Sept. 28, 1937. M. W. KENNEY ET AL 2,094,323

COMPRESSOR

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FIG. 1.

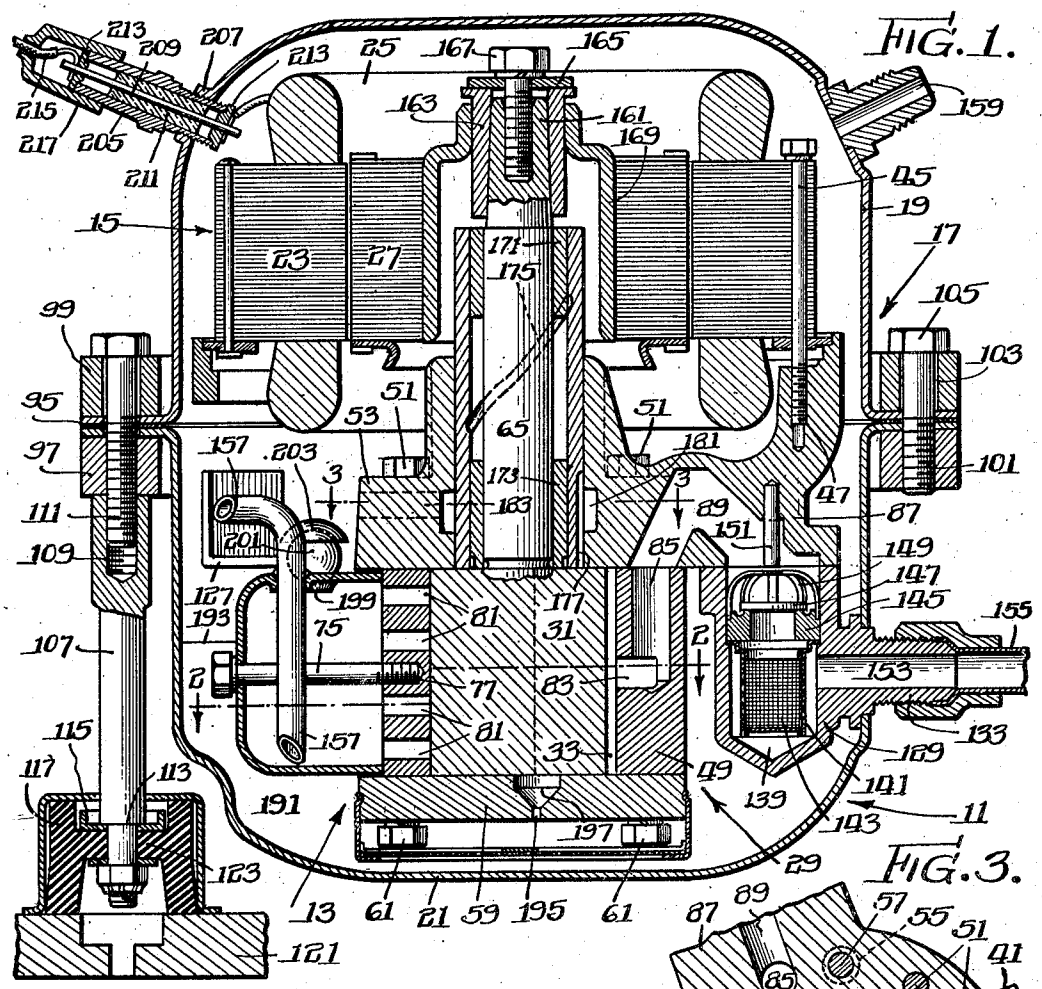


FIG. 2.

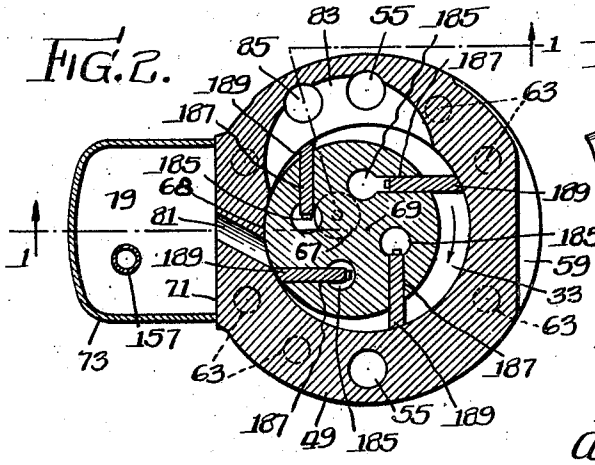
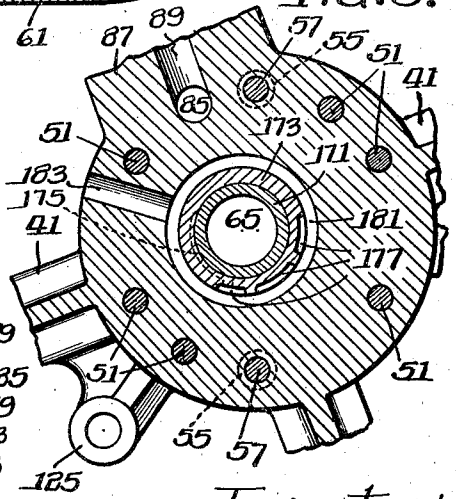


FIG. 3.



