# United States Patent

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[54] **CONTROL OF AIR-CONDITIONING APPARATUS**
**4 Claims, 2 Drawing Figs.**


[52] **U.S. Cl.** ..... **165/1,** 165/39, 165/123
[51] **Int. Cl.** ..... **B60h 1/00**
[50] **Field of Search** ..... 165/26, 39, 40, 27, 123, 22, 1



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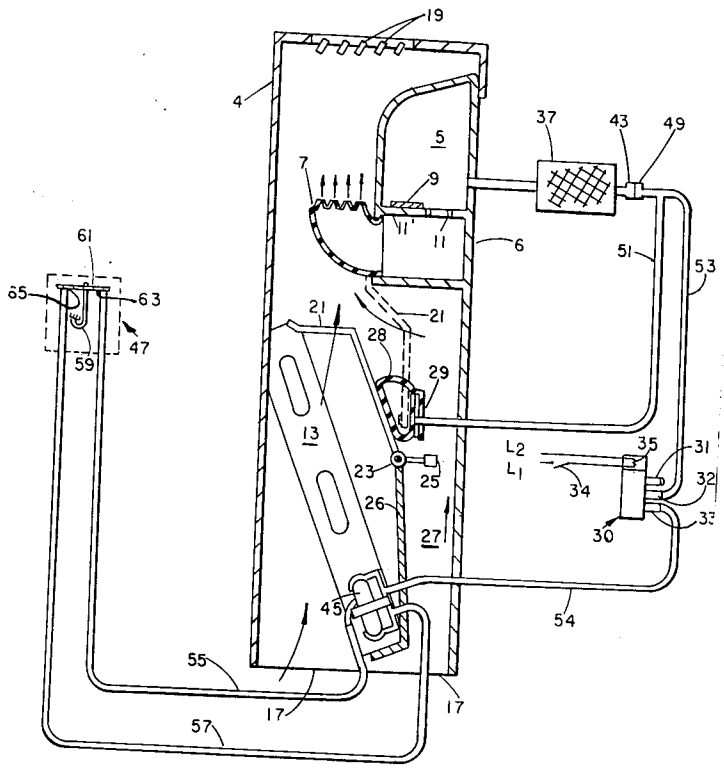
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**ABSTRACT:** A control system for air-conditioning apparatus adapted to be placed in communication with a source of primary air and operable for conditioning the air in an area. During normal operation of the air-conditioning apparatus, controls regulate the operation thereof in response to the temperature of the air in the area. The controls include a normally open valve, the closure thereof being operable to interrupt the flow of conditioned air from said apparatus, irrespective of the area demand as sensed by said controls.

