July 12, 1949. F. M. JONES 2,475,841

AIR CONDITIONING UNIT

Filed June 15, 1944 3 Sheets-Sheet 1

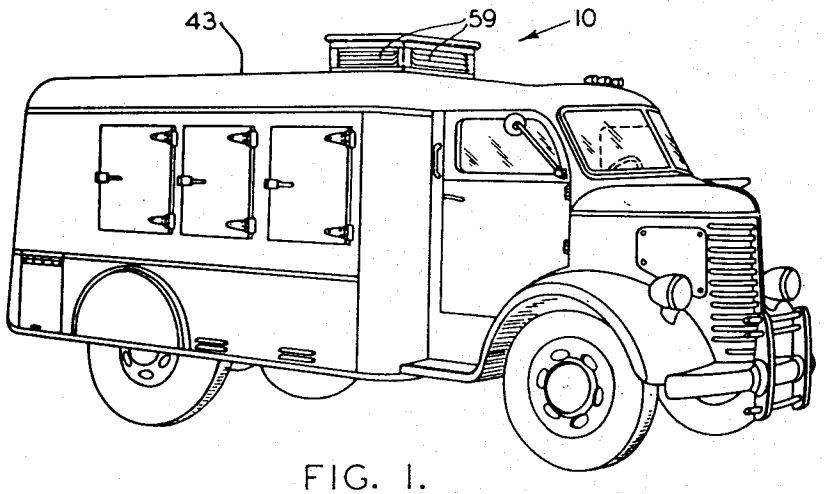


FIG. 1.

FIG. 2.

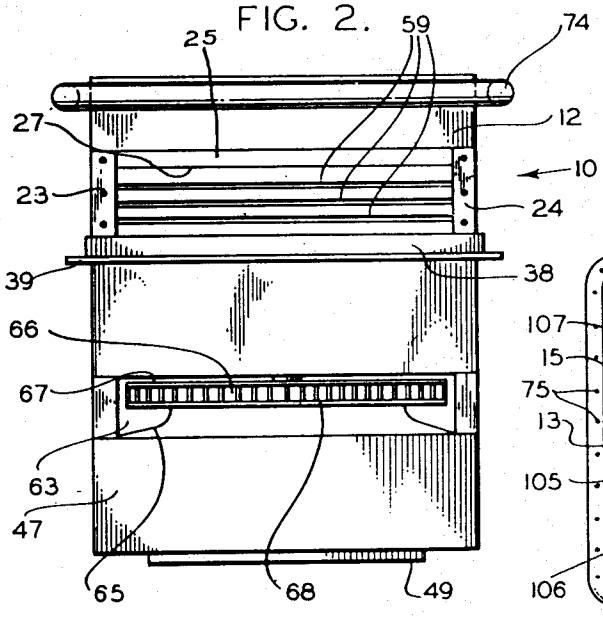
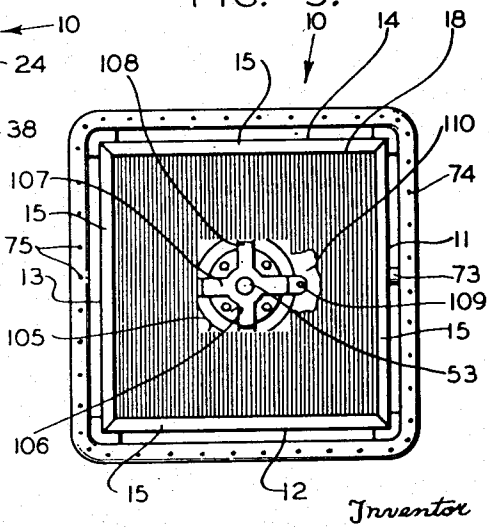


FIG. 3.



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AIR CONDITIONING UNIT

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FIG. 4.

