

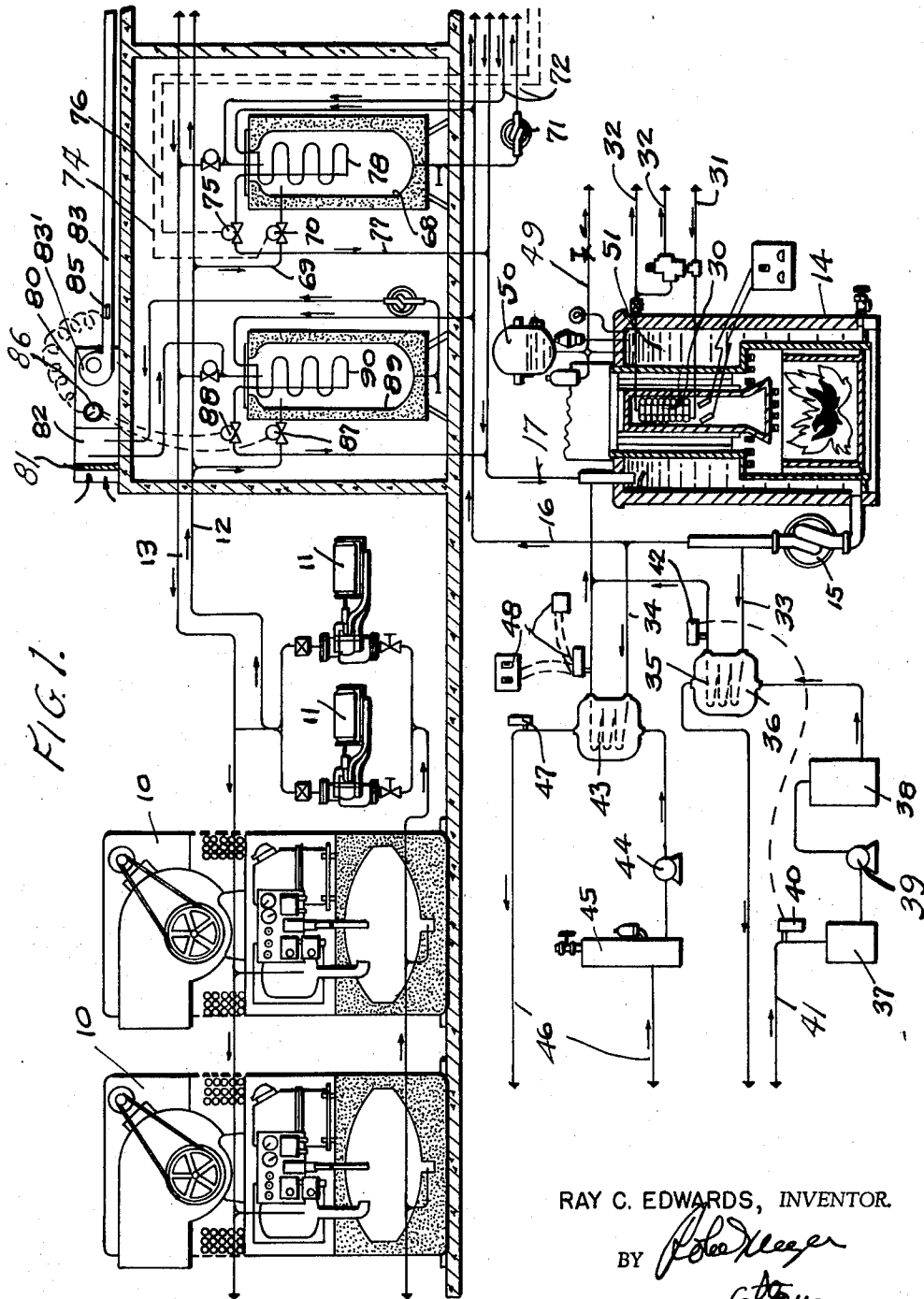
April 5, 1966

R. C. EDWARDS
HEATING AND COOLING SYSTEM AND
APPARATUS FOR ENCLOSURES

3,244,223

Filed Nov. 14, 1963

3 Sheets-Sheet 1



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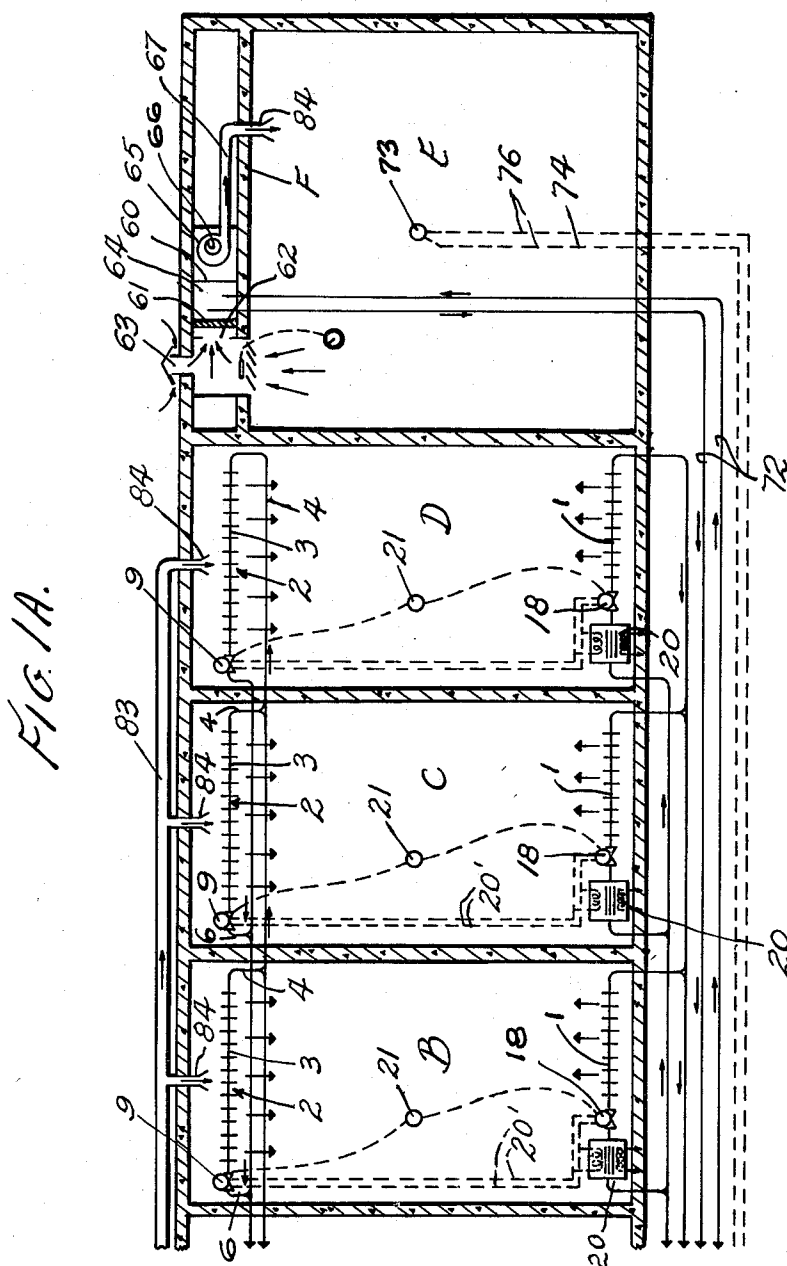