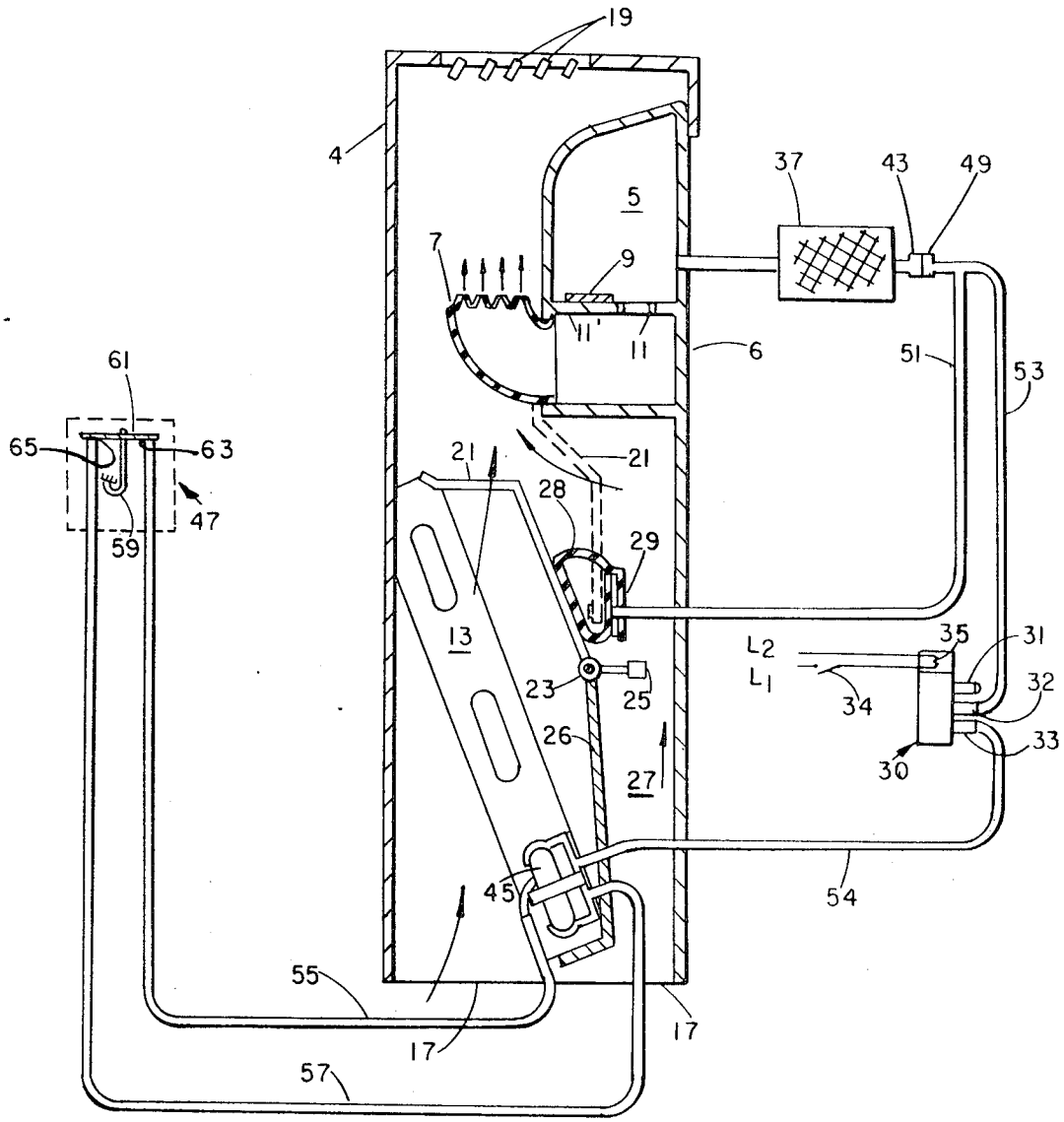



FIG. 1

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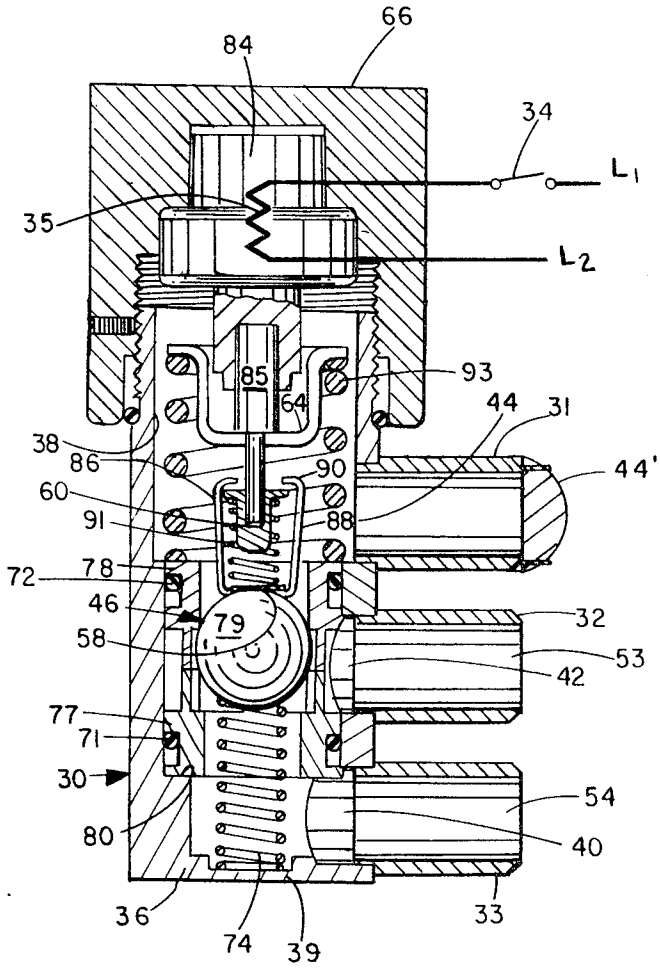



