

March 2, 1937.

J. H. O'BRIEN

2,072,427

AIR CONDITIONING SYSTEM

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2 Sheets-Sheet 1

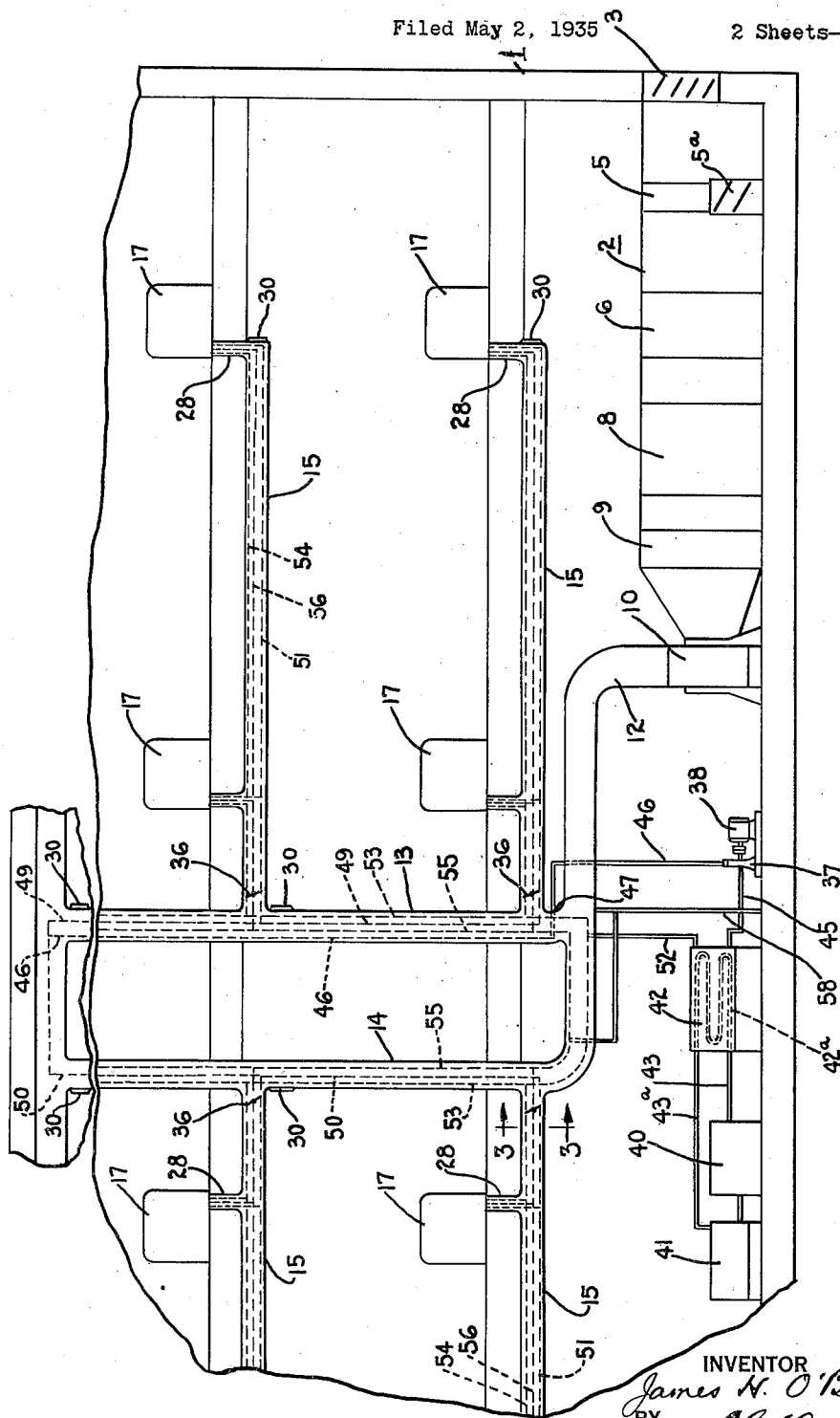


Fig. 1

INVENTOR
James H. O'Brien
BY
C. E. Regency
his ATTORNEY

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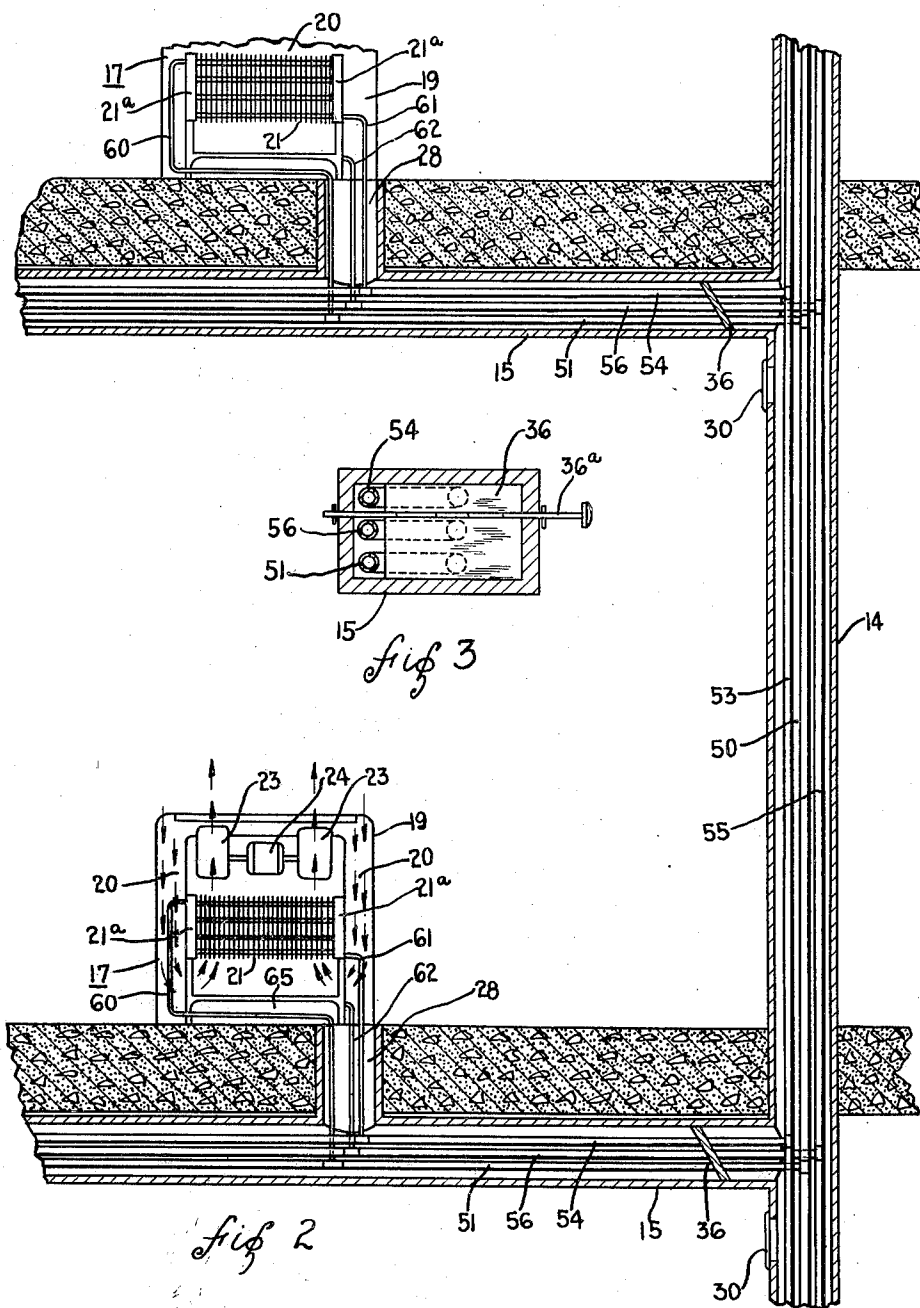
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2,072,427

AIR CONDITIONING SYSTEM

James H. O'Brien, Chicago, Ill., assignor to
American Blower Corporation, Detroit, Mich.,
a corporation of Delaware

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My invention relates generally to air conditioning systems and more particularly to the insulating of pipes employed in such systems.