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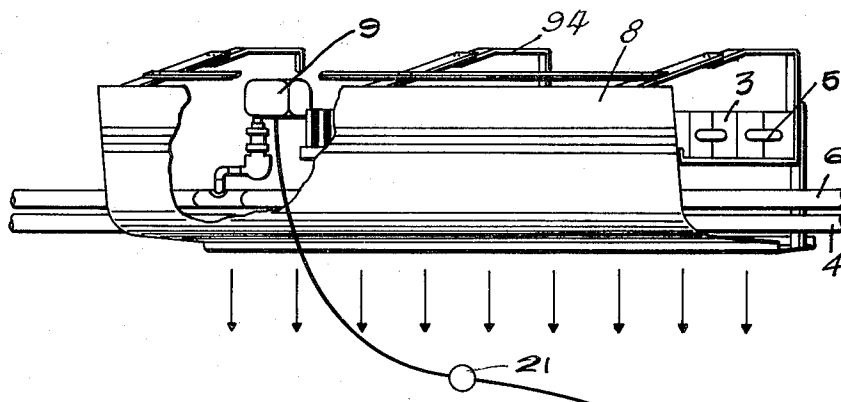
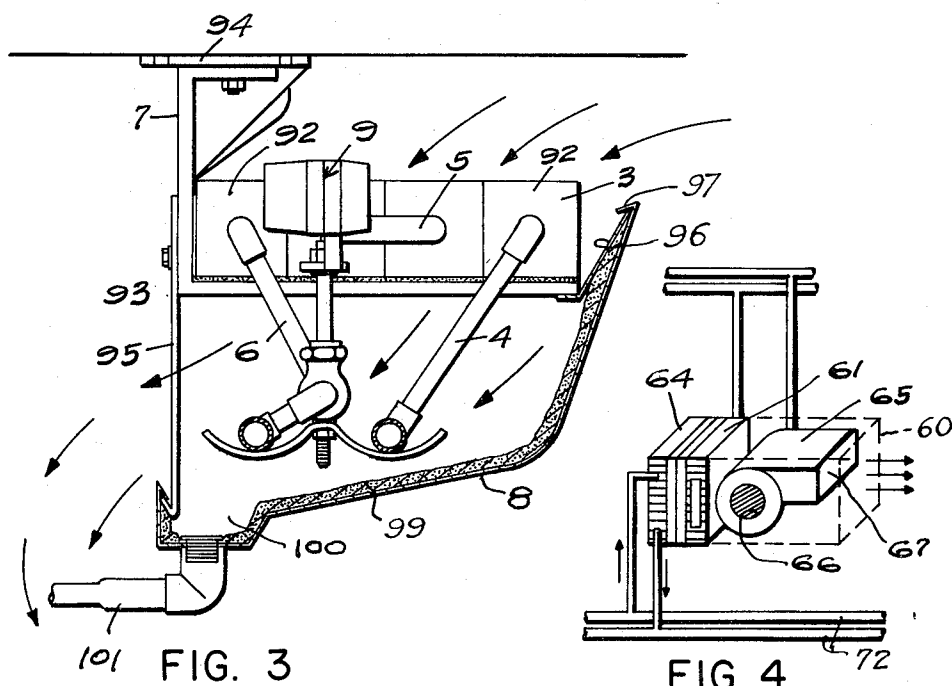
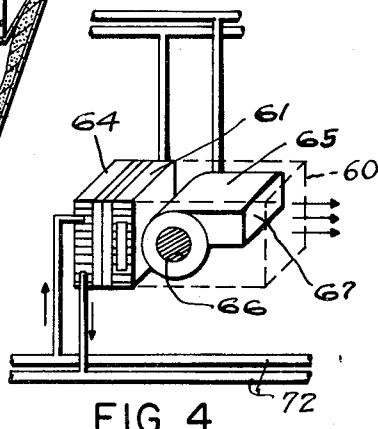
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HEATING AND COOLING SYSTEM AND APPARATUS FOR ENCLOSURES

