Sept. 22, 1942. E. E. McEWAN 2,296,725

REFRIGERATING APPARATUS

Filed March 30, 1939 5 Sheets-Sheet 1

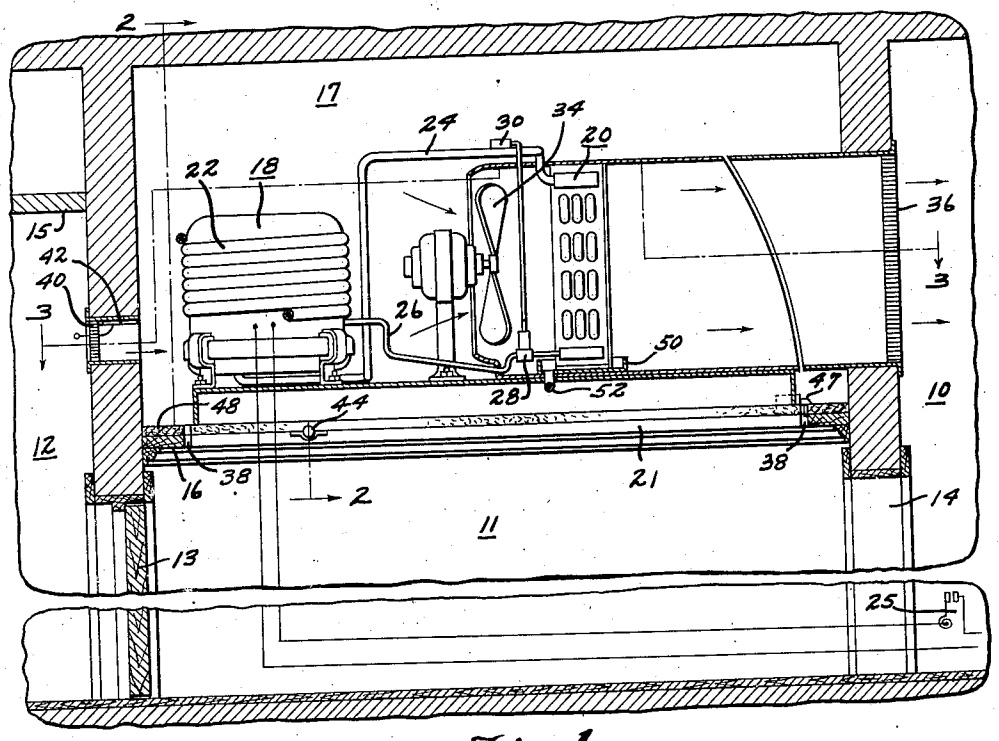

Fig. 1

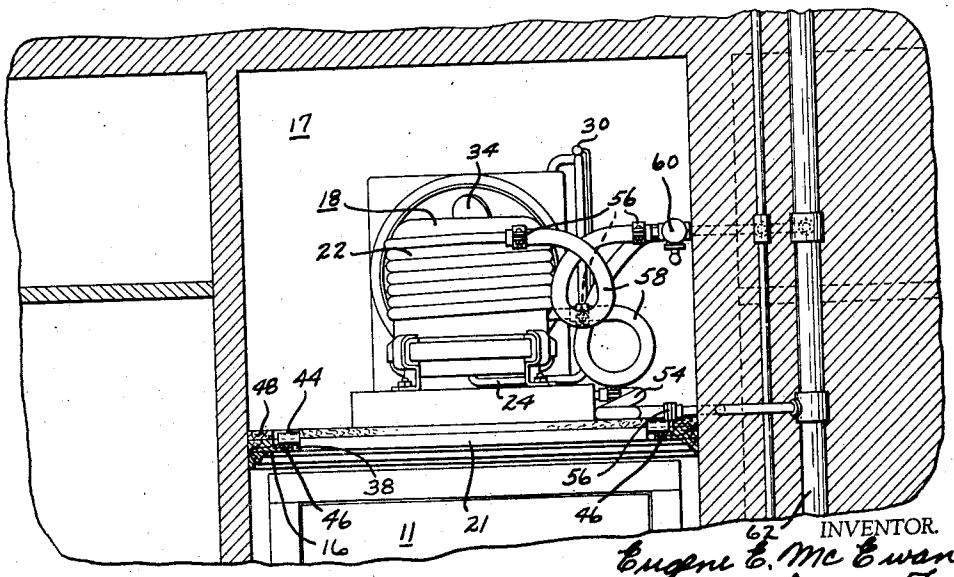

Fig. 2

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REFRIGERATING APPARATUS

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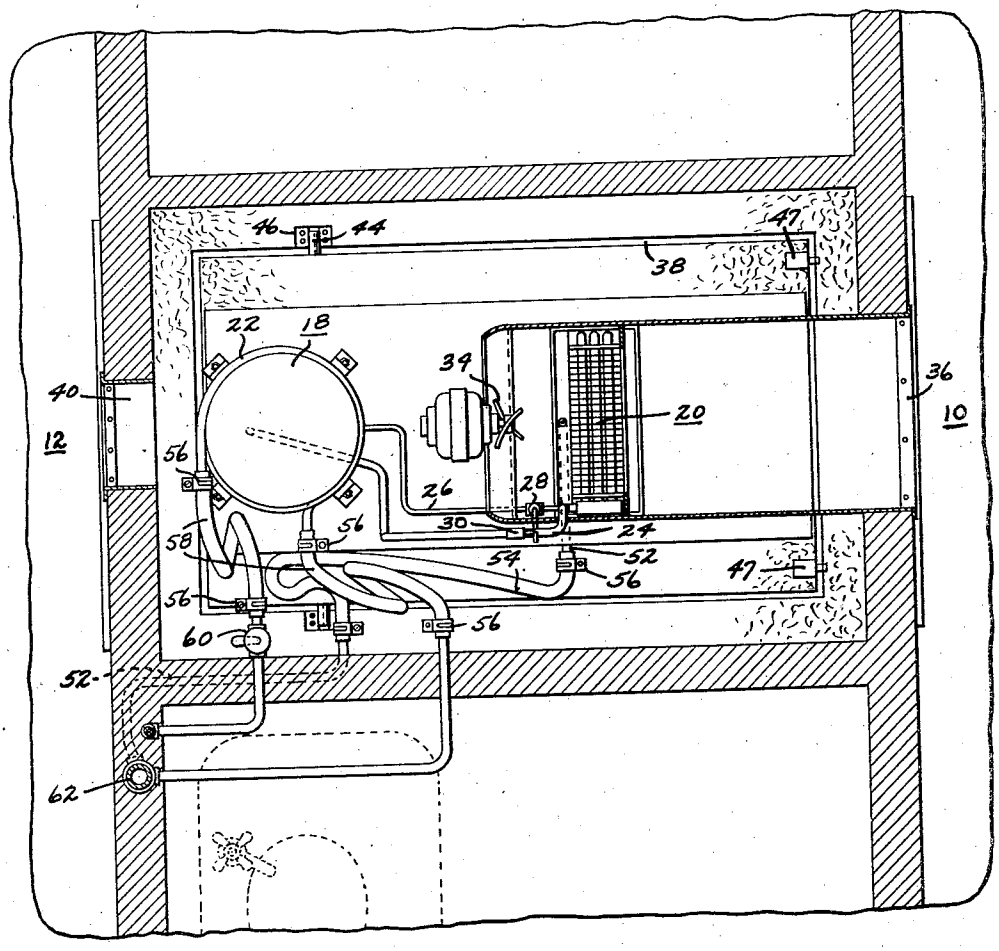