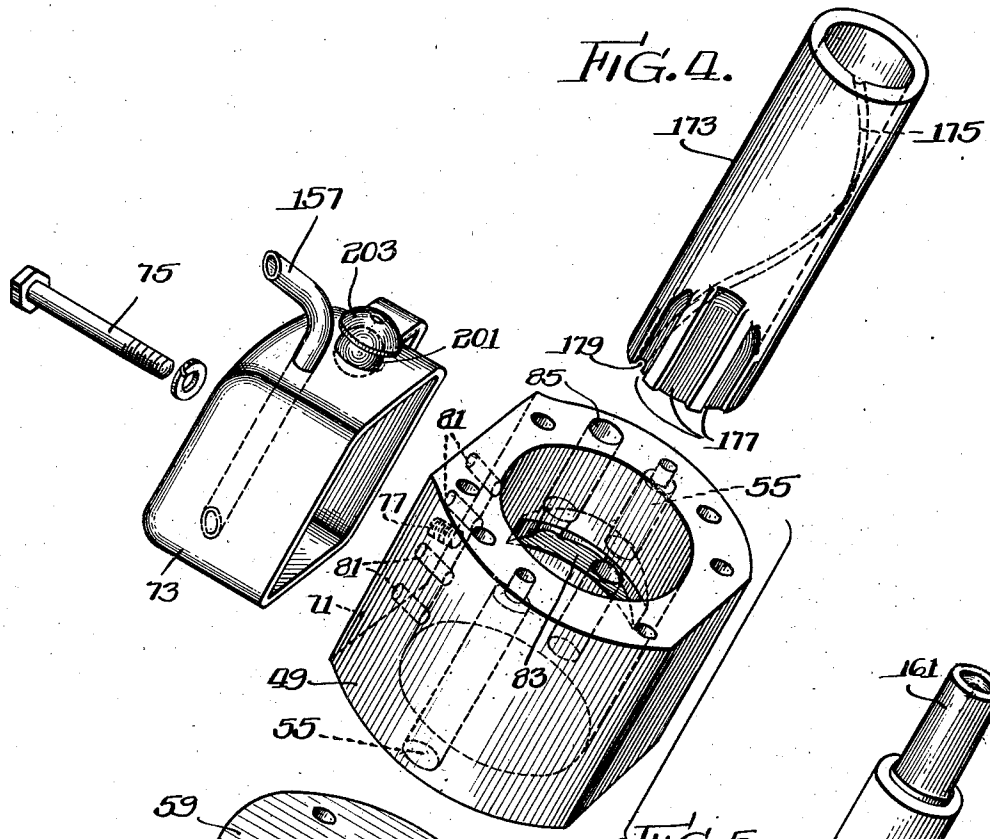
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COMPRESSOR

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FIG. 4.



