Oct. 6, 1936. C. F. HAUNZ 2,056,353

APPARATUS FOR CONDITIONING AIR AND OTHER GASES

Filed April 19, 1933 4 Sheets-Sheet 1

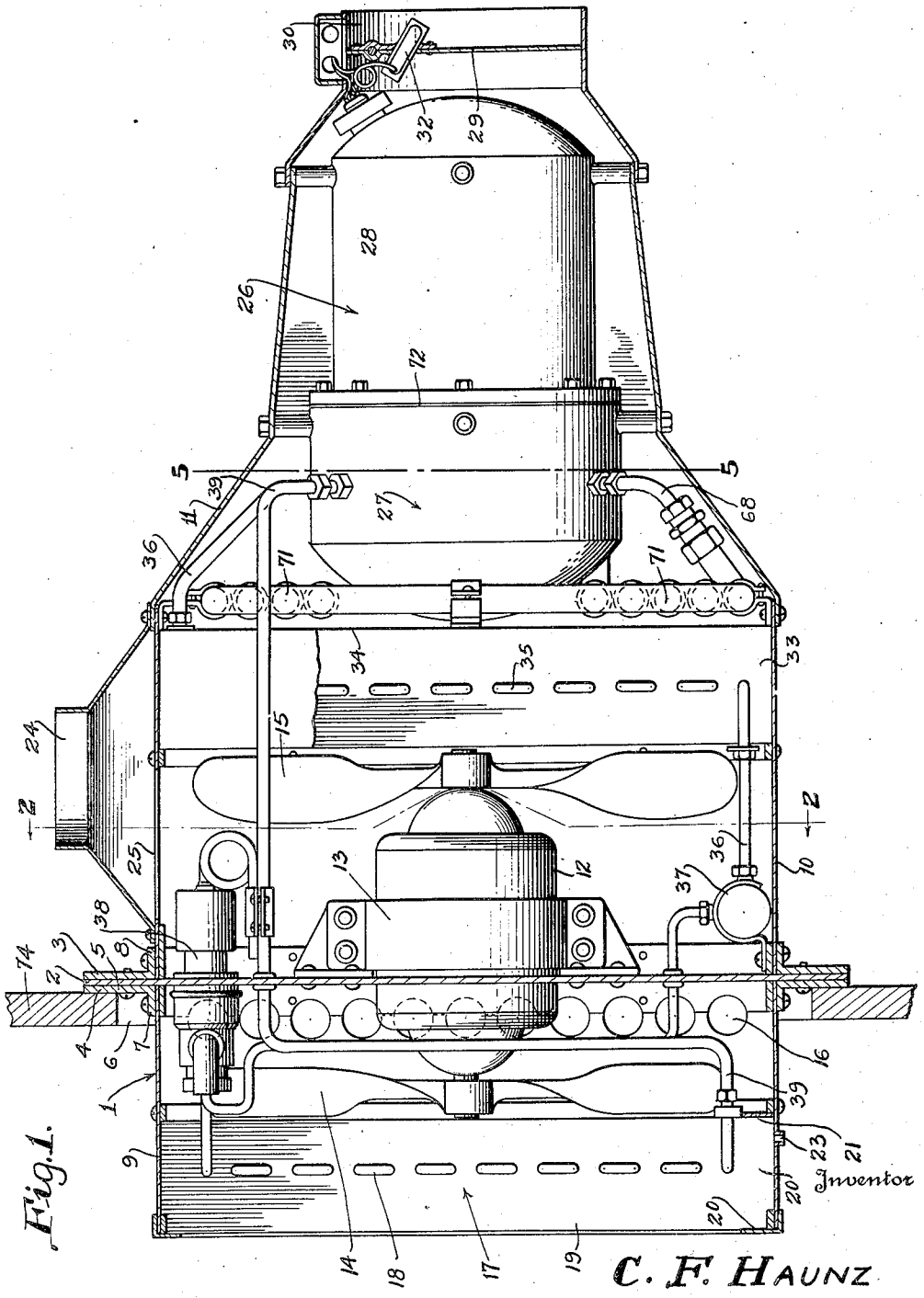


Fig. 1.

