MOVE-A-THERMOSTAT SYSTEM

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ABSTRACT

A method and system for easily relocating a thermostat for a heating and/or cooling system is used to enable a more suitable location for the efficient control of heating or cooling. The thermostat system utilizes a selectively pliable transmitting thermostat that communicates with a receiver that is installed in place of the original, removed thermostat and connects by the existing original thermostat wiring to the HVAC units. In another aspect, multiple transmitting thermostats communicate with a single receiver which accepts thermostatic and other data. The receiver is configured to allow the user to select which one or more of the thermostats are made active. If multiple thermostats are activated, the user can select the priority assigned to each.
Remote Thermostat

Battery Power Supply

Hard Wired Communication Line

Receiver / Interface to Furnace

Furnace / Air Cond.

FIG. 2
Activate System in Heating Mode

101

Hot Room
Only Selected
YES
NO

Hot Room Therm. Trigger
YES
NO

Activate Trigger Signal to Furnace

104

Cold Room
Only Selected
YES
NO

Cold Room Therm. Trigger
YES
NO

Activate Trigger Signal to Furnace

107

Run Both Rooms Selected Heating Algorithm
System ON
System OFF

110

111

FIG. 4
Activate System in Cooling Mode

Hot Room Only Selected

Cold Room Only Selected

Hot Rm Therm. Trigger On

Cold Rm Therm. Trigger On

Activate Trigger Signal to Air Cond.

Run Both Rooms Selected Cooling Algorithm

System ON

System OFF

Activate Trigger Signal to Air Cond.

FIG. 5
Activate System in Heating Mode

Single Thermostat Selected

YES

Active Room Trigger On

YES

Activate Trigger Signal to Furnace

NO

System OFF

System ON

Run Multi Room Selected Heating Algorithm

FIG. 8
Activate System in Cooling Mode

Single Thermostat Selected

Active Rm. Therm. Trig.

Active Room Trigger On

Activate Trigger Signal to Air Cond.

Run Multi Room Selected Heating Algorithm

Activate Trigger Signal to Air Cond.

FIG 9
MOVE-A-THERMOSTAT SYSTEM

CROSS REFERENCE TO CO-PENDING APPLICATION

This application claims the benefit of priority of provisional patent application Ser. No. 60/819,566 filed on Jul. 10, 2006, the entire contents of which are incorporated herein.

TECHNICAL FIELD

The present disclosure generally relates to heating and cooling systems and, more specifically, to those that either provide better comfort by minimizing hot and cold spots in the controlled environment and/or conserve energy usage of the HVAC system.

BACKGROUND

The design and construction of homes and other structures creates a condition whereby it is substantially difficult to provide even heating and cooling from room to room and, in some cases, within a particular room. Modern and legacy heating and cooling (HVAC) systems have never been designed to overcome the diversity of architectural design and the diversity of construction techniques both new and old. The resulting situation is one that leaves certain rooms either colder (cold spots) or warmer (hot spots) than what the home owners set at the thermostat. This is often times exacerbated by thermostats that are located in either a cold spot or a warm spot. This makes it problematic to acheive proper temperature control everywhere in the house or structure.

The HVAC industry provides few solutions to this dilemma. One such solution is a flow booster that consists of a fan that is mounted in-line to a particular duct. This fan increases flow of the heated or cooled air to a particular room when the main system blower fan is operating. This is an inexpensive solution that can be installed in a "do-it-yourself" fashion; however, it often results in a particular room becoming over-cooled or over-heated as there is no thermostat control of the booster fan. Another more costly solution is a multi-zone HVAC system. These systems usually consist of multiple furnaces and air conditioners. Typically, multiple units are installed as a result of heating and cooling capacity rather than to provide comfort or energy efficiency. Additionally, these HVAC systems and thermostatic control must be installed by a contractor and continue to provide potentially uneven heating and cooling control as each zone typically consists of multiple rooms.

Therefore, there is an unaddressed need for a product that provides room-to-room temperature control which provides whole house temperature consistency at an affordable price. Additionally, there is an unaddressed need for such system to be easily installed in a do-it-yourself fashion and for there to be an option to relocate the home’s thermostat to a more suitable location for consistent temperature control.