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Filed Nov. 14, 1963, Ser. No. 323,622

11 Claims. (Cl. 165—22)

This invention relates to a heating and cooling system and apparatus for enclosures which is silent in operation, will provide draftless comfort in the enclosure, is clean and will provide warm floors in cold weather with even floor-to-ceiling temperatures.

The heating and cooling system and apparatus of the present invention is particularly adaptable for use in buildings, such as motels, hotels, hospitals, nursing homes and the like, where the various rooms are occupied by different persons whose temperament, physical condition, circulatory systems, etc., may require that the individual room temperatures of various rooms be different to provide comfort and contentment for the respective individuals, although it is not limited to use in such buildings and may be employed in a residence to provide individual temperature control of the various rooms therein.

Up to this time multiple room buildings as above referred to have used the various fan and heat transfer coil systems of approved structures, of the central heating and cooling type embodying ducts to carry the cool or heated air to the individual rooms, and fans for circulating the air in the rooms. Such systems have many disadvantages and undesirable features or effects of their operation for example:

A recent study was made in a number of new glamour motels, all of which used the fan, heat transfer coil air conditioners. With the fans in operation the noise measured at the bed level ranged from 42 to 60 decibels. This is an intolerable noise level for sleeping resulting either in restless sleeping or the turning off of the cooling by the occupant.