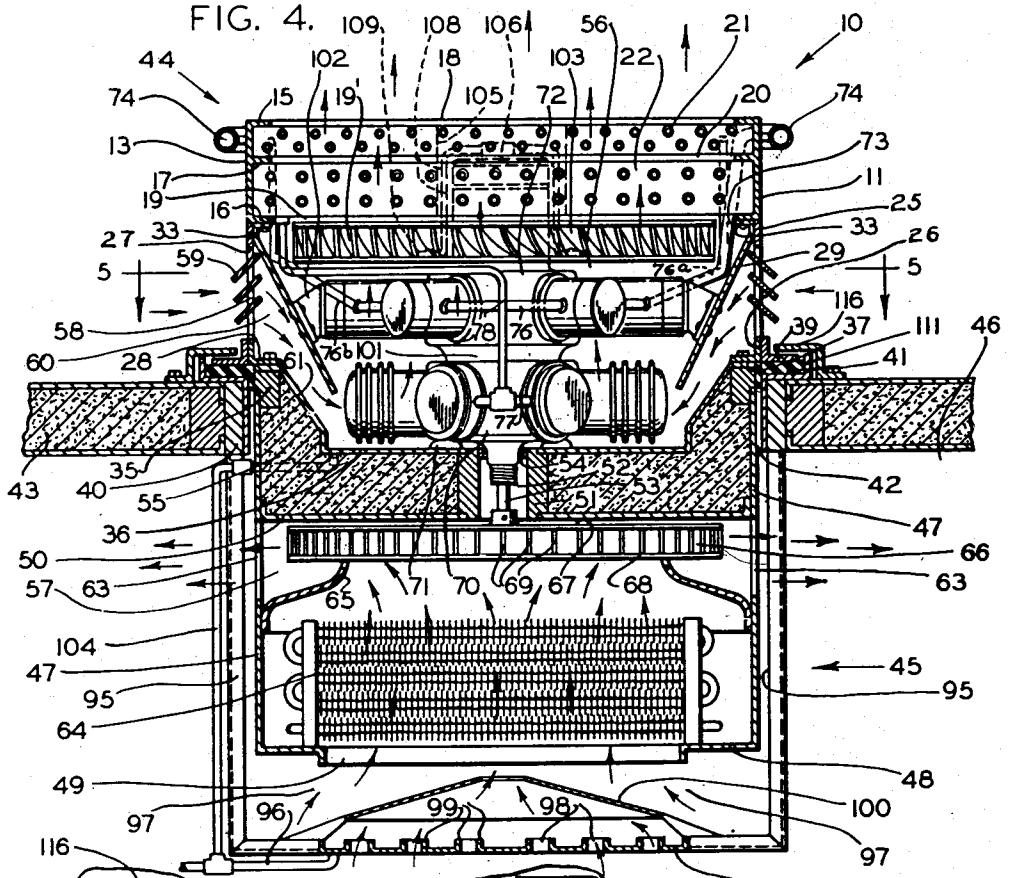

FIG. 5.

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AIR CONDITIONING UNIT

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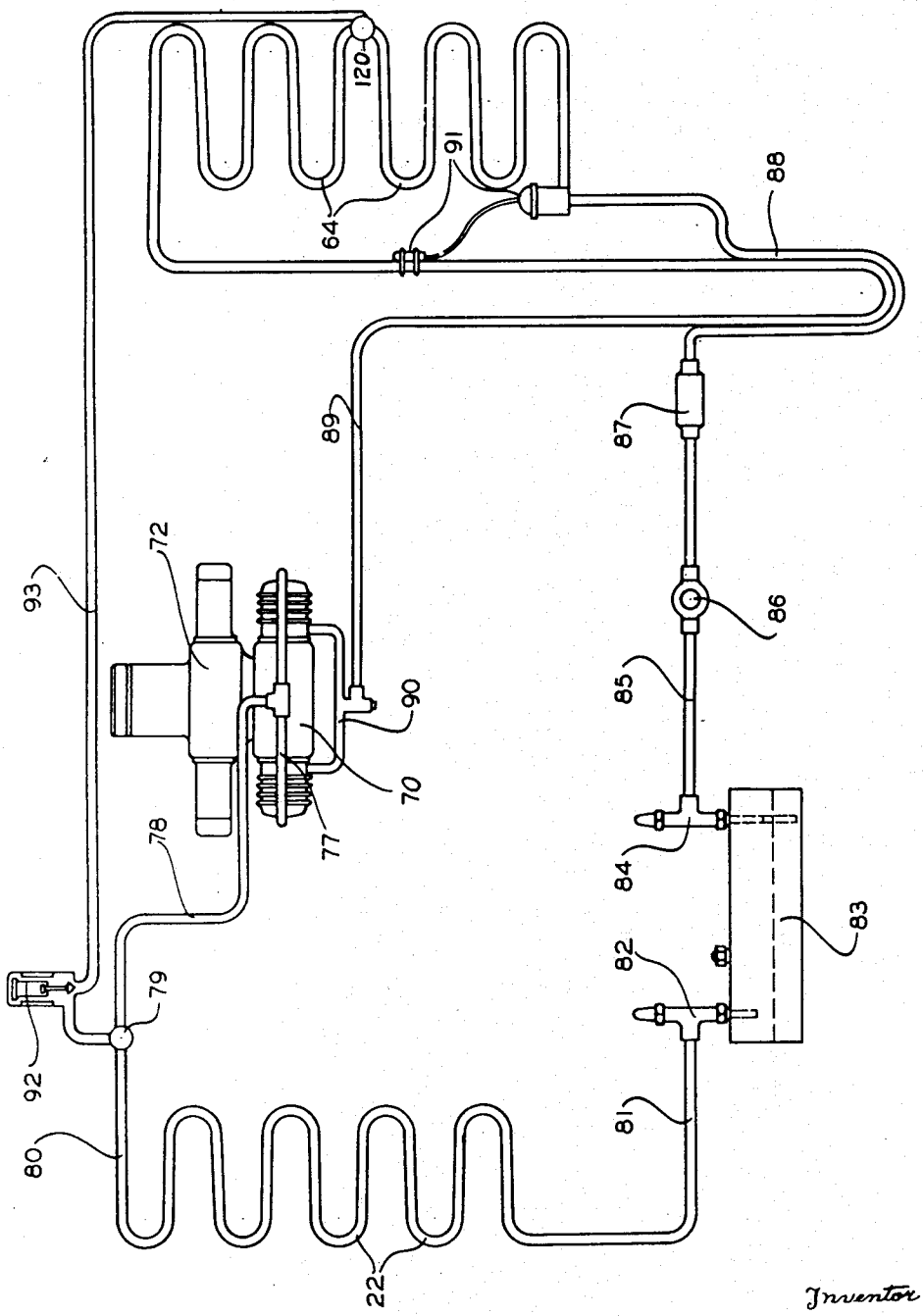
FIG. 6.