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APPARATUS FOR CONDITIONING AIR AND OTHER GASES

Filed April 19, 1933 4 Sheets-Sheet 2

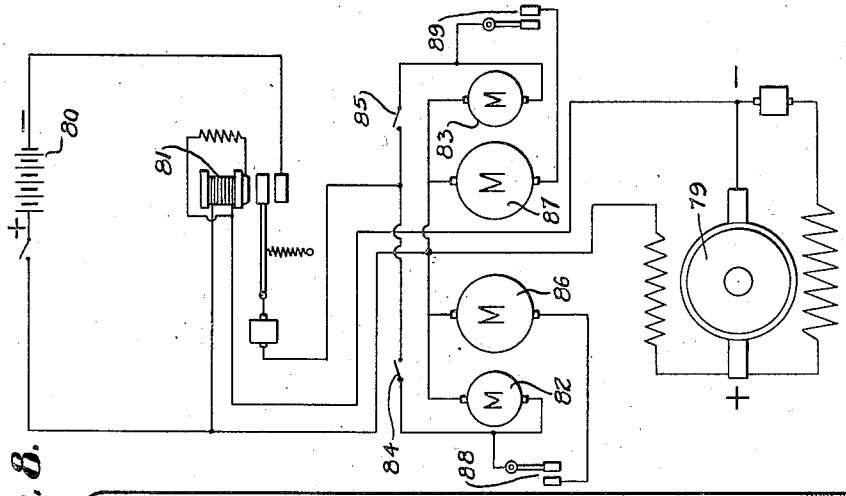


Fig. 8.

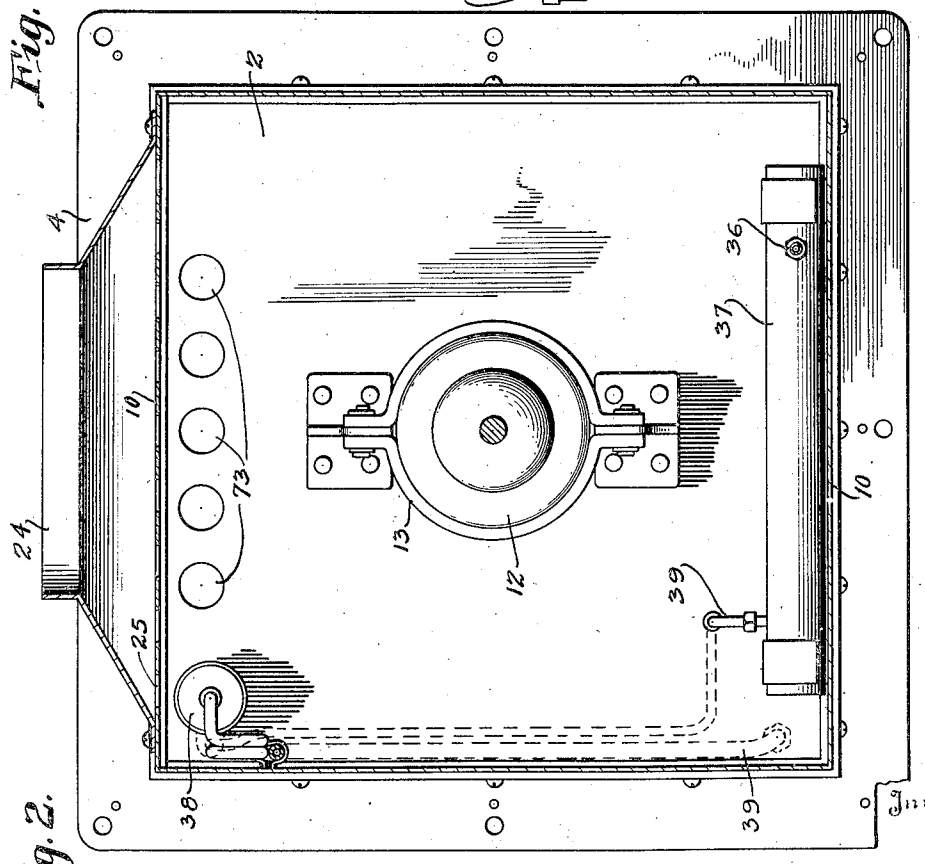


Fig. 2.