In systems for conditioning the air in buildings, and particularly in large buildings it has usually been the practice to have an air conditioning unit in each room and to refrigerate and circulate a liquid cooling medium through pipes or conduits to the units for heat transfer relation with the room air. These systems also usually have apparatus for supplying air to the rooms through other pipes or ducts and this air is usually dehumidified and cooled to reduce the humidity of the room in summer. In the past it has been necessary to the efficiency of these systems that the air ducts and the cooling medium ducts be covered with a non-heat conducting material to prevent condensation on the pipes commonly known as sweating of the pipes. However, heat insulating materials have not proven entirely satisfactory, as such, and in addition are expensive particularly when insulating both the cooling medium and air ducts throughout large buildings.

Accordingly, it is one of the objects of my invention to provide an air conditioning system of the above mentioned character in which the necessity for using a heat insulating covering for the air conveying pipes or conduits to prevent the condensation or precipitation of moisture thereon is eliminated.

Another object is to eliminate the necessity of a heat insulating covering for the liquid conveying pipes or conduits.

In the accompanying drawings, to be taken as a part of this specification, I have fully and clearly illustrated a preferred embodiment of my invention, in which drawings—

Figure 1 is a fragmentary diagrammatic view shown in elevation of a building having my improved air conditioning system installed therein;

Figure 2 is an enlarged fragmentary view of a portion of Figure 1 shown in cross-section, and

Figure 3 is an enlarged view shown in cross-section taken along the line 3-3 of Figure 1.

Referring now to the drawings, there is shown in Fig. 1, a building designated in general by the numeral 1 and in which there is shown installed an air conditioning system for conditioning the air of the rooms throughout the building during summer when treatment of the air is necessary for comfort. The system includes air conditioning apparatus enclosed within a housing 2 which may be located in the basement of the building

1, as shown, and which may have a fresh air intake 3. Any suitable type of air conditioning apparatus, having provision for dehumidifying air may be employed. The present apparatus comprises in general, heating coils 5 with by-pass damper 5a, an air filter 6, a moisture absorption bed 8 and cooling coil 9. A fan, enclosed within a housing 10, may be employed to draw air into the housing 2 through the fresh air intake 3. In communication with the outlet side of the fan housing 10, there is a main air duct 12 into which the conditioned air is discharged and propelled therethrough by the fan. Vertically extending ducts 13 and 14 extend from main ducts 12 and have branch ducts 15 for each floor for conveying dehumidified air to the rooms of each floor.

Any suitable type of heat transfer units may be employed, such as, the individual units designated in general by the numeral 17, one or more of which may be installed in each room of a building, as desired. The type of air conditioning unit shown in connection with the present system includes a cabinet 19 having a compartment for a heat transfer or cooling element 21 preferably located intermediate the top and bottom of the cabinet. The cooling element comprises the end header members 21^a connected by pipes which preferably have fins, as shown, to obtain a large or extended surface exposed to circulating room air.

To induce the circulation of room air over the cooling element 21, fans 23 may be employed and may be driven by an electric motor indicated at 24. The fans are preferably located adjacent the top of the cabinet and above the cooling element 21, as shown. In the present instance, the cabinet 19 has passageways 20 having inlets adjacent the top of the cabinet for room air and which passageways extend downwardly to a point adjacent the bottom of the cabinet where they lead into the cooling element compartment and below the cooling element. The fans 23 draw room air into the passageways 20, which air enters the cooling element compartment and rising comes into contact with the cooling element 21 to be cooled thereby after which it is discharged by the fans into the room.

