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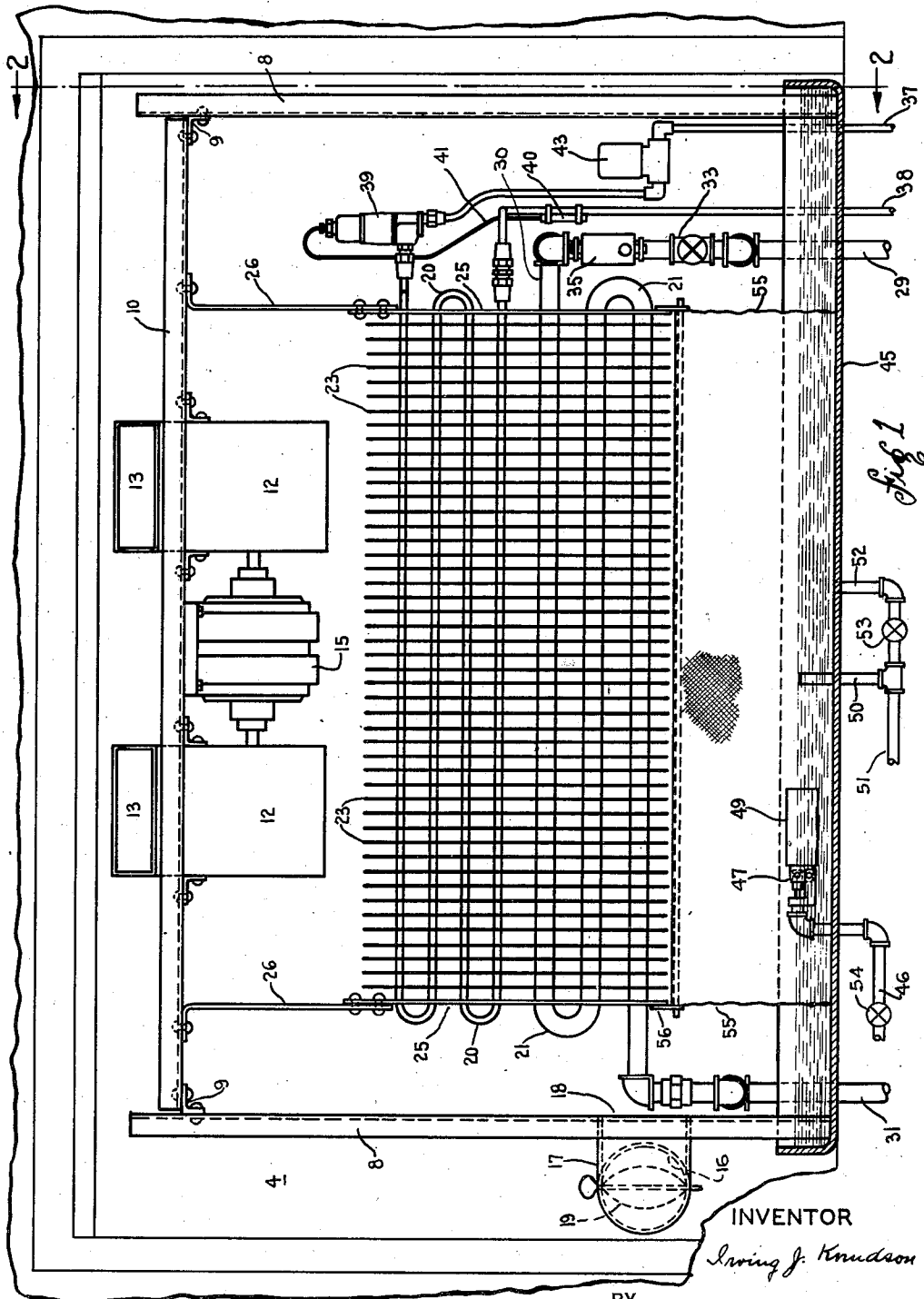
I. J. KNUDSON