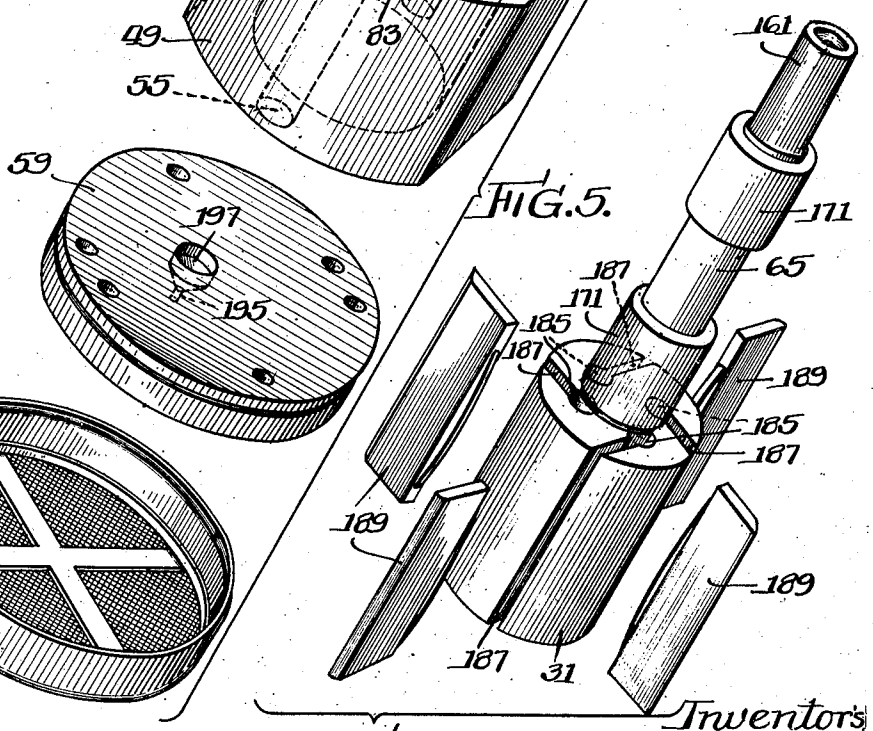


FIG. 5.

FIG. 6.

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FIG. 7.

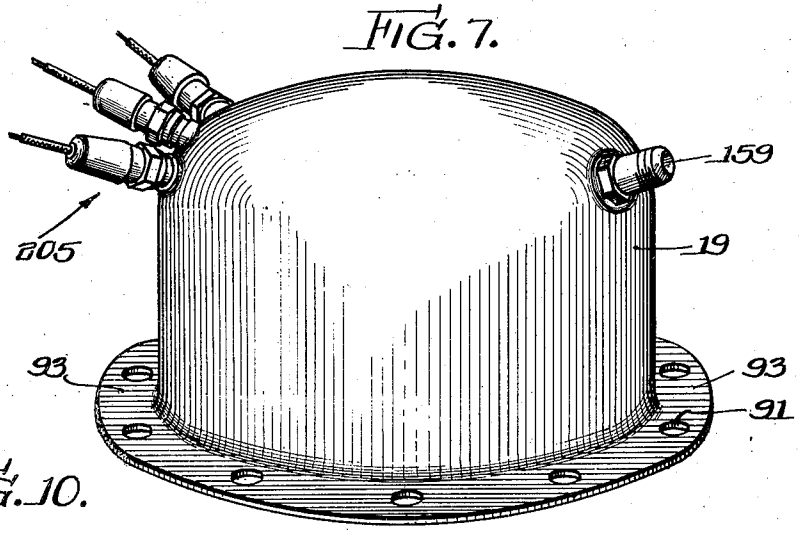


FIG. 10.

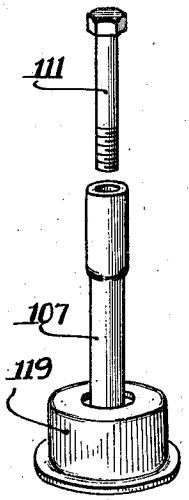


FIG. 9.

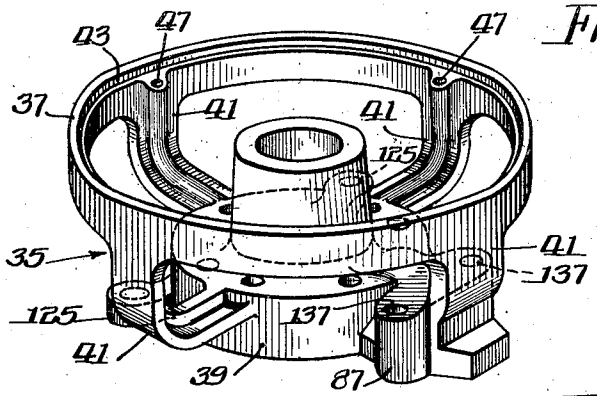
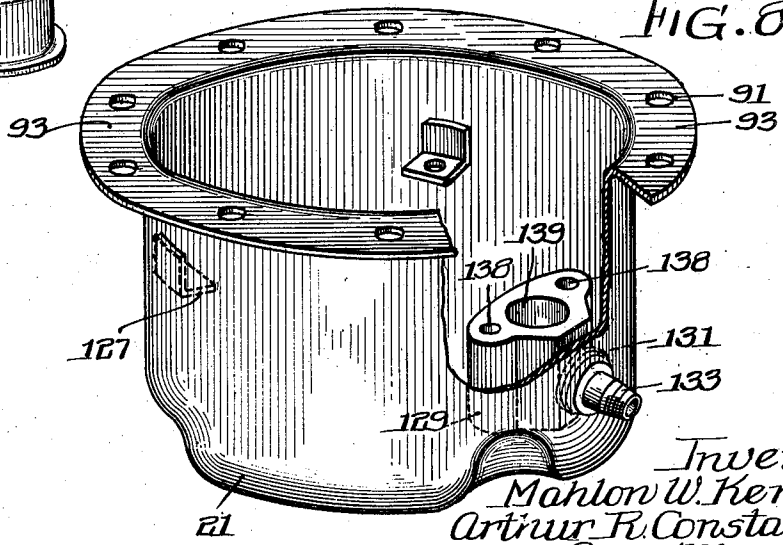


FIG. 8.



