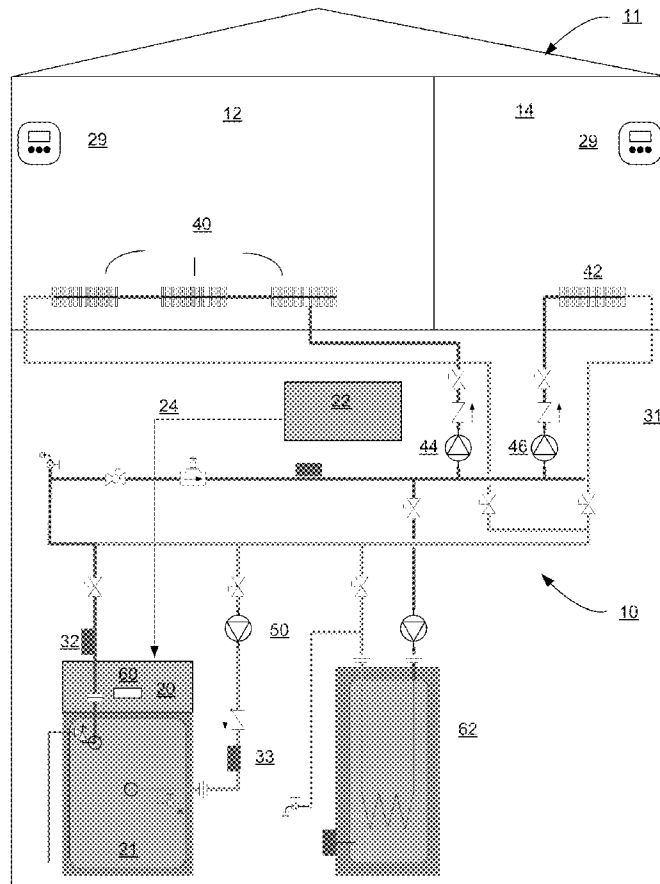




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(19) **United States**(12) **Patent Application Publication**
CLOONAN et al.(10) **Pub. No.: US 2015/0108230 A1**(43) **Pub. Date: Apr. 23, 2015**(54) **MULTIPLE ZONE CONTROL SYSTEM AND METHOD OF OPERATION**(71) Applicants: **BURNHAM HOLDINGS, INC.**,
Lancaster, PA (US); **U.S. BOILER COMPANY, INC.**, Lancaster, PA (US)(72) Inventors: **Peter Michael CLOONAN**, Lititz, PA (US); **Christopher Read DREW**, Lititz, PA (US)(73) Assignees: **BURNHAM HOLDINGS, INC.**,
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F24F 3/00 (2006.01)(52) **U.S. Cl.**CPC **F24F 11/0012** (2013.01); **F24F 11/0034** (2013.01); **F24F 3/00** (2013.01); **F24F 11/0076** (2013.01); **F24F 11/0086** (2013.01); **F24D 3/02** (2013.01); **F24D 19/1003** (2013.01); **F24F 2011/0013** (2013.01)(57) **ABSTRACT**

A multiple heating/cooling zone control system is disclosed. A heating/cooling system control device continuously monitors heating/cooling zone demand and matches the heating/cooling device output capacity to the total space or heat input required. Within the calculated heating/cooling device output capacity the heating/cooling device is modulated based on zone temperature setpoint to further adjust heating/cooling device output. As heat/cooling loss is increased heating/cooling device capacity and modulation are increased. Should heat/cooling loss decrease heating/cooling device capacity and modulation are decreased. Since heat/cooling output is adjusted based on the heat loss(gain) the heating/cooling device can be immediately adjusted to the proper or matching heating/cooling rate even before water/air temperature based adjustments can be made. Hence, the overall effect of the control device is a reduction in cycles of the heating/cooling device and the life of the heating/cooling device is extended and subsequent energy is saved.