The air ducts 12, 13, 14 and 15 may be metallic ducts and be exposed to the room air without necessity of a heat insulating covering and preferably the branch ducts 15 are disposed adjacent the ceiling of the room, as shown. The horizontally extending branch ducts 15 have vertical outlet ducts or conduits 28 which extend through openings in the floors located beneath the units

17 and through which the dehumidified air is discharged into the cabinets or units and thence into the rooms. The duct 12, disposed within the basement, will require an outer covering of insulating material unless the air in the basement is also conditioned as will be understood from the following description.

Dehumidified air may also be discharged into the rooms through outlet openings in the ducts, the openings preferably being located near the tops of the rooms and being provided with suitable outlet grilles 30. The grilles 30 are preferably of the type having dampers (not shown) by means of which to regulate the volume of air being supplied to the rooms through the grilles. Dampers 36 may be provided in the air ducts at suitable places, such as for example, they may be provided in the branch horizontal floor ducts 15, one for each duct and preferably located adjacent the intersection of the horizontal ducts 15 and the vertically rising ducts 13 and 14. By means of the dampers 36, the volume of air passing through the branch ducts 15 to a plurality of rooms, supplied therefrom, may be varied as desired. The dampers 36 may be supported within the air ducts 15 by means of rods 36^a journaled in apertures in opposite side walls of the ducts, as shown in Fig. 3. The dampers 36 may be fixed to the rods 36^a in any suitable manner, for example the rods 36^a may be split longitudinally to receive the damper panels which may be tightly clamped between the split portions by means of screws or other suitable fastening means. Thus, dehumidified air may be discharged into the rooms either through the units 17 or through the grilles 30 or through both as may be desired.

A cooling medium, such as, cold water, brine or any other suitable cooling medium is circulated through the cooling elements 21 of the units 17 and may be delivered thereto and returned through duct means or conduits or pipes. These liquid cooling medium conveying pipes are disposed within the dehumidified air ducts 13, 14 and 15. The system includes refrigerating apparatus for cooling the liquid for circulation through the cooling medium pipes and also a pump 37 driven by an electric motor 38 for circulating the cooling medium to the units 17. The refrigerating system may be of any suitable type including a motor-compressor unit 40, a condenser 41 and a cooling tank 42 containing a cooling coil or evaporator 42^a, the unit, condenser and coil being operably connected by conduits 43 and 43^a. The cooled liquid is brought to the pump 37 through conduit 45 and leaves the pump through the vertically extending pipe or conduit 46. The pipe 46 enters the conduit 13, as at 47, and extends vertically upward in the conduit preferably to the uppermost floor where it is in communication with pipe 49 also disposed in duct 13 and with pipe 50 disposed in duct 14. The practice of first pumping the liquid to the highest point of distribution is a well known practice to obtain good distribution of the liquid throughout the building. Branch pipes 51 for each floor extend through the branch ducts 15 and may be connected, such as by fittings, to the vertically extending pipes 49 and 50. Also housed within the ducts 13 and 14 are return pipes 53 having branch communicating pipes 54 in ducts 15. Also in ducts 13 and 14 are drain pipes 55 having communicating branch pipes 56 in ducts 15. The drain pipes 55 empty into a common drain pipe 58 to the sewer.

The cooling element 21 of the units 17 may be

connected in communication with the pipes 51 and 54 through conduits or pipes 60 and 61 which extend through the openings 28 in the floors of the building. The conduit 60 is the inlet conduit and is connected, as shown, to one side or header member 21^a of the cooling element 21 preferably at the top thereof. Conduit 61 is the outlet pipe and is connected to the side or header member 21^a of the cooling element 21 opposite the inlet and preferably near the bottom of the cooling element. A drain pipe 62 is connected in communication with a drip pan 65 provided beneath the cooling element 21 for catching liquid resulting from precipitation from the room air taking place on the cooling element and is connected to drain pipe 56.