2,110,367

AIR CONDITIONING SYSTEM

Filed July 25, 1935

2 Sheets-Sheet 1



INVENTOR

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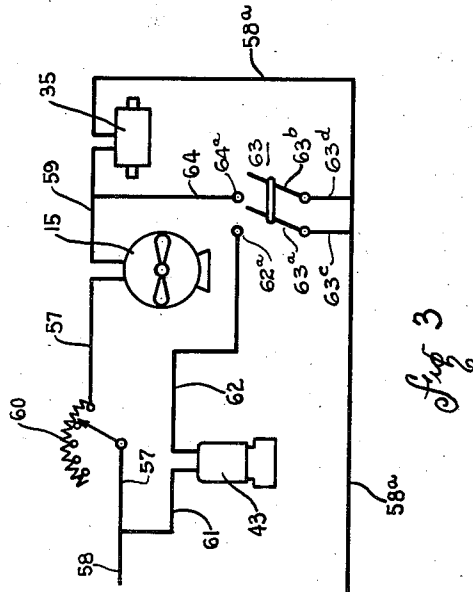
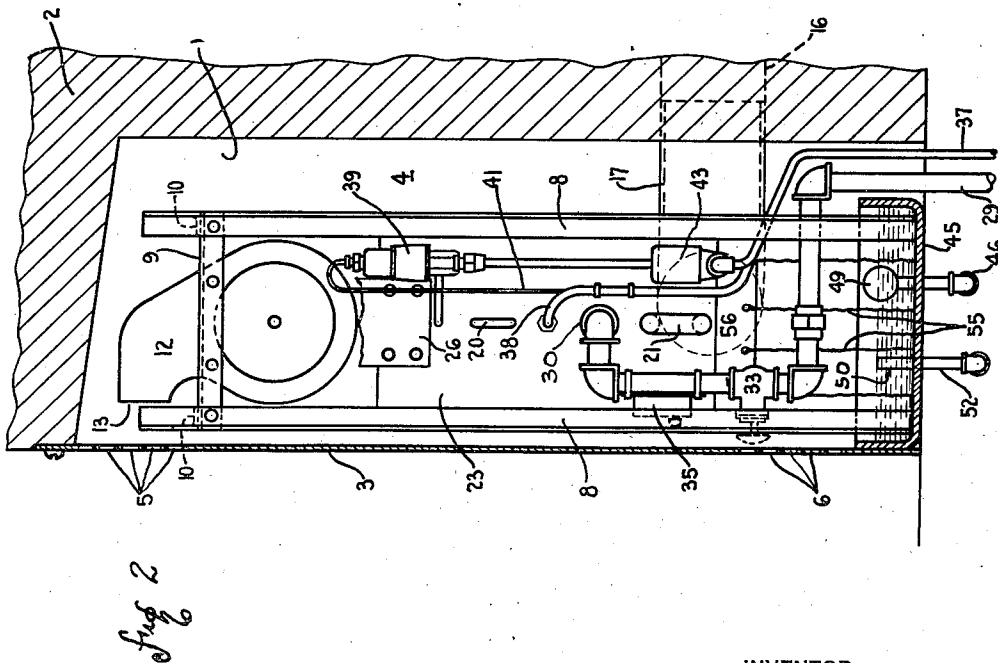
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2 Sheets-Sheet 2



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2,110,367

AIR CONDITIONING SYSTEM

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Application July 25, 1935, Serial No. 33,113

3 Claims. (Cl. 257-3)

My invention relates generally to air conditioning systems and more particularly to control system therefor.

It is an object of my invention to provide a new and improved air conditioning system of the type having a combined heating and cooling unit and to provide a system of this character which is highly efficient in operation.

Another object of my invention is to provide an air conditioning system of the type having both a cooling unit and a heating unit and to provide a new and improved cooperative arrangement of the control devices therefor.

Other objects of my invention will be apparent from the following detailed description taken in connection with the accompanying drawings which form a part of the specification, and in which drawings—

Figure 1 is a view showing an air conditioning system embodying my invention;

Fig. 2 is a view taken in the direction of the arrows 2—2 of Fig. 1, and

Fig. 3 is a diagrammatic view showing the arrangement of the control devices of the system in an electric circuit.

In the drawings there is shown apparatus of an air conditioning system for conditioning the air of a room and which apparatus is preferably disposed in a recess 1 of a vertical wall 2 of a room, as shown. The recess 1 may be closed and the apparatus therein hidden by a closure member or panel 3 which thus cooperates with the walls defining the recess 1 to provide a closed compartment 4 for the air conditioning apparatus. The panel 3 may be attached to the wall 2 by means of screws or other suitable attaching means. In the panel 3 and preferably adjacent the upper wall of the compartment 4 there is provided a plurality of apertures 5 for the passage of air from compartment 4 into the room, and in the panel 3 and preferably adjacent the floor of the room there is provided a plurality of apertures 6 for the passage of room air into compartment 4.