FIG. 2

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# CONTROL OF AIR-CONDITIONING APPARATUS

## BACKGROUND OF THE INVENTION

This invention relates to air-conditioning apparatus and more particularly to a control system for such apparatus employed to condition the air within a plurality of areas.

A number of modern multistory buildings such as office buildings, apartment buildings, factories, and schools employ centrally located refrigeration machinery to provide a fluid for conditioning the air within each of the areas or rooms within the multistory building. The fluid is supplied to each of the areas from air-conditioning apparatus disposed therein. The fluid provided by such refrigeration machinery may include primary air and/or a conditioned heat exchange medium such as water. In one type of apparatus in which the novel control may be employed, the primary air is used to induce room air over a heat exchange coil disposed in the apparatus, said coil being supplied with a conditioned heat exchange medium from a central source, for varying the temperature of the room air flowing thereover. Generally, the operation of such apparatus is regulated in accordance with the temperature of the air within the areas; when less conditioning is required, the air flowing through the apparatus is bypassed around the heat exchange coil therein. The primary air and heat exchange medium may be either cooled or heated to provide the required conditioning effect in the areas.

The novel control may be employed with other types of air-conditioning apparatus wherein the operating characteristics thereof are varied in accordance with the temperature conditions of the air in the area being conditioned.

Many of the rooms within such multistory buildings, particularly those buildings used for commercial purposes, are vacant during a substantial period of time during each day and also are vacant on holidays and weekends. During such times it would be extremely desirable to override the control means regulating the operation of each apparatus disposed in the unoccupied areas to reduce the load on the refrigeration machine and thus obtain more economical operation.

The object of this invention is a novel control operable to achieve the desideratum hereinbefore described.

## SUMMARY OF THE INVENTION

This invention relates to a control system for air-conditioning apparatus of the type hereinabove described wherein such apparatus is employed to condition the air within a plurality of separate areas in an enclosure. Preferably, each area will have its own apparatus for supplying conditioned air thereto.

The present invention provides a control system for the air-conditioning apparatus including a normally open valve associated with the air-conditioning apparatus, said valve being open during normal operating conditions, so the operation of said apparatus is controlled in response to the temperature within the associated area. The normally open valve is closed when it is desired to override the control means normally employed to regulate the operation of said apparatus. Closure of said valve means discontinues the supply of conditioned air from said apparatus irrespective of the demands of said control means. Preferably, the operation of said valve may be controlled from a remote station.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view of an induction type air-conditioning apparatus embodying the present invention; and

FIG. 2 is a longitudinal cross-sectional view of a valve that may be employed in the control means for the present invention.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, there is illustrated air-conditioning apparatus of the type hereinbefore described, embodying the present invention. In referring to the drawings, like numerals shall refer to like parts.



Referring now particularly to FIG. 1, there is illustrated an air-conditioning apparatus of the induction type. The apparatus is located in an area within the building equipped with an air-conditioning system including a central station and ductwork connecting the station with the individual room or area units.