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APPARATUS FOR CONDITIONING AIR AND OTHER GASES

Filed April 19, 1933 4 Sheets-Sheet 3

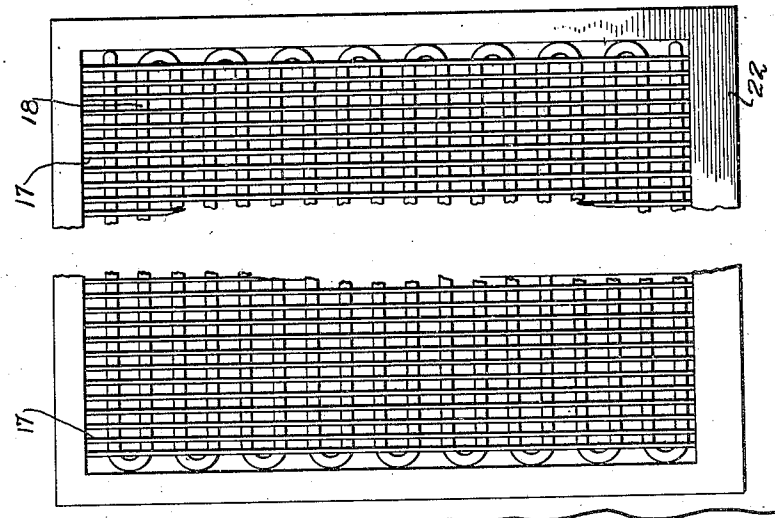


Fig. 3.

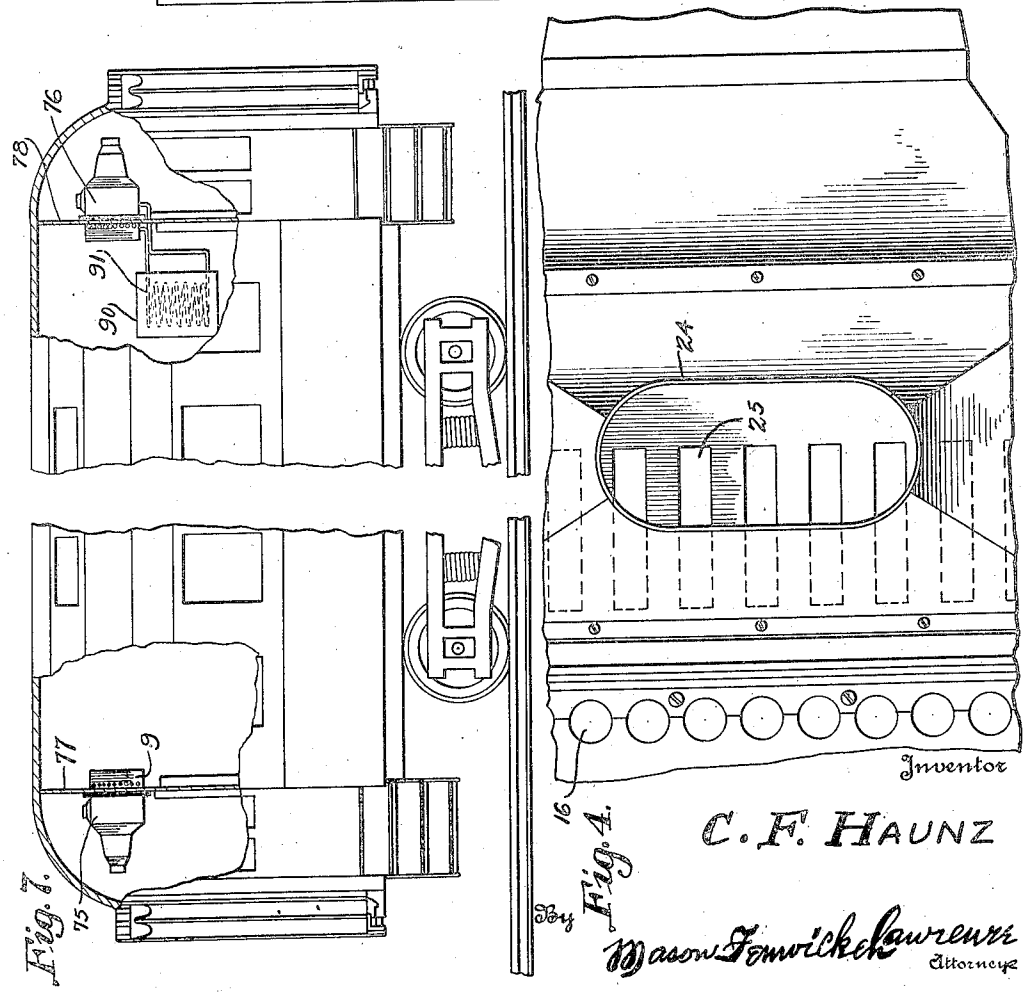


Fig. 1.

Fig. 4.