Due to the high velocity of the fan, required to provide proper cooling, the room is drafty, or full of drafts, and drafts are conducive of colds, and discomfort.

These fan coil systems provide poor distribution of temperature, or in other words, poor uniformity of temperature in a room, as for example, during the heating period of the room cold air accumulates at the floor level providing cold floors while excessive temperature is found at breathing level.

The fan stirs up dust in the room, causing frequent dusting and cleaning of the room and also causing considerable discomfort to persons allergic to dust particles.

Control of temperature in the individual rooms, irrespective of the temperature in any other room is very poor. The room occupant must either heat or cool the room, depending on whether hot water or cold water is being circulated through the heat transfer coils. He can vary the degree of heating or cooling in some installations, but he may require or desire heating when chilled water is being supplied the coils or vice versa. He has no choice.

In such fan and coil systems seasonal change-over is required and the owner of the building may be required to make a complicated, time-consuming switch-over from heating to cooling many times during the year, particularly in the spring and autumn, to satisfy occupants of the rooms.

Then also he is often burdened with the labor and cost of filter maintenance. If such filter maintenance is neglected, the capacity of the system will be reduced.

The present invention provides a heating-cooling system and apparatus which will be free of all of these disadvantages. The noise of operation will be reduced by

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the lack of use of fans in the present system. There will be no drafts in the rooms, since the present system employs base-board heating units and valance cooling units in each individual room, both controlled from within the room, and these units employing the convection action of heating and cooling will not only eliminate drafts but will provide uniformity of temperature throughout the room with very negligible temperature difference from floor to ceiling.

The present system promotes cleanliness in that the general air motion due to the convection action does not stir up dust, and by the use of individual room thermostats controlling the heating and cooling units in the room any occupant can heat or cool the room to any desired temperature any time of year.

Another advantage of the system and apparatus of the present invention is that no seasonal change-over is required. The switch from heating to cooling, or from cooling to heating is done automatically on an individual room basis, without any change-over operation of the heating medium or cooling medium supplying structures.

The present invention also embodies in combination with the individual room cooling or heating means and arrangement, a control system and apparatus for providing constant room temperature in all of the rooms of the building.

This feature of the present invention consists of a fan and single heat transfer coil and a control operation therefor which gives the effect of a modulating control but requires only on and off motorized valves and thermostats. This construction and arrangement of apparatus is shown, described and claimed in a co-pending application filed November 14, 1963, Serial Number 323,623, and its inclusion in the present invention is to provide, where desired means for providing a constant temperature in all of the rooms of a building which temperature may be either raised or lowered in any room, independently of change of temperature in other rooms, to meet the requirements or desires of the occupant of the room.

In the drawings,

FIGURE 1 is a diagrammatic layout partly in section of the present heating and cooling system and apparatus.

FIGURE 1A is a continuation of FIGURE 1 continuing from the right terminus of FIGURE 1 and showing in diagrammatic layout the individual room arrangements of the invention.

FIGURE 2 is a view partly in perspective of the valance cooling unit employed in the system.

FIGURE 3 is an end view of a valance cooling unit employed in the system.

FIGURE 4 is a view showing the heat transfer coil unit employed in the constant temperature maintaining feature of the invention.

Referring more particularly to the drawings B, C, D and E indicate rooms or enclosures provided with heating and cooling means. These enclosures may be rooms in a home, a motel, hotel, hospital, nursing home, etc. The rooms B, C and D are indicated for individual occupancy, while room E is indicated as an assembly room, such as the lobby of a motel or hotel, a dining room or the like.

Each of the rooms B, C and D is shown as having a base board heating unit 1 and a valance cooling unit 2 placed therein, with the valance cooling unit 2 placed at the top or ceiling of the room while the base board heating unit 1 is placed at approximately floor level.

The base board heating unit is of approved structure such as that manufactured and sold by Edwards Engineering Corporation of Pompton Plains, New Jersey and its specific structure forms no part of the present invention.