Fig. 3

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REFRIGERATING APPARATUS

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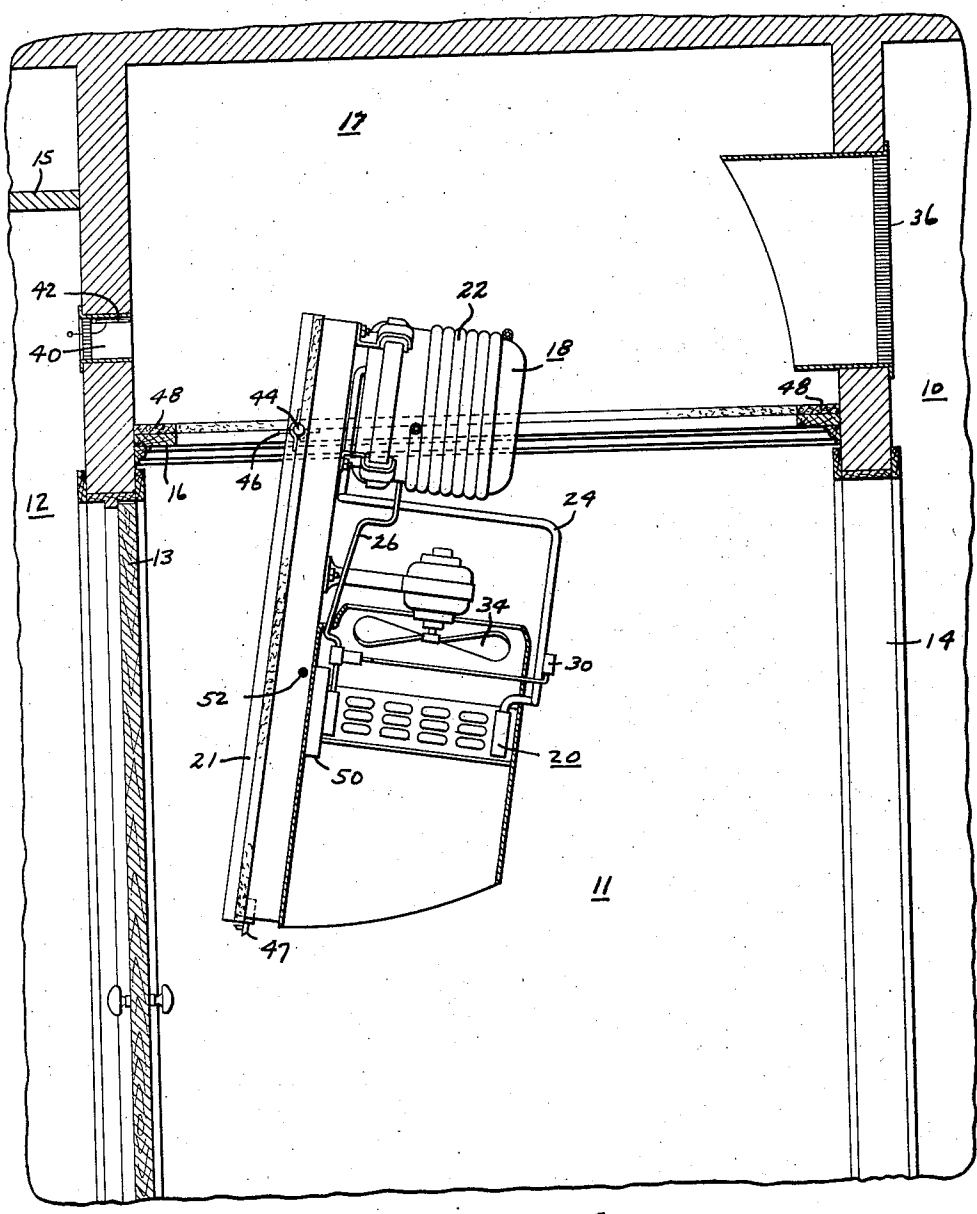