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APPARATUS FOR CONDITIONING AIR AND OTHER GASES

Filed April 19, 1933 4 Sheets-Sheet 4

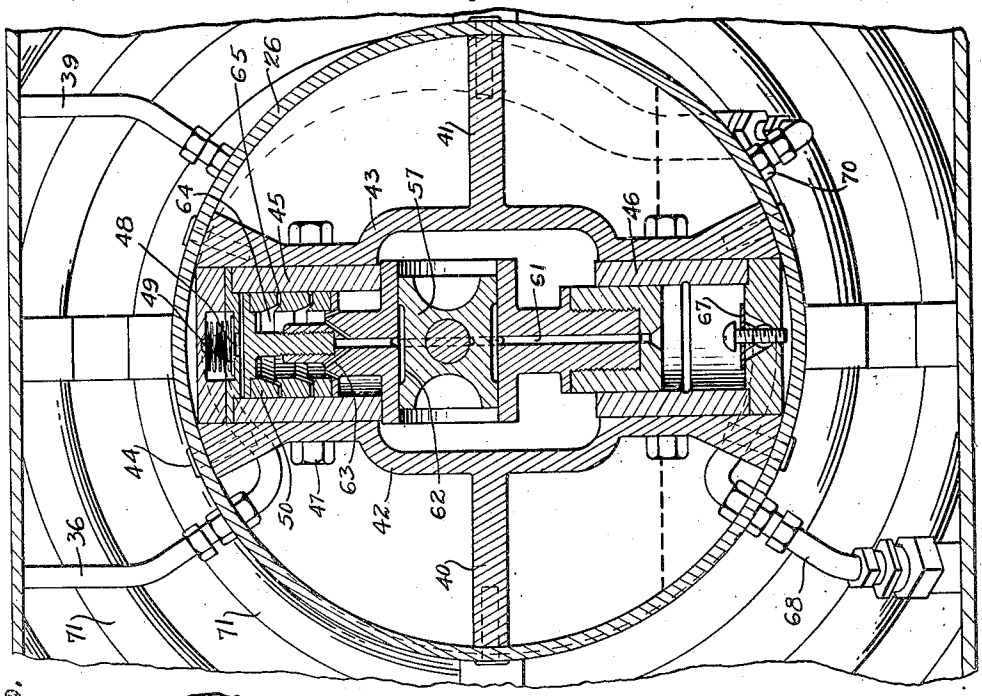


Fig. 5.

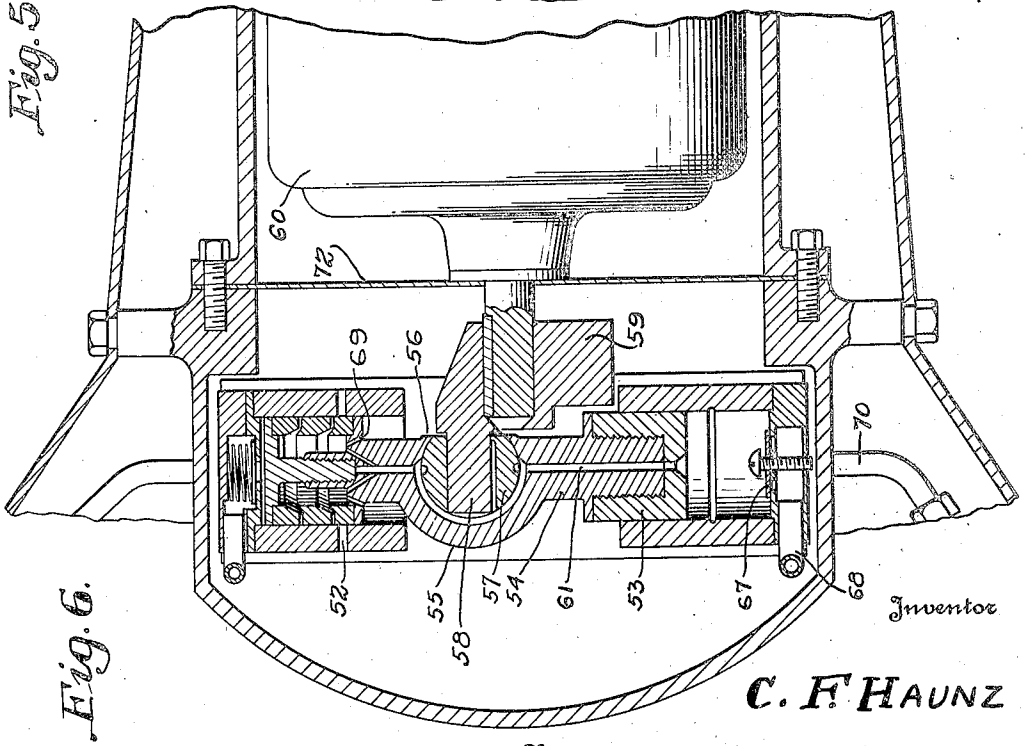


Fig. 6.