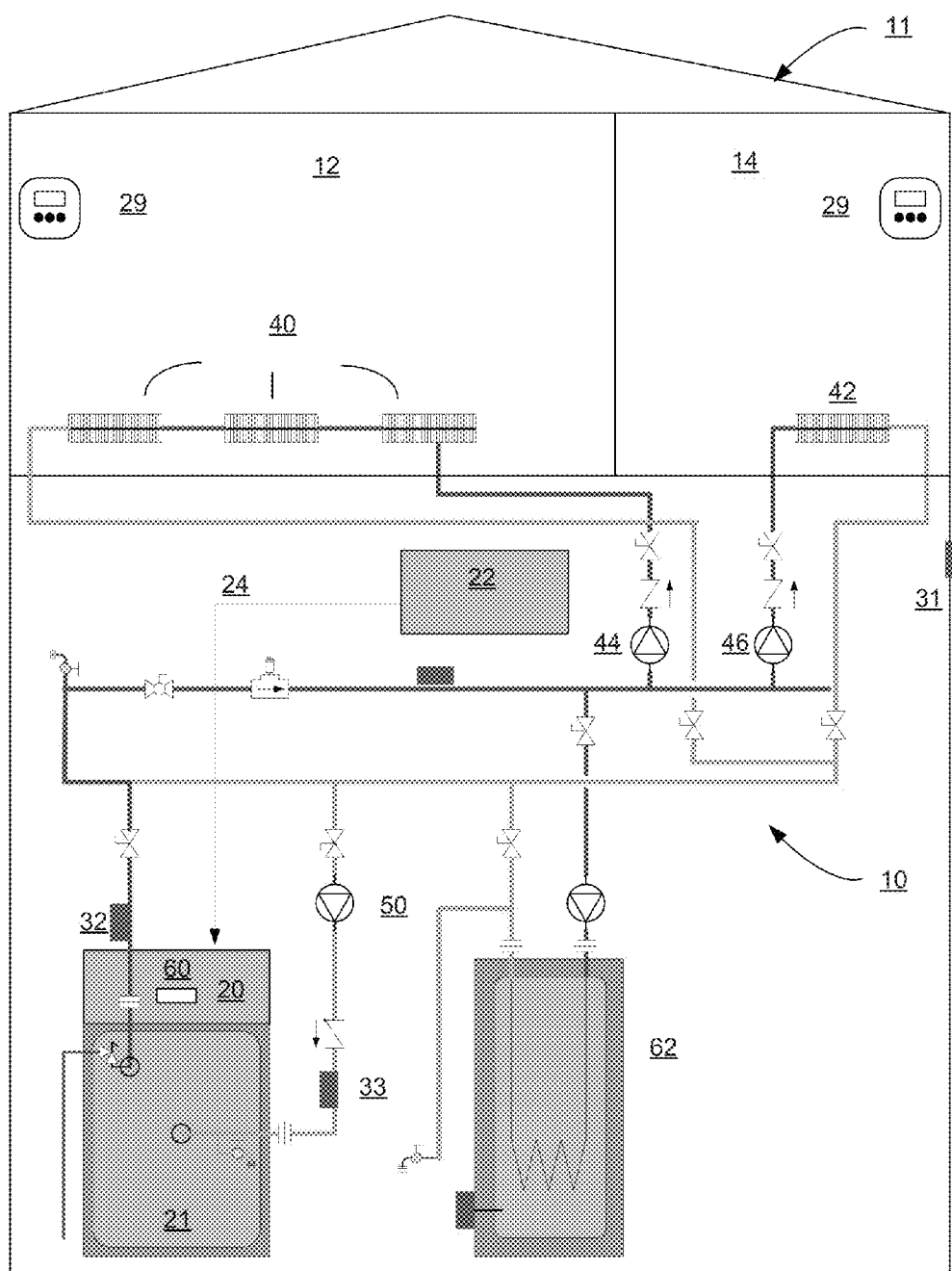


FIG. 1

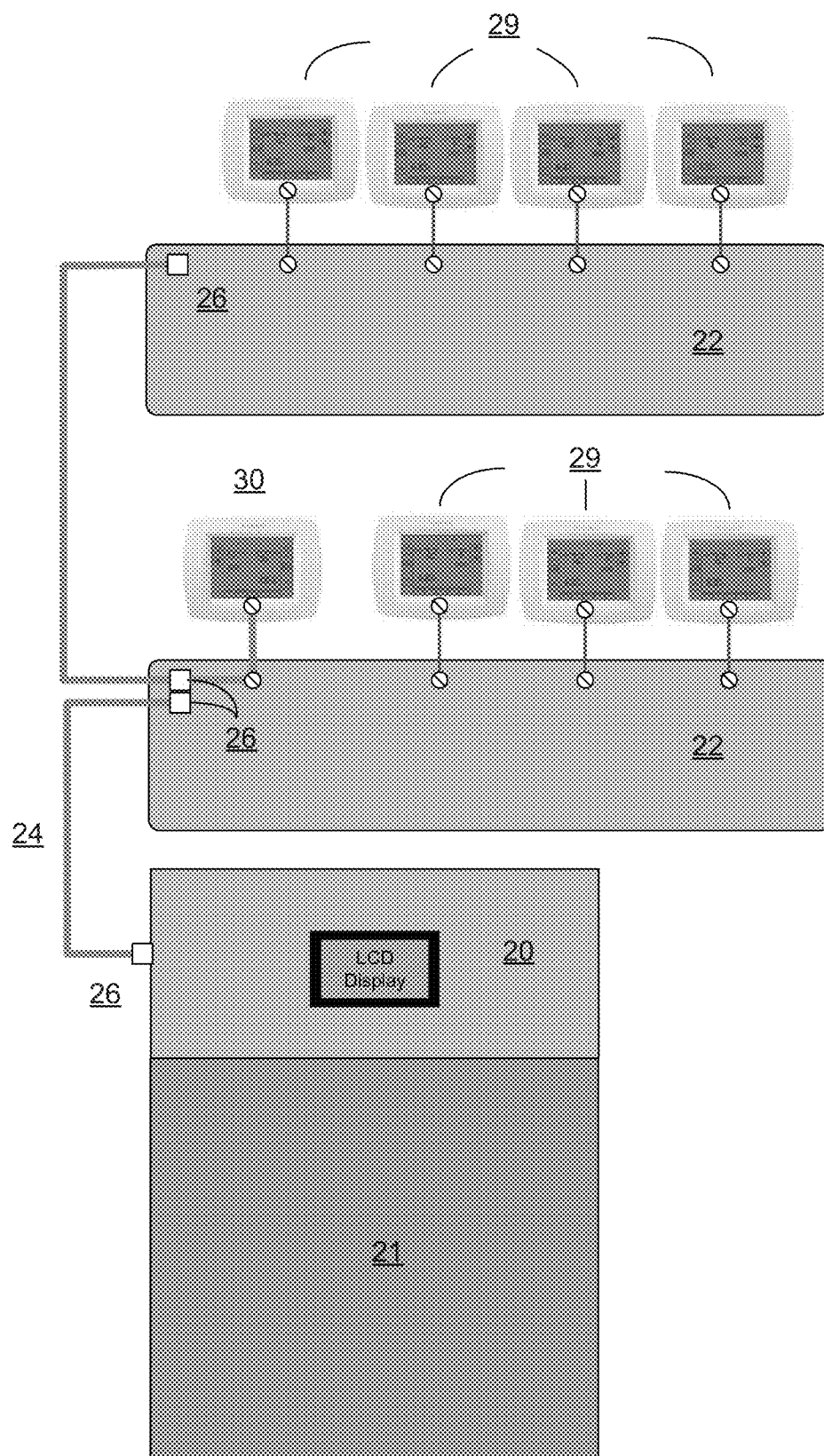


FIG. 2

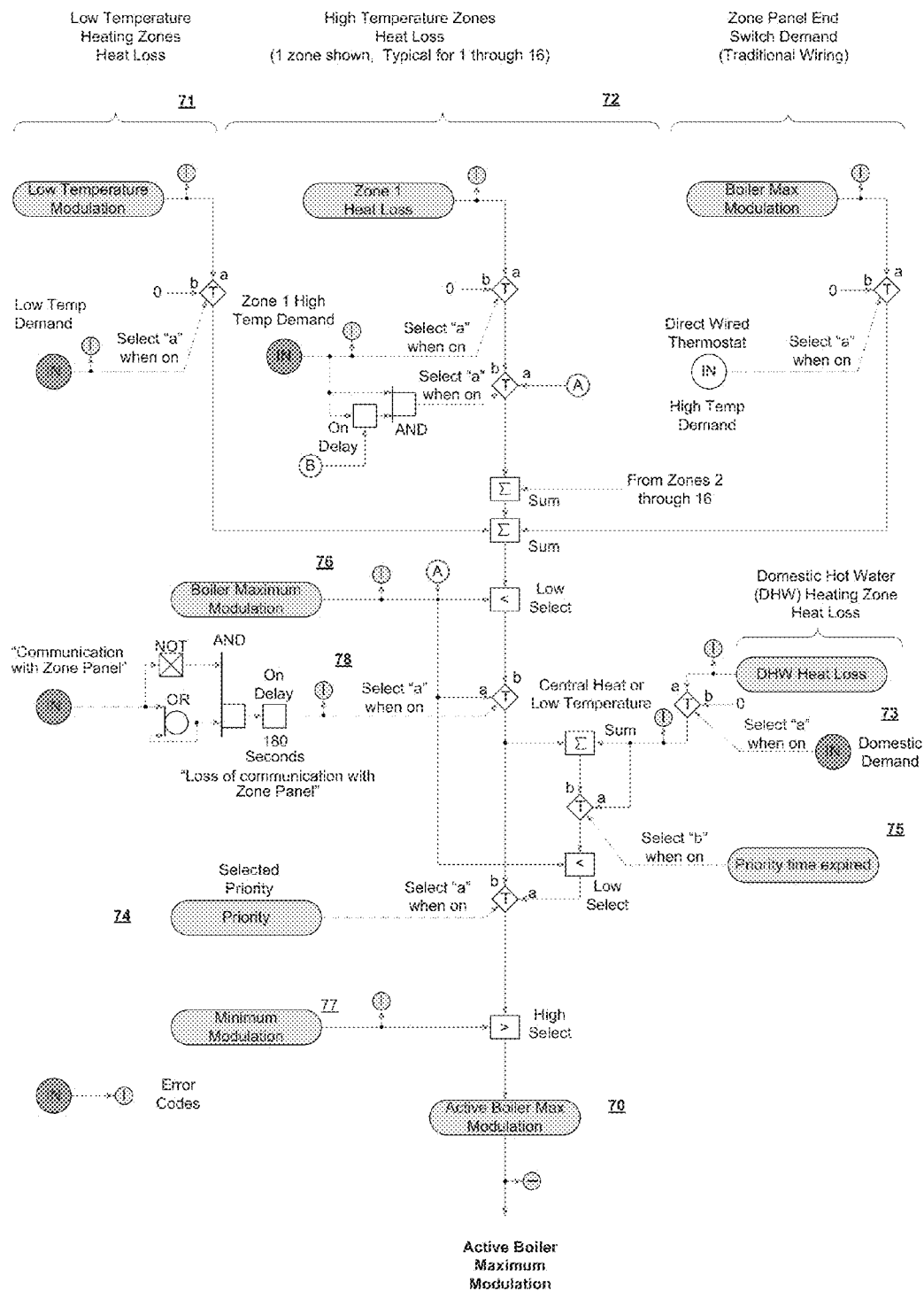


FIG. 3

MULTIPLE ZONE CONTROL SYSTEM AND METHOD OF OPERATION

FIELD OF THE INVENTION

[0001] The present invention relates generally to a multiple zone control system for controlling heating and/or air conditioning and a method of operation thereof. In particular, the invention is directed to the control and operation of multiple heating (cooling) zones for single and multiple family residences.

BACKGROUND OF THE INVENTION

[0002] Boiler systems have been used to regulate the temperature of commercial and residential facilities for a number of years. However, despite the fact that boiler systems have been around for many years, innovations continue to change the manner in which these systems operate.

[0003] The first residential boilers were coal or wood fired and were always “on”. The resulting over or under heating was corrected by opening a window, putting on a sweater and adding more or less fuel the next day. Next the industry introduced the “on/off” boiler that turned “on” the boiler when the home was cold and turned it “off” after it became warm. A single thermostat sensed room temperature at a single home position. The remainder of the home was either cooler or warmer as a result. To solve this issue the industry introduced multiple heating zones. This provided individual rooms or groups of rooms with separate thermostats and heated water was only circulated to where it was needed. This innovation greatly improved home comfort, however, it sometimes lead to a dramatically over sized heat source for when a small zone calls for heat. The result was potentially excessive boiler cycling. Boiler cycles add wear and tear on boiler, reduce equipment life and waste energy. They also lead to less home comfort as warm water is not consistently supplied. To address this issue the industry introduced the modulating boiler. This boiler could reduce British thermal unit (BTU) output when the demand was from a smaller zone.