Fig. 4

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REFRIGERATING APPARATUS

Filed March 30, 1939 5 Sheets-Sheet 4

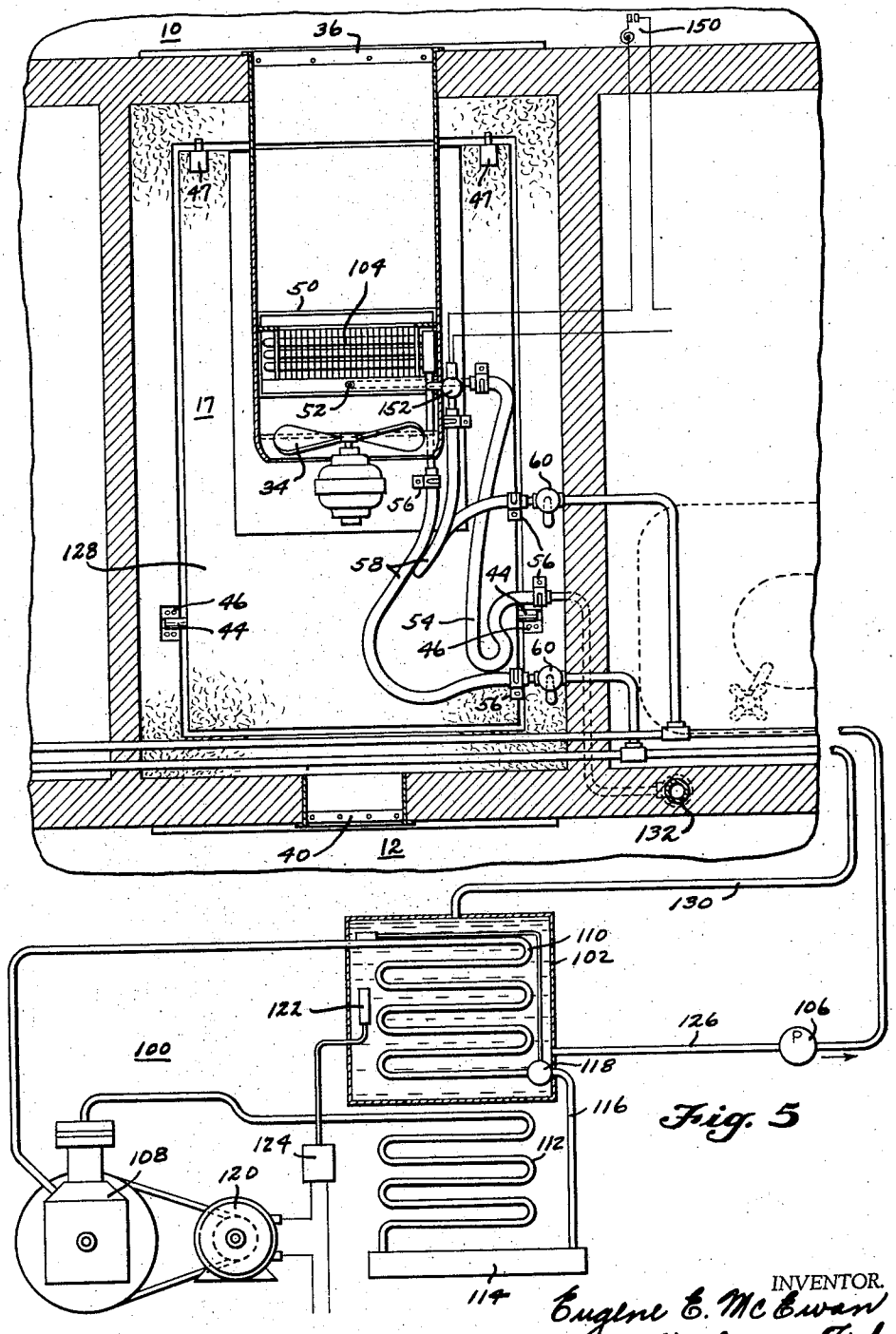

Fig. 5

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REFRIGERATING APPARATUS

Filed March 30, 1939 5 Sheets-Sheet 5

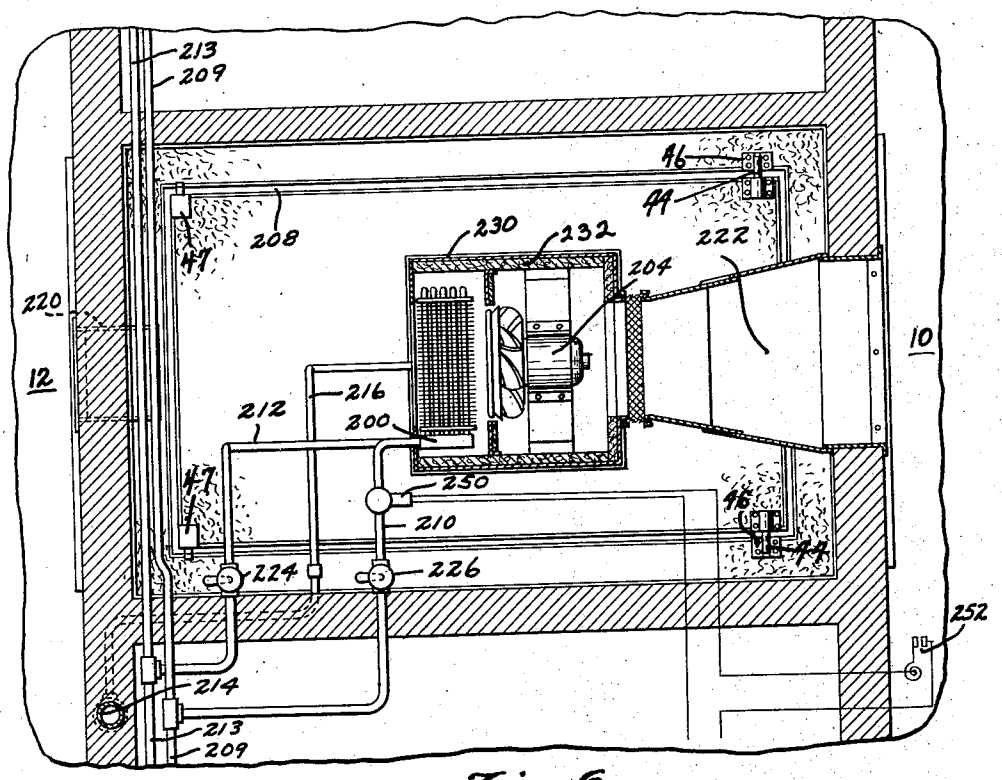

Fig. 6

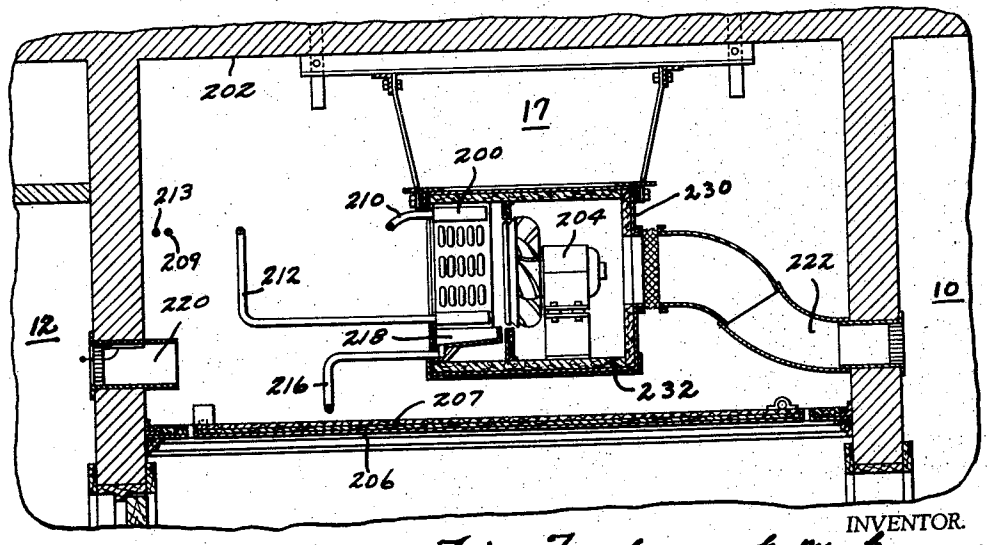

Fig. 7

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Patented Sept. 22, 1942

2,296,725

UNITED STATES PATENT OFFICE

2,296,725

REFRIGERATING APPARATUS

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Application March 30, 1939, Serial No. 265,005

11 Claims. (Cl. 62—140)

This invention relates to refrigerating apparatus and more particularly to apparatus for cooling and dehumidifying air.

One object of this invention is to provide conditioning apparatus which may be concealed from view by means of a removable panel.

Another object of this invention is to provide a special system of refrigeration suitable for installation in hotels, offices and the like.

Another object of this invention is to provide air conditioning apparatus for a hotel room or the like which does not require the usual form of unsightly return air grille.

Still another object of this invention is to so construct and arrange the conditioning apparatus that acoustical material may be placed immediately adjacent the conditioning unit.

Another object of the invention is to provide air conditioning apparatus which is readily accessible for maintenance and service.

A further object of this invention is to provide air conditioning apparatus which may be mounted above a false ceiling panel without marring or otherwise defacing the ceiling.