Disposed within the compartment 4 there is a frame for supporting the air conditioning apparatus and which is constructed, in the present instance, by spaced, end upright members 8, there being two at each end of the compartment 4 and connected at their upper ends by horizontal end or side cross members 9 and front and rear cross members 10. Mounted on the horizontal cross members 10 there are two spaced fan units enclosed in housings 12 which have air outlets, as at 13, and which are arranged for discharg-

ing air into the room through the apertures 5 in the panel 3 and for increasing the rate of air flow through chamber 4. Mounted on the horizontal cross members 10 and between the spaced fan units there is an electric motor 15 arranged to drive both fans. Preferably there is provided an opening 16 through the wall 2 for the intake of fresh outdoor air by the fans and preferably the intake is located and leads into the compartment 4 at one end thereof and adjacent the floor of the room, as shown in Fig. 1. In the present instance, an extension or duct 17 is provided for connection with the intake passage 16 and has an outlet 18 disposed to direct the incoming air longitudinally of the compartment 4. A damper 19 may be provided in the extension or duct 17 for controlling the volume of incoming outdoor air.

Disposed within compartment 4 and beneath the fans there is a combined heater and cooler element which comprises a cooling coil 20 and a heating coil 21. The coils 20 and 21 preferably have a sinuous form and are arranged one above the other in the same vertical plane with the cooling coil preferably located above the heating coil. The cooling coil 20 and the heating coil 21 extend transversely through a plurality of spaced and vertically extending plate members or fins 23, which fins serve as a common extended surface for both the heating and the cooling coils. The fin structure includes end supporting members 25 and the structure may be supported by depending brackets 26 rigidly fixed to the cross members 10 and the end supporting members 25 of the fin structure.

From the source of supply of the heating medium, which may be a steam boiler located in the basement of a building, there is a supply pipe or conduit 29 which leads into the compartment 4 and connects to one end of the heating coil 21, as at 30. To the other end of the heating coil 21 there is connected a conduit or pipe 31 which returns to the source of supply. In the inlet line 29 there is preferably provided a manually operated valve 33 for controlling the flow of the heat conveying medium through the heating coil 21. The valve 33 is preferably located within compartment 4 and so that it will be readily accessible upon removal of panel 3. Clamped in good heat transfer relation to the supply pipe 29 and preferably adjacent the inlet end of coil 21 there is a temperature responsive switch means, designated generally by the numeral 35, which controls and is preferably in circuit with the fan motor 15, as shown diagram-

matically in Fig. 3, and the purpose of which is hereafter described.

The cooling system includes the usual refrigerant condensing element (not shown) which is preferably located in the basement of a building and which is operatively connected to the cooling element 20 by a supply conduit 37 and a return conduit or suction line 38. A control device 39, which may be an expansion valve of the thermostatic type, as shown, is provided for controlling the admittance of refrigerant to the cooling coil 20 and is preferably connected in the line at the inlet of coil 20. The thermostatic expansion valve includes a temperature responsive bulb 40 connected thereto by means of a tube or conduit 41, the bulb and tube being charged with a suitable expansible-contractible fluid such as methyl chloride. Preferably the bulb is clamped in good heat transfer relation to the suction line 38 and adjacent the outlet end of coil 20. Disposed in the supply line 37, between the expansion valve 39 and the condenser element, there is a solenoid valve, designated generally by the numeral 43, for controlling flow to the cooling coil 20. The solenoid valve 43 may be of any suitable type and is preferably located within compartment 4.