[0004] However, modulating boilers could only use water temperature feedback to modulate the firing rate. When water temperature is below setpoint the firing rate is increased to heat water and increase water temperature until it matches the setpoint. This method is aware of the amount of heat loss (heating load) only after sensing the temperature and the rate of temperature change. This method allows the system to overshoot and/or excessively cycle as cold return water drives the firing rate to maximum modulation even if only a small zone is calling. This problem is increased by the fact that boilers are not sized (selected and installed) to match the active load. Boilers actually cannot be sized to match the active load. Boilers are sized to meet the total home heat demand on a design day. Typical condensing boiler installations have four water zones. When only one zone is calling for heat the boiler is dramatically oversized for that demand. As a result, the boiler first senses a low boiler supply temperature and fires the boiler as if the entire home was calling. This initial response produces unneeded and potentially excessive cycles.

[0005] It would be beneficial to provide a multiple zone control system for controlling heating and/or air conditioning and a method of operation thereof which is efficient and which eliminates excessive wear and cycle of the heating/cooling unit.

SUMMARY OF THE INVENTION

[0006] An object of the invention is to provide a means to detect active (turned “on”) zones, totals BTUs required and sets the heating/cooling firing rate to “match” actual home demand.

[0007] An object of the invention is to provide a heating/cooling system which is able to satisfy each individual zone with the appropriate amount of heat/cooling without extra cycles, component life reduction or wasted energy.

[0008] An object of the invention is to provide adaptive firing rate control. This type of control adds feed-forward to the conventional temperature based feedback control system. This control device calculates the boiler size required based on the particular zone that is calling, a control technique called “feed-forward” control. Before the boiler is even released to fire the boiler, “size” is set to match the possible heat loss. Temperature modulation is then used to adjust this firing rate further to suit the active load. The control device optimizes condensing boiler firing rate by preventing the firing rate from driving too high based on measuring temperature alone. The result is a significantly increased amount of time the boiler operates in the condensing mode, reduced cycling, increasing equipment life and saving fuel.

[0009] An embodiment is directed to a multiple heating zone control system in which a boiler or stage is provided with heating BTU/hr capacity required and water temperatures required. A heating system control device continuously monitors heating zone demand and matches the boiler output capacity to the total space or indirect water heater heat input required. Within the calculated boiler output capacity the boiler is modulated based on zone water temperature setpoint to further adjust boiler heat output. As heat loss is increased boiler capacity and modulation are increased. Should heat loss decrease, boiler capacity and modulation are decreased. Hence, the overall effect of the control device is a reduction in boiler cycles, extended boiler life and subsequent energy savings.

[0010] An embodiment is directed to a method for controlling a multiple zoned heating/cooling system. The method includes: establishing a heating/cooling demand for individual zones; communicating to a controller active zones of the multiple zoned heating/cooling system which require heating/cooling; summing the total heating/cooling demand required by the active zones; establishing a maximum heating/cooling rate based on the total heating/cooling demand required by the active zones; establishing the type of heating/cooling radiation type associated with heating/cooling demand; communicating to the controller active heating/cooling radiation type; establishing a target temperature setpoint based on active heating/cooling radiation type; and setting a heating/cooling rate based on measured temperature, target temperature setpoint and a maximum heating/cooling rate.

[0011] An embodiment is directed to a method for controlling a multiple zoned boiler heating system. The method includes: establishing the heating demand for an amount of hot water flowing or for individual heating zones; establishing a maximum firing rate based on the total heating demand; setting the firing rate based on measured temperature, the target water temperature setpoint and the maximum firing rate.

[0012] An embodiment is directed to a boiler control system. The boiler system includes at least one zone panel with thermostats connected thereto, with individual thermostats

monitoring individual zones. A boiler controller communicates with a boiler to control the operation of the boiler. A communication bus extends between the at least one zone panel and the boiler controller. The boiler controller receives information from the at least one zone controller and sums the total heating demand required by the individual zones which require heat. The boiler controller sets the water temperature setpoint for the boiler and the firing rate for the boiler based measured water temperature, target temperature setpoint and the total heating demand required by the active zones.

[0013] Other features and advantages of the present invention will be apparent from the following more detailed description of the preferred embodiment, taken in conjunction with the accompanying drawings which illustrate, by way of example, the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. 1 is a diagrammatic schematic view of an illustrative multi-zoned heating system according to the present invention.

[0015] FIG. 2 is a diagrammatic view of an illustrative embodiment of zone panels and the boiler controller according to the present invention.

[0016] FIG. 3 is a diagrammatic view of an illustrative embodiment of the system control logic according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0017] The present invention will be described more fully hereinafter with reference to the accompanying drawings, in which illustrative embodiments of the invention are shown. In the drawings, the relative sizes of regions or features may be exaggerated for clarity. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art.

[0018] It will be understood that spatially relative terms, such as “top”, “upper”, “lower” and the like, may be used herein for ease of description to describe one element’s or feature’s relationship to another element(s) or feature(s) as illustrated in the figures. It will be understood that the spatially relative terms are intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. For example, if the device in the figures is turned over, elements described as “over” other elements or features would then be oriented “under” the other elements or features. Thus, the exemplary term “over” can encompass both an orientation of over and under. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein interpreted accordingly.

[0019] The present invention is directed to a system and method for controlling heating and/or air conditioning which receives input from multiple zones. The system includes multiple zones with control inputs for receiving signals from individual thermostats to sense individual zone demand. The system also includes control outputs to provide heating or cooling to individual zones, i.e. turn on water flow to individual zones.

[0020] Referring to FIG. 1, an illustrative multiple zoned heating system 10 is shown. While the present invention is not

limited to multi-zoned heating systems, a multi-zoned heating system is used for illustration. The system shown in FIG. 1 is used to control the temperature in an enclosure 11 in which a first zone 12 and a second zone 14 have been defined. While the illustrative embodiment depicts two zones, additional zones may be provided, including but not limited to, sixteen (16) total zones.