Still another object of this invention is to provide an air conditioning system which is inexpensive, simple to install, quiet, and at the same time readily accessible for inspection and repair.

Another object of this invention is to provide an improved return air grille or panel.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Fig. 1 is an elevational view partly in section showing somewhat diagrammatically one form of air conditioning apparatus mounted above the false ceiling in the foyer of a hotel suite;

Fig. 2 is a sectional view taken on line 2—2 as shown in Figs. 1 and 3;

Fig. 3 is a sectional plan view taken on line 3—3 of Fig. 1;

Fig. 4 is a view somewhat similar to the view shown in Fig. 1 showing the air conditioning apparatus lowered for inspection and repair purposes;

Fig. 5 is a view corresponding to the view in Fig. 3 showing a modified form of air conditioning equipment;

Fig. 6 is a view somewhat similar to Figs. 3 and 5 showing a still further modified form; and

Fig. 7 is an elevational view partly in section of the apparatus shown in Fig. 6.

In the ordinary systems for conditioning rooms in hotels and private offices, it has been customary to place the entire apparatus or at least the cooling coil directly within the conditioned space. Units mounted directly within the room are of necessity noisy as well as unsightly and very often occupy valuable space. I have designed a conditioning apparatus which is suitable for mounting above a false ceiling or which may be concealed behind a wall panel or the like.

