



PATENT SPECIFICATION

(11) S84192

(21) Application No. S2004/0500

(22) Date of Filing of Application: 26/07/2004

(45) Specification Published: 19 April 2006

(51) Int. Cl. (2006)
F28F 27/00
F24D 19/00

(54) Title: A controller, and a heating system incorporating the controller

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"A controller, and a heating system incorporating the controller"

The present invention relates to a controller, and in particular, though not limited to a controller for controlling a heating system, and the invention also relates to a heating
5 system incorporating the controller.

According to the invention there is provided a controller for controlling the operation of a primary bi-state device, and a plurality of secondary bi-state devices, the controller comprising a primary output for providing a primary signal to the primary
10 device for operating the primary device in a predetermined one of two states, a plurality of secondary outputs for independently providing respective secondary signals to the respective secondary devices for operating corresponding ones of the secondary devices in respective predetermined ones of two states independently of each other, a timing means for timing a plurality of discrete time periods during which
15 corresponding ones of the secondary devices are to be operated in the respective predetermined ones of the two states, and a switch network responsive to the timing means timing one of the discrete time periods for one of the secondary devices for applying one of the secondary signals to the secondary output corresponding to the device for which the discrete time period is being timed for operating the
20 corresponding device in the predetermined state during the discrete time period, and for applying the primary signal to the primary output for operating the primary device in the predetermined state while the timing means is timing any one of the discrete time periods for any one of the secondary devices.

In one embodiment of the invention the controller comprises a control input for receiving a bi-state input signal, and the secondary signals are applied to the secondary outputs in response to the input signal on the control input being in one of the two states and the timing means timing the corresponding discrete time periods,
5 and the secondary signals are inhibited when the input signal on the control input is in the other of the two states.

In another embodiment of the invention each secondary signal comprises a power supply for powering the corresponding secondary device, and in a further
10 embodiment of the invention the primary signal comprises a power supply for powering the primary device.

Preferably, the switch network is responsive to the timing means for switching the primary output and the secondary outputs to a power supply.
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In one embodiment of the invention the controller comprises a main power supply input for receiving a power supply, and the switch network is responsive to the timing means for switching the primary output to the main power supply input for applying the power supply to the primary output.

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In another embodiment of the invention the control input is adapted for receiving a power supply, and the switch network is responsive to the timing means for switching the respective secondary outputs to the control input for providing the power supply on the secondary outputs to the corresponding secondary devices.

In one embodiment of the invention the power supply to the control input is applied to the control input in response to a characteristic of the primary device being in a predetermined state.

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In a further embodiment of the invention the controller is adapted for controlling the operation of a heating system, whereby the heating system comprises a bi-state boiler which forms the primary device, and a plurality of heating circuits coupled to the boiler by corresponding bi-state supply means which form the secondary
10 devices, each supply means being selectively operable in an on state for supplying water from the boiler to the corresponding heating circuit independently of the other heating circuits, the boiler being electrically coupled to the primary output of the controller and being responsive to the primary signal for operating in an on state for heating the water, and the supply means of the respective heating circuits being
15 electrically coupled to the corresponding ones of the secondary outputs of the controller and being responsive to the respective corresponding secondary signals for operating in the on state.

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In one embodiment of the invention the heating system comprises a domestic indirect hot water tank, and the input signal which is applied to the control input of the controller is applied to the control input through a temperature responsive bi-state switch associated with the indirect hot water tank, and preferably, the input signal being applied to the control input in response to the temperature of the water in the indirect hot water tank being above a predetermined temperature.

In one embodiment of the invention the primary signal inputted to the boiler from the primary output is the power supply from the main power supply input.

- 5 In another embodiment of the invention the input signal applied to the control input is derived from the power supply from the primary output.

The invention also provides a central heating system comprising a boiler and a plurality of heating zones independently coupled to the boiler by respective supply
10 means, and a controller according to the invention being provided for controlling the operation of the central heating system, the boiler being electrically coupled to the primary output of the controller, and each supply means being electrically coupled to a corresponding one of the secondary outputs so that each supply means is
operated in response to the timing means timing one of the discrete time periods for
15 that supply means, and the boiler is responsive to the timing means timing one of the discrete time periods for any one of the supply means.