Disposed beneath the heating and cooling element there is a container or reservoir 45 for containing water to supply artificial humidification to the air of a room during the season when artificial humidification becomes necessary to the comfort of persons in the room. Water is supplied to the container 45 from a source of supply by means of a pipe or conduit 46 which, in the present instance, extends through the bottom wall of the container and leads to a valve 47, the valve 47 being controlled by a float 49 to maintain a substantially constant level of water in the container 45. Preferably a drain is provided to insure against overflow of the water from the container on to the floor, and which drain may consist of a vertically extending pipe or conduit, as at 50, which extends upwardly into the container to the maximum liquid level desired. The vertically extending drain pipe 50 connects into, and intermediate the ends of, a main drain pipe 51. Also connected to the main drain pipe 51 but at the end thereof there is a second drain pipe 52 which terminates at the container bottom wall for completely draining the container. In the drain line or pipe 51 there is a shut-off or control valve 53 positioned between outlet pipes 50 and 52 and which is closed when it is desired to maintain water in the container 45. In the supply pipe 46 there is a valve 54 to be closed when humidification is not desired and when valve 53 is open. When artificial humidification is desired the container 45 is filled with water to the desired level for supplying additional moisture to the incoming air for discharge into the room. To facilitate the entraining of additional moisture by the air, there may be provided a plurality of spaced, vertically disposed pieces or sheets of absorbing material or fabric, as at 55, arranged in the path of the circulating air and with their lower ends disposed in the water in the container 45. The pieces of fabric will thus absorb the water and provide a large extended wetted surface in the path of the circulating air. The pieces of fabric may be supported at their upper ends by the end supporting members 25 of the fin structure. The pieces of fabric may be hung from rods extending coextensive with the fin structure and

supported at their opposite ends by brackets 56 having apertures for receiving the rods, the brackets being welded or otherwise secured to the end supporting members 25.

Referring now to Fig. 3 which shows diagrammatically the arrangement of the electric circuit or circuits, including the fan motor 15, the solenoid valve 43 and the temperature responsive switch 35, the lines 58 and 58^a represent the lead wires from the main line which may be the usual 110 volt line. Connected to the lead wire 58 there is a wire 57 which leads to the fan motor 15, and from the fan motor there is a lead wire 59 connected to one terminal of the switch means 35, the lead wire 58^a being connected to the other terminal of the switch means to complete the circuit. Preferably a rheostat 60 is provided in the lead wire 57 for controlling the speed of the fans, and the rheostat may be located on the wall of the room or in any other suitably accessible location. Connected to the lead wire 58 there is a lead wire 61 which connects to the solenoid valve 43, and leading from the solenoid valve there is a lead wire 62 which connects to one terminal 62^a of a manual switch 63. The manual switch 63 is shown as a double pole single throw type having one blade 63^a cooperating with terminal 62^a, which blade is connected by a lead wire 63^c to line wire 58^a. Lead wire 64 is connected to the other terminal 62^b of the switch 63, which terminal cooperates with blade 63^b, the lead wire 64 joining lead wire 59 between the fan motor 15 and the automatic switch 35. The blade 63^b is connected by a lead wire 63^d to line wire 58^a. Thus it will be seen that the fan motor 15 and the temperature responsive switch 35 that controls operation of the fan during the heating season, are in series circuit irrespective of whether the manual switch 63 is in open or closed position. Also, it will be seen that the solenoid valve 43 and the fan motor 15 will be in parallel circuit when the manual switch 63 is closed, and that the fan will operate continuously irrespective of the operation of the temperature responsive switch 35.

A complete operation of my system is as follows: When neither heating nor cooling of the room air is desired, if such should be the case, the supplying of the heating medium to the heating coil 21 may be discontinued by means of the manual valve 33 and the supplying of refrigerant to the cooling coil may be discontinued by opening the circuit to the solenoid valve 43 by means of the manual switch 63. When it is desired to employ the heating element to heat the room or other space, the valve 33 being normally open to permit the heating medium to flow through the heating coil 21 and the circuit to lead wires 58, 58^a being closed, the switch 63 is opened. When the temperature of the heating medium flowing through the supply pipe, and controlled at the source of supply, causes the temperature responsive switch 35 to operate and close the circuit to the fan motor 15, air will be circulated by the fans 12 over the finned element 20 and be discharged through outlets 5 into the room. Upon discontinuance of flow of the heating medium or decrease in temperature thereof, below the desired degree, the temperature responsive switch means 35 will act to open the circuit to the fans, thereby preventing the circulation of low temperature air. The fans therefore operate during the heating period only when the heat conveying medium is supplied at the desired temperature through the supply line

29 to the coil 21. As the fans operate they draw room air, through the apertures 6, into chamber 4 where it flows over the heating coils and fins and is heated, after which the heated air is returned to the room, the air being discharged by the fans through the apertures 5 in the panel 3. If there is water in the container 45 the circulating air passing through compartment 4 will have moisture added thereto and the humidified air will be delivered to the room. If desired, the damper 19 may be operated to permit the entrance of outdoor air into chamber 4 for mixing with the room air prior to contact with the heating element.