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Patented July 12, 1949 2,475,841

UNITED STATES PATENT OFFICE

2,475,841

AIR CONDITIONING UNIT

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Application June 15, 1944, Serial No. 540,433

11 Claims. (Cl. 62—129)

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My invention relates to an air conditioning unit adapted to be positioned upon, and supported by and to extend through the top wall of any room or compartment, and when so supported to be held in a vertical position, with part of the unit outside of the wall and part of the unit extending below the top wall into the compartment, together with a horizonal partition dividing the space within the casing into an upper and a lower chamber, the upper chamber opening outside the compartment above the top wall thereof, and the lower chamber opening into the upper part of the compartment below its top wall. Furthermore, a compressor, gas engine or other motor, starter generator, blower, blower fan, condenser and engine radiator will be located in the upper compartment, and a blower and evaporator heat exchanger will be positioned in the lower compartment, all in serially superposed positions along the axis of the motor, the blower in the upper compartment acting to draw air into the same about the compressor and motor and to blow it out through the condenser and radiator at the top, and the blower in the lower compartment acting to draw air from below it at the center of the compartment and to blow it out in all directions laterally below the top thereof.

This arrangement results in extreme simplicity, lightness, compactness, and effectiveness in operation of the entire structure. It is particularly compact and free from complicated driving mechanism, every moving part being operated directly from the driven shaft of the motor. The unit is detachably secured upon and extends through a top wall of the enclosure so that it readily may be withdrawn for repair or servicing and a replacement quickly inserted in its stead. And while the discovery and development of the unit and its showing in the drawings herein have to do with its use in connection with trucks, particularly light and not too large trucks, the invention is applicable to any situation where it is desirable to effect air conditioning of a compartment or room and where it is convenient and practical to apply the air conditioning unit to the top wall thereof.

As applied to trucks where a part of an air conditioning unit is exposed to air movements outside the truck, it has been discovered that certain wind conditions at times seriously interfere with the efficiency of operation of such cooling units, particularly with withdrawal of heat from the motor and the cooling system itself through operation of a condenser. I have discovered that by having the projecting part of the unit open on all sides this difficulty is avoided.

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Another problem which involves very considerable difficulties in connection with air conditioning units is related to the withdrawal of heat from the gas engine and the compressor when they are located in a chamber of a cooling unit. The practice has been to discharge the heat laterally through a radiator having connection with the cooling system of the gas engine and through the condenser of the cooling system. In these arrangements natural convection has been substantially ineffective, although it is well known that effective heat removal can be accomplished with no added cost for power by natural convection.

I have discovered that by arranging the compressor and the gas engine vertically and close together, and by admitting air entirely around and underneath these members, convection cooling will very substantially reduce the power required to move the air entirely by the operation of a blower and will largely prevent the overheating which otherwise takes place for a short time after operation of the motor and compressor is stopped.

It is well known that trucks used to transport perishables, such for example as citrus fruits, vegetables, and the like are not provided with heating means and as a result very great loss is at times suffered because of severe blizzards and cold spells overtaking trucks loaded with such perishables while in transit. The arrangement of parts constituting my invention, as herein disclosed, is peculiarly effective as a safe and sure means of supplying sufficient heat to the compartment of a truck under such conditions. For by a simple arrangement which may be thermostatically controlled by means not shown, the direction of flow of the fluid may be reversed, the hot fluid going through evaporator heat exchanger coils which then become a heat radiator. The horizontal blower will then disseminate this heat throughout the truck and particularly along the top wall where heat losses are greatest and maintaining a temperature within the compartment of the truck which will avoid freezing.

It is a principal object of my invention to provide an air conditioning unit which is adapted to be positioned in and vertically extending through the top wall of an enclosure with a first portion positioned on the outside of the enclosure containing an engine, compressor, a condenser and an engine cooling radiator together with a first blower for circulating air about these portions, and a second portion positioned on the interior of

the enclosure having an evaporator and a blower for circulating air within the interior of the enclosure wherein the compressor and the two blowers are operated by a single driving member which extends vertically through the unit.

It is a further object of my invention to provide means for easily and quickly attaching the unit to a top wall of a compartment or room so that the same may be readily applied thereto and removed therefrom, the casing of the unit being partly outside of said top wall and partly inside the compartment or room, said means being such as to hermetically seal the unit in air tight and water tight relation upon said top wall.

It is a further object of my invention to provide the unit with a vertically extending casing when the same is positioned upon and extending through a top wall of a compartment or room and to provide in said casing a heavily insulated horizontal partition which will divide the space within the casing into an upper chamber, which principally extends beyond and outside of said top wall and a lower chamber which extends into the compartment or room below said top wall, said partition in effect being a continuation of the top wall of the compartment or room.

It is a further object of my invention to mount a radial-type motor and a compressor of corresponding form as an integral unit in the upper chamber and resting upon and supported by the partition, said motor and compressor being horizontally disposed, with the driven shaft of the motor extending vertically through the center of both the compressor and the motor, rotated by the latter in a customary manner and connected to operate the compressor as the driven shaft is rotated.

It is a further object of my invention to form the casing with a substantially open upper end and to place across said opening a condenser and a cooling radiator for the gas engine, the disposition of such members to be such as to give the highest measure of efficiency and specifically, as shown, to have the radiator positioned above the condenser.

A further object of my invention is to provide the turret-like part of the unit casing extending above the top wall of a compartment with openings to atmosphere on all sides so that regardless of the direction of wind pressure, in relation to the operation of the unit when applied to a truck, the heat withdrawal will be maintained effectively uniform.

It is a further object of my invention to arrange a fan blower within the upper chamber of the unit casing immediately below the condenser therein and with an operative area comparable to the area of the fronting side of the condenser, said blower being mounted upon the vertical driven shaft of the motor, and to provide openings through all walls of the casing for admission of outside air into the upper chamber to be moved about the compressor and motor by the fan blower, and also by natural convection and to be passed through the condenser and radiator for withdrawing heat from the cooling system and from the motor.