The valance cooling unit which is specifically described and claimed in a co-pending application filed January 6, 1964, Serial Number 335,864, embodies one or more cooling coils 3 which receive a cooling medium (such as cold water) through a pipe 4, entering the inlet end of one of the coils of the unit. The coils 3 of the unit are connected in series for flow of the cooling medium therethrough by suitable piping or tubing 5 while from the outlet of the unit the cooling medium flows into the return pipe 6. Suitable supporting structure indicated at 7 is provided for supporting the cooling unit 2 near the ceiling of the room and a condensate drain pan 8 is provided to receive and drain off any condensate forming on the unit 2.

Flow of the cold water or cooling medium through the coil or coils 3 of the unit is controlled by a motorized valve structure 9. This motorized valve structure may be of any suitable type purchasable on the market, but preferably is that manufactured and sold by Edwards Engineering Corporation of Pompton Plains, New Jersey.

The condensate drain pan is attractively designed and forms a cover for the cooling coil unit 2 so as to present a pleasing appearance in the room, and yet provide free and complete circulation of air about the coils and through the unit as shown by the arrows in FIGURE 3.

As shown in FIGURE 1A of the drawings the cooling units in the various rooms are connected in series with the flow of cold water through each unit controlled by its individual motorized valve 9, thereby providing independent cooling of each room.

The supply of cold water is delivered to the valance cooling units from a chiller 10 by a circulating pump 11 and suitable piping shown at 12 and is returned to the chiller through the return piping 13. The chiller 10 is shown described and claimed in application Serial Number 232,730, filed October 24, 1962.

Hot water for heating the rooms is delivered to the base-board heating units 1 in the rooms from a boiler 14, which for purposes of providing hot water to the heating units 1 may be of any approved type, but which is shown in the drawings as a special type of boiler to provide auxiliary features to the system as will be hereinafter referred to.

A circulating pump 15 circulates the hot water through the heating units 1 through the outgoing pipe 16 and return pipe 17 and the passage of the hot water through the heating units 1 is controlled individually by the motorized valve 18 of each unit 1.

The motorized valves 18 are the same as the motorized valves 9 in construction and all of these valves are connected to a source of electrical energy (not shown) by suitable wiring etc, shown at 20'.

The motorized valves 9 and 18 in each room are connected to and operation thereof is controlled by a thermostat 21 placed in each room, so that by setting the thermostat in any room the air temperature in that room may be regulated as desired by the occupant or another.

There are no fans associated with the heating units 1 and cooling units 2 in the rooms. These units effect convection heating and convection cooling of the room.

The heat from the baseboard heating units 1 rises and blankets the outer walls of the room and counteracts any natural drafts and infiltration which may be associated with cold outer walls.

With cooling, the valance cooling units 2 being suspended from the ceiling of the room along the outer wall cools the warm ceiling air and moves it down gently, blanketing the outer wall. This convection movement of cool air counteracts the warm air rising from the wall or infiltrating through windows. Thus both the baseboard heater and valance cooler by their very nature produce silent draftless cooling or heating and minimize floor to ceiling temperature differences. In actual practice the differences in temperature between

floor and ceiling has been found to be no more than 2 degrees F.

The furnace 14 has a domestic water heating coil 30 therein, through which water is circulated and heated for domestic hot water for such usages, dish washing, use in hand and face wash basins, etc. Water is fed to the coil 30 through an inlet pipe 31 and out through a pipe or pipes 32 to its place of use.

Two hot water take-offs 33 and 34 are shown in the drawings. One, namely, take-off 33 leads the hot water into the coil 35 of a heat exchanger 36, from which heat exchanger 36, the hot water returns into the normal circulating system for the hot water. The heat exchanger is provided for heating water for a swimming pool. Water from the pool (not shown) passes through a strainer 37 and filter 38 under force created by a pump 39 and passes through the heat exchanger 36 where it is heated by contact with coil 35 through which the hot water is circulated.

Aquastat 40 connected in the outlet pipe 41 from the pool (not shown) is connected in electric connection with a motorized valve 42 in the hot water piping of the heat exchanger 35 to operate the valve 42 under temperature variances of the water in the pipe 41 and consequently in the pool.

The other hot water take-off 34 delivers hot water to the heating coil in a heat exchanger 43. Water is circulated through the heat exchanger 43 for heating by a pump 44. The pump 44 receives water from an expansion tank 45 in the water circuit 46. Heated water in the water circuit may be used for any desired service, such as a grid in a driveway or walk for removing snow from the driveway or walk. Circulation of hot water through the heat exchanger 43 is under control of a thermometer 47 and suitable co-operating mechanism 48.

