperature of the water in the circulating system has been raised to a sufficient value to transfer heat to the radiator 13. Whether or not the oil burner 11 is in operation, as soon as the temperature of the water in the coal-fired boiler 12 has reached the proper value the thermostat contacts 48 close, energizing the valve operating winding 47 to permit the circulating pump 22 to drive water through the coal-fired boiler 12 and the oil burner 11 as well as the remainder of the system. In the event that the temperature of the heat transfer medium in the boiler 11 should be too low to close the thermostat contacts 38, the circuit to the circulating pump motor 22 is in any event closed by the closing of the contacts 50 carried by the plunger 54 of the valve operating winding 47. In this case a circuit for the circulating pump motor 22 is formed from the contact 34 through a conductor 77 through the contacts 50, a conductor 78 and the conductor 65 to the motor 22, the remainder of the circuit being the same as before. Thus it is apparent that means are provided for causing the operation of the circulating pump 21 whenever the temperature of the heat transfer medium in either of the boilers 11 or 12 reaches the proper minimum value. In this way overheating of the boilers is prevented as well as utilization of the heat storage capacity of the heat transfer medium whenever available. As soon as the temperature of the heat transfer medium in the boiler 11 rises to the upper limit for which the thermostat 39 is set, for example 130 degrees, the combustion control for the boiler 11 is cut-out by the opening of the contacts 42, and the other boiler 12 continues to supply all of the required heat for the circulating system. The boiler 12 continues in operation until its thermostat contacts 43 open at a temperature which is set above that of the thermostat 39.

In the event that the boiler 12 is not in operation the valve operating winding 47 remains de-energized and the valve 26 remains in the by-pass condition so that no heat from the oil burner 11 is wasted in raising the temperature of the coal-fired boiler 12, and the entire heating requirements of the system are supplied by the oil burner 11. It will be understood that the apparatus such as the oil burner 11 may be provided with relatively small water storage facilities in view of the fact that the combustion controls are easily arranged for quick transfer from "on to off" operation or between "high and low" rate operation. On the other hand a boiler such as a coal-fired boiler 12 ordinarily is built with a bulkier and

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heavier construction so that it has a larger water storage compartment and greater loss of heat is represented by the use of the oil burner 11 to heat the water in the boiler 12, than is represented by the use of the coal-fired boiler 12 to raise the temperature of the water in the boiler 11. In cases where the heaters 11 and 12 are on a par as to the desirability of avoiding energy loss by heating the heat transfer medium therein when the heater is not in use, parallel connections of the heaters to the supply in the return pipes 14 and 15 may be provided in which case the arrangement for cutting out one or the other of the boilers may simply take the form of a shut-off valve interposed in the connection of the heater to the circulating water system.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention together with the apparatus which I now believe to represent the best embodiment thereof, but desire to have it understood that the apparatus shown and described is only illustrative and that my invention may be carried out by other arrangements.

What I claim is:

1. A heating system comprising in combination a boiler with an oil burner, and a coal-fired boiler for heating fluid circulating medium, a radiator for such a medium, a circulator for causing the medium to travel through the said boilers and through the radiator, electrically operated combustion control devices for each of said boilers, each control device having a low fuel consumption setting and a high fuel consumption setting, room temperature responsive means for simultaneously tending to translate the combustion control devices to the high fuel consumption settings and for energizing the circulator, means responsive to temperature of the circulating medium for preventing operation of the circulator when the temperature of the circulating medium is below a predetermined minimum temperature, means for transferring the combustion control device for the oil burner to the low fuel consumption setting when the temperature of the circulating medium rises above a predetermined maximum, means associated with the coal-fired boiler for transferring its combustion control device to the low fuel consumption setting when the temperature of the medium rises above a predetermined maximum temperature higher than that for which the upper limit control of the oil burner is set and means for cutting out the coal-fired boiler from the circulating system of the oil burner boiler and the radiator when the temperature of the medium in the coal-fired boiler falls below a predetermined minimum temperature.