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2,094,323

UNITED STATES PATENT OFFICE

2,094,323

COMPRESSOR

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Application August 26, 1935, Serial No. 37,861

3 Claims. (Cl. 230—152)

Our invention relates in general to fluid-dynamics and more particularly to fluid-flow devices, the invention having specific reference to a compressor especially well adapted for use in refrigerating systems.

The invention has, for an important object, the provision of an improved fluid-dynamic device especially suitable for pumping or compressing a fluid media, especially gases, although many features of the invention may have general application in fluid dynamics. The device of our present invention, however, is particularly well adapted for use as a compressor in a refrigerating system wherein a suitable refrigerating medium, in gaseous condition, is compressed, then liquefied and finally evaporated for the absorption of heat, the gases, evolved by the evaporation of the refrigerating medium, being returned to the compressor for a repetition of the refrigerating cycle.

Another important object is to provide a mechanism of the character mentioned, which is compact, efficient, and substantially noiseless in operation and which is sealed against the escape of the working medium, the mechanism including driving means for the compressor, which, with the compressor mechanism, is enclosed in a sheet metal housing whereby to reduce the cost of construction and, at the same time, promote heat dissipation to maintain the unit at a low efficient operating temperature.

Another important object is to provide a motor-compressor unit having a hermetic enclosure entirely of sheet metal.

Another important object is to mount the dynamic mechanism in a sheet metal shell by suspending the same directly on the shell whereby the resilience of the sheet metal itself serves to resiliently support the operating mechanism.

Another important object is to provide three-point suspension of an operating mechanism within a sheet metal shell in order to improve its mounted stability.

Another important object is to support a compressor or pump and its driving motor on opposite ends of a shaft journalled intermediate its ends in a single bearing formed in a support frame, which, in turn, is carried entirely on a sheet metal shell.

Another important object is to provide a device having a rotating element carrying blades projecting from the working surface of the element so that the outer edges of the blade may perform a dynamic function with a fluid work medium, while the portions of the blade, carried by and within the rotary element, are utilized to pump a lubricating medium to desired places of the compressor and motor requiring lubrication.

Another object is to utilize the moving element of a dynamic device to accomplish a plurality of dynamic functions with corresponding work media.

Another important object is to provide a pump or compressor comprising a cylinder immersed in a lubricating medium and including a rotary piston within the cylinder having fluid-forcing blades reciprocating on the piston during rotation thereof within the cylinder in order to perform a dynamic function upon a fluid medium in the cylinder, said cylinder having a lubricant port disposed with respect to the piston so that the reciprocating action of the blades in the piston may be utilized to draw lubricant through said port and into the interior of the piston and expel the same thence to any desired place requiring lubrication; a further object being to discharge the lubricant, so pumped, to the piston bearing in order to lubricate the same.

Another important object is to provide a lubricant duct surrounding the bearing and to deliver an excess of oil through said duct for the purpose of cooling the bearing.

Numerous other objects, advantages, and inherent functions of the invention will be apparent from the following description, which, taken in connection with the accompanying drawings, discloses preferred embodiments of the invention.

Referring to the drawings:

Figure 1 is a vertical section through a sealed unit, embodying our present invention and comprising a motor, a compressor and support means therefor including a frame carrying a lubricant-cooled main bearing and an enclosing housing of sheet metal;

Figure 2 is a horizontal section taken substantially along the line 2—2 in Figure 1;

Figure 3 is a horizontal section taken substantially along the line 3—3 in Figure 1;

Figure 4 is a perspective view of a bushing forming a part of the lubricant-cooled bearing;

Figure 5 is a perspective view of parts forming the cylinder of the compressor element;

Figure 6 is a perspective view of parts forming the compressor piston;

Figures 7 and 8 are perspective views of the co-operating parts of the sheet metal housing;

Figure 9 is a perspective view of the support frame; and

Figure 10 is a perspective view of a supporting leg for the housing.

To illustrate our invention, we have shown on the drawings, a fluid-forcing device particularly adapted for use as a compressor in a refrigerating system of the compression-evaporation type, although it will be obvious that the invention is not necessarily restricted in all of its features to compressors or to devices used in refrigerating systems. On the contrary, the invention includes many features which may be incorporated to advantage in fluid-dynamic devices generally.