It is a further object of my invention to arrange the openings on the sides of the casing above the top of the compartment in connection with a series of downwardly sloping louvers and to provide adjacent the inside of said openings a series of downwardly turned partitions extending from all walls thereof to cause the incoming air to circulate first about the compressor, then about the motor and then, after passing through the fan, to move through the condenser and the radiator.

A further object of my invention is to mount a starter-generator above the gas engine in axial alignment therewith and with the motor shaft extending vertically through the starter-generator to the outside thereof, and to provide a suspending cradle connected with said outside end of the motor shaft and with the fan blower in the upper chamber, the cradle and the blower surrounding the starter-generator.

It is a further oject of my invention to extend the vertical motor shaft through and to the outside of the compressor and through the partition dividing the unit casing into two compartments in such a manner as to seal at such point the upper chamber from the lower chamber, and to support on the shaft in suspension a horizontally operating blower in the lower chamber.

It is a further object of my invention to secure an evaporator heat exchanger having fluid connection with the compressor, or the storage chamber from the compressor, so as to lie horizontally at the lower end of the lower chamber and substantially cover the opening through the larger part of said lower end and to provide shields extending to the inner part of the horizontal blower so that air moved thereby will be drawn through the evaporator heat exchanger.

It is a further object of my invention to provide adjacent the outer limits of the horizontal blower in the lower chamber, openings extending through all walls of the casing forming said lower chamber, such that when the blower is in operation the air will be drawn up vertically from the center of the compartment or room, the air being cooled by being drawn through the evaporator heat exchanger and then being thrown out radially in all horizontal directions from the vanes of the horizontal blower, passing through the openings from the lower chamber in horizontal directions close to the top wall of the compartment or chamber, so the cooled air will spread to all parts of the top of the upper part of said compartment or chamber and will settle to the bottom, particularly along the walls thereof, displacing the warmer air which will rise at the center of the compartment and be drawn through the evaporator heat exchanger for re-cooling.

It is a further object of my invention to suspend a pan from the top wall and permanently connected thereto at points outside of the opening through said top wall. This pan comes beneath the lower side of the evaporator heat exchanger and receives the condensate from the same both under normal conditions and during defrosting, and has a suitable pipe connection to discharge the water so accumulated to a point outside of the compartment.

The full objects and advantages of my invention will be given in further detail in connection with the description thereof in the following specification, and the novel features of my invention by which the advantageous results above enumerated are obtained will be particularly pointed out in the claims.

In the drawings illustrating an application of my invention in one of its forms:

Fig. 1 is a perspective elevation view of a small truck having my cooling unit applied thereto.

Fig. 2 is a side elevation view of the cooling unit.

Fig. 3 is a top plan view of the cooling unit.

Fig. 4 is a part sectional elevation view of the unit on an enlarged scale as mounted upon the

top wall of a compartment or room, showing the relations of the parts.

Fig. 5 is a sectional plan view taken on line 5—5 of Fig. 4.

Fig. 6 is a schematic view showing the course of travel of the cooling fluid as operated by the unit.

As shown, the unit as a whole is designated by an arrow and the numeral 10. It comprises in general a casing member in parts secured together, the casing being formed of a number of interconnected portions. Thus the top of the casing comprises side walls 11, 12, 13, and 14, Fig. 3, formed with upper and lower and intermediate inwardly extending flanges 15, 16, and 17, extending inwardly from the several walls so as to leave a plurality of rectangular openings 18, 19, and 20, Figs. 3 and 4. These openings, it will be noted, comprise in area nearly the entire area of the top of the casing.

Between flanges 15 and 17 is mounted a cooling radiator 21 and between flanges 16 and 17 is mounted a condenser member 22. Directly beneath the casing section made up of walls 11, 12, 13, and 14 is a second rectangular casing section of identical cross-section. Each of the walls forming the second casing is as shown in Figs. 2, 4 and 5, composed of a pair of corner posts 23 and 24 which are joined at the top by bars 25 and at the bottom by angle irons 26 having an inner flange 28. The several walls collectively form an inner chamber 27. An inner skirt, rectangularly funnel-shaped, is formed of walls 29, 30, 31 and 32 and is provided with flanges 33. The flanges 16 and 33 are bolted together to unite the two sections of the casing at their respective lower and upper margins and the skirt sections 29, 30, 31, and 32 are united together at their beveled points of union at 34 as shown in Fig. 5. The lower flanges 28 of angle irons 26 are bolted to supporting blocks 35, Fig. 4. A sheet metal upper lining 36 forming part of a transverse partition has flanges 37 that are secured to the supporting block structure 35 by the same bolting means that secures the flanges 28 thereto. Angle irons 38 are bolted to the lower part of members 23, 24 and to the angle irons 26. The horizontal flanges 39 of the angle bars form a support for the entire unit 10 upon a framing 40, Fig. 4, which carries on its upper surface rubber gasket strips 41.

The framing 40 surrounds an opening 42 cut in the top wall 43 of the truck compartment or room, and it will be seen that the entire unit is suspended from said top wall with one portion 44 extending upwardly above said top wall and another portion 45 depending from the top wall and extending into the compartment 46 below the top wall. Secured to the blocks 35 and enclosing the part of the casing extended below the top wall 43 is a casing section made up of depending side walls 47 which are provided with connected bottom horizontal flanges 48 which surround a bottom opening 49, Fig. 4.

A sheet metal partition member 50, Fig. 4, is secured to the walls 47 and through them to supporting blocks 35 and also is secured to sheet metal partition lining 36 by an inner drum member 51 which has through its center an opening 52 through which extends the driven motor shaft 53 as later described. Packing material 54, Fig. 4, seals the opening 52. Between the plates 36 and 50 is insulating material indicated at 55, Fig. 4.