Referring now to Fig. 1 in which I have shown one modification of my invention, the reference character 10 designates a hotel room or the like, 11 designates a foyer having a false ceiling 16, and 12 designates the corridor having a false ceiling 15, this being a common arrangement in many hotels. With this arrangement, a person coming from the outside first enters the corridor 12 which is separated from the foyer by the usual entrance door 13. Between the foyer 11 and the room 10 there is an opening 14.

In the modification shown in Fig. 1 the conditioning apparatus comprises a hermetically sealed motor-compressor-condenser unit 18 and an evaporator 20, both of which are mounted on the panel 21 which is a part of the false ceiling 16. The panel 21 is slightly smaller than the opening in which it is mounted whereby an air passage 38 is formed surrounding the panel 21. The hermetically sealed motor-compressor-condenser unit 18 is of the type in which the housing of the motor-compressor unit constitutes the condenser for the compressed refrigerant. Inasmuch as it is not convenient to circulate outside air over the condenser to cool the same, water pipes 22 are provided which encircle the motor-compressor-condenser housing 18 and which are connected to any convenient source of cold water such as the water mains or a source of refrigerated water. The refrigerant which is evaporated in the evaporator 20 returns to the motor-compressor-condenser unit through the line 24, and the condensed refrigerant is discharged from the housing 18 through the line 26 which leads to the lower part of the evaporator. The usual form of thermostatic expansion valve 28 is provided for controlling the flow of refrigerant from the condenser to the evaporator. The thermostatic bulb 30 is provided for closing the expansion valve 28 in the event that liquid refrigerant enters the return line 24. A thermostat 25 located so as to be responsive to the room temperature starts and stops the compressor motor.