The cooling medium, in the tank 42, which may be water, may be cooled to any desired temperature by the refrigerating apparatus, the evaporation coil 42^a being in heat transfer relation with the water. The refrigerating system shown operates in the usual manner, gaseous refrigerant being withdrawn from the evaporator coil 42^a through conduit 43, by the compressor 40 which compresses it and delivers the compressed gas to the condenser 41 wherein it is liquefied. The liquid refrigerant is then delivered to the evaporator coil 42^a through conduit 43^a after first passing through a high side float mechanism or expansion valve (not shown). The cooling medium or water in the tank 42, is thus refrigerated by the evaporating refrigerant in the evaporator coil 42^a. The expanded gaseous refrigerant is withdrawn from the coil through conduit 43 by the compressor and is again delivered to the condenser and the cycle repeated. In the present system, the pump 37 pumps the cold liquid cooling medium through pipe 46 to the uppermost floor of the building, the liquid then descending through pipes 45 and 50 to pass through the branch pipes 51 and connecting pipes 60 to the cooling elements 21. Room air is circulated, as above described, over and in contact with the cooling element 21 by means of the fans 23 for transferring the sensible heat of the air to the liquid cooling medium and also to reduce the moisture content of the air which precipitates on the surface of the cooling element. Dehumidified air entering the bottom of the cabinets 19 passes over the cooling element 21 and is cooled thereby, the cooling element removing only the sensible heat of the dehumidified air. Thus, the dehumidified air is cooled upon entering the rooms through the units 17 and is also thoroughly mixed with room air that is being circulated over the cooling element 21 by the fans 23. The circulated liquid which has absorbed the heat of the room air returns to the refrigerating apparatus through pipes 61, 55 and 52 to again be refrigerated to the desired temperature.

In the operation of my system, the air treating or dehumidifying apparatus 2 is controlled or operated so that the air supplied by the fan in housing 10 to duct 12 is maintained at a higher dry bulb temperature than the dew point temperature of the air in the rooms or other spaces to be conditioned so that there will not be any precipitation of moisture from the room air onto the exposed surfaces of the ducts 13, 14 and 15. The apparatus 2 is also so controlled as to provide air of the proper moisture content to the ducts 13, 14 and 15, that is, air of such relatively low moisture content or so dehumidified that when mixed and blended with the room air, the resultant air mixture will have a suitable relative hu-

midity for human comfort. The refrigerating apparatus is also operated to cool the liquid cooling medium supplied by pump 37 to the units 17, the temperature of the cooling medium being controlled so that the dehumidified and room air which is passed over the cooling elements 21 will be chilled thereby sufficiently to provide, when mixed and blended in the room with the room air, a room air temperature suitable for human comfort. The particular dry bulb temperatures and relative humidities to be maintained in the rooms in order to provide for human comfort can be readily ascertained from the well known "comfort charts" or the temperatures and the relative humidities may be regulated or governed in accordance with the desires of the room occupants. The refrigerated liquid cooling medium can be cooled safely to a degree of temperature which can be properly utilized in the described system without any precipitation of moisture on the pipes conveying the same, as the air in the ducts and surrounding the pipes has been, in order to obtain the necessary dehumidification of the room air, dehumidified, sufficiently so that its dew point is below the dew point temperature corresponding to the temperature of the liquid cooling medium. In order that the foregoing generalization of operation may be clearly understood, a specific example illustrative of the conditions of operation may be considered as follows:

When the outdoor atmosphere has a dry bulb temperature of say 90° F., a wet bulb temperature of 75° F., and therefore a dew point temperature of about 68.7° F., the indoor atmosphere will be comfortable if it has a dry bulb temperature of say 80° F. and a wet bulb temperature of 67° F. resulting in a dew point temperature of 60° F. This condition of the room air or indoor atmosphere may be acquired by the dehumidifying and cooling systems without danger of precipitation taking place either on the air ducts exposed to room air or on the water pipes exposed to the dehumidified air. For example, in order to obtain the above comfortable indoor atmosphere, the dehumidified air in the ducts may have a dew point temperature of say 55° F. and a dry bulb temperature of 60° F. and the temperature of the water or cooling medium passing through the pipes within the air ducts could be 55° F.