[0021] The system includes a boiler controller 20 which controls at least one boiler 21 and separate zone controller/panel 22 connected by a communication bus 24. The communication bus 24 allows two way communication between the zone panel 22 and the boiler controller 20. In the embodiment shown, the communication bus 24 is a standard ethernet cable with standard connectors 26 (FIG. 2), such as, but not limited to RJ45 splitters.

[0022] In the embodiment shown, up to four (4) zone panels 22 may be connected to the boiler controller 20 at one time using. Each zone panel 22 may have up to four (4) zones, thereby allowing up to sixteen (16) zones to be monitored by the boiler controller 20. Each zone has a thermostat 29 to sense the heating demand for that zone.

[0023] Additionally, a configurable communicating thermostat 30 may be connected to the zone panel 22. The communicating thermostat 30 is “instanced” with an individual zone address. The communicating thermostat 30 allows a user to program an appropriate temperature range for each zone, as well as program various factors/inputs, including, but not limited to time of day and occupancy of home. Both the respective zone panel 22 and the boiler controller 20 receive input from the communicating thermostat 30. In addition to the communicating with the zone panels 22, the boiler controller 20 can communicate and control additional inputs and outputs. In the embodiment shown, twenty-four (24) additional inputs and outputs can be used. Such inputs/outputs are used, for example, to communicate with various sensors and to properly control the flow of heated water to the required zones. While particular numbers of zones, panels, thermostats, inputs and outputs, etc. are shown and described with respect to the illustrative embodiments, the invention is not limited to the numbers shown or described.

[0024] The boiler controller 20 may be, but is not limited to, an integrated controller that includes a single PC board or a small number of PC boards. The controller 20 may be housed in a single enclosure or housing that can be easily accessed. Each zone panel 22 may be, but is not limited to, an integrated controller that includes a single PC board or small number of PC boards. Each zone panel 22 may be housed in a single enclosure or housing that can be easily accessed.

[0025] In some embodiments, an outdoor air sensor 31 may provide temperature information that the boiler controller 20 may use to determine the appropriate boiler target temperature setpoint to efficiently operate the boiler 21. For example, some boilers 21 are designed to create an efficiency curve that relates supply water temperature 32 to outdoor air temperature 31. The boiler controller 20 may use these curves (or may include information related to or approximating these curves) to determine the target operating temperature of the boiler 21 at a given outside air temperature.

[0026] The boiler controller 20 may also capture information from other sources, such as, but not limited to, a supply water 32 and/or return water sensor 33, which in the illustrative embodiment, determines the temperature of water leaving the boiler 21 and in the system at or just before the boiler 21. The boiler controller 20 may use this information to adjust

the heat output of the boiler 21. In addition, other sensors commonly used in the industry may be provided to allow the boiler controller 20 to properly operate the boiler 21 to allow the boiler 21 to provide heat in an efficient manner.

[0027] In the illustrative embodiment shown, a first radiator or heat dissipation unit or heat emitter 40 supplies heat into the first zone 12, and a second radiator or heat dissipation unit 42 supplies heat into the second zone 14. A first water pump 44 controls whether water is forced through the first radiator or heat dissipation unit 40 into the first zone 12, while a second water pump 46 controls whether water is forced through the second radiator or heat dissipation unit 42 into the second zone 14.

[0028] During operation of the illustrative zoned multi-source system shown in FIG. 1, the boiler controller 20 may sense whether either zone 12 and/or zone 14, which includes a thermostat 29, indicates a call for heat. If there is a call for heat, the boiler controller 20 will determine the total demand and will fire the boiler and adjust the modulation rate according to the demand, as will be more fully described below. The boiler controller 20 also activates a water pump 50, and zone panel 22 selectively operates water pump 44 and/or water pump 46 corresponds to the calling zone(s) to allow the heat to be delivered to the active zone which is calling for the heat. As will be more fully described below the activation of the boiler 21, the heating or modulation rate and the like may be adjusted based on the information that the boiler controller 20 receives from the outdoor air sensor 31, supply sensor 32, return sensor 33 or other appropriate sensors/sources.

[0029] In some zoned systems, a multi-speed pump may be provided to vary the amount of water that is forced through the system depending on the number of calling zones. For example, the pump 50 may have two speeds and use a lower speed when only one zone is calling for heat, and a higher speed when two or more zones are calling for heat.

[0030] Referring to FIG. 2, an illustrative control system 11 is shown diagrammatically. The system includes a boiler controller 20 which controls at least one boiler 21 and separate zone controller/panels 22 connected by a communication bus 24. The communication bus 24 allows two way communication between the zone panels 22 and the boiler controller 20. In the embodiment shown, the communication bus 24 is one or more standard ethernet cables with standard connectors 26, such as, but not limited to RJ45 connectors and/or splitters. In the embodiment shown, two (2) zone panels 22 are connected to the boiler controller 20. One zone panel has four (4) conventional thermostats 29. The other zone panel has three (3) conventional thermostats 29 and a configurable communicating thermostat 30. As discussed above, the communicating thermostat 30 is "instanced" with an individual zone address. Both the zone panel 22 and boiler controller 20 read this address and the information programmed into the communicating thermostat. While two zone panels 22 and eight thermostats 29,30 are shown, other numbers of panels 22 and thermostats 29, 30 may be used without departing from the scope of the invention. For example, four (4) zone panels 22 may be connected to the boiler controller 20 at one time using the communication bus or busses 24.

[0031] The boiler controller 20 controls the boiler 21, as will be more fully described below. The boiler controller 20 also controls blowers, fuel valves, pumps or other items associated with the proper operation of the boiler 21. A display panel 60, such as, but not limited to, an LCD display is provided to provide information to the operator. In the

embodiment shown, the display panel 60 is provided on the boiler; however, the display panel 60 may be located away from the boiler 21.

