Sept. 13, 1938. J. R. HORNADAY 2,130,276

REFRIGERATING APPARATUS

Original Filed Oct. 31, 1934 2 Sheets-Sheet 1

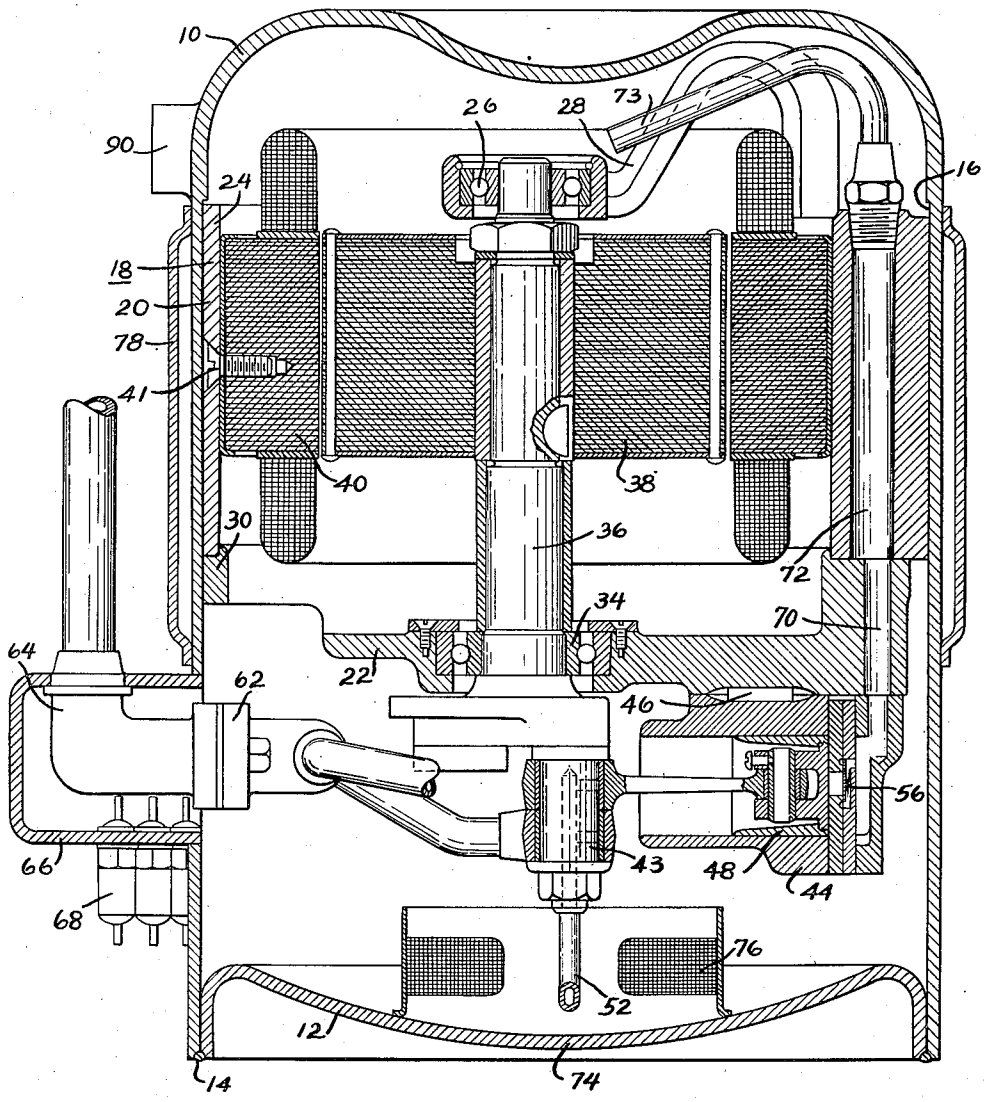


Fig. 1

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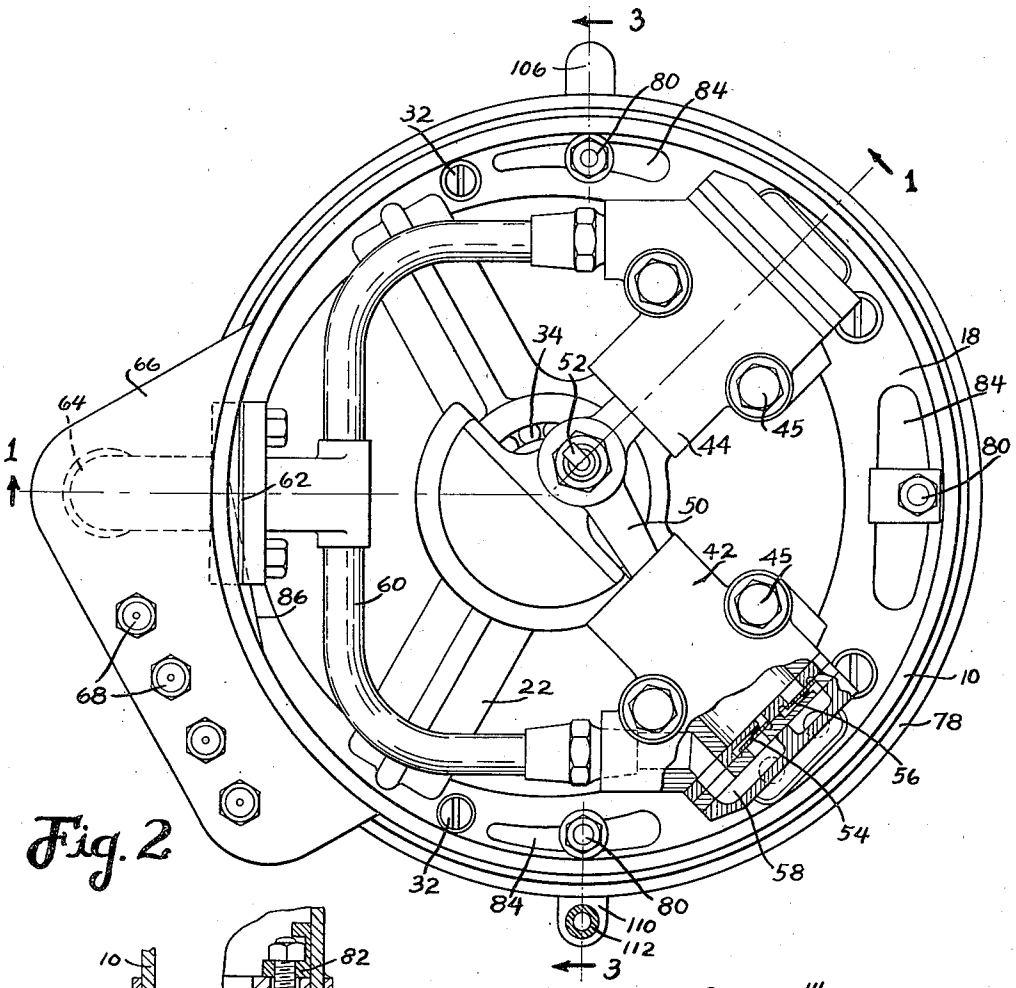