From the foregoing description, it will now be appreciated that I have provided an air conditioning system of a character such that the necessity of using insulating covering either for the air ducts or the liquid cooling medium pipes is eliminated without resultant precipitation from the air taking place thereon. In this system, the dehumidified air can be initially cooled to a dry bulb temperature less than the dry bulb temperature of the room air without precipitation from room air on the air ducts so that, if desired, the dehumidified air may be employed as a cooling medium to cool the room air, as well as, to reduce its humidity. It will also be appreciated that the liquid cooling medium pipes are insulated to a highly efficient degree when arranged in the dehumidified air ducts, for the dehumidified air can be initially cooled to a dry bulb temperature substantially equal to the temperature of the cooling medium so that there will be substantially no transfer of heat from the dehumidified air to the liquid cooling medium. In fact, for all practical purposes, the dry bulb temperature of the dehumidified air could be a degree or two

lower than the temperature of the liquid cooling medium without any noticeable precipitation taking place so that there would be no transfer of heat from the dehumidified air to the liquid cooling medium. Since the liquid cooling medium cannot absorb heat from the dehumidified air if the temperature of the air is lower, the dehumidified air or cooling medium provides a more efficient insulating medium than conventional insulating materials. Even though the dry bulb temperature of the dehumidified air is maintained at a temperature higher than the temperature of the cooling medium, transfer of heat to the cooling medium would be negligible if pipes having a small exposed surface are employed for the liquid cooling medium and particularly so if polished copper or brass pipes are used. Furthermore, it will be seen that transfer of heat from the dehumidified air to the liquid cooling medium would not entail a loss, since the amount of refrigeration given up by the cooling liquid has its equivalent cooling effect in the rooms.

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

1. In a system for conditioning the air in a building, duct means for conveying dehumidified air for supply to the building atmosphere, and second duct means within the first for circulating a cooling medium whereby the dehumidified air in the first duct means serves to insulate the cooling medium in said second duct means against heat, the dew point temperature of the dehumidified air being below the temperature of the cooling medium to prevent the condensation of moisture on said second duct means.

2. In a system for conditioning the air in a building, duct means for the passage of dehumidified air to a room of a building, means for transferring air through said duct means, a second duct means for circulating a cooling medium, said second duct means being inclosed within the first-named duct means, said dehumidified air having a dry bulb temperature higher than the dry bulb temperature of the room air surrounding said first-named duct means to prevent the condensation of room air moisture on said first-named duct means, and means for cooling said cooling medium.

3. In a system for conditioning the air in a building, duct means for conveying dehumidified air, and a second duct means within said first named duct means for circulating a liquid cooling medium, the dew point temperature of the dehumidified air being below the temperature of the cooling medium whereby to prevent the condensation of moisture on said liquid conveying duct means.

4. In a system for conditioning the air in a building, a plurality of pipes for circulating a liquid cooling medium through the building, refrigerating apparatus for refrigerating said cooling medium, duct means surrounding said pipes for insulating the same, means for propelling dehumidified air through said ducts for ventilating the building, and means for dehumidifying the air prior to its delivery through said ducts, said dehumidified air having a dew point temperature below the temperature of the cooling medium whereby condensation of moisture from the dehumidified air on the cooling medium pipes is prevented.

5. In a system for conditioning the air in a building, duct means in the building for the transfer of dehumidified air, means for dehu-

midifying the air, outlets in a wall of said duct means for discharge of air into the rooms, second duct means for the circulation of a liquid cooling medium, said second-named duct means being disposed within the first, and refrigerating apparatus for cooling said liquid cooling medium.