In one embodiment of the invention the central heating system comprises an indirect hot water tank, which is heated by the boiler, and the power supply is applied to the
20 control input through a temperature responsive bi-state switch associated with the indirect hot water tank so that powering of the respective supply means is inhibited until the water in the indirect hot water tank reaches a predetermined temperature.

In one embodiment of the invention at least one of the supply means is provided by

a motorised valve, and in another embodiment of the invention at least one of the supply means is provided by a water pump.

The invention will be more clearly understood from the following description of an embodiment thereof, which is given by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 is a circuit diagram of a central heating system according to the invention, and

Fig. 2 is a front elevational view of a controller also according to the invention of the central heating system of Fig. 1.

Referring to the drawings, there is illustrated a central heating system according to the invention, indicated generally by the reference numeral 1, which is controlled by a controller also according to the invention, indicated generally by the reference numeral 2. Before describing the controller 2 in detail, the central heating system 1 will first be described. The central heating system 1 comprises a boiler 5 which comprises a burner (not shown) and a circulating pump 6 for circulating water through the central heating system. For convenience the water circuits are illustrated in broken lines in Fig. 1, while the electrical circuits are illustrated in full lines. The boiler including the burner (not shown) and the circulating pump 6 are powered under the control of the controller 2 as will be described below. A hot water supply is provided from an indirect domestic hot water tank 10 which is heated by

water from the boiler 5. The water supply from the boiler 5 to the indirect hot water tank 10 may be provided by a gravity feed, or if a gravity feed is not possible, a circulating pump 12 is provided for circulating water between the boiler 5 and the indirect hot water tank 10. Where the circulating pump 12 is required, the circulating
5 pump 12 is powered by the power supply to the boiler 5 through a thermostat switch 14 as will be described below.

A main circuit 18 from the boiler 5 supplies water to a plurality of independent heating circuits 16 of the central heating system 1 for heating respective zones of a
10 building, namely, zone 2 to zone 6. The heating circuits 16 of zones 2 to 6 each comprise heat exchange radiators (not shown), and the heating circuits 16 of the zones 2 to 6 are independently coupled to the main circuit 18 by respective corresponding supply means, in this embodiment of the invention corresponding motorised valves 15. A domestic hot water circuit 19 of zone 1 is provided for
15 supplying pressurised hot water from the indirect hot water tank 10, and comprises a pump 17 for pumping hot water from the indirect hot water tank 10. Each motorised valve 15 is powered independently under the control of the controller 2, and the pump 17 for supplying pressurised hot water from the indirect hot water tank 10 is also independently powered by the controller 2.

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Central heating systems which comprise a boiler, an indirect hot water tank and a plurality of heating circuits for heating respective zones of a building similar to the central heating system 1 will be well known to those skilled in the art, and it is not intended to describe the central heating system in further detail.

The controller 2 comprises a main power supply input 20 for receiving an AC power supply for powering the controller 2, and also for providing power as will be described below to the boiler 5. A control input 21 is provided to the controller 2 for receiving an input signal, which in this embodiment of the invention is a power supply through the thermostat switch 14 of the indirect hot water tank 10. A primary output 23 is provided from the controller 2 through which a primary signal, in this embodiment of the invention the power supply for powering the boiler 5 is provided to the boiler 5. A plurality of secondary outputs 25 are provided from the controller 2 for providing secondary signals, in this embodiment of the invention power supplies to the respective motorised valves 15 and the pump 17, independently of each other.

A timing means provided by a programmable timer (not shown) is located in the controller 2 for timing a plurality of discrete time periods during which the motorised valves 15 and the pump 17 are to be powered for supplying water to the heating circuits 16 of the zones 2 to 6 and for supplying pressurised water from the indirect hot water tank 10, respectively.

A switch network 26 which comprises a plurality of main relays 27 and a plurality of secondary relays 28 which are operated under the control of the programmable timer selectively switch the secondary outputs 25 to the control input 21 for applying power to the motorised valves 15 and the pump 17 when the power supply is applied to the control input 21 through the thermostat switch 14. Each main relay 27 is a double pole relay, and couples a neutral of the power supply on a neutral supply line 30 to

the pump 17 and the motorised valves 15, and the power supply on a supply line 31 from the control input 21 to the pump 17 and the motorised valves 15. The relay coils of the main relays 27 are independently powered by respective power supplies from the secondary relays 28 and a neutral from a neutral supply line 32.