2. A heating system comprising in combination a fluid-fuel heater adapted to heat a fluid heat circulating medium, a solid fuel-fired heater also adapted to heat a fluid circulating medium, a radiator for such a medium, a circulator for circulating the medium through said heaters and said radiator, a combustion control device for each of said heaters having low fuel consumption and high fuel consumption settings, means responsive to room temperature for simultaneously tending to transfer the combustion control devices to the high fuel consumption setting and to energize the said circulator, means for de-energizing said circulator when the temperature of the heat transfer medium in the fluid fuel-fired heater falls below a pre-determined temperature, means for transferring the combustion control device of the fluid-fuel heater to the low fuel consumption setting

when the temperature of the heat transfer medium in the fluid-fuel heater rises above a predetermined temperature, means for transferring the combustion control device of the solid fuel-fired heater to the low consumption setting when the temperature of the heat transfer medium therein rises to a still higher temperature and means for disconnecting the solid fuel-fired heater from the circulating system of the other heater and the radiator when the heat transfer medium in the solid fuel-fired heater falls below a predetermined temperature.

3. A heating system comprising in combination with a radiator and a heat transfer medium, a first heater for heating the heat transfer medium, a second heater for heating the heat transfer medium, and a circulator, said radiator, circulator and heaters normally being in operative relation to each other, heating-rate control devices for each of said heaters having low and high rate settings, means responsive to room temperature below a predetermined value tending to transfer said control devices to the high rate settings and to energize the circulator for the heat transfer medium, and means responsive to temperature of the heat transfer medium below a predetermined value for diverting load to one of said heaters.

4. In a heating system utilizing a heat transfer medium and a distribution system for said medium, a heater and a combustion control device for the heater, both adapted for relatively rapid transfer from low rate to high rate combustion and vice versa, a second heater adapted for steady combustion, and a combustion control device therefor adapted for gradual transfer from low rate to high rate combustion and vice versa, means responsive to room temperature for transferring both of the combustion control devices to high rate condition when room temperature falls below a predetermined level and for transferring both heaters to low rate combustion condition when the room temperature rises above a predetermined level, means responsive to temperature of the heat transfer medium for transferring the combustion control device of the first heater to low rate condition when the temperature of the heat transfer medium in said heater rises above a predetermined temperature while permitting the second heater to operate at high rate conditions and means for cutting out the second heater when the temperature of the heat transfer medium therein falls below a predetermined minimum temperature the connections being such that the first heater remains at such minimum temperature.

5. Apparatus as in the preceding claim wherein the second heater is provided with means for transferring the combustion control device to low rate combustion condition when the temperature of the heat transfer medium in the second heater rises to a predetermined temperature higher than that for which the upper limit control of the first heater is set.

6. A heater for a heat transfer medium and a combustion control device therefor both adapted for relatively rapid transfer from high rate to low rate combustion condition and vice versa and a second heater adapted to be interconnected to the first heater having a relatively steady combustion condition and a combustion control device therefor adapted for gradual transfer from high rate to low rate heat combustion condition and vice versa, an upper limit control for the first heater adapted to transfer the combus-

tion control device to low rate condition when the temperature of the heat transfer medium in the first heater rises above a given predetermined temperature and an upper limit control for the second heater adapted to transfer the combustion control device of the second heater to a low rate condition after the temperature of the heat transfer medium in the second heater has risen above that for which the upper limit control of the first heater is set.

7. A thermostat responsive to temperature in the space to be heated, a relay controlled by said thermostat, a circulator for heat transfer medium controlled by said relay, first and second heaters connected to said circulator, a relatively fast combustion control device also controlled by said relay, a less fast acting combustion control device controlled by said relay, the first and second heaters being controlled by the first and second combustion control devices, respectively, and means for disconnecting the second heater when the temperature thereof falls below a predetermined value.

8. A heating system comprising in combination first and second heaters with electrically operated combustion control devices with electrical control circuits, a common circulating pump for said heaters with an electric motor for driving said pump and a thermostat relay having three sets of contacts arranged to open and close together, one of said sets of contacts being connected to the combustion control device of the first heater for opening and closing the electrical circuit thereof, another set of said contacts being connected to the combustion control device of the second heater for opening and closing the electrical circuit thereof and the third set of contacts being connected in circuit with the circulating pump motor for opening and closing the electrical circuit thereof.