It will be apparent from the above description that the partition lining plates 36 and 50 taken with the insulating material 55 form an insulated

horizontal partition wall dividing the space within the entire casing into an upper chamber 56 in the part of the casing which extends above the top wall and a lower chamber 57 in the part of the casing which extends below the top wall. Each of the walls formed of parts 23, 24, 25 and 26 has the chamber 27 above described, Fig. 4, in which is a removable section 58 provided with downwardly sloping louvres 59 admitting outside air through passageways indicated at 60 extending between sloping walls 61 of the sheet metal liner partition 36 and the several walls 29, 30, 31, and 32 of the funnel-shaped skirt. The louvres are so positioned as to largely keep out any rain but at the same time admit air which is constrained to flow to the bottom of chamber 56 and then to flow upwardly through rectangular opening indicated at 62, Fig. 5. This causes the air to circulate over the compressor and motor before going through the condenser 22 and then the radiator 21, as will be later described.

Each of the four walls 47 extending downwardly through the opening 42 of the top wall have an opening 63, Figs. 2 and 4, at a point just below partition lining 50 and close to the top wall 43 of the compartment when the unit is in operative position. An evaporator heat exchanger 64 is positioned to cover the bottom opening 49 from lower chamber 57, and a funnel-shaped skirt 65, Fig. 4, constrains air moving through the coils of the heat exchanger to move to the center of a blower 66, Fig. 4.

This blower is of customary construction. It has a back wall 67 which seals the back of the blower 66 and an annular front wall 68 which leaves a large opening at and about the central part of the blower 66. The blower 66 is carried upon the depending end of driven motor shaft 53 which is vertically positioned in the unit, so the blower operates between horizontal planes. It has a multiplicity of vanes 69 which, as the blower is rotated, throw the air drawn in through the evaporator heat exchanger 64 radially outward and through the openings 63 in the walls 47 practically in every horizontal direction. This spreads the cooled air uniformly along the top of the compartment from where it will strike the side and end walls of the compartment and gravitate downwardly along said walls to the floor. The cold air will accumulate at the floor, pushing up the warmer air in the center of the compartment, which will continually be drawn up through opening 49 into the chamber 57, to be continually driven out horizontally and radially, thus, forming a continuously flowing sheet of cooled air adjacent the top of the compartment.

A multiple cylinder radial-type compressor 70 is supported with its cylinders extending radially between horizontal planes upon an annular cushion or buffer 71, Fig. 4, which rests on the top partition plate 36 and is supported about the axial center of driven shaft 53 in that manner. Mounted directly upon the compressor 70 and connected to drive it is a radial-type gas engine 72. As the details of construction of this gas engine are in general known and as those details form no part of my invention claimed herein, no detailed description of the gas engine need here be given.

The mounting of the gas engine, with its driven shaft vertical, upon the compressor and with the vertical shaft of the gas engine directly operating every moving part of the unit, is, however, a very important feature of my invention.

As to the operation of the gas engine, it need be stated here only that it is supplied with gas from the gas supply of the truck, or other gas

supply if the unit is used independently of a truck, by gas pumping means which are well known and that the exhaust passes through a pipe 73 to an exhaust pipe 74 which, as clearly shown in Fig. 3, entirely surrounds the upper margin of flanges 15 and discharges the gases of combustion through small openings 75 in the top of said exhaust member, thus furnishing a very efficient and quiet muffler mechanism and at the same time acting to rapidly dissipate the heat of combustion.

Referring now to Fig. 6, is shown a schematic diagram of the refrigeration system shown in Fig. 4. A header 77 is joined to the high pressure side of compressor 70 and extends to a conduit 78 which in turn is joined to a T-connection 79. A conduit 80 extends from one side of T-connection 79 to the condenser 22, which on its other end is joined to a conduit 81 that extends through a connection 82 to a receiver 83. Extending from connection 84 on the opposite portion of receiver 83, is a conduit 85, which is joined to a sight glass 86 and a dehydrater 87. A conduit 88 extends from the dehydrator 87 to one end of evaporator 64, from whose opposite end extends a conduit 89 which terminates in a header 90 on the low pressure side of compressor 70. A thermostatic expansion valve 91 controls the flow of liquid refrigerant from conduit 88 to the evaporator 64.

The valve 91 is a commercial product available on the market, and is controlled by a thermostatic bulb connected to return conduit 89. The valve is constructed to admit fluid from conduit 88 to evaporator 64 upon a rise in temperature of conduit 89. It is also constructed to positively close communication between conduit 88 and evaporator 64 when the pressure within the evaporator 64 exceeds a predetermined limit.

To provide for defrosting the evaporator 64 by means of hot gas from the compressor, a solenoid valve 92, controlled by conventional circuit means, not shown, is joined to T-connection 79 and to a conduit 93 which extends to a T-connection 120, that is joined to evaporator 64.