Fig. 2

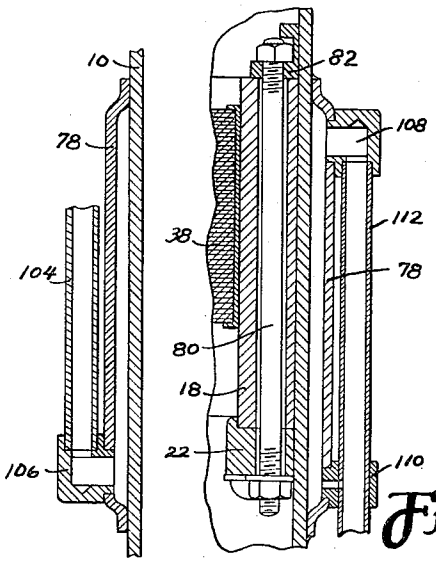


Fig. 3

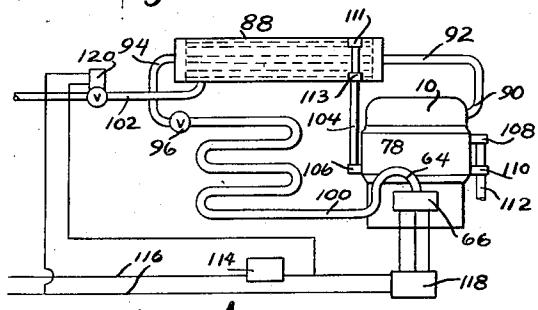


Fig. 4

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UNITED STATES PATENT OFFICE

2,130,276

REFRIGERATING APPARATUS

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Original application October 31, 1934, Serial No. 750,850. Divided and this application March 19, 1937, Serial No. 131,915

3 Claims. (Cl. 230—58)

This invention relates to refrigerating apparatus and more particularly to a novel refrigerant liquefying unit embodying a hermetically sealed motor-compressor particularly adapted for units of large capacity.

This application is a division of my co-pending application, Serial No. 750,850, which was filed on October 31, 1934.

It is an object of the invention to provide a hermetically sealed motor-compressor unit having a removable frame within the housing upon which the motor and compressor are mounted and may be operated as a unit outside the housing.

A further object is to provide a novel means for insuring the maintenance of an unfailing supply of lubricant to the top bearing of the motor-compressor unit.

It is also an object to provide a motor-compressor unit which is quiet in operation and which embodies a built in muffler for the discharged refrigerant.

A further object is to provide a water cooled refrigerant liquefying unit having provision for automatically draining the chamber or chambers containing cooling fluid at each time that the supply of cooling fluid is cut off.

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 a vertical cross section of a motor-compressor unit embodying the present invention, and is taken on line 1—1 of Fig. 2;

Fig. 2 is a bottom view of the unit shown in Fig. 1;

Fig. 3 is a cross section on line 3—3 of Fig. 2; and

Fig. 4 is a diagrammatic view of a refrigerating apparatus including a refrigerant liquefying unit embodying the present invention.

Referring now to Fig. 1, there is illustrated a motor-compressor unit comprising a dome shaped housing 10 having its lower end closed with a base plate 12 which is secured to the dome member, as by welding, at 14. The dome member 10 has an internal cylindrical bore 16 within which is slidably fitted a main frame 18. The frame 18 is comprised of two portions, 20 and 22, the upper portion 20 of which is provided with an internal bore 24 which is eccentric to the external surface of the portion 20. An upper bearing 26 is supported on the frame portion 20, preferably by a plurality of integrally formed spider arms 28. The lower portion 22 of the frame 18 is provided with an upstanding rim 30 which fits snugly within the internal bore 24 of the frame member 20 and is secured thereto by bolts 32 (see Fig. 2). The member 22 carries the lower bearing 34.

Journaled in the bearings 26 and 34 is the main shaft 36 which carries at its upper end the rotor 38 of an electric motor. The stator 40 of the motor is secured to the internal bore 24 in the frame member 20 as by screws 41. The shaft 36 projects below the bearing 34 and at its lower end is formed with a crank pin 43 forming part of a reciprocating piston compressor. A pair of compressor cylinders 42 and 44 are bolted to the lower surface of the frame member 22 and preferably adjustably mounted thereon by means of keys 46. The cylinders are movable radially due to a limited clearance around the bolts 45 in order to vary the clearance volume of the compressor. Suitable pistons 48 are reciprocated within the cylinder 42 by means of the usual connecting rods 50 which in turn are journaled on the crank pin 43. The crank pin 43 is preferably drilled for lubricating the bearings thereon and a downwardly directed lubricant scoop 52 is provided for delivering lubricant to the bearings under slight pressure.