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Patented Oct. 6, 1936 2,056,353

UNITED STATES PATENT OFFICE

2,056,353

APPARATUS FOR CONDITIONING AIR AND OTHER GASES

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Application April 19, 1933, Serial No. 666,924

8 Claims. (Cl. 62—4)

This invention relates to apparatus for conditioning air and other gases through cooling and dehumidification.

One of the objects of the invention is to provide apparatus of the class described including, preferably in unitary assemblage, a mechanical refrigeration system having the evaporator thereof arranged within the chamber the atmosphere of which is to be conditioned, and having the compressor and condenser arranged outside of said chamber and preferably in the open air, the apparatus including means for creating currents of air, one within the chamber whose atmosphere is to be conditioned for directing said current into heat exchanging proximity to said evaporator and the other outside of said chamber for bringing the outside air into cooling relationship to the compressor, condenser, and parts appurtenant thereto.

Another object of the invention is to provide for the cooling of the lubricant of the compressor by circulating it through a conduit placed in the path of the outside air current.

Still another object of the invention is the provision in apparatus as above described of a motor for operating the current producing means and a motor for operating the compressor, the operation of the first motor being incited either manually or by automatic means responsive to the need for air conditioning, and the compressor motor being operated directly responsive to the current created by the operation of said first motor.

A further object of the invention relates to the novel construction of the compressor.

Other objects of the invention will appear as the following description of a preferred and practical embodiment thereof proceeds.

In the drawings which accompany and form a part of the following specification and throughout the several figures of which the same characters of reference have been employed to designate identical parts:

Figure 1 is a side elevation through an air or gas conditioning device embodying the principles of the present invention, the casing being shown in section;

Figure 2 is a section taken along the line 2—2 of Figure 1;

Figure 3 is a front elevation, part being broken away;

Figure 4 is a fragmentary top view;

Figure 5 is an enlarged section taken along the line 5—5 of Figure 1, parts being omitted and parts being broken away;

Figure 6 is a section taken at right angles to Figure 5, parts being broken away;

Figure 7 is a side elevation partly in section and partly broken away showing an adaptation of my invention to the air conditioning of a car body; and

Figure 8 is a diagrammatic view of an electrical system for the control of the dual unit installation shown in Figure 5.

Referring now in detail to the several figures and first adverting to that form of the invention shown in Figures 1 to 6, inclusive, the numeral 1 represents in general a casing constituted by a partition 2 having angle members 3 and 4 arranged peripherally thereabout on both sides, in the form of a frame, with their angles exterior, so as to form a supporting flange 5 adapted to be arranged adjacent the edges of an aperture 6 in a wall. The inner flanges 7 and 8 of the angle members 3 and 4 form upstanding flanges on the opposite surfaces of the plate 2. To one of these flanges is suitably secured an open ended sheet metal member 9 while to the opposite flange is secured a similar but somewhat longer member 10 having an auxiliary casing 11 bolted or otherwise suitably secured to the edge portion of the open end of the member 10. When the exterior flange 5 of the casing is secured in occluding relation to the aperture 6, the member 9 extends into the chamber, the atmosphere of which is to be conditioned while the member 10 together with the auxiliary casing 11 extend exterior to said chamber, being preferably located in the open air.

The partition 2 insulates the chamber within the member 9 from the chamber within the member 10. Said plate is suitably apertured in the middle portion as clearly shown in Figure 2 for the reception of an electric motor 12 which is supported by a suitable bracket 13 fixed to said partition, said motor extending partly through said partition. Fans 14 and 15 are mounted at the opposite ends of the armature shaft of the motor 12, one fan being within the chamber of the member 9 while the other is in the chamber of the member 10. The pitch of the fans is so directed that while they rotate in common with the armature shaft, they throw air currents in opposite directions. The member 9 is formed adjacent the partition 2 with a series of air inlets 16. The action of the fan 14 is to draw air in through these inlets from the chamber whose atmosphere is to be conditioned and to throw it outwardly through the open front of the member 9. An evaporator 17 is arranged within the member 9,

constituting a sinuously disposed coil 18 passing through vertical fins 19. The air is chilled through contact with the cold fins and coils and the moisture squeezed out of it by its cooling condenses upon the vertical fins 19 and drops into a trough 20 formed within the bottom portion of the member 19 between a partition 21 and the front flange 22 of the frame which affords a finish for the inner end of the apparatus. The condensed moisture may be disposed of in any suitable manner as by permitting it to pass through a drain 23 which may be connected with a pipe, not shown, and led away to any desired point of disposal.