Make-up water is supplied to the boiler 14 through an inlet pipe 49 and an expansion tank 50 is connected to the water chamber 51 in the boiler 14 and the make-up water inlet pipe 49.

As earlier stated herein, means are provided to maintain a constant temperature in all of the rooms of the building and this structure per se is disclosed and claimed in a co-pending application for patent filed November 14, 1963, Serial Number 323,623.

This air handling unit is disclosed herein to establish the combination arrangement of heating and cooling for enclosures, wherein a constant predetermined temperature may be maintained in all rooms in a building without manual attention or adjustment and the temperature of the individual rooms may be controlled by manual adjustment to meet individual requirements or desires in any of the rooms.

The present invention comprehends the use of the room heating and cooling system and apparatus hereinbefore described, including the baseboard heating units 1, Valance cooling units 2, and their co-operating structures either independently or in a combination heating and cooling system embodying the constant temperature providing air handling unit.

In FIGURE 1A of the drawings, room E is shown as provided with only the constant temperature providing air handling unit structure as this is a public or assembly room, such as a dining room, a lobby, etc.

The constant temperature providing air handling unit includes a housing 60 which is shown in room E as placed in a space above the ceiling F of the room.

The housing 60 has an air filter 61 of any approved type located therein inwardly of the air inlet 62 of the housing. Outside air is admitted to the housing 60 through a flue 63.

A heat exchange coil 64 (as shown in FIGURES 4 and 5), is placed in the housing 60 inwardly of the filter 61 and heats or cools the air passing through the housing as hereinafter specified.

A fan 65 is provided having its inlet 66 opening into the housing 60 to draw the heated or cooled air therefrom and discharge it through the duct 67 into the room E at ceiling level.

A tank 68 has cold water fed thereinto from the chiller 10 through a pipe 69 under control of a motorized valve 70 and the water from the tank is circulated through the heat exchange coil 64 by a circulating pump 71 and suitable piping 72.

A thermostat 73 is located in the room E and is simply an on and off thermostat set to operate in a predetermined range. The thermostat is connected in electrical connection with the motorized valve 70 as shown by dotted line 74 and with a suitable source of electric energy (not shown) in any suitable manner.

When the temperature in the room E rises above the setting of the thermostat 73 it will operate to cause operation of the motorized valve 70, opening the valve to admit cold water into the tank and this cold water will be circulated through the heat exchange coil to bring the air temperature in room E down to the desired degree. As soon as the temperature in room E is brought to the desired degree the thermostat 73 acts to shut off the flow of cold water to the tank 68. If the temperature in room E falls below the set degree of the thermostat, the thermostat 74 will operate to open the motorized valve 75 to which it is electrically connected by wiring 76.

The motorized valves 70 and 75 are identical and are the same structure as the motorized valves 9 and 18 hereinbefore described.

The motorized valve 75 is located in the hot water line 77 which extends from the coil 78 in the tank 68 to the boiler 14. Hot water is delivered to and circulates through the coil 78 from the boiler 14 when the motorized valve 75 is open and serves to heat the water in the tank 68. The circulating pump 71 circulates this hot water through the heat exchanger coil 64 to heat the air in housing 60 and raise the temperature in the room E to the high degree determined by the setting of the thermostat 73, at which time the thermostat acts to close the motorized valve 75 and cut off the flow of hot water through the coil 78.

By setting the thermostat 73 to operate within a range of temperature variance of a few degrees F. it will be seen that substantially constant temperature will be maintained in the room E.

The constant temperature maintaining means for the rooms B, C and D is substantially the same as that employed in connection with room E in that outside air is taken into the housing 80 passes through a filter 81 and heat exchange coil 82 after which the air is picked up and delivered into the duct 83 by a fan 83'. From the duct 84 the air is delivered into the rooms B, C and D at ceiling level through outlets 84.

Since the air at the desired constant temperature is delivered into a plurality of rooms from the duct 83 and the heat exchange coil 82, each room of which plurality has its own independent temperature control apparatus it is necessary to provide control of flow of heating or cooling water by some means exterior of the rooms.