BRIEF DESCRIPTION OF THE DRAWINGS

The various features, advantages and other uses of the present heating and cooling control apparatus will become more apparent by referring to the following detailed description and drawings in which:

[0007] FIG. 1 is a system diagram of a remote and relocated thermostat for a HVAC control system utilizing wireless communication means;
[0008] FIG. 2 is a system diagram of a remote and relocated thermostat for a HVAC control system utilizing hard wired communication means;
[0009] FIG. 3 is a system diagram of a remote and relocated thermostat based apparatus that utilizes two remote and relocated thermostats for a HVAC control system; one for a hot room and one for a cold room;
[0010] FIG. 4 is a system diagram of an aspect of the apparatus that utilizes three or more relocated thermostats for a HVAC control system;
[0011] FIG. 5 is a system logic diagram for a two room system in a heating mode;
[0012] FIG. 6 is a system logic diagram for a two room system in a cooling mode;
[0013] FIG. 7 is a system logic diagram for a three or more room system in a heating mode;
[0014] FIG. 8 is a system logic diagram for a three or more room system in a cooling mode;
[0015] FIG. 9 is a front view of a receiver for a two room system; and
[0016] FIG. 10 is a front view of a receiver for a three or more room system.

DETAILED DESCRIPTION

In addition to the drawings above, this description describes multiple aspects of a removed and relocated thermostat system as illustrated in the above referenced drawings. However, there is no intent to limit this disclosure to a single aspect onto the multiple aspects that are disclosed herein. On the contrary, the intent is to cover multiple alternatives, modifications, and equivalents included within the spirit and scope of this disclosure and as defined by the appended claims.

This disclosure describes several means for relocating an otherwise fixed thermostat location for a heating, ventilating, and cooling system (HVAC system). The apparatus allows an individual to relocate the central thermostatic control of a heating or cooling system to a room or location different from that where it was originally located in the structure. In some cases, the current location of the thermostatic control system is not desirous due to it being in a hot or cold zone of the structure. In one aspect, the Move-a-Thermostat apparatus consists of a receiver that is mounted in the location of the current thermostat and connected to the control wire that leads to the heating and cooling devices. Additionally, there is a transmitting thermostat that includes the main temperature selection control. This apparatus interacts with the receiver by hardwire or wireless means. This apparatus is illustrated in FIGS. 1 and 2.

In another aspect, the apparatus provides for two transmitting thermostats to be located one in a typically warm room and one in a typically cold room. Both thermostats transmit to the single receiver which is to be placed in the location of the original, removed and replaced thermostat. The receiver allows the user to select one thermostat (room) or the other or to select both. If the user selects both, he/she is able to provide priority to one or the other by means of a dial or switch. This may also be administered by a programmable receiver unit. This apparatus is illustrated in FIGS. 3, 4, 5, and 6.
In another aspect, the apparatus provides for three or more transmitting thermostats to be located in any or all of the rooms of the environment. All of the thermostats transmit to the single receiver which is to be placed in the location of the original, removed and replaced thermostat. The receiver allows the user to select one, any two, or all of the thermostats to be active. If the user selects more than one, he/she can assign priority to each thermostat by means of a dial or switch. An algorithm determines whether heating or cooling should be called for. This may also be administered by a programmable receiver unit. This apparatus is illustrated in FIGS. 7, 8, 9, and 10.

Throughout the following description the term “room” will be understood to have its conventional meaning as well as to encompass an area or zone covering one or more rooms whose temperature is being controlled.

FIGS. 1 and 2 illustrate the basic system. In this system, the receiver 12 replaces the originally installed thermostat which is discarded and not employed in the system. A new remote thermostat 11 is then installed in a location that is desirous in terms of providing thermostatic data to achieve the user’s objectives (energy efficiency, evenness of temperature throughout the dwelling, imperviousness to sunlight/open doors/etc.). The remote thermostat 11 transmits binary data (call for heating or no call for cooling or no) to the receiver 12 by either wireless means 13 or by hardwired means 14. The remote thermostat 11 may include a housing with a dial or digital display of a desired set temperature for the surrounding room, the existing temperature as sensed by a temperature sensor or thermocouple mounted in the thermostat housing, as well as a rotatable dial or input members, such as pushbuttons to allow the set temperature to be increased or decreased as desired by the user and/or to select heating, cooling, ventilation or off modes. The temperature sensor output can be used solely by the thermostat 11 in order to generate or cease the call for heating or cooling or the output may be transmitted by the thermostat 11 as part of the temperature related binary data signal.