When it is desired to defrost the evaporator, or use it as a heater during cold weather, the solenoid valve 92 is opened by circuit means, not shown, and the hot gas from conduit 78 which has been compressed by compressor 70, will pass through T-connection 79 to valve 92, conduit 93, and T-connection 120 into evaporator 64. At the point at which T-connection 120 joins the evaporator 64, the fluid therein, by actual test, is known to be largely in a saturated gaseous condition, although there will be a certain amount of liquid refrigerant in the lower portion of the evaporator. When the highly superheated hot gas enters evaporator 64, two things take place. First, the increase in pressure will cause the expansion valve 91 to close and to remain closed even though the temperature of conduit 89 rises. Secondly, the hot gas tends to divide the evaporator into two portions of substantially equal capacities. In the upper portion composed principally of gaseous material, the hot gas will transfer its heat to the fluid present therein to convert all of the fluid to a gaseous condition which is slightly superheated before it leaves the evaporator. The gas in the upper portion of the evaporator is quickly removed by the compressor which is in continuous operation during the entire period of defrosting or heating. Because the compressor is always running, it will tend to maintain a partially reduced pressure within the upper portion of the evaporator and the heat of the hot gas will thereby quickly bring about a defrosting of the evaporator coil. Thereafter the hot gas entering the evaporator at connection 120 tends to have an aspirating effect and will draw liquid or a combination of liquid and gas from the lower portion of the evaporator so that the fluid present in the lower portion of the evaporator will intermingle with the hot gas and be completely converted to a gaseous condition before leaving the evaporator. Thereafter the hot gas will extend throughout the entire evaporator to heat the same even though it is being continuously removed by the compressor. This arrangement of the fluid circuit for heating and cooling is disclosed in my Reissue Patent 23,000, dated May 11, 1948.

It should be understood that T-connection 79 will not preclude gas leaving the compressor 70 from entering condenser 22, nor will it prevent gas present in condenser 22 from passing through conduit 80 into the T-connection 79, if the pressure of gas in condenser 22 is equal to or greater than the pressure of gas leaving the compressor. This condition whereby a certain amount of gas present in condenser 22 can aid in defrosting or heating operation is known to exist particularly for a short period of time after the solenoid valve is opened because the temperature of a portion of the gas in the condenser will be relatively high. Therefore, because condenser 22 is positioned next to a cooling radiator containing the hot water from the engine cooling system, and because hot air from the engine is continuously blown over the condenser, and because the condenser is in free communication with the compressor, as mentioned above, it tends to act as a heatbank to supply a certain amount of heat which is useful in aiding the defrosting action and the heating action. It will be recognized from the well-known gas laws that temperatures are readily transferred from one portion of the body of gas to another so that any heat absorbed by the gases in condenser 22 as a result of radiation, will be tranferred to the gas going through T-connection 79, and the solenoid valve 92 to the defrosting line 93. However, it is believed that a substantial portion of the heat conveyed by the hot refrigerant gas comes directly from the compressor and results from the conversion of work into heat. It has been found that the heat thus conveyed to the gas is ample to serve the purpose of defrosting the evaporator and also to heat the compartment when this latter feature is required due to lowered outdoor temperatures.

As shown in Fig. 4 a pan 94 extends beneath the lower end of the unit and particularly beneath the bottom opening 49 therefrom. This pan extends outside the limits of the bottom casing portion 49 and is adapted to receive the drippings of water condensed upon the walls of the casing and from the evaporator heat exchanger 64. The pan is supported in permanent position by rods or angle irons 95 attached to the corners of the pan and to the framing 40 which is positioned within the opening through the top 43 of the compartment. Water received by the pan is carried by a pipe 96 to a point outside of the side walls of the compartment.

The edges of the pan are spaced from the lower edges of the casing 47 as indicated at 97 and in order to insure circulation of air through the

center of the evaporator heat exchanger the pan has in its bottom a series of arcuate openings 98 surrounded by upstanding lip members 99 which are covered by a funnel-shaped drip receiver 100 open at its center to direct a certain part of the air to and through the center of the evaporator heat exchanger.

The gas engine 72 is, as stated, a radial-type engine and has a base 101 which rests directly upon the top of the correspondingly arranged compressor 70. In practice the compressor and the gas engine may be cast integrally. The weight of these members and of all parts connected with the driven shaft 53 is primarily supported upon the cushion ring 71. This weight is also partially supported and the entire organization stabilized by brackets 102, secured to the ends of the cylinders making up the gas engine or to the ends of some of the cylinders and also bolted to the walls 29, 30, 31, and 32 of the skirt funnel. This not only aids in the support of the motor, compressor, blower, and starter assemblage, but it stabilizes it for holding the parts with the axes of the driven shaft 53 and the blowers in a vertical position.

The blower 19' is a suction fan blower which draws the air from underneath the bottom edges of walls 29, 30, 31, and 32 into the upper chamber 56 and about the several cylinders of the compressor and the motor and which then by means of dished fan blades 103 forces the air through the condenser 22 and the radiator 21 to discharge vertically out of doors. When the unit is attached to the top wall of a truck, as shown in Fig. 1, it might happen that the truck would be operated in the rain, which would permit rain water to enter the upper chamber 56. Such rain water would ordinarily be drained from the system by means of a pipe 104 which would connect with the discharge pipe from the pan 94.

The radiator 21 and the condenser 22 are formed with a central passageway or chamber 105, Fig. 3, and, in dotted lines, Fig. 4. This passageway or chamber 105 receives a cylinder casing 106 which is fixedly mounted on engine 72 and houses the starter generator. The driven shaft 53 extends through the top of the generator casing 106 and at its outer end has secured thereto a cage member 107, Fig. 3, which has depending arms 108 spanning the casing 106, Fig. 3, and as shown in dotted lines in Fig. 4. Each of the arms 108 is provided with an offset bottom member 109, which is bolted to a ring 110, Fig. 3, fast on the fan blower 19'. By this means the blower is operated directly from the driven motor shaft 53 by the gauge 107 which rotates about the generator casing 106. Since the unit 10 is designed for quick application and removal, means must be provided for readily attaching and detaching the unit to and from the top wall of the casing. The unit as completed has the supporting flange 39 attached thereto along all of its sides. The flange member 111 and the rubber gasket block 41 within this flange member constitute part of the frame 40 which is set within the opening 42 through the top wall of the compartment. To assemble the unit on that top wall it is only necessary to drop the portion bounded by the walls 47 thereof through the opening 42 to bring the flange member 39 in contact with the surrounding gasket block 41.