For this purpose a thermal bulb 85 is placed in the duct 83 near the outlet of the fan 83' or a point sufficiently remote from the first room served with the air from the duct 83. The thermal bulb is connected to and operates a thermostat 86, thus operation of the thermostat 86 is controlled by the temperature of the air discharged into the rooms.

The thermostat 86 is of the same construction as the thermostat 73 (i.e. an on and off thermostat), and it controls the opening and closing of the motorized valves 87 and 88 which control the flow of cold water to the tank 89 and heating hot water to the coil 90 in the tank 89. The water flow through the tank 89 and coil 90 therein is the same as described in connection with tank 68, coil 78 and heat transfer coil 60. Thus the

air temperature is maintained constant in the rooms B, C and D so long as the thermostats 21 in these rooms are not operated to vary the temperature in any one of them.

However, should this maintained constant temperature not be satisfactory to the occupant of one of the rooms he can vary the temperature either up or down by adjustment of the thermostat 21 in his room, resulting in the changing of the temperature by either the valance cooling unit 2 or the baseboard heating unit 1 in the room.

Referring more specifically to the valance cooling units 2, the heat transfer coils 3 may be connected in series in a bank of coils of any suitable number depending upon the cooling load required. Each coil consists of a central tube 91 upon which are a plurality of fins 92 forming radiating surfaces to dissipate the cold from the tube 91. The form of heat transfer coil shown is the "Box Fin" type manufactured by Edwards Engineering Corporation of Pompton Plains, New Jersey, as covered by U.S. Patent No. 2,959,402, issued Nov. 8, 1960, but any suitable type of heat transfer coil may be used.

The bank of coils 3 is supported by the bracket 93 of the supporting structure 7. The bracket 93 is attached to the ceiling of a room through the medium of an attaching plate 94. A hanger plate 95 is attached to the wall facing surface of the bracket 93 and has its lower end shaped for supporting suspending snap engagement with the upturned rear edge of the condensate drain pan 8 while the outward edge of the bracket 93 has an attaching supporting plate 96 attached thereto and extending upwardly therefrom. The upper edge of the attaching supporting plate 96 is engaged by the attaching portion 97 along the upper edge of the condensate drain pan 8. As clearly shown in FIGURE 3 of the drawings the upper edge 97 and the upper edge of the upturned rear edge of the drain pan are formed to permit snap over engagement with the plates 95 and 96 to provide easy assembly of the unit, or easy attachment of the drain pan 8 in position during assembly and also permit easy removal of the drain pan for access to the coil 3, valve 9 etc.

The drain pan 8 is constructed of sheet metal and has an insulating lining 99 on its inner surface, and it is also shaped to form a condensate catch well or space 100 into which condensate from the pan drains. Condensate flows away from the well or collector space 100 through a drain connection 101. The bracket 93 and plates 95 and 96 do not extend the entire length of the valance cooling unit, and any suitable number of such members may be employed to form firm support for the valance cooling unit.

The upper edge of the condensate pan 8 terminates a suitable distance below the ceiling of the room to provide an entrance space for air along the entire length of the valance cooling unit. The air entering the valance cooling unit passes over and through the fin spaces of the heat transfer coils 3 where it is cooled and passes out at the back or wall facing surface of the valance cooling unit, under the coils and against the wall of the room in which the unit is mounted. The cooled air travels by convection action along the wall of the room forming a descending blanket of cool air over the wall, which eventually is dissipated over the room to cool it.

While two tanks 68 and 89 and two chillers 10 are shown in the drawings, only one of each of these units may be employed, depending upon the capacity of the units and the load demand thereon.

What is claimed is:

1. In a heating and cooling system and apparatus for an enclosure, means for maintaining a constant temperature in the enclosure including a heat exchange unit, heating means for providing a variable temperature in said enclosure including a heat exchanger at floor level of the enclosure cooling means for providing a variable

temperature in said enclosure and including a heat exchange unit located at ceiling level of said enclosure, said variable temperature heating means and said variable temperature cooling means arranged to provide a convection flow of heating or cooling air along a wall of said enclosure, and means for providing a heating or a cooling medium to both said constant temperature producing means and said variable temperature providing means.