The thermostat 11 may actually embody an existing type of thermostat with appropriate dials, digital display and pushbuttons with the addition of a transmitter for wireless operation and a processor which is capable of providing digital binary data to the transmitter specifying the set temperature and the sensed or existing temperature so as to create a demand or trigger signal for heating or cooling for the room. The processor or control circuitry mounted within the thermostat housing may also provide a thermostat I.D. to prevent miscommunication with other wireless devices in the room or other thermostats, as described heretofore, which may transmit temperature-related data to the single receiver 12. The processor or control circuitry is capable of arranging the temperature-related digital data in the proper order or packet format required for a particular wireless or hardwired communication protocol.

The thermostat housing is capable of being mounted by various means, such as mechanical hangers or fasteners, double-backed tape, adhesive, etc., to a wall surface to enable the thermostat 11 to be located on any wall surface in a room and then moved to a different location if accurate temperature readings are not obtained.

If the receiver 12 receives a signal from the remote thermostat 11 to call for heating/cooling, the receiver 12 or a signal generator in the receiver 16 generates the appropriate signal and transmits this signal to the furnace/air conditioner 16 through the original wires that the old, removed and replaced thermostat used. If the remote thermostat 11 communicates to the receiver 12 by wireless means 13, there are many known to those skilled in the art and include, but are not limited to, Bluetooth technology, RF communication, and infrared transmission. FIGS. 1 and 2 show that the remote thermostat 11 is powered by means of a battery power supply 15. Those skilled in the art of thermostatic devices know that there are other powering means available such as hard wired systems, solar, and others.

FIGS. 3, 4, 5, and 6 describe a two thermostat system. Typically, the two thermostat system is configured such that one remote thermostat 21 is located in a typically warm room and another remote thermostat 22 is located in a typically cold room. It will be understood that the terms “warm room,” “hot room,” and “cold room” are used as relative temperature indications as the terms “hot room” and “cold room” may be only a few degrees different in temperature.

In terms of transmission of data, this system works in the same way that the single thermostat system does except that the transmitting thermostats 21, 22 transmit not only the binary data for need for heating/cooling but also: 1) the actual temperature of its environment (T), and 2) the set and desired temperature (S). The receiver 27 receives this data and applies a logic sequence and algorithm to determine whether heating or cooling should be called for.

FIG. 6 shows the front panel of one design configuration of the receiver 27 for a two room system. This receiver 27 has buttons 30 and 31. These buttons 30 and 31, are for the user to make a selection. The user may select one or the other, or both of the remote thermostats 21 and 22. If only the hot room is selected and the system is in heating mode, FIG. 4, steps 102 through 105, depict the logic and operation of the system for the heating mode. When the receiver 27 receives signal 104 from the hot room remote thermostat 21, the receiver 27 calls for heating by generating and sending a signal 105. There is a similar sequence of operations if only the cold room button 31 is selected; these are described in FIG. 4, steps 106 through 109. FIG. 5 also similarly describes these same logic steps if the system is set to cooling mode. Alternatively, the user may decide to select both the hot room button 30 and the cold room button 31. In this scenario, the priority dial 32 becomes active.

The priority dial 32 may be rotatable over a pre-set output range of values or magnitudes, such as 0.1 to 1.0 units over an approximate 300° range of rotation. Full left rotation of the priority dial 32 can cause the priority dial or associated circuitry, such as a potentiometer, to generate an appropriate signal equal to a low-priority i.e.: “0.1”, while a full rightward rotation of the priority dial 32 can generate a high-priority output i.e., “1.0”, for the selected hot room or cold room.

For example, when both the hot room and cold room buttons 30 and 31 are selected, the priority dial 32 may be rotated to the full right-most position to indicate 100% priority for the hot room control with respect to the cold room control. Alternately, one of the rooms, such as the hot room, for example, may be selected by the setting of the priority dial 32 as a percentage of the full range of motion or output magnitude of the priority dial 32, i.e., 75% with the related magnitude or value being (25%) provided as the priority of the cold room. For example, with the priority dial
set at 75% towards the hot room thermostat settings and output receive priority over the related cold room settings on a factor of 3:1.