The air-conditioning apparatus includes a casing **4** in which a base unit **6** is disposed, having a primary air plenum **5** adapted for communication with a source of conditioned air (not shown), hereinafter referred to as primary air. Plenum chamber **5** is provided with suitable discharge means such as nozzles **7** to discharge primary air under relatively high pressure and velocity within the apparatus. The flow of primary air from plenum **5** to nozzle **7** may be regulated by a balancing damper **9** which is movable to restrict flow of air through slot **11** in wall **11'**.

The base unit **6** is provided with a heat exchanger **13** adapted for connection to a suitable source (not shown) of conditioned medium such as chilled or heated water for flow therethrough. Heat exchanger **13** is located within casing **4** for flow of induced room air thereover in heat transfer relation with the conditioned medium flowing therethrough.

The room air-conditioning apparatus casing **4** has an opening or inlet **17** at the bottom thereof to permit room air to be induced into the unit by the primary air discharged from nozzles **7**. A grille **19** in the top of casing **4** is provided for passage of the mixture of induced air and primary air into the area or room being conditioned.

Passage of room air through heat exchanger **13** is regulated by means of a bellows-damper arrangement. A damper **21**, substantially coextensive with the length of the heat exchanger **13**, is mounted on shaft **23** which is journaled in the sides (not shown) of base unit **6**. The damper is urged by a counterbalance **25** in a clockwise direction to allow passage of induced air through heat exchanger **13**. A partition **26** in the air-conditioning apparatus cooperates with damper **21** to create a passageway **27** for passage of induced air around heat exchanger **13**. Depending on the position of damper **21**, induced air may be passed through heat exchanger **13** or through passage **27**. As shown, damper **21**, as represented by the solid lines, is in the position wherein the induced air is flowing through passage **27**. The dotted line representation of damper **21** indicates the position wherein all induced air will be directed over heat exchanger **13**.

An expansible balloon or bellows **28** is provided to move damper **21** in a counterclockwise direction in opposition to counterbalance **25**. The bellows may be made of any suitable elastomeric material. The bellows are secured to a support bracket **29**, which is affixed to an end wall not shown.

The inflation of bellows **28** and therefore the disposition of damper **21** is regulated by a control air system comprised of a filter **37**, a restrictor **43**, valve means **30**, changeover valve **45**, and a dual-bleed thermostat **47**. A small quantity of conditioned primary air from plenum **5** is passed through air filter **37** to eliminate dust particles that may have escaped the central air filtration system (not shown). The filtered air is then passed through a restrictor **43** which contains an orifice **49**. A line **51** communicates bellows **28** with the downstream side of restrictor **43**.

The changeover valve **45** also communicates with the downstream side of restrictor **43** through line **53**, valve means **30**, and line **54**. Communicating lines **53** and **54** are valve means **30**, the function of which shall be explained more fully hereinafter. Changeover valve **45** senses the temperature of the conditioning medium flowing through heat exchanger **13** and deflects the air from line **54** through line **55** or line **57** to the heating or cooling portion of the thermostat **47**. For a detailed description of a suitable changeover valve, reference may be had to U.S. Pat. No. 3,165,263, granted on Jan. 12, 1965, to R. C. Dreibelbis.

Thermostat **47** includes a bimetal actuator **59**, responsive to room temperature for selectively positioning a sliding plate **61** over heating bleed port **63** which communicates with line **55**

or over cooling bleed port 65 which communicates with line 57.

Air-conditioning apparatus of the type hereinabove described are generally utilized in applications when it is desired to simultaneously heat or cool a plurality of areas or rooms within a common enclosure, such as offices in a multistory office building. Thermostat 47 permits the occupant of an individual area served by one such apparatus to vary the temperature in such area or room in accordance with his particular preference.