[0032] The boiler controller 20 may also control several water pumps, including pumps for individual zones as required. The pumps control the flow of heated water to the individual zones. The pumps may be of any suitable type for use in an HVAC system. As previously described with respect to FIG. 1, the boiler controller 20 may also receive information from an outdoor temperature sensor, a humidity sensor, and/or any other type of sensor.

[0033] To help determine whether the heating source/boiler 21 is capable of providing sufficient heat to satisfy the expected heating load of the zone(s) that are currently calling for heat, reference may be made to information relating to an estimated heating load of each of the zones and information relating to an estimated heating capacity of the heating source. The estimated heating load of the zone(s) that are currently calling for heat (active zones) as well as the estimated heating capacity of the heating source may depend on the outdoor air temperature and/or the outdoor air humidity.

[0034] Individual zones are monitored by the boiler controller 20. When an individual zone is active a heat loss, as described above, associated with that zone is "switched in" or recognized by the thermostat 29 and communicated through the respective zone panel 22 to the boiler controller 20. When "switched in" or active, that zone's heat loss is added together with the heat loss associated with other active zones. The total heat loss summation associated with active zones is compared with the maximum and minimum allowable boiler capacity. Once calculated, this heat loss summation is used to set the boiler's 21 maximum modulation rate. As the boiler 21 is released to modulation the boiler controller senses the boiler water temperature and compares the sensed water temperature to the information that the boiler controller 20 receives from the active type dissipation unit or heat emitter, the outdoor air sensor 30, supply sensor 32, return sensor 33 or other appropriate sensors and sets a firing rate. This firing rate is now limited to the heat capacity required by the active zones.

[0035] The maximum heating or modulation rate and setpoint varies as different zones are "switched in" and the water target setpoint varies as different types of heat emitters are active. Therefore, the boiler controller 20 continually monitors and communicates with the zone panels 22 and adjusts the setpoint and maximum modulation rate based on the changing demands received from the thermostats 29, 30.

[0036] If a zone panel 22 loses communication with the boiler controller 20 the maximum heat loss associated with that zone panel 22 is used as the default when setting the maximum modulation for boiler firing. If all zone panels 22 lose communication with the boiler controller 20 the maximum heat loss associated with all zone panels 22 is used as the default when setting the maximum modulation for boiler firing. This insures that sufficient heat will be provided to the home in case of a fault. Therefore, a fault or failure in communication results in the boiler using the maximum allowable boiler capacity to set the modulation rate, which is the equivalent to a conventionally heated home.

[0037] In addition to supplying heat, the system and method can be used to supply domestic hot water demand to a hot water tank 62 (FIG. 1). In this arrangement, the hot water demand is treated as another zone. Therefore, when priority for hot water is not demanded or selected, the heating requirement for the hot water zone is added together with the other

active heating zones. The total heat loss summation associated with active zones, including the hot water zone, is used to set the boiler's 21 maximum modulation rate. As the boiler 21 is released to modulation the boiler controller senses the boiler water temperature and compares the sensed water temperature to the information that the boiler controller 20 receives from the outdoor air sensor 30, supply sensor 32, return sensor 33 or other appropriate sensors/sources and sets a firing rate. This firing rate is now limited to the heat capacity required by the active zones.

[0038] However, if hot water is a priority, the hot water zone indicates the same. This allows the hot water zone to remain active and the other heating zones to be turned off. Under such circumstances, the maximum modulation of the boiler is set to the domestic hot water maximum modulation. This allows the boiler to be sized to suit the domestic hot water demand. The domestic hot water demand may be wired to either the boiler's or zone panel's domestic hot water demand terminals.

[0039] The water setpoint may be based on various factors/inputs, including, but not limited to individual zone demand, time of day, occupancy of home and outside air temperature.

[0040] In operation, various methods can be used to impact heat delivery. The following is a listing of exemplary methods for impacting heat delivery when the zone panels and the boiler controller described above are used. The methods recited are not meant as an exhaustive listing, as other methods to impact heat delivery may be used. While the exemplary methods are described below as a series of acts or events, it will be appreciated that the present invention is not limited by the illustrated ordering of such acts or events. For example, some acts may occur in different order and/or concurrently with other acts or events apart from those illustrated and/or described herein, in accordance with the invention. In addition, not all illustrated steps may be required to implement a methodology in accordance with the present invention. In addition, the illustrative methods are not meant to be mutually exclusive. Many or all of the methods may be used together.

[0041] A first illustrative method of impacting heat delivery is to adjust the maximum heating/firing rate based on the heating requirements of the active zones. In this process, the zone panels are programmed to reflect the heat loss associated with each individual zone. The boiler controller monitors the individual zones and determines which zones are active and require heat. The boiler controller then sums the heat loss of all active zones to calculate the total heat loss measured. The boiler controller calculates the heat output of the boiler based on blower rpm or pump speed. The boiler controller sets the actual heating/firing rate based on the heat output of the heating device and the measured heat loss. Variables which influence the firing rate include, but are not limited to, the measured temperature, the target water temperature set point and the maximum firing rate of the system. As the boiler controller continually monitors the system the controller recalculates demand as the active zone changes.

[0042] A second illustrative method of impacting heat delivery is based on the particular zone or zones that are active (or calling for heat). In this process, the zone panels are programmed to reflect the radiation type associated with each individual zone. Setpoints are programmed/established for up to three radiation types. For example, in a sixteen (16) zone system, zones 1, 2 or 5-16 may have first setpoint, zone 3 may have a second setpoint and zone 4 may have a third setpoint. The boiler controller monitors the individual zones and deter-

mines which zones are active and require heat. The boiler controller sets the boiler water target temperature based on the active heat demand type. The boiler controller modulates the boiler to reach this target while remaining below maximum heating/firing rate.