Further, separate priority dials 32 may be provided for each of the hot room and the cold room to provide individual priority settings between 0% and 100%.

The priority dial 32 allows the user to determine which thermostat 21 or 22 takes precedence and by how much it does so. Also in this scenario, steps 110 and 111 of FIG. 4 determine whether or not the receiver 27 calls for heating or, in steps 210 and 211 of FIG. 5, for cooling. Steps 110 and 210 employ an algorithm based on data inputs (T, S, binary trigger (Tr) from the thermostats 21, 22 and the position of the priority dial 32) to determine the action for heating or cooling. One version of this algorithm for heating mode 110 is as follows:

\[ T_{h} = \text{Hot Room Temperature} \]
\[ T_{c} = \text{Cold Room Temperature} \]
\[ S_{h} = \text{Hot Room Set Temperature} \]
\[ S_{c} = \text{Cold Room Set Temperature} \]
\[ TR_{h} = \text{Trigger Hot Room Thermostat} \] (1=call for heat, 0=not calling for heat)
\[ TR_{c} = \text{Trigger Cold Room Thermostat} \] (1=call for heat, 0=not calling for heat)
\[ PD = \text{Setting on the priority dial} \text{ (0.1-1.0, 0.1 for cold/1 for hot)} \]
\[ \Delta_{h} = S_{h} - T_{h} \]
\[ \Delta_{c} = S_{c} - T_{c} \]

[0040] IF (TR_{h}=1 AND TR_{c}=1) THEN Trigger for Heating, ELSE - - -
[0041] IF (TR_{h}=0 AND TR_{c}=0) THEN No Trigger, ELSE - - -
[0042] IF (\Delta_{h} \geq 0 AND \Delta_{c} \geq PD \cdot \Delta_{h}) THEN, Trigger for Heating, ELSE - - -
[0043] IF (\Delta_{h} < 0 AND \Delta_{c} \geq PD \cdot \Delta_{h}) THEN, Trigger for Heating, ELSE No Trigger.

Similarly, one version of the algorithm for cooling mode 210 is as follows:

[0045] IF (TR_{h}=1 AND TR_{c}=1) THEN Trigger for Cooling, ELSE - - -
[0046] IF (TR_{h}=0 AND TR_{c}=0) THEN No Trigger, ELSE - - -
[0047] IF (\Delta_{h} \geq 0 AND \Delta_{c} \geq PD \cdot \Delta_{c}) THEN, Trigger for Cooling, ELSE - - -
[0048] IF (\Delta_{h} > 0 AND \Delta_{c} \geq PD \cdot \Delta_{c}) THEN, Trigger for Cooling, ELSE No Trigger.

Those skilled in the art of programming such devices understand that these algorithms and logic are just one version or example and describe a linear relationship between the position of the priority dial 32 and the outcome of the algorithm. Many other versions are possible including, but not limited to, non-linear relationships, such as logarithmic, exponential, quadratic and others.

FIGS. 7, 8, 9, and 10 depict a system with two or more or a plurality of thermostats 41, 42, and 43; with a three-thermostat system being shown only for simplicity. In terms of the transmission of data, this system works in every way that the two thermostat system does.

FIG. 10 shows the front panel of one example of a design configuration of the receiver 50 for a three room system. This receiver 50 has buttons 44, 45, and 46. These buttons 44, 45, and 46, are for the user to make a selection. The user may select any one, any combination of two, or all of the thermostats 44, 45, and 46. If only the one room with one thermostat 44, 45, or 46 is selected and the system is in heating mode, FIG. 8, steps 302 through 305, depict the logic and operation of the system for the heating mode. If the receiver 50 is receiving signal 304 from the active room remote thermostat 41 in room 44, the receiver 50 calls for heating by generating and sending a signal 305. FIG. 9 also similarly depicts these same logic steps if the system is set to cooling mode.