Each of the cylinders 42 and 44 is provided with intake valves 54 and exhaust valves 56 of suitable design in their respective cylinder heads. Communicating with the intake valves 54 through suitable intake passages 58 is an intake manifold 60 having a separable joint 62 situated within the limits of the internal bore 16 of the housing 10. A suitable external inlet connection 64 is provided within a protruding portion 66 formed on the housing member 10. The protruding portion 66 also is provided with electric current lead-in conductors 68 which are connected to the windings of the stator 40. The exhaust valves 56 are in communication with outlet conduits 70 formed in the frame 18. The conduits 70 preferably comprise enlarged portions 72 formed in the frame member 20 at its thicker portion for the purpose of acting as a sound muffler. The outlet conduits 70 terminate in discharge portions 73 opening adjacent the upper bearing 26 for the purpose of directing entrained lubricant upon the bearing 26.

The bottom housing member 12 is formed with a concave portion 74 which acts as a lubricant sump and within which is provided a circular screen member 76 for filtering the lubricant be-

fore entering the lubricant scoop 52. A jacket or chamber 78 is provided on the outside of the housing member 10 through which water or other cooling fluid may be circulated for withdrawing heat from the stator 40 and from the compressed gas within the housing 10. The frame 18 together with the motor and compressor parts may be assembled outside the casing and operated as a unit before its insertion into the housing 10. After satisfactory testing, the motor, compressor and frame may be inserted into the open end of the housing 10 and secured thereto by bolts 80, which in turn, are anchored to holding lugs 82 welded to the housing 10. The bolts 80 pass through elongated apertures 84 in the frame 18 so that the entire unit may be rotated relative to the housing 10 during assembly. The frame 18 is provided adjacent its thinner portion with a flat or relieved portion 86 which permits the frame to pass the inlet connection 64 at the separable joint 62. After the frame has been inserted into the housing sufficiently to pass the inlet connection 64, the frame may be rotated into the position illustrated and bolted in place, after which the separable connection 62 is coupled together.

The motor-compressor unit is particularly adapted for use in a refrigerating apparatus which may comprise a water cooled condenser 88 to which compressed refrigerant is delivered from the outlet 90 of the compressor by the conduit 92. Refrigerant liquefied in the condenser 88 is delivered by conduit 94 to a liquid refrigerant control device 96 and expanded in the evaporator 98. The expanded refrigerant is delivered to the inlet 64 of the compressor by conduit 100. Water or other cooling fluid is preferably conducted from a suitable source to the condenser 88 by a conduit 102. From the condenser 88, the water is conducted to the cooling jacket of the compressor unit by a conduit 104. The water inlet 106 to the jacket 78 is preferably located at the bottom of the jacket as illustrated (see Fig. 3) while the outlet from the jacket is of special construction. The outlet preferably comprises a fitting 108 situated at the top of the water jacket and an additional outlet fitting 110 situated at the bottom of the water jacket. The outlet 110 is of restricted size so that it will not pass water at as great a rate as water is delivered to the jacket through the inlet connection 106. The discharged water may be conducted to a suitable drain by a conduit 112 which communicates with both outlet fittings 108 and 110. The water outlet connections from the condenser 88 comprise upper and lower fittings 111 and 113 which may be similar to the fittings 108 and 110 respectively.

Suitable electric control devices are provided in the refrigerating apparatus which may comprise a thermostatic switch 114 in one of the current supply lines 116 and suitable motor starting control devices 118. An automatic water valve 120 of suitable type is provided in the water inlet line 102 to maintain the supply of cooling water closed during the idle periods of the motor-compressor unit, and as illustrated comprises a solenoid valve connected to the current supply lines to be energized concurrently with the motor-compressor unit.