We propose the features of our present invention, however, more particularly for application in fluid-forcing means adapted for substantially noiseless, leak-proof, and efficient operation over long periods of time without attention in order to produce a preferably motor-driven compressor for use in refrigerating systems wherein the foregoing characteristics are desirable.

Compressors, made in accordance with our present invention, are particularly well suited for use in domestic refrigerators where simplicity and cheapness of construction, and silent, as well as trouble-free, operation over long periods of time without attention are highly desirable features.

The illustrated motor-compressor mechanism comprises a sealed unit 11, including fluid-dynamic means 13, namely a compressor, and dynamo-electric means 15, namely an electric motor, preferably of the induction type, drivingly connected with the compressor, said compressor and motor being sealingly enclosed in a preferably hermetic housing 17 of sheet metal. The housing preferably comprises a pair of sheet metal shells 19 and 21 for the sake of convenient assembly. The fluid-dynamic and dynamo-electric devices 13 and 15 are supported in and by said sheet metal housing 17 so that the entire weight of said devices is carried by the relatively flimsy and resilient sheet metal walls of the housing.

The motor 15 preferably comprises a stationary portion or stator 23, carrying windings 25, and a movable portion or rotor 27, and the compressor 13 comprises a cylinder 29 and a piston 31 within the cylinder and forming therewith a compression or working space 33. The cylinder 29 and piston 31 are relatively movable to perform a fluid dynamic function with a fluid work medium within the working space 33. We prefer to form the cylinder as a stationary element while the piston is rotatable within the cylinder and about an axis 67 eccentric with respect to the axis 69 of the cylinder.

All of the parts of the mtor and compressor are supported preferably upon a frame or spider 35 comprising an annular rim 37, a central hub 39 and arms 41 interconnecting the hub and rim. The rim 37 is formed with a seat 43 adapted to receive the stationary element 23 of the motor, which is secured in place by preferably elongated fastening elements 45 extending through the stator 23 and threading into openings 47 in the rim 37 opposite the legs 41.

The compressor cylinder 29 comprises a cylindrical element 49, the inner bore of which defines the outer surface of the compression space 33. One end of the element 49 is secured to an end of the central hub 39 by means of headed studs 51 passing through a flanged portion 53 of said hub and threading in sockets formed in the end of the element 49. The walls of the element 49 also are formed with a pair of channels 55, in which are received headed fastening members 57, which take into the hub portion 53 and additionally secure the cylinder element 49 on the hub. The other end of the cylinder element is closed by a cover 59, comprising a preferably circular disk secured on the end of the element 49 by headed fastening members 61, which penetrate perforations formed in the disk 59 and thread into openings 63 formed in the end of the cylinder element.

The piston 31 comprises a cylindrical element carried on a preferably integral axle 65, which is journalled in the hub 39 in position such that the axis 67 of the piston is eccentric with respect to the axis 69 of the cylinder. The position of the piston axis is, of course, fixed and determined by the location of its shaft journal in the frame 35. The cylinder fastening elements 51 and 57, however, afford means for adjusting the position of the cylinder slightly on the hub 39 during assembly so that the parts may be arranged to provide running contact between the outer surface of the piston and the inner bore of the cylinder along a line 68 lying in a plane common to the axes 67 and 69 so that the work space 33, defined between the piston and cylinder, is crescent shape in cross-sectional configuration with the horns of the crescent extending on opposite sides of the line of contact 68.

The outer surface of the cylinder element is flattened to form a seat 71 substantially opposite the line of contact 68 and a preferably sheet metal housing 73, comprising a cup-shaped element, is secured with its edges in engagement on the seat 71. This cup-shaped element is held in place by means of a headed fastening stud 75 extending through its wall and threading into a suitable opening 77 formed in the walls of the cylinder element 49. The housing 73 forms a receiving chamber 79 and the cylinder is formed with a plurality of openings 81 comprising discharge ports communicating an arm or horn of the work space, on one side of the contact line 68, with the interior of the receiving chamber 79.

The cylinder element also is formed with a slot opening upon the other arm of the work space on the side of the contact line 68 opposite from the ports 81. The walls of the cylinder element are formed with a channel or duct 85 extending from the slot 83 to the end of the element, which is secured to the end of the hub. One of the legs 41 of the frame is enlarged, as at 87, said enlargement containing a duct 89 opening at one end on the surface of the hub 39 in communication with the channel 85. The duct 89, at its other end, opens outwardly of the cylinder element.