During the heating season the switch 63 will be in open circuit position and the valve 43 will be in closed position, preventing flow of the cooling medium to the cooling element or coil 20. When it is desired to cool the air of the room and decrease the relative humidity thereof the switch 63 is closed, completing the circuit of the solenoid valve which is then energized and opens to permit flow of the refrigerant to the cooling coil 20. When the switch 63 is closed, the solenoid valve 43 and fan motor 15 are in parallel circuit, the switch 35 being shunt circuited or in parallel circuit with the fans and valve 43, and thus the fans operate continuously when the switch 63 is closed. Since the supplying of the heating medium is discontinued when the cooling system is started, the heating element 21 will not heat the air circulated by the fans. The automatic switch 35 being, when switch 63 is closed, in parallel circuit with fan motor 15, the operation of switch 35 will not affect the fan motor circuit. The thermostatic expansion valve 39 operates in the usual manner to control the admittance of refrigerant to the cooling coil 20 to maintain the coil completely refrigerated. Air is drawn into the compartment 4 by the fans and is circulated over the cooling coil and its extended fin surface. Some of the moisture in the air condenses on the cooling element 20 whence it drips into the container 45 and drains therefrom through drain pipe 52, the water inlet valve 54, of course, having been closed and the valve 53 having been opened.

From the foregoing description it will now be appreciated that I have provided a new and improved arrangement, in an electric circuit, of the control device and cooperating units of a combined heater and cooler unit. By arranging the fan, solenoid valve, temperature responsive switch and manual switch in circuit, as described, it will be seen that by closing the manual switch the solenoid valve and the fan will be in parallel circuit and the temperature responsive switch will be shunted, and that by opening the manual switch the fan and the temperature responsive switch will be in series circuit and the solenoid valve will be deenergized.

What I claim and desire to secure by Letters Patent of the United States is:

1. In an air conditioning system, a cooling element to which a cooling medium is supplied for passage therethrough, electrically operated valve means for controlling the flow of said cooling medium to said cooling element, a heating element to which a heating medium is supplied for passage therethrough, only one of said elements being in operation at the same time, a temperature responsive switch means in multiple circuit

with said electrically operated valve means, a fan controlled by said electrically operated switch means and in multiple circuit with said electrically operated valve means, said fan being operable to increase flow of air for heat exchange with both said heating element and said cooling element, said temperature responsive switch means being in heat transfer relation with said heating medium and operable during the heating season to close the circuit to said fan only when the heating medium is being supplied at a predetermined temperature to the said heating element, and a single switch means for controlling both the circuit of the electrically operated means and the operation of said fan by the temperature responsive switch means.

2. In an air conditioning system, a cooling element to which a cooling medium is supplied for circulation therethrough, an electrically operated valve for controlling flow to said cooling element, a heating element to which a heating medium is supplied for circulation therethrough, only one of said elements being in operation at the same time, means for controlling flow of said heating medium to said heating element, a temperature responsive switch means in multiple circuit with said electrically operated valve, an electrically operated fan in multiple circuit with said electrically operated valve and in series circuit with said temperature responsive switch means for inducing circulation of air for heat transfer relation with both said heating and said cooling elements, said temperature responsive switch means being in heat transfer relation with said heating medium for controlling the operation of said fan, and a single switch controlling the circuit of said electrically operated valve and of said fan, said electrically operated valve being in closed circuit with said fan when said switch is in closed circuit position, said temperature responsive switch means being in closed circuit with said fan when said switch is in either open or closed position and said fan being in closed circuit in either position of said last-named switch means.

3. In an air conditioning apparatus, a cooling element to which a cooling medium is supplied for passage therethrough, an electrically operated valve for controlling flow of the cooling medium to said cooling element, means regulating the temperature of said cooling element, a heating element to which a heating medium is supplied for passage therethrough, electrically operated fan means in parallel circuit with said electrically operated valve, said fan means being arranged to increase air flow for heat transfer relation with the cooling element and with the heating element, a temperature responsive switch means in circuit with said fan means, said temperature responsive switch means being in heat transfer relation with said heating medium to control the operation of the fan means so that the fan means will only operate during the heating season when the heating medium is being supplied at a predetermined temperature to the said heating element, means for controlling the flow of said heating medium to said heating element, and a single switch controlling simultaneously both the circuit of the electrically operated valve and the operation of said fan means.

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