Considering the operation of air-conditioning apparatus when chilled water is supplied to heat exchanger 13, changeover valve 45 will provide communication between lines 54 and 57 to bleed control air through cooling port 65. If the room temperature, as sensed by bimetal actuator 59, is warmer than the thermostat setting, the bimetal actuator will move plate 61 to uncover bleed port 65 to bleed air therefrom and decrease control air pressure in the control air lines downstream of restrictor 43. Less pressure, accordingly, is imposed upon bellows 28, causing bellows 28 to deflate and move damper 21 toward an open position so that room air induced into the apparatus passes through heat exchanger 13 in heat exchange relation with a relatively cold medium passing through the coil and is cooled thereby.

As the room temperature approaches the desired level, the bimetal actuator will move plate 61 to partially cover port 65, increasing control air pressure and moving damper 21 toward a closed position to allow a portion of the induced air flowing through the apparatus to bypass heat exchanger 13. Ordinarily, a condition is reached where the damper is modulated between open and closed positions and room temperature is stabilized at the desired level.

For heating operation, hot water is supplied to heat exchanger 13; changeover valve 45 responding to the temperature of the hot heat exchange medium passing through exchanger 13 places lines 54 and 55 in communication to provide control air to heating bleed port 63. The quantities of air bled from port 63 will control the position of damper 21, as explained above, to regulate the amount of air passing through heat exchanger 13.

Referring to FIG. 2, there is shown a cross-sectional view of a type of valve means 30, which may be employed in the present invention. Valve means 30 includes housing 36. Housing 36 is generally cylindrical and has a longitudinal bore 38. Wall 39 closes one end of housing 36 and the opposite end is closed by cap 66. Extending through the wall of housing 36 and in communication with the longitudinal bore 38 are a plurality of ports 40, 42, and 44. Connector 33 is secured to housing 36 in communication with port 40 at one end and is connected to line 54 when used with the apparatus shown in FIG. 1. Connector 32 is similarly connected to housing 36 in communication with port 42 at one end and is connected at the other end with line 53 when utilized with the apparatus of FIG. 1. Connector 31 is secured to housing 36 at one end in communication with port 44, the other end thereof having cap member 44' enclosing same to prevent passage of fluid therethrough for a reason to be more fully explained hereinafter.

Disposed within the longitudinal bore 38 is a valve assembly 46, the operation thereof to be more fully explained hereinafter. The valve assembly is comprised of a first retainer 77, a second retainer 78, and a spherical ball 79 disposed within a cage formed by the first and second retainers. The first retainer is seated against shoulder 80 within housing 36. O-rings 71 and 72 provide a seal between the first and second retainers, respectively, and the surface of the longitudinal bore. Spring 74, which is disposed between wall 39 and ball 79 urges the ball upwardly as viewed in FIG. 2, so as to communicate port 40 with port 42.

The means for urging ball valve 79 downwardly as viewed in FIG. 2 close the passage between ports 42 and 40 comprises a power element 84, a push rod 85, and overtravel mechanism 86. Within the power element 84 is a temperature responsive substance having a high coefficient of expansion. As the power element is heated, the substance therein expands and forces push rod 85 against overtravel mechanism 86 to urge valve 79 downwardly as viewed in FIG. 2. Disposed in power element 84 is heating element 35, which is connected to a source of power represented by lines $L_1$ and $L_2$. Connected in series with heating element 35 is switch 34, the closure of which supplies power to energize the heating element. The energization of heating element 35 expands the temperature responsive substance included in power element 84 for a reason to be more fully explained hereinafter.

Overtravel mechanism 86, which compensates for overtravel of the push rod, comprises support arms 88 secured to a base 58, which is adapted to engage ball 79. The inturned part 90 of each arm cooperates to retain cup 60 within the support arms. Cup 60, which is engaged by push rod 85, cooperates with base 58 to support spring 91 therebetween.

When the substance within power element 84 cools and contracts, spring 93 acts to return the push rod 85 to its initial position. Return spring 93 bears at one end upon the second retainer 78 and at the other end upon bell cap 64. The bell cap 64 has an opening therein through which the push rod extends. Cap 66 acts to enclose the upper end of the valve means.

Referring again to FIG. 1, the manner in which valve means 30 is utilized in the control system of the present invention shall be explained.