[0043] A third illustrative method of impacting heat delivery is to adjust heat loss based on individual zone call duration. In this process, a maximum zone run time is established and programmed into the boiler controller or the zone panel. The demand time is field adjustable. If the demand time exceeds the maximum zone run time, the boiler controller releases the boiler to maximum fire. The system has an ability to adjust boiler capacity for the total heat capacity of the home, maximum central heat demand or total heat capacity for domestic hot water, maximum domestic hot water demand. When the duration of any zone within these categories has exceeded the maximum zone run time the boiler capacity is released to the maximum for that category. This allows the system to adapt to changing conditions, such as, but not limited to, changes which effect zone heat loss, such as open windows or doors.

[0044] Alternatively, a reduced firing rate maximum run time for maximum firing rate reduced below boiler capacity may be established. If the actual run time exceeds the reduced firing rate maximum run time, the firing rate is adjusted to the maximum firing rate to boiler capacity.

[0045] A fourth illustrative method of impacting heat delivery is to adjust heat based on home status, such as, but not limited to, time of day and occupancy. In this process, the boiler controller communicates with and receives input from a communicating/programmable thermostat. The boiler controller adjusts the water temperature setpoint based on time of day and occupancy feedback from the thermostat.

[0046] A fifth illustrative method of impacting heat delivery is to adjust heat based on the outdoor temperature. In this process, the outdoor temperature is monitored and communicated to the boiler controller and/or the zone panels. Based on the outdoor temperature, each zone's setpoint temperature may be adjusted.

[0047] A sixth illustrative method of impacting heat delivery provides frost protection. In this process, the zone activity of each zone is monitored by the boiler controller or a zone panel. The outdoor air temperature is also monitored by the boiler controller or a zone panel. If it is determined that a particular zone has not operated in a set time period, i.e. one hour, and the outdoor temperature is below a set temperature, i.e. zero degrees Fahrenheit, the zone is activated, causing an individual zone pump and a primary pump to start, allowing warm water to move into the zone, thereby providing frost protection by preventing the water pipes from freezing. This will move warm water into a zone that may have a failed or poorly located thermostat. In this process, a zone is activated even when the thermostat is not requesting heat to protect from freezing.

[0048] A seventh illustrative method of impacting heat delivery provides diagnostic information to the user or service technician. Information regarding individual zones and system performance, such as, but not limited to, zone cycles counts, zone status, zone heat loss, zone alarms and other relevant information can be stored in the boiler controller or the zone panels. The information can be accessed using diagnostic equipment or through the display panel on the boiler. The information may be used to diagnose problems and to adjust various settings, including, but not limited to, thermo-

stat settings, zone groupings or heat loss settings, to maximize the efficiency of the heating system and/or the users comfort.

[0049] The method and system described herein has many benefits. One such benefit is minimized cycling of the boilers. As the zone panels are continually communicating with the boiler controller, the boiler or boilers are started and stay running in response to the changing demand. This avoids wear and tear and standby losses.

[0050] Another benefit is that the firing rate is kept low or minimized. Allowing for a low firing rate enables the heating system to operate at a high efficiency operation. In addition, due to the minimized cycling and low firing rate, a steady, even heat is delivered, thereby increasing home comfort while maximizing efficiency. For example, when a home has a 150 kbtu boiler installed, using known or conventional technology and systems, the boiler is normally released with a boiler size of 150 k BTU. A conventional control would drive the boiler to high fire (150 k BTU) in response to measure supply temperature and the rate of rise of supply temperature and begin to reduce the firing rate only after supply temperature begins to rise. In contrast, when the system and method of the current invention is used and a 40 k BTU zone is calling for heat the boiler is sized to be 40 k BTU. The boiler then modulates between minimum modulation and 40 k BTU to satisfy the demand. The boiler is not driven to fire at 150 k BTU.

[0051] The use of the zone panels and boiler controller which allow for standard ethernet cable allows for easy installation for new and existing systems. This eliminates line and low voltage wiring between zone controls and the boiler control that is required in known systems.

[0052] Referring to FIG. 3, the active boiler maximum modulation **70** is the maximum boiler modulation rate required to satisfy the active heat demand. This value is the combination of maximum heat loss from low temperature heating zones **71**, high temperature heating zones **72** and domestic hot water heating zone **73**. Domestic hot water heat zones **73** are added to the central heating zones or replace the central heating zone heat loss based on the priority selection **74** and priority timer **75** value. The low temperature heating zones heat loss and high temperature heating zones heat loss are subsets of the central heating maximum heat loss. Both the central heating and domestic hot water heat loss are compared with the boiler maximum **76** and boiler minimum **77** modulations. Upon loss of communication **78** the boiler control sets heat loss equal to the boiler maximum modulation **76**. Active zone demand time is monitored. If any active zone demand time exceeds the zone release time **79** the active boiler maximum modulation is set to the boiler maximum modulation. The boiler controller senses the boiler water temperature and compares the sensed water temperature to the target temperature setpoint further adjust firing rates for each boiler within the calculated maximum modulation rate. Target temperature setpoint is based on the type of dissipation units or heating elements. Separate setpoints are established for low temperature, high temperature and domestic hot water heating zones. These target temperature setpoints are further adjusted based on home status, including time of day or occupancy, outdoor air temperature and other settings. Individual zone status is used to develop a field resettable individual zone cycle count. The cycle count is used to alert an installing contractor to mechanical or electrical issues with the heating system.

[0053] In applications in which multiple boilers are used to provide heat, the boiler controller **20** performs the same functions as above to determine total required boiler heat capability required. However, instead of individual zone demands, the control may use other methods to obtain heat demand, such as, but not limited to, system pump speed, system differential temperature, system differential pressure. The boiler controller **20** fires required boilers to match the heat loss. The boiler controller senses the boiler water temperature and compares the sensed water temperature to the setpoint further adjust firing rates for each boiler within the calculated maximum modulation rate.