The air to be conditioned is circulated by means of the fan 34 which forces the air over the evap-

orator and thereafter through the outlet grille 36 into the room 10. The return air from room 10 enters the foyer 11 and thereafter passes upwardly into the conditioning compartment through the passage 38 which is formed at the periphery of main panel 21. A certain amount of outside air is permitted to enter the corridor, and from thence enters the air conditioning compartment 17 through the opening 40 provided directly between the corridor and the compartment 17.

In order to control the amount of outside air introduced, I have provided a manually operated damper 42 in the opening 40. While, for purposes of illustration, this has been shown as being manually operated, it is to be understood that this may be operated automatically in response to the dry bulb temperature, effective temperature, or moisture content of either the room air or the outside air.

Inasmuch as it is desirable to have the air conditioning apparatus readily accessible for inspection and repair, the main supporting panel 21 is pivotally mounted by means of the trunnions 44 which are supported in the open bearings 46. In order to hold the panel in its operative position, I have provided latch members 47 which latch the panel in place. By unlatching the latches 47 the main panel 21 swings into the position in which it is shown in Fig. 4. In order to facilitate the raising and lowering of the panel 21 and its associated parts, the motor-compressor-condenser unit which is the heaviest portion of the apparatus is mounted on that end of the panel which is most directly above the pivot. By properly placing the elements on the panel very little effort is required to raise and lower the panel. Inasmuch as the bearings 46 are of the open type, the entire air conditioning unit may be readily lowered from the position in which it is shown in Fig. 4 merely by raising the apparatus, turning it slightly about its vertical axis, and then lowering it. All minor repairs may be made on the apparatus in the position in which it is shown in Fig. 4. Sound insulating material 48 is placed on the upper side of the false ceiling 16 whereby very little of the noise is transmitted from the conditioning compartment to the hotel room.

Inasmuch as a certain amount of condensate forms on the evaporator, it is necessary to provide means for draining the condensate which is formed from time to time. To accomplish this purpose, I have provided a condensate collecting pan 50 which has a drain line 52. The line 52 includes a flexible portion 54 which may comprise an ordinary rubber hose or the like which is of sufficient length to permit the conditioning apparatus to swing from the position in which it is shown in Fig. 1 to the position in which it is shown in Fig. 4 without disconnecting the drain line.

Any convenient form of clamps 56 may be used for securing the flexible hose to the rigid pipes. Inasmuch as water is circulated through the cooling coil 22, it is also necessary to provide the cooling coil inlet and outlet pipes with each a section of flexible tubing 58 which is similarly held in place by means of clamps such as 56. Inasmuch as it may be desirable at times to completely disconnect the water coil from the supply lines, a shut-off valve 60 has been provided in the main supply line whereby the water supply may be shut off before disconnecting the flexible tubing 58. The condensate and the waste water from the water cooling coil are both discharged through the drain pipe 62. The water discharged into the drain 62 may be cooled by any suitable means and reused, or it may be discharged into the sewer or any equivalent drain.

In certain types of installations it is more expedient to mount the motor-compressor mechanism at a point remote from the cooling coil. In Fig. 5 I have shown a system of this type in which a single primary refrigerating system, generally designated by the reference character 100, is used for cooling water or the like in a main storage tank 102 from which the cooling fluid is circulated to one or more cooling coils 104 by means of a pump 106. With this type of arrangement, the cooling fluid from the supply tank 102 may be circulated to a plurality of individual room cooling coils mounted in the same manner in which the cooling coil shown in the first modification is mounted.

For purposes of illustration, the refrigerating mechanism for cooling the water in the main supply tank 102 has been shown as comprising a compressor 108 which withdraws vaporized refrigerant from the evaporator 110 and discharges the compressed refrigerant into the condenser 112 in which the refrigerant is condensed. The liquid refrigerant which collects in the receiver 114 flows through the line 116 leading to the evaporator and is controlled by the usual form of thermostatic expansion valve 118. The compressor 108 is driven by means of an electric motor 120 which is started and stopped in response to the temperature of the cooling fluid in the main supply tank 102. For purposes of illustration, I have disclosed a temperature responsive element 122 which is adapted to control the circuit maker and breaker 124 in the usual well-known manner.