The evaporator is part of a refrigeration system, the other elements of which are on the opposite side of the partition 2, and excluded from contact with the air or gas within the chamber to be conditioned. Thus the heating effect of the compressor and condenser of the refrigerating system is not imparted to the air or gas being treated.

Outer air is admitted to the chamber within the member 10 preferably by means of a hood 24. Air is drawn in through the hood 24 and through a set of louvers 25 in the upper wall of the member 10 by the fan 15 and discharged from the open end of the chamber of the auxiliary casing 11. It will be observed that within the auxiliary casing 11 and coaxially arranged, there is an hermetically sealed shell 26 comprising a compressor chamber 27 and a motor chamber 28. The sealing of the motor within said shell is a matter of convenience and expediency which is not essential to the spirit of the invention, since the motor might be exposed within the auxiliary casing 11 without materially affecting the operation of the apparatus.

A swinging damper 29 normally closes the air discharge opening 30 at the outer end of the auxiliary casing, said damper being pivoted in an unbalanced manner so as to be opened by pressure on its inner side. It will be understood that the current of air created by the fan 15 and passing through the auxiliary casing 11 impinges upon the damper 29, swinging it to open position and permitting the discharge of the air. The circuit of the compressor motor 28 is controlled by a mercoid switch 32 mounted on the damper 29. When said damper is closed, the mercoid switch is opened and the motor 28 does not operate. When the damper is inclined outwardly by air pressure from the fan 15, the mercoid switch closes the motor circuit and the motor starts to operate, remaining in operation while the damper 29 remains open. As soon as the fan 15 comes to a standstill, the damper 29 being unsustained by pressure from within the auxiliary casing 11, closes and the compressor stops. It thus appears that the operation of the refrigeration cycle is dependent upon the condition of activity or inactivity of the fan 15 and that the fans 14 and 15 act together, so that it may be truly said that the refrigeration cycle operates responsively to the circulation of the air through the conditioning element of the apparatus.

Before adverting to a description of the compressor per se, it may be stated that the condenser 33 may be similar in construction to the evaporator 17, that is to say, having vertical fins 34 and sinuous tubing 35, preferably horizontally disposed. Since the condenser is not concerned with the condensation of moisture, it is not essential that its construction be as shown or suggested. On the contrary any construction of condenser may be adapted to the use of the present invention providing that it is capable of being placed in the path of the air current created by the fan 15. The condenser is connected at its upper end with the high side of the compressor by means of a pipe 36 and at its lower end with a receiver 37 by means of the pipe 36. The receiver carries liquefied refrigerant to an expansion valve 38. Here the liquid refrigerant is permitted to spray out into the anterior end of the coil 18 of the evaporator. The spent expanded gas from the evaporator is carried by means of the pipe 39 back to the low side of the compressor.

Referring now to Figures 5 and 6, that portion of the shell 26 is shown which forms the compression chamber. Mounted within this shell is a supporting structure comprising the laterally extending webs 40 and 41 carrying the matching cylinder frames 42 and 43. These cylinder frames are substantially secured to the shell 26 as by bolts 44, said frames when in matched position forming square openings at their tops and bottoms and receiving respectively the compression cylinder 45 and the lubricant pump cylinder 46. The cylinder frames are clamped together by bolts 47 arranged outside of the cylinder receiving spaces.

The head of the upper cylinder is provided with a port 48 normally closed by a spring pressed valve 49 which when open places the cylinder 45 in communication with the condenser by means of the pipe 36. A pump piston 50 works in the cylinder 45 and receives expanded gas from the evaporator and which is discharged into the chamber 27 by way of the pipe 39, through a series of ports 52 opening into said chamber.

The piston 50 is made rigid with the piston 53 of the lubrication pump by means of a sturdy connecting rod 54 having a cross head guide 55 at its intermediate portion. Said cross head guide is formed with cylindrical curvature and cut away on one side as indicated at 56 in Figure 6 to provide an opening less than the diametrical dimension of said guide. A similarly shaped block 57 reciprocates laterally in said guide, said block forming the journal for a pin 58 projecting from one side of a counterbalance fitting 59 keyed to the armature shaft of the compressor motor 60.