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Each secondary relay 28 is operated under the control of the programmable timer, and the respective secondary relays 28 are operated in the on state during periods when the programmable timer is timing discrete time periods during which the corresponding ones of the motorised valves 15 or the pump 17 are to be operated in
 10 the on state. Accordingly, during each discrete time period timed by the programmable timer during which the pump 17 is to be powered, the secondary relay 28 corresponding to the pump 17 is operated in the on state, for in turn operating the corresponding main relay 27 in the on state. Similarly, during each discrete time period timed by the programmable timer during which the motorised
 15 valve 15 of zone 2 is to be powered, the secondary relay 28 corresponding to the motorised valve 15 of zone 2 is operated in the on state for in turn operating the corresponding main relay 27 in the on state for powering the motorised valve 15, and so on up to the secondary relay 28 which is operated in the on state when the programmable timer is timing discrete time periods during which the motorised valve
 20 15 of the heating circuit 16 of the zone 6 is to be powered, for in turn operating the corresponding main relay 27 in the on state.

The switch network 26 also comprises a bank of six primary relays 34 for switching the primary output 23 to the main power supply input 20 for applying power to the

boiler 5. Each primary relay 34 couples the primary output 23 to the main power supply input 20 and is operated in response to the corresponding one of the secondary relays 28 being in the on state. Accordingly, when the programmable timer times any one of the discrete time periods during which any one of the motorised valves 15 or the pump 17 are to be operated in the on state, the corresponding one or more of the primary relays 34 is or are operated in the on state for powering the boiler 5. The power supply to the control input 21 which is supplied through the thermostat switch 14 in the indirect hot water tank 10 is derived from the primary output 23, and thus, the power supply will only be applied to the control input 21 when the water in the indirect hot water tank 10 reaches a predetermined temperature, and accordingly, the power supply will be inhibited to the motorised valves 15 and the pump 17 until the water in the indirect hot water tank 10 reaches the predetermined temperature. This permits rapid heating of the water in the indirect hot water tank 10, and once the temperature of the water in the indirect hot water tank 10 has reached the predetermined temperature, those motorised valves 15 and the pump 17 for which the programmable timer has commenced timing a discrete time period are then powered via the thermostat switch 14 and the main relays 27.

The thermostat switch 14 is a bi-state switch, and when the temperature of the water in the indirect hot water tank 10 is below the predetermined temperature, the thermostat switch 14 switches to one state for powering the circulating pump 12 should such a circulating pump 12 be provided for circulating water between the boiler 5 and the indirect hot water tank 10 for heating the water therein. On the

temperature of the water in the indirect hot water tank 10 reaching the predetermined temperature, the thermostat 14 switches to the other state for applying the power supply to the control input 21.

- 5 Additionally, in this embodiment of the invention a plurality of booster switches 35 are provided in parallel with the secondary relays 28 for facilitating manual overriding of the programmable timer for supplying power to corresponding ones of the motorised valves 15 and the pump 17, assuming of course that the temperature of the hot water in the indirect hot water tank 10 is at or above the predetermined
- 10 temperature and power is supplied through the thermostat switch 14 to the control input 21.

- Input keys 36 to 40 are provided on the controller 2, see Fig. 2 for inputting data for programming the programmable timer for selecting the discrete time periods during
- 15 which the motorised valves 15 and the pump 17 are to be powered. In this embodiment of the invention the programmable timer is a seven day timer and permits three discrete time periods to be timed during each day for each motorised valve 15 and pump 17. The programming of such programmable timers will be well known to those skilled in the art. A screen 41 is provided on the controller 2 for
- 20 facilitating programming of the discrete time periods which are to be timed by the programmable timer (not shown) of the controller 2. Light emitting diodes 42 and 43 indicate respectively when the controller 2 is powered up, and the boiler 5 is powered up under the control of the controller 2. A light emitting diode 44 is provided for indicating when a fault occurs in the boiler 5. Light emitting diodes 45 to

50 indicate when the pump 17 and the motorised valves 15 of zones 1 to 6, respectively are powered up. An input terminal 51 is provided for coupling to the boiler 5 for indicating when the boiler 5 has developed a fault.