To hold the parts so contacted permanently secured, corner clamps 112, 113, 114, and 115, Fig. 5, are bolted to the top wall 43. These corner clamps have inwardly extending horizontal portions 116, which overlie the horizontal portions of angle iron flange members 39 at the corners and thus clamp and hold the entire assemblage firmly in position upon the top wall of the compartment. It will be noted that the engagement of the horizontal portion of angle iron members 39 with the rubber gasket strips 41 acts as an effective seal against the leakage of water to the interior of the compartment.

The advantages of my invention have been made to appear in connection with the foregoing detailed description. The primary and highly important advantage comes from the extreme compactness, lightness, and simplicity of construction resulting from the arrangement of all parts of the unit in a vertical column with the condenser and radiator at the top and the evaporator heat exchanger at the bottom and all of the power-operated parts of the unit—the motor itself, the compressor, the two blowers and the starter generator—disposed vertically about the driven motor shaft as an axial center.

A further great advantage growing directly out of this arrangement is the use of a horizontal blower above the evaporator heat exchanger so that the blower itself, without directing passageways, baffles, or the like, draws the warmer air within the compartment from below at the center of the compartment and drives this air radially in all horizontal directions substantially along the top wall of the compartment and to the side end walls, where it will gravitate along the walls to the floor of the compartment, thus causing the cooled air to move along all heat withdrawing surfaces so as to produce the most effective possible uniformly cooled temperature within all parts of the compartment.

Another great advantage of the invention, also made possible by the vertical arrangement and super-positioning of the parts, comes from drawing air from all sides of the part of the unit above the top wall of the compartment so that no matter from what direction the wind blows or how violent the wind movement is, the apparatus will still operate with uniform efficiency for the removal of heat from the heat generating parts of the unit organization.

A further great advantage of the invention which also is made possible by the arrangement of parts vertically, one above the other, comes from the fact that the air drawn into the upper chamber is caused to circulate about and over all parts of the motor and the compressor and then is moved uniformly through the condenser and the radiator, discharging from the latter directly outdoors without the intervention of any passages, baffles, or the like.

A further advantage of my invention resides in the fact that it is peculiarly adapted to be used as a heating means for moderately tempering the air within the compartment. This may have very great advantages when the unit is used on a truck transporting perishables for insuring against freezing within the truck compartment while the same is in transit. A feature of the unit which peculiarly adapts it for heating purposes is the manner in which the air from the center of the compartment is drawn through the heat exchanger, which has become a radiator, and is moved horizontally in all directions outwardly from the part of the unit within the compartment where the warmed air will strike the cold walls of the compartment and, because of the circulation set up through drawing the air into the system from the center of the compartment,

will tend to move downwardly along the walls and thus heat the compartment sufficiently to prevent freezing.

I claim:

1. An air conditioning unit, comprising a casing adapted to be inserted through a top wall of a compartment with a part of the casing extending into said compartment and another part extending on the outside thereof, an insulated partition extending horizontally within said casing and dividing the casing into two vertically separated chambers, a prime mover positioned in the uppermost of said chambers, a compressor positioned in said chamber beneath the prime mover, a condenser positioned in said chamber above the prime mover, a first blower positioned in said chamber and being operative to circulate air over said condenser, an evaporator positioned in the lowermost of said chambers, a second blower in said last named chamber and being operative to circulate air over said evaporator, and a vertical shaft extending in opposite directions from said prime mover and joined to said blowers and said compressor for simultaneously moving the blowers and the compressor.

2. An air conditioning unit, comprising a casing adapted to be inserted through a top wall of an enclosure with a first part of the casing extending outside of the enclosure and a second part of the casing extending within the enclosure, an insulated partition extending horizontally within said casing and dividing the interior thereof into a first chamber and a second chamber corresponding to the first and second parts of the casing, a radial cylinder compressor, a radial cylinder motor having a vertically extending driven shaft operatively connected with the compressor, said motor being mounted above the compressor in said first chamber, said first chamber having an opening in the upper surface thereof, and ventilating means positioned in the side walls of said first chamber operative to direct the flow of air about the motor and compressor and through said opening by convection.

3. An air conditioning unit, comprising a casing adapted to be inserted through and supported upon an upper surface of a truck body with a part of the casing extending into the truck body and another part of the casing extending to the outside of the truck body, an insulating partition extending horizontally within the interior of said casing and dividing the same into an upper and a lower chamber, a radial cylinder compressor mounted in the upper chamber, a radial cylinder motor mounted in said chamber above the compressor and having a vertically extending driven shaft operatively connected to said compressor, and ventilating means in all of the side walls of said upper chamber formed in a manner as to direct air serially over the compressor and motor, the arrangement of said ventilating means being such that wind pressure from any direction cannot substantially affect the flow of air through the upper chamber.

4. An air conditioning unit, comprising a casing adapted to be inserted through and supported on the top wall of a compartment with a portion of the casing extending into the interior of the compartment, an insulating partition extending horizontally within said casing dividing the casing into two vertically extending chambers, a horizontally disposed radial cylinder compressor supported on the upper surface of said partition, a horizontally disposed radial cylinder motor supported on the upper surface of said compressor, and a vertically extending driven shaft extending from said motor and operatively connected with said compressor, said driven shaft extending on either side of said motor and compressor and passing through said partition in such a manner that it is operative to drive other moving parts in either chamber.