The pump 106 circulates the cooling fluid through the supply line 126 which leads to one or more cooling coils such as cooling coil 104 which is carried directly by the ceiling panel 128 corresponding to the ceiling panel 21 shown in the first modification. The cooling fluid leaving the coil 104 is returned to the main supply tank 102 by means of the pipe line 130, and the condensate water is disposed of in the same manner in which the condensate water is disposed of in the first modification; namely, by discharging into a drain 132. The various pipe lines may be placed in the space above the false ceiling or may be imbedded directly in the walls. The cooling coil 104 together with the associated ducts, etc., all of which are similar to the ducts shown in Figs. 1 through 4 may be inspected and serviced in the same manner in which the cooling coil shown in the first modification may be inspected and serviced. While I have shown the cooling medium as being supplied from the refrigerated tank 102, other sources of cooling fluid may be used. The cooling fluid may be ordinary water from the city mains in those installations where this water or a similar source of cold water is available for cooling purposes. A thermostat 150 is provided in the conditioned space for controlling the solenoid valve 152 at the inlet to the coil 104.

In Figs. 6 and 7, I have shown a slightly modified arrangement in which the room cooling coil 200 is directly suspended from the main ceiling 202 and in which the conditioned air is circulated over the coil 200 by means of a fan 204 which is also supported from the ceiling 202. In this modification, a false ceiling similar to the

false ceiling shown in the other modifications is provided which comprises a pivotally mounted panel 206 corresponding to the panel 21 shown in Fig. 1. The panel 206 is slightly smaller than the opening in the ceiling in which it is mounted so as to provide an air intake opening 208 similar to the air intake openings shown in the other modifications. The panel 206, however, has none of the air conditioning mechanism supported thereon. As in the other modifications, sound insulating material such as 207 is secured to one side of the panel 206.

The cooling coil 200 may be supplied with a volatile refrigerant or it may be supplied with any suitable cooling fluid such as precooled water or ordinary tap water. The cooling medium is supplied to the coil 200 through the feeder pipe 209 which is connected to the branch line 210 leading to the cooling coil 200 and is discharged from the cooling coil through the line 212 which leads to the main return line 213. The condensate is discharged into the drain 214 by means of the drain pipe 216 which leads from the condensate collecting pan 218 to the main drain pipe 214.

In this modification, as in the prior modifications described, the air to be conditioned enters the compartment above the false ceiling panel 206 through the rectangular opening or slot 208. A certain amount of corridor air may enter through the opening 220 in the same manner as in the other modifications. The air to be conditioned which enters the space above the panel 206 is caused to circulate over the coil 200 and is thereafter discharged into the main room through the duct 222. The valves 224 and 226 have been provided so as to make it possible to shut off the flow of cooling medium through the cooling coil and, if necessary, disconnect the cooling coil from the main supply lines. The flow of cooling fluid through coil 200 is controlled by the solenoid valve 250. Thermostat 252 located in the conditioned space controls the operation of the valve 250.

In each of the modifications the arrangement is such that sound insulation may be used to the best advantage without interfering with the operation and efficiency of the device. Thus, in the modification shown in Figs. 6 and 7, the coil 200 as well as the fan 204 are mounted within the chamber 230 which is lined with sound insulating material 232. Similar sound insulating material may be provided in the other modifications. By providing sound insulating material around the fan unit as well as on the upper side of the ceiling panel a very quiet conditioning unit is provided.

For simplicity of illustration the air circulating fans have not been shown as being under control of the room thermostats since these fans may be operated continuously. However, manual and/or automatic controls responsive to the psychrometric condition of the air in the conditioned space may be used for starting and stopping each fan.

While the form of embodiment of the invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. In combination with a room or the like, a main supporting panel, a volatile refrigerant evaporator supported on said panel, refrigerant liquefying means for supplying refrigerant to said evaporator supported on said panel, a recess in one wall of said room having an opening slightly larger than said panel, means for supporting said panel substantially centrally of said opening whereby an air passage is formed between said panel and the edges of said opening and whereby said evaporator and liquefying means are concealed from view, and means for circulating air from said room through said air passage into thermal exchange with said evaporator and back into said room.

2. In combination with a room or the like, a main supporting panel, a volatile refrigerant evaporator supported on said panel, refrigerant liquefying means for supplying refrigerant to said evaporator supported on said panel, a recess in one wall of said room having an opening slightly larger than said panel, means for supporting said panel substantially centrally of said opening whereby an air passage is formed between said panel and the edges of said opening and whereby said evaporator and liquefying means are concealed from view, means for circulating air from said room through said air passage into thermal exchange with said evaporator and back into said room, and a layer of sound insulating material between said panel and said air circulating means.