- 5 Room thermostats 55 are provided on each of the power supplies from the secondary outputs 25 to the motorised valves 15 for controlling the power supply to the motorised valves 15 in response to the corresponding room temperature.

In use, with the programmable timer (not shown) appropriately programmed, the
10 central heating system 1 is ready for use. When the programmable timer times one of the discrete time periods for any one of the motorised valves 15 and the pump 17, the appropriate secondary relay 28 is operated in the on state. This operates the corresponding primary relay 34 which powers the boiler 5. If the boiler is already being powered through another of the primary relays 34, powering of the boiler
15 continues through each and every one of the primary relays 34 which is being operated in the on state. On the other hand, if the boiler 5 is not currently being powered, then the boiler 5 is powered through the primary relay 34 which has just been operated by the corresponding secondary relay 28. If the temperature of the water in the indirect hot water tank 10 is at or above the predetermined temperature,
20 the power supply is switched through the thermostat switch 14 to the control input 21, and the secondary relay 28, which has been operated, simultaneously operates the corresponding main relay 27, and thus power is applied to the corresponding one of the motorised valve 15 or the pump 17, the discrete time period of which is being timed. On the other hand, if the temperature of the water in the indirect hot water

tank 10 is below the predetermined temperature, the power supply is isolated from the control input 21 by the thermostat switch 14, and although the main relay 27 corresponding to the secondary relay 28, which has been operated in the on state, will also be operated in the on state, power will be inhibited to the corresponding one
5 of the motorised valve 15 or the pump 17 until the temperature of the water in the indirect hot water tank 10 reaches the predetermined temperature, at which stage the power supply is applied to the control input 21 through the thermostat switch 14, and so operation of the central heating system 1 continues.

10 Although not illustrated, a back-up battery power supply is provided in the controller for maintaining the settings programmed into the programmable timer.

While the power supply to the control input has been described as being provided through the thermostat switch of the indirect hot water tank, it is envisaged in certain
15 cases that the power supply may be applied directly to the control input if priority of heating is not to be given to heating of the water in the indirect hot water tank.

While the controller has been described for controlling a central heating system, it will be readily apparent to those skilled in the art that the controller may be provided
20 for controlling any other system besides a central heating system.

The invention is not limited to the embodiment hereinbefore described, which may be varied in construction and detail.

CLAIMS

1. A controller for controlling the operation of a primary bi-state device and a plurality of secondary bi-state devices, the controller comprising a primary output for providing a primary signal to the primary device for selectively operating the primary device in a predetermined one of two states, a plurality of secondary outputs for independently providing respective secondary signals to the respective secondary devices for selectively operating corresponding ones of the secondary devices independently of each other in respective predetermined ones of two states, a timing means for timing a plurality of discrete time periods during which corresponding ones of the secondary devices are to be operated in the respective predetermined ones of the two states, and a switch network responsive to the timing means timing one of the discrete time periods for one of the secondary devices for applying one of the secondary signals to the secondary output corresponding to the device for which the discrete time period is being timed for operating the corresponding device in the predetermined state during the discrete time period, and for applying the primary signal to the primary output for operating the primary device in the predetermined state while the timing means is timing any one of the discrete time periods for any one of the secondary devices.
2. A controller as claimed in Claim 1 in which a control input is provided for receiving a bi-state input signal, and the secondary signals are applied to the secondary outputs in response to the input signal on the control input being in one of the two states and the timing means timing the corresponding discrete time periods, and the secondary signals are inhibited on the input signal being in the other of the

two states.

3. A controller as claimed in Claim 2 in which a main power supply input is provided for receiving a power supply, the switch network being responsive to the timing means for switching the primary output to the main power supply input for applying the power supply to the primary output, and the control input is adapted for receiving a power supply, the switch network being responsive to the timing means for switching the respective secondary outputs to the control input for providing the power supply on the secondary outputs to the corresponding secondary devices.
- 10 4. A controller for controlling the operation of a primary bi-state device and a plurality of secondary bi-state devices, the controller being substantially as described herein with reference to and as illustrated in the accompanying drawings.
- 15 5. A central heating system comprising a boiler and a plurality of heating zones independently coupled to the boiler by respective supply means, and a controller as claimed in any preceding claim being provided for controlling the operation of the central heating system, the boiler being electrically coupled to the primary output of the controller, and each supply means being electrically coupled to a corresponding one of the secondary outputs so that each supply means is operated in response to the timing means timing one of the discrete time periods for that supply means, and the boiler is operated on the timing means timing each one of the discrete time periods.
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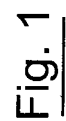