The connecting rod 54 is cored to form a lubrication passage 61, and the block 57 is formed with a wide channel 62 in an intermediate zone, communicating with the lubrication passage 61. Said lubrication passage has branches 63 opening in the interior of the compressor piston 50. Said piston is formed on its inner wall with a plurality of annular channels 64 having radial bores 65 communicating with the cylindrical joint between the piston and cylinder. The coacting surfaces of said joint are thus forcibly lubricated by oil supplied by way of the passage 61 and the branches 63 to the channels 64 and bores 65. The lubrication pump piston 53 draws oil through a check valve 67 from the pipe 68 which passes to the exterior of the shell 26 and is arranged in a flat spiral coil 71 in the path of the air current from the fan 15. The oil is forced by the piston 53 through the passage 61 as has been described and keeps the interior of the piston 50 filled with oil under pressure. Overflow from the said piston is permitted by means of the passages 69, the overflowing oil gravitating down to the bottom of the chamber 27 where it enters the pipe 70 at the anterior end of the coil 71. The oil

is kept from fouling the electric motor by means of a plate or partition 72 separating the compressor chamber 27 from the motor chamber 28.

In operation, the fan motor 12 may be started either manually or in response to some instrumentality affected by the temperature or humidity of the air to be conditioned. Starting of the motor sets the fans 14 and 15 in motion and creates air currents respectively through the evaporator 17 on the one hand, and through the condenser, lubricant cooling coil 71, and the auxiliary casing 11 surrounding the shell 26. The pressure of this air current against the damper 29 deflects said damper to the rightward, tilting the mercoid switch 32 and starting the motor of the compressor. The refrigerating cycle at once begins, the evaporator becomes cold and the cooling of the air passing through the evaporator and the condensation of its moisture against the fins of the evaporator takes place. The operation of the fan motor 12 may be terminated either at will or in response to the automatic devices as hereinbefore suggested. Immediately the fan 15 ceases to rotate, and the pressure of air against the damper 29 is relieved, said damper returns by gravity to the normal position shown in Figure 1 in which the mercoid switch is tilted to open circuit position and the compressor motor is cut off. In this manner, there is no waste of energy, for the refrigerating system works only when the air or gas is being conditioned.

Since it is generally desirable to mix a certain proportion of outside air with the air being humidified the partition 2 is provided, preferably adjacent the upper part thereof with a series of openings 73 establishing communication between the outside air which enters the chamber within the member 10, with the air being conditioned.

The apparatus as above described is characterized as constituting a rigid unitary assemblage capable of being bodily installed in any relation in which it may be desired to cool or dehumidify air or gas. Figures 1 to 6 inclusive contemplate its use in connection with the wall 74 of a stationary chamber such as a room. It is however as readily adaptable to the conditioning of the atmosphere in a vehicle such for example as a Pullman car. Figures 7 and 8 suggest such an adaptation. Figure 7 shows the opposite platforms of a railway car, two units 75 and 76 being installed, one in relation to each end of the car. They are shown mounted in the end walls 77 and 78 with the evaporator on the inside of the car and the motor, compressor and condenser on the outside. The currents of air established in the atmosphere being conditioned, will be from the ends of the car toward the center, downward toward the floor and then back toward the ends of the car, a thorough and complete movement of the entire body of air being thus accomplished. Figure 8 suggests an electrical system for the operation of the dual unit installation illustrated in Figure 7, an axle operated generator being indicated at 79, which charges a storage battery 80. A solenoid 81 shifts the operating circuit from the battery to the generator according to whether the generator is turning fast enough to generate the requisite current. When the car is stationary the solenoid shifts the operating circuit to the battery, and vice versa, after the car has attained a certain speed. The operating circuit includes the fan motors 82 and 83 which are energized by the closing of switches 84 and 85. These may be closed at will or preferably by some thermostatic or hygroscopic device. The compressor motors are represented at 86 and 87 and are energized through the closing of the switches 88 and 89. These switches represent the mercoids, carried by the dampers which are tilted by the draft created by the fan motors 82 and 83.

Figure 7 shows that the refrigeration system of one or both of the units is adapted to be extended so as to function as a water cooler. This is illustrated by the tank 90 containing a cooling coil 91 one end of which is tapped into the high side of the refrigeration system, preferably in the region of the receiver 37, see Figure 1, and the other end of which is adapted to be connected to the low side of the compressor preferably by tapping it at some point into the pipe 39.

It is to be understood that the invention primarily concerns itself with the novel combination of the several elements unitedly associated in the consummation of the present invention and only secondarily in the specific construction of the several elements, that substitution of equivalents for those elements specifically disclosed, are within the purview of the invention, and that the details of construction as shown and described are merely by way of example and not to be construed as limiting the scope of the invention as claimed.