3. In a hotel or the like having a plurality of adjoining rooms; air conditioning and circulating apparatus disposed within one of said rooms adjacent the ceiling thereof; a false ceiling below said apparatus for enclosing and concealing the same from view; said false ceiling comprising a border portion, a substantially centrally disposed panel section and a narrow air passage formed around the outer edges of said panel section whereby air to be conditioned may pass upwardly through said passage and into said conditioning compartment; means for discharging the conditioned air into a room adjoining said one room; said air conditioning and circulating apparatus comprising a volatile refrigerant evaporator and a refrigerant liquefying unit for supplying refrigerant to said evaporator; and means for circulating air from said room in thermal exchange with said evaporator; said refrigerant evaporator, liquefying unit and fan being directly supported by said panel section.

4. In a hotel or the like having a foyer between the main corridor and a room the air of which is to be conditioned, air conditioning apartus disposed adjacent the ceiling of said foyer, a false ceiling below said conditioning apparatus, an access opening in said false ceiling, a panel member slightly smaller than said opening substantially centrally disposed within said opening whereby an air passage is formed between said panel and the outer extremity of said opening, means for circulating air to be conditioned upwardly through said passage into thermal exchange with a portion of said apparatus and thereafter back into said room, said air conditioning apparatus comprising a volatile refrigerant evaporator, and a refrigerant liquefying unit for supplying liquid refrigerant to said evaporator.

5. In a hotel or the like having a foyer between the main corridor and a room the air of which is to be conditioned, air conditioning apparatus disposed adjacent the ceiling of said foyer, a false ceiling below said conditioning apparatus, an access opening in said false ceiling, a panel member slightly smaller than said opening substantially centrally disposed within said

opening whereby an air passage is formed between said panel and the outer extremity of said opening, means for circulating air to be conditioned upwardly through said passage into thermal exchange with a portion of said apparatus and thereafter back into said room, said air conditioning apparatus comprising a cooling coil arranged in the path of the air circulated by said air circulating means.

6. In a hotel or the like having a foyer between the main corridor and a room the air of which is to be conditioned, air conditioning apparatus disposed adjacent the ceiling of said foyer, a false ceiling below said conditioning apparatus, an access opening in said false ceiling, a panel member slightly smaller than said opening substantially centrally disposed within said opening whereby an air passage is formed between said panel and the outer extremity of said opening, and means for circulating air to be conditioned upwardly through said passage into thermal exchange with a portion of said apparatus and thereafter back into said room.

7. In a hotel or the like having a plurality of adjoining rooms; air conditioning and circulating apparatus disposed within one of said rooms adjacent the ceiling thereof; a false ceiling below said apparatus for enclosing and concealing the same from view; said false ceiling comprising a border portion, a substantially centrally disposed panel section and a narrow air passage formed around the outer edges of said panel section whereby air to be conditioned may pass upwardly through said passage and into said conditioning compartment; and means for discharging the conditioned air into a room adjoining said one room.

8. In combination with a room or the like having a false ceiling portion, an air conditioning compartment disposed above said false ceiling, air conditioning means within said compartment, an access opening in said false ceiling between said room and said compartment, a removable panel slightly smaller than said opening disposed within said opening for concealing said apparatus and for separating said room from said compartment, and means for circulating air to be conditioned from said room through the space between said panel and said opening over said air conditioning means and returning the same to said room.

9. An air conditioning panel unit for a room, or the like, comprising in combination, a wall portion having an opening therein, a sound absorbing panel member smaller than the opening disposed substantially centrally within said opening and having a flat surface substantially in alignment with said wall portion, and means for conditioning air mounted on the back of said panel member, said means comprising a cooling coil and means for circulating air to be conditioned from said room through the opening formed around the periphery of said panel member, thence in thermal exchange with said cooling coil and back into said room.

10. In combination with a room or the like having a false ceiling portion, an air conditioning compartment disposed above said false ceiling, air conditioning means within said compartment, an access opening in said false ceiling between said room and said compartment, a removable panel slightly smaller than said opening disposed within said opening for concealing said apparatus and for separating said room from said compartment, means for circulating air to be conditioned from said room through the space between said panel and said opening over said air conditioning means and returning the same to said room, and means located remote from said air conditioning means for supplying an air cooling liquid to said air conditioning means.

11. An air conditioning panel unit for a room, or the like, comprising in combination, a wall portion having an opening therein, a sound absorbing panel member smaller than the opening disposed substantially centrally within said opening and having a flat surface substantially in alignment with said wall portion, means for conditioning air mounted on the back of said panel member, said means comprising a cooling coil and means for circulating air to be conditioned from said room through the opening formed around the periphery of said panel member, thence in thermal exchange with said cooling coil and back into said room, and means located remote from said cooling coil for refrigerating water and for circulating said refrigerated water between said cooling coil and said refrigerating means.

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