[0054] The system and method disclosed herein is described with reference to an exemplary boiler heating system. However, the system and method is applicable and can be used with other types of heating systems, including, but not limited to heat pumps or furnaces. The system and method is applicable and can be used with cooling systems and other types of air conditioning systems. In addition, the system and method can be with heating or cooling systems which have one or more heating or cooling sources.

[0055] In general, the method described herein is for controlling a multiple zoned heating/cooling system. The method includes: communicating to a controller individual active zones of the multiple zoned heating/cooling system which require heating/cooling; establishing the heating/cooling demand size for the active zones; summing the total heating/cooling demand size required by the active zones; establishing a maximum firing/cooling rate for a heating/cooling device based on the total heating/cooling demand required by the active zones; and setting a temperature setpoint for a heating/cooling device based on outside air sensor **30**, supply sensor **32**, return sensor **33** or other appropriate sensors. This firing rate/cooling rate is now limited to the heat capacity required by the active zones.

[0056] While the invention has been described with reference to a preferred embodiment, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the spirit and scope of the invention as defined in the accompanying claims. In particular, it will be clear to those skilled in the art that the present invention may be embodied in other specific forms, structures, arrangements, proportions, sizes, and with other elements, materials, and components, without departing from the spirit or essential characteristics thereof. One skilled in the art will appreciate that the invention may be used with many modifications of structure, arrangement, proportions, sizes, materials, and components and otherwise, used in the practice of the invention, which are particularly adapted to specific environments and operative requirements without departing from the principles of the present invention. The presently disclosed embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being defined by the appended claims, and not limited to the foregoing description or embodiments.

What is claimed is:

1. A method for controlling a multiple zoned heating/cooling system, the method comprising:
 - establishing a heating/cooling demand for multiple individual zones;
 - communicating to a controller active zones which require heating/cooling;

summing the total heating/cooling demand required by the active zones;
 establishing a maximum heating/cooling rate based on the total heating/cooling demand required by the active zones;
 establishing the type of heating/cooling radiation type associated with heating/cooling demand;
 communicating to the controller active heating/cooling radiation type;
 establishing a target temperature setpoint based on active heating/cooling radiation type;
 setting a heating/cooling rate based on measured temperature, target temperature setpoint and a maximum heating/cooling rate.

2. The method of claim 1 further comprising:
 adjusting the maximum heating/cooling rate based on the requirements of the active zones as the active zones vary.

3. The method of claim 1 further comprising:
 adjusting the heating/cooling rate based on the output of a heating/cooling device and the total heating/cooling demand required by the active zones.

4. The method of claim 1 further comprising:
 establishing a maximum zone run time for each individual zone;
 determining if a demand time for any active zone exceeds the maximum zone run time;
 adjusting a heating/cooling device capacity for the total heating/cooling demand for all zones if the demand time for any active zone exceeds the maximum zone run time.

5. The method of claim 1 further comprising:
 monitoring home status, including time of day or occupancy;
 adjusting the target temperature setpoint equal to the temperature setpoint for the radiation type for the active zones based on the home status.

6. The method of claim 1 further comprising:
 monitoring outside temperature;
 adjusting the target setpoint equal to the temperature setpoint for the radiation type for the active zone based on the outdoor temperature.

7. The method of claim 1 further comprising:
 establishing a set period of time in which a respective zone must become active;
 establishing a minimum fixed temperature;
 monitoring outside temperature;
 causing warm water to flow through pipes of the respective zone of the heating system if the respective zone has not become active in a set time period and the outdoor temperature is below minimum fixed temperature.

8. The method of claim 1 further comprising:
 displaying diagnostic information regarding the heating/cooling system.

9. The method of claim 1 further comprising:
 displaying information regarding individual zone status, individual zone total cycles and/or system performance.

10. A method for controlling a multiple zoned boiler heating system, the method comprising:

establishing a heating demand required for an amount of hot water flowing or for multiple individual zones;
 establishing a maximum firing rate based on the total heating demand required;
 setting the firing rate based on measured temperature, the target water temperature setpoint and the maximum firing rate.

11. The method of claim 10 further comprising:
 adjusting the maximum firing rate of a boiler based on the active heat demand as the active heat demand varies.

12. The method of claim 10 further comprising:
 adjusting the firing rate of the boiler based on a heat output of the boiler and the total heating demand required.

13. The method of claim 10 further comprising:
 establishing a reduced firing rate maximum run time for maximum firing rate reduced below boiler capacity;
 determining if the run time exceeds the reduced firing rate maximum run time;
 adjusting the maximum firing rate to boiler capacity if the demand time exceeds the reduced firing rate maximum run time.

14. The method of claim 10 further comprising:
 monitoring home status, including time of day or occupancy;
 adjusting the target water temperature setpoint of the boiler based on the building status.

15. The method of claim 10 further comprising:
 monitoring outside temperature;
 adjusting the target water setpoint temperature of the boiler based on the outdoor temperature.

16. The method of claim 10 further comprising:
 displaying diagnostic information regarding the heating system.

17. The method of claim 16 further comprising:
 displaying information regarding total heat demand or system performance.

18. A boiler control system comprising:
 at least one zone panel with thermostats connected thereto, individual thermostats monitoring individual zones;
 a boiler controller, the boiler controller communicates with a boiler to control the operation of the boiler;
 a communication bus extending between the at least one zone panel and the boiler controller;
 the boiler controller receives information from at least one zone panel, the boiler controller sums the total heating demand required by the individual zones which require heat and sets the water temperature setpoint for the boiler and the firing rate for the boiler based upon the total heating demand from the individual zones which require heat.

19. The boiler control system as recited in claim 18, wherein the communication bus is an ethernet cable which allows two way communication between the at least one zone panel and the boiler controller.

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