5. In an air conditioning unit, a vertically-disposed chamber adapted to be extended outside the top wall of a truck compartment or room, a gas engine and a compressor in said chamber, a radiator for the engine and a condenser for the compressor held to span the otherwise open end of the chamber, openings on all sides of the chamber for admitting air thereto, a funnel-shaped skirt in said chamber forming passageways therein to direct the air downwardly to flow beneath and about the compressor and the engine, whereby outside air will tend to move by convection through the chamber, and additional means in the chamber operated by the engine to draw outside air through said passages into the chamber from all sides and to move it about said compressor and engine and from the chamber through the condenser and radiator.

6. In an air conditioning unit, a vertically-disposed chamber adapted to be extended outside the top wall of a truck compartment or room, a horizontal floor to said chamber having therein a depressed portion with sloping side walls, a radially-disposed multi-cylinder compressor supported upon said floor within the depressed portion, a radially-disposed multi-cylinder gas engine supported upon the compressor, a skirt with sloping walls inside the chamber on all sides of the chamber forming with said first named sloping side walls passageways directed to the bottom of the compressor, and openings through all side walls of the chamber communicating with said passageways, the top of said chamber being open, whereby convection currents induced by the heat of the compressor and motor will be caused to flow through the passageways to the bottom and about the compressor and the motor to discharge heat from the chamber.

7. In an air conditioning unit, a vertically-disposed chamber adapted to be extended outside the top wall of a truck compartment or room, a horizontal floor to said chamber having therein a depressed portion with sloping side walls, a radially-disposed multi-cylinder compressor supported upon said floor within the depressed portion, a radially-disposed multi-cylinder gas engine having a vertically extending drive shaft supported upon the compressor, sloping walls inside the chamber on all sides of the chamber forming with said sloping side walls passageways directed to the bottom of the compressor, and openings through all side walls of the chamber communicating with said passageways, the top of said chamber being open, whereby convection currents induced by the heat of the compressor and motor will be caused to flow through the passageways to the bottom and about the compressor and the motor to discharge heat from the chamber, a condenser and a radiator across the open top of said chamber, and a blower on the vertically driven shaft for additionally moving said air and forcing it through the compressor and the radiator outside the chamber.

8. In an air conditioning unit, a vertically extending chamber adapted to extend upwardly from the top wall of a compartment, a horizontally disposed partition forming the bottom of said chamber, a radially-disposed multi-cylinder

compressor supported on said partition, a radially-disposed multi-cylinder gas engine supported on the compressor, said engine having a vertically extending driven shaft operatively connected to the compressor, a condenser and a radiator mounted in the upper end of said chamber, said condenser and radiator having a central opening therein, a starter generator mounted on said engine and operatively connected to said driven shaft, said starter generator extending into the opening in said condenser and radiator, a blower positioned in said chamber beneath the condenser and radiator for moving air therethrough, and a rotatable cage connected at one end to the driven shaft on the upper end of the starter generator and at the other end to the blower.

9. An air conditioning unit, comprising a casing adapted to be inserted through and supported on the top wall of a compartment with part of the casing extending into the compartment, an insulating partition dividing the casing into an upper and a lower chamber, a radially-disposed multi-cylinder compressor supported on said partition in the upper chamber, a radially-disposed multi-cylinder gas engine supported on the compressor, a condenser and a radiator mounted in the upper end of said upper chamber, a blower positioned in said upper chamber for drawing air over the compressor and engine and passing the same through said condenser and radiator, a starter generator positioned in said upper chamber and forming an operative connection to said blower, an evaporator positioned in the lower chamber, a blower positioned in the lower chamber for circulating air over the evaporator, and a driven shaft extending from either side of said gas engine passing through said partition and forming a single operative connection for the compressor, starter generator, and the two blowers.

10. An air conditioning unit for controlling the temperature of the space within an enclosure, comprising a casing adapted to be supported on a wall of the enclosure with a part of the casing inside of the enclosure and another part extending to the outside of the enclosure, an insulating partition extending midway between the ends of the casing and dividing the same into separated chambers, a condenser mounted in a first of said chambers and spaced away from the partition, an evaporator mounted in the second of said chambers and spaced away from said partition, an internal combustion engine mounted in the first chamber between the condenser and the partition, a unitary main driven shaft extending on either side of the engine and penetrating the partition into the second chamber, a first blower mounted on said shaft in the second chamber between the partition and the evaporator, a second blower mounted in the first chamber between the condenser and the engine, and a starter generator forming a rigid operative connection between said second blower and the other end of said shaft.

11. An air conditioning unit for controlling the temperature of the space within an enclosure, comprising a casing adapted to be extended through an opening in a wall of the enclosure with one part of the casing inside the enclosure and another part of the casing outside of the enclosure, an insulating partition extending midway between the ends of the casing and dividing the same into separated chambers, a condenser mounted in a first of said chambers and spaced away from said partition, an evaporator mounted in a second of said chambers and spaced away from the partition, an internal combustion engine mounted in the first chamber between the condenser and the partition, a main shaft driven by said engine and having its opposite ends extending outwardly on either side of the engine with one end penetrating the partition and extending into said second chamber, a first blower positioned in the first chamber between the condenser and the engine and rigidly connected to one end of said main shaft for forcibly circulating air with respect to the condenser, and a second blower positioned in the second chamber between the partition and the evaporator and rigidly connected to the other end of said main shaft for forcibly circulating air with respect to the evaporator.

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