As heretofore mentioned, the hermetic casing 17 preferably comprises a pair of co-operating shell-like portions 19 and 21, which may be conveniently formed of sheet metal in any suitable fashion, as by pressing or otherwise forming metal sheets of gauge suitable for desired strength in the finished casing. The casing portions are preferably of cup-shaped configuration having marginal flanges 93, by means of which the same may be secured together in any suitable fashion, said flanges being provided with a series of circularly arranged registering perforations 91 and secured together, upon an intermediate sealing gasket 95, by and between a pair of annular rings 97 and 99. The ring 97 underlies one of the flanges and is formed with threaded openings 101 in position aligning with the flange perforations 91. The ring 99

overlies the other flange and is formed with openings 103 adapted to align with the openings 91; and the parts are clamped together preferably by headed studs 105 penetrating the openings 103 and 91 and threading into the openings 101.

We also preferably provide means comprising a plurality of legs for supporting the casing and the mechanism enclosed therein. These legs preferably comprise each an elongated element 107 having a threaded socket 109 at one end whereby the same may be attached to the threaded end 111 of one of the studs 105, certain of which extend beyond the ring 97 in position to carry the legs. Three or more legs of this character may be used. Any suitable means may be utilized to mount or secure the legs 107 on a supporting base but we prefer to utilize a resilient mounting construction wherein the lower end of each leg 107 provides a shoulder 113 seating on a washer 115, which, in turn, is supported in a resilient, preferably rubber, mounting block 117. The resilient mounting block 117 is preferably enclosed in a shell-like element 119, by means of which it is secured on the base 121. The leg 107 has an extension penetrating the washer 115 and a web-like portion 123 of the resilient mounting block and carrying, on its threaded end, a washer and a suitable holding nut for the purpose of securing the leg on the resilient mounting block.

To support the motor and compressor on the shell, the frame 35 is provided with a pair of ears 125 formed on the enlarged portion 53 of the hub 39. These ears 125 project outwardly in position to rest upon and be supported by flanged hangers 127 formed or otherwise secured on the shell element 21. The ears 125 and hangers 127 are preferably perforated to permit the parts to be bolted together. In addition, a fitting 129 is mounted on the wall of the shell element 21, at an opening 131 formed therein. The fitting 129 has a nipple 133 extending through the opening and sealingly secured therein so that the fitting 129 forms a hanger on which to support the enlargement 87 of the frame, said parts being preferably secured together by fastening elements passing through openings 138 in the fitting 129 and corresponding openings 137 in the frame portion 87.

The fitting 129 is formed with an enlarged chamber 139 opening into the duct 89 of the frame when the same is positioned on the fitting 129. The lower portions of the chamber 139 are adapted to contain a frame 141 carrying a sieve or strainer 143 and supporting an annular element 145 providing a valve seat for a disk valve 147. The upper portion of the chamber carries a preferably sheet metal valve guard 149, which is held in place, when the frame is connected on the fitting 129, by means of a pin 151 carried by the frame and having an end projecting in position to engage the guard and prevent shifting of the same within the chamber. The nipple 133 is formed with a duct 153 communicating with the valve chamber 139 and opening outwardly of the casing through the end of the nipple, which is threaded, as shown, to facilitate attachment of a conduit 155, through which a work medium may be delivered through the duct 153 and the valve chamber and into the duct 89 of the frame, thence through the duct 85 to the inlet space 83 of the compressor. Rotation of the piston relative to the cylinder in a direction as shown by the arrow in Figure 2 of the drawings will cause the work medium to be compressed in the work space 33 and delivered thence in compressed condition through the outlet ducts 81 and into the receiving chamber 79. The shell 73 has a pipe 157 mounted with an end exposed within the compartment 79 and an end opening within the sealed casing 17, so that gases, delivered into the chamber 79, may escape thence through the pipe 157 into the casing.

The function of the housing 73 is to provide a muffler chamber, into which the compressed work medium may be delivered from the compressor and which is adapted to muffle or suppress the noise of expulsion of the work medium under pressure from the compressor. During the operation of the device, the work medium consequently is delivered into the housing 17, which, of course, becomes loaded with the work medium at the delivery pressure of the compressor. The compressed medium may be delivered from the casing through a nipple or nozzle 159 preferably sealed in an opening formed in the casing portion 19, the external portions of said nozzle being threaded for connection with suitable conduit means, through which delivery of the compressed medium may be made to any desired place of use.

The shaft 65 has an end extending upwardly of the hub portion 39 of the frame and formed to receive and support the rotor 27 of the motor, said upwardly extending end being preferably tapered, as at 161, to receive a correspondingly tapered sleeve 163, which may be held on the shaft by means of a washer 165 and a threaded stud 167, which engages in a threaded socket formed in the end of the shaft. The sleeve 163 carries a depending frame 169, on which the rotor 27 is constructed.