Fig. 1

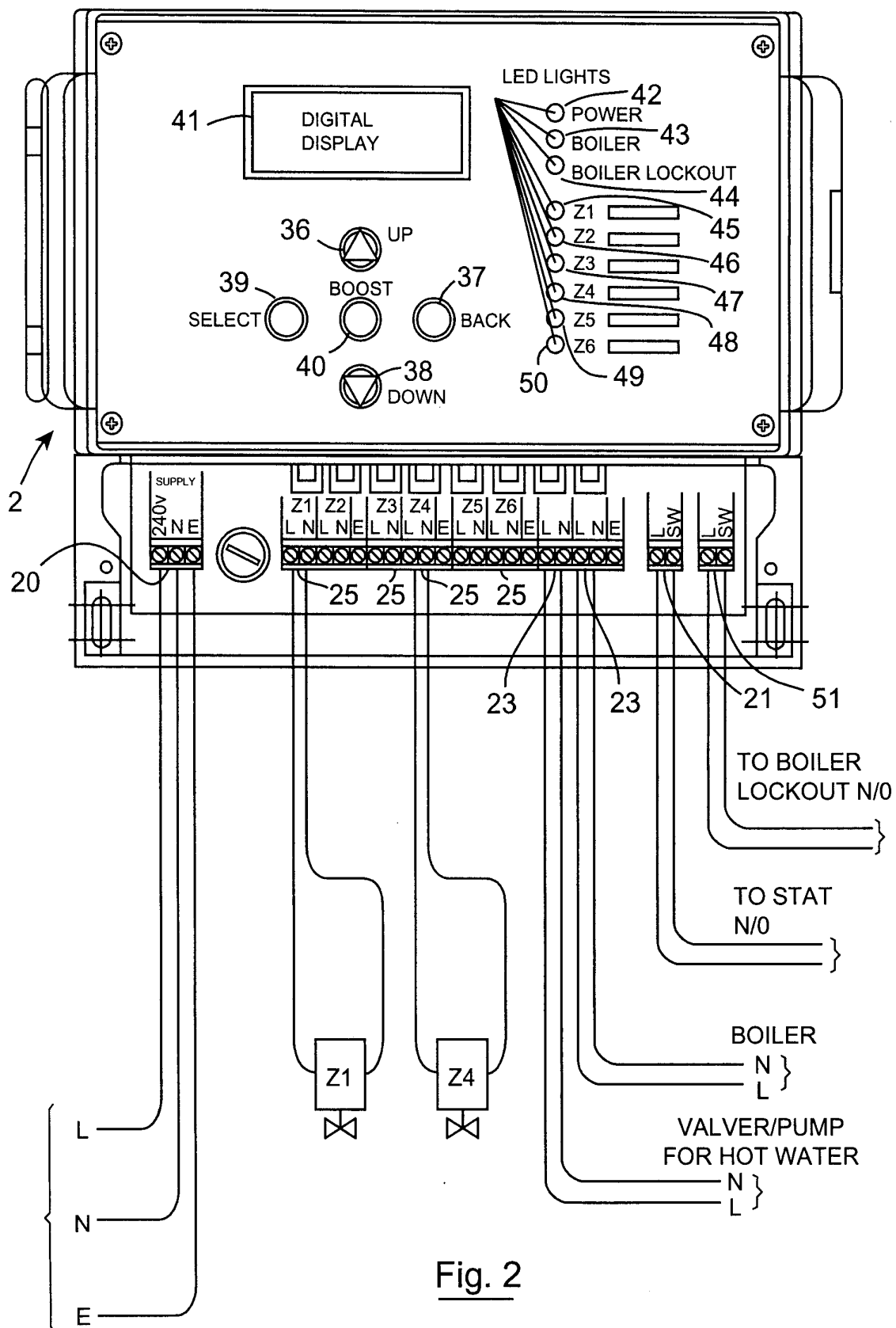


Fig. 2