Alternatively, the user may decide to select two or more thermostats to be active. In this scenario, priority dials 47, 48, or 49 become active. The priority dials 47, 48, and 49 allow the user to determine which thermostat 41, 42, or 43 takes precedence and by how much it does so. The priority dials 47, 48, and 49 operate in the same manner as the priority dial 32 in that each is rotatable over a maximum range of rotation, such as 300° and by itself or in combination with suitable circuitry, generates an output signal ranging between 0.1% for a full left rotation of any of the dials 47, 48, and 49 up to 100% of maximum output value at a full right rotation position of any of the dials, 47, 48, and 49, by example.

In this manner, any one or any combination of two or all of the priority dials 47, 48, and 49 may be made active when any one or combination of two or all three of the room buttons 44, 45, and 46 are depressed. Any of the dials 47, 48, and 49 can be set by the user at position corresponding to an output value between 0 and 100 to determine the priority of control provided by the associated thermostat.

Also in this scenario, steps 306 and 307 of FIG. 8 determine whether or not the receiver 50 calls for heating or for cooling by steps 406 and 407 of FIG. 9. Steps 306 and 406 employ an algorithm based on data inputs (T, S, binary trigger (Tr) from the thermostats 41, 42 and 43, and the position of the priority dials 47, 48, and 49) to determine the action for heating or cooling. One version of this algorithm for heating mode 306 is as follows:

\[ \text{PD}_{1} = \frac{PD_{1} + PD_{2} + \text{PD}_{3}}{PS_{1}} \times 100 \] (for purposes of simplifying the algorithm, this is assigned to the PS of the highest value)
\[ \text{PS}_{1} = \frac{PD_{1} + PD_{2} + \text{PD}_{3}}{PS_{1}} \times 100 \] (as above, this is assigned to the PS with the middle value)
\[ \text{PS}_{2} = \frac{PD_{1} + PD_{2} + \text{PD}_{3}}{PS_{1}} \times 100 \] (as above, this is assigned to the PS with the lowest value)

[0060] IF (TR_{1}=1 AND TR_{2}=1 AND TR_{3}=1) THEN Trigger for Heating, ELSE - - - IF (TR_{1}=0 AND TR_{2}=0 AND TR_{3}=0) THEN No Trigger, ELSE - - -
[0061] IF (\Delta_{1} \geq 0 AND \Delta_{2} \geq 0 AND (\Delta_{3} \geq \text{F}_{1} \cdot \Delta_{2} \text{ OR } \Delta_{3} \geq \text{F}_{1} \cdot \Delta_{1}) \text{ OR } \Delta_{3} \geq \text{F}_{1} \cdot \Delta_{2} \text{ OR } \Delta_{3} \geq \text{F}_{1} \cdot \Delta_{1}) \text{ THEN, Trigger for Heating, ELSE - - -
IF (ΔA ≤ 0 AND ΔB ≤ 0 AND (ΔA ≥ ΔF/F OR ΔA ≥ ΔF/F OR ΔA ≥ ΔF/F) THEN, Trigger for Heating, ELSE No Trigger.

Similarly one version of the algorithm for cooling mode 406, is the following:

IF (TR₁ ≥ 1 AND TR₂ ≥ 1 AND TR₃ ≥ 1) THEN Trigger for Cooling, ELSE - - - - - -

IF (TR₁ ≤ 0 AND TR₂ ≤ 0 AND TR₃ ≤ 0) THEN No Trigger, ELSE - - - - - -

IF (ΔA ≤ 0 AND ΔB ≤ 0 AND (ΔA = ΔF/F) OR ΔA ≥ ΔF/F OR ΔB ≥ ΔF/F) THEN, Trigger for Cooling, ELSE No Trigger.

Those skilled in the art of programming such devices understand that these algorithms and logic are just one version or example and describe a linear relationship between the position of the priority dials 47, 48 and 49 and the outcome of the algorithm. Many other versions are possible including, but not limited to, non-linear relationships, such as logarithmic, exponential, quadratic and others.

What is claimed is:

1. A method of controlling temperature in an area of a building having a fixedly located, temperature set control point connected by an electrical conductor to an HVAC controller comprising the steps of:
   - providing a thermostat with a temperature set control;
   - mounting the thermostat in a location remote from the temperature detection and temperature set control point in the building;
   - providing a signal generator in the thermostat capable of generating a temperature related signal;
   - mounting a control capable of receiving control signals from the signal generator in the thermostat, the control including a signal generator responsive to the control signal and capable of generating temperature related control signals, the control located at the temperature detection and temperature set control point;
   - connecting the control signal generator to the electrical conductor connected to the HVAC controller;
   - transmitting the temperature related signal from the thermostat to the control; and
   - sending the temperature related control signals from the control signal generator to the HVAC controller over the electrical conductor to control the temperature of the environment regulated by the HVAC controller in response to the temperature signal from the thermostat.