2. A heating and cooling system and apparatus as claimed in claim 1 wherein said enclosure comprises a plurality of separate rooms, said constant temperature providing means providing a constant temperature in all of said rooms, variable temperature heating means and variable temperature cooling means in each of said separate rooms and means in each room controlling operation of the variable temperature heating means and operation of the variable temperature cooling means, independently of the variable heating and cooling means in any other of the rooms.

3. A heating and cooling system and apparatus as claimed in claim 1, including means located in the enclosure for controlling operation of said variable temperature providing heating and cooling means independently of said constant temperature providing means.

4. In a heating and cooling system and apparatus for an enclosure, means for controlling the temperature in said enclosure including a constant temperature providing heat exchange unit, means for delivering a heat varying fluid to and circulating it through said constant temperature providing heat exchange unit, means for delivering a chilled cooling fluid to said fluid delivering means, means for circulating a heating fluid through said fluid delivery means to raise the temperature of the fluid delivered to said heat exchange unit, a separate heating heat exchange unit in said enclosure, a separate cooling heat exchange unit in said enclosure, means for delivering heated fluid from said fluid delivering means to said separate heating unit, means for delivering cooled fluid from said fluid delivery means to said separate cooling heat exchange unit, a thermostat controlling delivery of fluid to said constant temperature providing heat exchange unit, a second thermostat controlling the delivery of heating fluid to said separate heating heat exchange unit and the delivery of cooling fluid to said separate cooling heat exchange unit.

5. A heating and cooling system and apparatus as claimed in claim 1, including a thermostat located at the discharge side of said constant temperature providing heat exchange unit and exteriorally of the enclosure and means associated with and controlled by said thermostat for controlling the flow of heating fluid or cooling fluid to said constant temperature providing heat exchange unit.

6. In a heating and cooling system and apparatus for an enclosure, means for maintaining a constant temperature in said enclosure including a constant temperature providing heat exchange unit, means for delivering a heat varying fluid to and circulating it through said constant temperature providing heat exchange unit, means for delivering a chilled cooling fluid to said fluid delivering means, means for circulating a heating fluid through said fluid delivery means to raise the temperature of the fluid delivered to said heat exchange unit, a variable heating heat exchange unit in said enclosure, a variable cooling heat exchange unit in said enclosure, means for delivering temperature varying fluid from said fluid delivery means to said variable cooling heat exchange unit, and means for delivering heating fluid to said variable heating heat exchange unit from said means which circulates heating fluid through said delivery means.

7. A heating and cooling system and apparatus as claimed in claim 6, including means exteriorly of the enclosure for controlling delivery of temperature varying fluid to said constant temperature providing heat exchange unit, and means within the enclosure for controlling delivery of temperature varying fluid to said variable heating heat exchange unit and to said variable cooling heat exchange unit.

8. A heating and cooling system and apparatus as claimed in claim 7, wherein said variable temperature heating heat exchange unit is located at floor level adjacent to a wall of the enclosure and the variable temperature cooling heat exchange unit is located at ceiling level adjacent a wall of the enclosure, said variable temperature heating heat exchange unit and said variable temperature cooling exchange unit each embodying means to direct heated air, or cooled air therefrom along the wall to provide a convection heating or cooling action in the enclosure.

9. In a heating and cooling system and apparatus for varying the temperature in a room, a baseboard heating unit located at floor level adjacent to a wall of the room, a valance cooling unit located at ceiling level of the room and adjacent to a wall of the room, a temperature fluid containing tank, means for delivering a chilled fluid to said tank, means for supplying a heating fluid to said tank to raise the temperature of the chilled fluid in the tank, said heating fluid supplying means supplying heated fluid to said baseboard heating unit, said baseboard heating unit and said valance cooling unit having their discharge outlets arranged to provide an ascending blanket of heated air along a wall of the room and a descending blanket of cooling air along a wall of the room.

10. A heating and cooling system and apparatus for varying the temperature in a room as claimed in claim 9 including a thermostat in said room, and means associated with and controlled by said thermostat for controlling delivery of cooling fluid to said valance cooling unit, delivery of heating fluid to said baseboard heating unit and controlling delivery heating fluid to said tank.

11. A heating and cooling system and apparatus as claimed in claim 9 including a heat exchange coil in said tank, said means supplying heating fluid to said tank delivering it to and through said heat exchange coil to prevent intermingling of the cooling fluid and heating fluid in the tank.

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