What I claim is:

1. Air conditioning apparatus comprising a casing; a partition dividing said casing into chambers, one adapted to communicate with a body of air subject to conditioning by said apparatus and the other adapted to communicate with a body of air not subject to conditioning by said apparatus, a fan unit having a fan in each chamber for setting up independent currents therein, a refrigeration system including an evaporator in the first named chamber and a condenser and compressor in the second named chamber, the condenser being arranged between the fan in said chamber and said compressor, an air inlet admitting air to said second named chamber anterior to said condenser whereby it passes over said condenser and compressor successively in the order named, and means for starting said compressor indirectly with respect to said fan unit through air pressure created in the second named chamber by said fan unit whereby said fan unit starts free from the load of said compressor.

2. Air conditioning apparatus comprising a casing, a partition dividing said casing into chambers, one adapted to communicate with a body of air subject to conditioning by said apparatus and the other adapted to communicate with a body of air not subject to conditioning by said apparatus, a fan unit having fans in each chamber for setting up independent currents of air therein, a refrigeration system including an evaporator in the first named chamber and a condenser and compressor in the second named chamber, the condenser being arranged between the fan and compressor, the part of said casing defining said second named chamber having an outlet in line with the axis of the fan in said chamber, an air inlet admitting air to said second named chamber anterior to said condenser whereby it passes successively over said condenser and compressor in the order named, and means for starting and stopping said compressor indirectly with respect to said fan unit comprising a damper in said outlet and constituting part of the wall of said chamber opening and closing

through pressure variations incident to the starting and stopping of the fan in said chamber, and a switch actuated responsively to the movements of said damper.

3. Air conditioning apparatus comprising a casing, a partition dividing said casing into chambers, one adapted to communicate with a body of air subject to conditioning by said apparatus and the other adapted to communicate with a body of air not subject to conditioning by said apparatus, a fan unit having fans in each chamber for setting up independent currents of air therein, a refrigeration system including an evaporator in the first named chamber and a condenser and compressor in the second named chamber, the condenser being arranged between the fan and compressor, the part of said casing defining said second named chamber having an outlet in line with the axis of the fan in said chamber, an air inlet admitting air to said second named chamber anterior to said condenser whereby it passes successively over said condenser and compressor in the order named, and means for starting and stopping said compressor indirectly with respect to said fan unit comprising a damper in said outlet and constituting part of the wall of said chamber opening and closing through pressure variations incident to the starting and stopping of the fan in said chamber, and a switch actuated responsively to the movements of said damper, said switch being normally open in the closed position of said damper.

4. Air conditioning apparatus as claimed in claim 3, including a shell hermeticaly sealing said compressor and spaced from the walls of said casing providing for air circulation on all sides of said shell, the latter forming a reservoir for the expanded gaseous refrigerant returning to said compressor, the latter having an inlet port opening into the chamber of said shell.

5. Air conditioning apparatus comprising a casing, a partition dividing said casing into chambers, and segregating the air associated with said apparatus into two portions with which said chambers communicate, one being a body of air subject to conditioning by said apparatus, and the other a body of air not subject to conditioning by said apparatus, a fan unit comprising a shaft extending through said partition having a fan in each chamber for setting up independent currents therein, a refrigeration system including an evaporator in the first named chamber and a condenser and compressor in the second named chamber, said chambers having air outlet openings in opposite ends of said casing in the direction of the axis of said shaft, and each chamber having circumferential air inlet openings adjacent said partitions and between said partition and fans, whereby the heat of the compressor and condenser is wasted into the body of air which is not subject to air conditioning.

6. Air conditioning apparatus as claimed in claim 5, said compressor having a lubrication system including a lubricant cooling coil extraneous to said compressor, said lubricant cooling coil being located in the same chamber with said compressor and between the fan and compressor.

7. Air conditioning apparatus as claimed in claim 5, the portion of casing which defines the first mentioned chamber being constructed as a trough beneath said evaporator for collecting water condensed upon said evaporator.

8. Air conditioning apparatus comprising a casing, a partition dividing said casing into chambers, and segregating the air associated with said apparatus into two bodies with which said chambers communicate, one being subject to and the other not subject to conditioning by said apparatus, a fan unit comprising a motor mounted in said partition having the shaft extending into both chambers and a fan in each chamber carried by opposite ends of said shaft for setting up independent air currents in said chambers, a refrigeration system including an evaporator in the first named chamber and a condenser and compressor in the second named chamber whereby the heat of the compressor and condenser are wasted into the body of air which is not subject to air conditioning, but condenser being arranged between the fan in said chamber and said compressor, and an air inlet admitting air to said second named chamber anterior to said condenser whereby it passes successively over said condenser and compressor in the order named, said chambers having air outlets at their opposite ends and in line with said shaft.

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