2. The method of claim 1 further comprising:
   - removing a thermostat from the temperature set control point;
   - and replacing the thermostat with the control at the control point.

3. The method of claim 1 wherein the step of transmitting the temperature related signal from the thermostat to the signal control comprises the steps of:
   - providing a signal receiver in the control; and
   - wirelessly transmitting the temperature related signal from the thermostat to the signal receiver.

4. The method of claim 1 wherein the step of transmitting the temperature related signal from the thermostat to the control comprises the step of:
   - transmitting the temperature related signal from the thermostat to the control via an electrical conductor.

5. The method of claim 1 wherein the step of providing a thermostat with temperature set controls comprises the steps of:
   - providing a plurality of discrete thermostats, each with discrete temperature set controls;
   - mounting each thermostat in a different location in a building remote from the signal receiver; and
   - selecting at least one of the thermostats for transmission of temperature related signals generated by the selected thermostat by the control signal generator.

6. The method of claim 5 further comprising the step of:
   - providing an input element to select each thermostat.

7. The method of claim 6 further comprising the step of:
   - mounting the input element for each thermostat on the control.

8. The method of claim 5 further comprising the step of:
   - providing a priority selection for each of the plurality of selected thermostats.

9. The method of claim 8 further comprising the step of:
   - providing a priority input selection element to establish the priority of each selected thermostat in controlling the temperature of the environment regulated by the HVAC controller.

10. The method of claim 9 further comprising a step of:
    - mounting the priority input selection element on the control.

11. The method of claim 1 further comprising a step of:
    - providing the thermostat with a temperature detection feature, the temperature related signal including temperature detection data.

12. An apparatus for controlling the temperature in an area of a building having a fixedly located, temperature set control point connected by an electrical conductor to an HVAC controller which regulates the temperature in the building comprising:
    - a thermostat having a temperature set control, the thermostat adapted to be mounted in a location remote from temperature set control point;
    - a temperature data signal generator in the thermostat;
    - a control capable of receiving signals from the signal generator in the thermostat, the control including a control temperature signal generator, the control located at the temperature set control point;
    - a control temperature signal generator connected by the electrical conductor to the HVAC controller;
    - the thermostat including means for transmitting a temperature related signal to the control; and
    - the control temperature signal generator sending signals to the HVAC controller over the electrical conductor to control the temperature of the environment regulated by the HVAC controller in response to the temperature signal from the thermostat.

13. The apparatus of claim 12 wherein transmitting means comprise:
    - wireless means for transmitting signals from the signal generator in the thermostat to a signal receiver in the control.

14. The apparatus of claim 12 wherein the transmitting means comprises:
    - means for transmitting the temperature related signal from the thermostat to the control via an electrical conductor.

15. The apparatus of claim 12 wherein a thermostat comprises:
a plurality of discrete thermostats, each with a discrete temperature set control;
each thermostat adapted to be mounted in a different location in a building remote from the signal receiver;
and
means for selecting at least one of the thermostats for transmission of the temperature related signal generated by the selected thermostat by the control temperature signal generator.

16. The apparatus of claim 15 wherein the selecting means comprises:
an input element to select each thermostat.

17. The apparatus of claim 15 wherein:
the input element for each thermostat is carried on the control.

18. The apparatus of claim 15 further comprises:
means for providing a priority selection for each of the plurality of selected thermostats.

19. The apparatus of claim 18 wherein the priority selection providing means comprises:
means for providing a priority input selection element to establish the priority of each selected thermostat in controlling the temperature of the environment regulated by the HVAC controller.

20. The apparatus of claim 19 wherein:
the priority input selection element is carried on the control.

21. The apparatus of claim 12 wherein:
the thermostat includes detection means for detecting the temperature of the ambient environment in which the thermostat is disposed; and
the signal generator transmitting temperature detection data in the temperature related signal.