Referring particularly to FIG. 1, the manner in which the apparatus therein shown functions during its normal operation has been hereinabove explained. As noted, such apparatus are particularly adaptable to be employed where a plurality of areas or rooms are being conditioned, each of said rooms having its own apparatus. During times when the rooms are unoccupied for a prolonged period, such as during nonworking hours in an office, it is extremely desirable to override the demands of thermostat 47 to terminate operation of the apparatus, irrespective of the temperature in the room being served. Valve means 30 is employed to obtain the desirable results.

Valve means 30 is designed so that during normal operating conditions, lines 53 and 54 are in communication, spring 74 urging ball 79 upwardly as viewed in FIG. 2 so as to communicate the two lines heretofore noted.

When the rooms are unoccupied, switch 34 is closed, thereby energizing heating element 35. Energization of heating element 35 causes the temperature responsive substance in power element 84 to expand, thereby causing ball 79 to move downwardly, interrupting the flow of air from line 53 to line 54. As noted hereinbefore, connector 31, associated with port 44, is capped by means 44'; thus with ball 79 blocking port 40, flow of primary air from line 53 through valve means 30 is prevented. All control air thereby flows through line 51 to bellows 28, thereby inflating the bellows. With the bellows inflated, all room air induced into the apparatus is bypassed around heat exchanger 13 as is desired. Preferably, one switch 34 may be used do discontinue the operation of apparatus in a plurality of rooms. The discontinuance of operation of the apparatus during prolonged periods of vacancy substantially reduces the operating costs of running the refrigeration machinery by reducing the load thereon.

It should be understood that valve means other than the type shown, affording the function required thereof, may be utilized in lieu of the valve means hereinbefore described.

The invention herein presented operates to effectively increase the operating efficiency of refrigeration machinery employed to condition the air in a plurality of areas. Means are afforded to discontinue the operation of apparatus serving a plurality of areas in an enclosure, irrespective of the demands of the area, where other areas in the same enclosure require conditioned air.

Also, it should be understood that this invention relates to other types of air-conditioning apparatus, wherein operation thereof is regulated in accordance with temperature conditions of the air in the area being served thereby.

While we have described and illustrated a preferred embodiment of the present invention, it will be understood that the invention is not so limited since it may be otherwise embodied within the scope of the following claims.

We claim:

1. A control system for use with air-conditioning apparatus of the type employed for discharging conditioned air into an area served by said apparatus comprising:

A. outlet means for passing air from said apparatus to said area being served;

B. control means including thermal responsive means to sense the temperature of the air in said area and operable to regulate a control signal, the magnitude thereof varying in response to the temperature sensed by said responsive means;

C. means for receiving said control signal, said last-mentioned means being operable to regulate the discharge of conditioned air from said apparatus through said outlet means, operation of said control signal receiving means varying in response to changes in the magnitude of the control signal; and

D. means for interrupting the transmission of said temperature related control signal to said signal receiving means, independently of said temperature sensed in said area.

2. The control system in accordance with claim 1 wherein said means for interrupting the transmission of said temperature related control signal includes:



A. normally open valve means; and

B. means associated with said valve means to close said valve means when it is desired to interrupt the transmission of said temperature related control signal.

3. The control system in accordance with claim 2 wherein said valve means includes:

A. temperature sensitive means; and

B. means to supply heat to said temperature sensitive means, the supply of heat thereto placing said valve means in its closed position.

4. A method of operating an air-conditioning apparatus employed for discharging conditioned air into an area comprising the steps of:

A. discharging conditioned air from the apparatus into the area being served thereby;

B. sensing the temperature of the air in the area;

C. regulating a control signal, the magnitude thereof varying in response to the sensed temperature;

D. supplying the control signal to regulate the quantity of conditioned air discharged from the apparatus in accordance with the sensed temperature; and

E. interrupting the supply of the temperature related control signal independently of the temperature of the air in the area.

* * * * *