6. In a system for conditioning the air in a room or other enclosed space, duct means through which a cooling medium is conveyed to the room for heat transfer relation with the room air, a second duct means enclosing said first-named duct means and through which dehumidified air is supplied to the room, said dehumidified air having a dew point temperature below the temperature of the cooling medium whereby to prevent condensation of moisture from the dehumidified air on said first-named duct means, said dehumidified air having a dry bulb temperature higher than the dew point temperature of the room air surrounding said second-named duct means, to prevent condensation of moisture from the room air on the outer wall of said second-named duct means.

7. In a system for conditioning the air in a room or other enclosed space, duct means, means for circulating a cooling medium through said duct means for heat transfer relation with the room air, a second duct means enclosing said first-named duct means, and a dehumidifying apparatus for supplying air to the room through said second-named duct means at a dew point temperature below the temperature of the cooling medium in said first-named duct means and at a higher temperature than the dew point temperature of the room air surrounding said second-named duct means, whereby condensation of moisture from the dehumidified air on said first-named duct means and condensation of moisture from the room air on the outer wall of second-named duct means will not occur.

8. In a system for conditioning the air in a room or other enclosed space, duct means leading to the room, air conditioning apparatus for supplying dehumidified air to the room through said duct means at a dry bulb temperature higher than the dew point temperature of the room air to prevent condensation of moisture from the room air on the duct means, conduit means located within the duct means in exposed relation to the dehumidified air therein, means for circulating a cooling medium through said conduit means for heat transfer relation with the room air, and means for refrigerating said cooling medium, said cooling medium being maintained at a temperature higher than the dew point temperature of the air passing through the duct means to prevent precipitation of moisture from the dehumidified air on the conduit means.

9. In a system for conditioning the air in the rooms of a building, duct means extending through the building and exposed to the air of

the rooms, said duct means having outlets into the rooms, means for supplying dehumidified air to the rooms through said duct means, said dehumidified air having a temperature while passing through said duct means higher than the dew point temperature of the surrounding room air to prevent condensation of room air moisture on said duct means, conduit means leading to said rooms within said air duct means and exposed to the dehumidified air therein, and means for circulating a cooling medium through said conduit means for heat transfer relation with the air of the room, said cooling medium having a temperature within the conduit means higher than the dew point temperature of the surrounding dehumidified air in said duct means to prevent condensation of moisture from the dehumidified air on said conduit means.

10. In an air conditioning system for conditioning the air in the rooms of a building, duct means of heat conducting material extending through the building in exposed relation to the air in the rooms, said duct means having outlets for each room, a dehumidifying apparatus for supplying dehumidified air to the rooms, said dehumidified air having a temperature in the duct means higher than the dew point temperature of the surrounding room air to prevent condensation of room air moisture on the exposed duct means, cooling elements at said air outlets, conduit means extending through the air duct means and leading to said cooling elements, means for supplying a cooling medium to said elements through said conduit means and at a temperature above the dew point temperature of the dehumidified air to prevent condensation of moisture from the dehumidified air on the cooling medium conduit means.

11. In an air conditioning system for conditioning the air in the rooms of a building, duct means of heat conducting material extending through the building in exposed relation to the air in the rooms, said duct means having outlets for each room, a dehumidifying apparatus for supplying dehumidified air to the rooms through said duct means, said dehumidified air having a temperature in the duct means higher than the dew point temperature of the surrounding room air to prevent condensation of room air moisture on the exposed ducts, cooling elements at the air outlets, conduit means extending through the air duct means and leading to said cooling elements, means for supplying a cooling medium to said cooling elements through said conduit means and at a temperature above the dew point temperature of the dehumidified air in said duct means to prevent condensation of the moisture of the dehumidified air on the conduit means, and means for mixing the dehumidified air with the room air at the said outlets.

JAMES H. O'BRIEN.