In operation, the system being suitably charged with refrigerant and a body of lubricant within the housing 10 of the compressor, thermostatic switch 114 is closed causing the starting device 118 to initiate operation of the motor-compressor unit. Rotation of the shaft 36 causes reciprocation of the pistons 48 in the well-known manner and withdraws expanded refrigerant through the inlet connection 64 and the inlet manifold 60. Compressed refrigerant is delivered through the outlet conduits 70, the mufflers 72 and the discharge orifices 73. The lubricant entrained in the refrigerant delivered from the orifices 73 maintains the bearing 26 well lubricated. The lower bearing 34 is lubricated by the splash within the lubricant sump 74 while the bearings on the crank pin 43 are lubricated by the lubricant scoop 52. The mufflers 72 being situated in the thick walled portion of the frame member 20, efficiently damp vibrations in the body of gas passing through the outlet conduits 70 and in addition, being of larger diameter than the remainder of the conduit 70, permit the discharged gaseous refrigerant to slow down and give up some heat to the adjacent water jacket 78. As long as the switch 114 remains closed, the water valve 120 will be energized permitting water to be delivered through conduit 102 to the condenser 88 and through conduit 104 to the water jacket 78. As soon as the thermostatic switch opens, the water valve 120 will close, thus shutting off the supply of cooling fluid to the condenser 88 and the water jacket 78. The water containing chambers of the refrigerant liquefying unit are self-draining in the following manner. Since the condenser 88 is situated above the water jacket 78, all the water in the condenser 88 will drain by gravity through connection 113 to the drain. As soon as condenser 88 is emptied of water in this manner, the jacket 78 will be emptied in a similar manner through the restricted outlet 110. The conduits 104 and 112 are made sufficiently large to permit air to bubble upwardly therethrough to displace the water being drained. This results in effectively draining the entire unit of water at each time that the motor-compressor unit shuts down, thus eliminating the possibility of a freeze-up in cold weather. Upon restarting of the refrigerant liquefying unit, the water is delivered through the valve 120 to condenser 88 at a greater rate than it will pass through the restricted outlet 113. This results in the level of water in the condenser gradually rising until it overflows through the unrestricted outlet 111. Thereafter water is delivered to the jacket 78 at a faster rate than it can escape through the restricted outlet 110 and the level in the jacket therefore rises until it overflows through the outlet 108. Thus, it is insured that both the condenser and the jacket of the compressor will be filled with water soon after the unit is started after each idle period.

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 a hermetically sealed motor-compressor unit, the combination of a cylindrical housing having an end closure, a frame member removably secured to the interior of said housing and having an eccentric interior bore for receiving a motor stator, upper and lower bearings supported on said frame, a motor rotor intermediate said bearings and journaled therein, a reciprocating compressor positioned below said motor and carried entirely by said frame, said compressor discharging compressed gas and entrained oil into a sound muffling passage in the thicker portion of said frame, said passage having a conduit ter-

minating above and adjacent to said upper bearing for directing said entrained lubricant thereon.

2. In a hermetically sealed motor-compressor unit, the combination of a cylindrical housing having an end closure, a frame member removably secured to the interior of said housing and having an eccentric interior bore for receiving a motor stator, upper and lower bearings supported on said frame, a motor rotor intermediate said bearings and journaled therein, a reciprocating compressor positioned below said motor and carried entirely by said frame, an outlet conduit for said compressor passing upwardly through said frame member adjacent the housing and having an enlarged portion intermediate the ends thereof and within the thicker portion of said frame to provide a sound muffler.

3. A hermetically sealed motor-compressor unit comprising, a housing having a closure, a frame member secured to the interior of said housing and supporting a motor stator, upper and lower bearings supported on said frame, a motor rotor intermediate said bearings and journaled therein, a compressor positioned below said motor and carried by said frame, an upwardly extending outlet passage for said compressor including a conduit formed directly in said frame member adjacent the housing, said conduit being of a larger diameter than the remainder of the passage for providing a sound muffling portion in said frame adjacent said motor stator, said passage terminating above and adjacent said upper bearing for directing lubricant entrained in the discharged refrigerant thereon.

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