The shaft 65 preferably is formed with a pair of spaced apart bearing portions 171 and is received in a sleeve-like bushing 173 having a preferably spiral groove 175 cut in its inner surface for purposes of aiding lubrication of the shaft bearings. The outer surface of the sleeve 173 is preferably formed with a plurality of parallel grooves 177 disposed on one side of and at one end of the sleeve, the end of the sleeve being notched as at 179 to connect one of said grooves 177 with an end of the spiral groove 175. The sleeve 173 is firmly fitted into the hub 39 of the frame, which is provided interiorly with an annular groove 181. The groove 181 communicates with the outer surface of the hub 39 through a duct 183. The annular groove 181 is positioned in the hub to communicate with the grooves 177 of the bearing sleeve.

The piston of the compressor is provided with a plurality of channels 185, extending parallel with and spaced from the piston axis 67 and slots 187 are formed in the body of the piston radially of said channels. These slots, as well as the channels 185, extend from end to end of the piston element and a fluid-forcing blade or vane 189 is arranged in each slot. These blades are long enough to slidingly engage the facing surfaces of the cover 59 and the hub 39 of the frame at their opposite ends and are slidable in the slots 187 so that the outer edges of the blades, which are slightly rounded, may bear upon the inner surface of the cylinder at all times during the rotation of the piston therein.

The driving motor, when energized, is adapted to rotate the piston within the work chamber in a direction causing the blades to sweep across the

crescent shaped work space from the arm thereof connected with the inlet space 83 to the arm which is in communication with the outlet ducts 81 whereby to force fluid, delivered at the inlet, through the chamber and thence under pressure into the muffler chamber 79. The blades 189, however, are freely depressible in the slots and consequently, during operation of the compressor, will reciprocate therein and establish an auxiliary pumping action in the channels 185, the blades, of course, being urged outwardly in the slots by centrifugal action and being depressed as the outer edges of the same ride upon the cylinder toward the contact line 68.

We utilize this auxiliary pumping action in order to supply a suitable lubricating medium to the operating parts requiring lubrication and particularly to the shaft bearing. To this end, the casing part 21 provides a reservoir of a suitable fluid lubricating medium 191, which normally fills the same to an approximate level indicated in Figure 1 by the line 193. The lower end of the compressor is thus immersed in the lubricating medium and the plate 59 is formed with a duct 195, which opens into a cup-shaped depression 197 on the inner face of the plate. This depression 197 has a relative position, with respect to the cylinder and piston axes 67 and 69, such that the ends of the channels 185 are each successively placed in communication with the opening 197 during the period when its corresponding blade 189 travels outwardly in the associated slot. During the period of the operating cycle of the compressor when the blade returns into its slot, the channel 185 is out of communication with the inlet opening 197. Consequently oil will be drawn successively into the channels 185 through the oil inlet 195 and will be compressed in the channels 185. The ends of the channel 185, facing the hub 39, are successively brought into communication with the grooves 177 during the rotation of the piston when the blades move inwardly in the slots, so that the lubricant, compressed in said channels 185, may be delivered to said grooves from whence an excess of lubricant may penetrate into the annular groove 181 and escape through the duct 183, thus serving to cool the bearing and the hub 39, and thence flow by gravity back to the lubricant reservoir 191.

A part of the lubricant, however, will be forced into the lower end of the groove 179 and thence through the shaft bearing to lubricate the same, the lubricant escaping at the upper end of said bearing and returning by gravity to the reservoir. A part of the lubricant may also escape from the channels 185 through the slots 187 on opposite sides of the blades in order to provide the reciprocating blades with adequate lubrication. Such oil, of course, enters the work space and will be expelled together with the work medium into the chamber 79 and will be forced through the tube 157 and out into the housing 17, whence it may return to the reservoir 191.

If the compressor stands idle for any length of time, lubricant from the pool or reservoir 191 may escape into the compressor and flood the same and the chamber 79 to the level of the oil in the reservoir 191. For this reason, it is desirable to provide for the rapid ejection of excess lubricant when the compressor is started in operation, and, at the same time, permit delivery into the casing of such gases as may be in the chamber 79.

To this end, the upper portion of the shell 73 is formed with an opening 199, in which is seated a check valve 201 comprising a ball which is held in place by suitable retaining means 203. Of course, any suitable form of check valve may be used. As soon as the compressor starts in operation, oil will be forced rapidly through the pipe 157, due to the development of excess pressure in the chamber 79. The excess pressure, developed in the chamber 79, will also raise the ball 201 from its seat and permit any gases, that are delivered in the chamber 79, to escape directly into the housing 17 together with any excess oil. The pipe 157 extends substantially to the bottom of the chamber so that the chamber may be substantially cleared of oil rapidly while the check valve permits compressed gases to enter the housing while the chamber 79 is being purged of oil. The oil ejected from the chamber 79 returns immediately to the reservoir 191. After the oil has thus been exhausted from the chamber 79, the pipe 157 may carry substantially all of the compressed gases and deliver the same into the housing 17, the check valve, under such conditions, remaining closed.