9. Apparatus as in claim 8 wherein one of the first two sets of contacts of the thermostat relay has connected in series therewith a pair of temperature responsive contacts which open at a temperature of the circulating medium exceeding a predetermined value whereby one of said heaters operates only when the other is incapable of carrying the load.

10. Apparatus as in claim 8, wherein the first two sets of thermostat relay contacts each have included in series therewith temperature responsive contacts which open at two different predetermined maximum temperature values of heat circulating medium in the two different heaters at which they are associated.

11. A heating system comprising in combination with a circulating system for heat transfer medium first and second heaters connected in series with said circulating system and a by-pass valve responsive to temperature of the heat circulating medium in the second heater for cutting out the second heater from the circulating system when the temperature of the medium in said heater falls below a predetermined value.

12. In a heating system, the combination comprising first and second heaters for a heat transfer medium, a common circulator for said heaters, means responsive to the temperature in either of said heaters for starting the circulator when the temperature in either of the heaters rises above a predetermined value and for shutting off the circulator when the temperature in both heaters falls below a predetermined value and means responsive to the temperature in one of the heaters for connecting it in the circuit

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only when the temperature thereof is above a predetermined value.

13. In a heating system, the combination comprising first and second heaters for a heat transfer medium, a common circulator for said heaters and means responsive to the temperature in either of said heaters for starting the circulator when the temperature in either of the heaters rises above a predetermined value and for shutting off the circulator when the temperature in both heaters falls below a predetermined value.

14. In a heating system, first and second heaters for a heat transfer medium, a common circulator for the heat transfer medium in said heaters, means responsive to the temperature in the first heater for causing operation of the circulator when the temperature of the heat transfer medium is above a predetermined value and means responsive to the temperature in the second heater for connecting it in circuit with the first heater when the temperature of the heat transfer medium in the second heater rises above a predetermined value.

15. Apparatus as in the preceding claim in which the cut-in means for the second heater includes mechanism for causing operation of the circulator simultaneously with the inter-connection of the second heater.

16. A heating system comprising in combination with a radiator and a heat transfer medium, a first heater for heating the heat transfer medium, a second heater for heating the heat transfer medium, a circulator, said radiator, circulator and heaters normally being in operative relation to each other, heating rate control devices for each of said heaters having low and high rate settings, means responsive to room temperature below a predetermined value tending to transfer said control devices to the high rate settings and to energize the circulator for the heat transfer mediums, means for normally diverting load to the second heater, and means responsive to temperature of the heat transfer medium in the second heater for disconnecting said heater from the circulating system when the temperature of the heat transfer medium in the second heater falls below a predetermined temperature.

17. A heating system comprising in combination a first heater employing fluid fuel adapted to heat a fluid heat transfer medium, a solid fuel-fired heater also adapted to heat a fluid heat transfer medium, a radiator for such a medium, a circulator for circulating the medium through said heaters and said radiator, a combustion control device for each of said heaters having low fuel consumption and high fuel consumption settings, means responsive to room temper-

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ature below a predetermined value for simultaneously tending to transfer the combustion control devices to the high fuel consumption setting, and means responsive to the temperature of the heat transfer medium of the first heater for transferring the control device thereof to the low rate setting when the temperature of the heat transfer medium rises above a predetermined value.

18. A heating system comprising in combination with a radiator and a heat transfer medium, a first heater for heating the heat transfer medium, a second heater for heating the heat transfer medium, and a circulator, said radiator, circulator and heaters normally being in operative relation to each other, heating-rate control devices for each of said heaters having low and high rate settings, means responsive to room temperature below a predetermined value tending to transfer said control devices to the high rate settings and to energize the circulator for the heat transfer medium, upper-limit means responsive to the temperature of the heat transfer medium of the first heater for transferring the control device thereof to the low rate setting when the temperature of the heat transfer medium rises above a predetermined temperature and means responsive to the temperature of the heat transfer medium in the second heater for transferring the control device of said heater to the low rate position when the temperature of the heat transfer medium in the second heater rises above a maximum temperature greater than that for which the upper limit means of the first heater is set.

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