Any suitable means may, of course, be utilized for powering the motor 15 from a suitable power source located externally of the casing. We prefer, however, to provide sleeve-like bushings 205 threaded or otherwise sealingly secured in openings 207 formed in the casing element 19. These bushings each carry a conductor 209 embedded in suitable insulation 211, the opposed ends of each conductor 209 being held in insulating washers 213 at opposite ends of its corresponding bushing 205. The ends of the conductors 209, exposed within the casing, may be connected in any convenient manner with the motor windings 25, while the outer ends of the conductors may be connected by suitable cable means 215 with the power source from which the motor is to be energized. The connection between the cable means 215 and the outer ends of the conductors 209 may be covered by suitable, preferably rubber, insulating caps 217.

As heretofore mentioned, motor-compressor units, embodying our present invention, are especially well adapted for use in refrigerating systems and we contemplate, particularly, using the herein described unit in a domestic refrigerator embodying a compressor-expansion refrigerating system utilizing dichloromethane as the refrigerating medium, the lubricating medium 191 comprising a suitable mineral oil. This particular refrigerant, when in gaseous condition, is substantially insoluble in mineral oils so that substantially no problem of separating the gaseous refrigerant from the liquid lubricant is encountered. The lubricant simply settles to the bottom of the casing 17, while the compressed refrigerant escapes through the nozzle 159 at the top of the casing.

It is thought that the invention and numerous of its attendant advantages will be understood from the foregoing description and it is obvious that numerous changes may be made in the form, construction, and arrangement of the several parts of the illustrated apparatus without departing from the spirit or scope of our invention or sacrificing any of its attendant advantages, the preferred modes and forms herein described being merely for the purpose of illustrating the invention.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent is as follows:

1. A device of the class described comprising a frame, fluid dynamic means carried by said frame

and comprising cooperating working elements including a piston element and a cylinder element forming a working space on one side of said frame, said frame forming a bearing support, a sleeve fitted in said bearing support and having longitudinal grooves in the outer surfaces of the sleeve at an end thereof communicating with the interior of said cylinder, at least one of said elements having a shaft extending within and journalled in said sleeve, means on said frame for driving said shaft and the element connected thereto, means formed and arranged on said driven element for delivering fluid under pressure to said longitudinal grooves, said bearing support having duct means communicating with said grooves and extending in and through said bearing support for the purpose of receiving cooling fluid.

2. A device of the class described comprising a frame, fluid dynamic means carried by said frame and comprising cooperating working elements including a piston element and a cylinder element forming a working space on one side of said frame, said frame forming a bearing support, a sleeve fitted in said bearing support having longitudinal grooves in the outer surfaces of the sleeve at an end thereof communicating with the interior of said cylinder, at least one of said elements having a shaft extending within and journaled in said sleeve, means on said frame for driving said shaft and the element connected thereto, means formed and arranged on said driven element for delivering fluid under pressure to said longitudinal grooves, said bearing support having duct means communicating with said grooves and extending in and through said bearing support for the purpose of receiving cooling fluid, an opening in said sleeve communicating at least one of the longitudinal grooves with the interior of the sleeve whereby a lubricant delivered in said groove may enter the sleeve to lubricate the shaft extending therein.

3. A device of the class described, comprising a pair of cooperating shell sections of generally cup-shaped configuration having outwardly extending integral marginal flanges at the edges thereof whereby said shells may be secured together to form a hermetic casing, said flanges also affording means for the attachment of support members for mounting the casing in operative position, working mechanism within said casing comprising a frame forming a plate portion, an annular ring-like rim and arms interconnecting the rim with said plate portion, said plate portion having a shaft bearing, fluid dynamic means forming a working space and mounted on one side of said plate portion in position extending within one of said cooperating shells, said shell having bracket means on the inner walls thereof in at least three circumferentially spaced locations, said frame having at least three mounting portions adapted to rest upon and be secured to said bracket means whereby to support the mechanism within the hermetic casing, said fluid dynamic means comprising a cylinder on said plate portion and a piston within the cylinder, a shaft extending through and journalled in said bearing and drivingly connected with said piston, a driving motor extending within the other shell portion and having an annular stator mounted on said rim and a rotor within said stator and drivingly connected on said shaft, at least one of said bracket means forming a channel opening outwardly of said hermetic casing and said fluid dynamic means having an inlet duct including a duct portion extending in said frame and communicating with the channel of said bracket means, said other casing portion having an outlet fitting thereon and at least one of said casing portions having gas-tight conductor inlets to permit said motor to be electrically energized from a source outside of said casing.

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