March 28, 1939. M. W. KENNEY ET AL 2,152,056

SEALED UNIT

Filed May 10, 1934 3 Sheets-Sheet 1

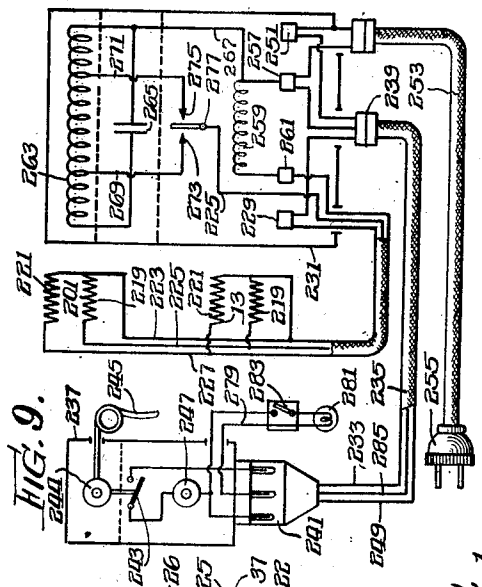


FIG. 9.

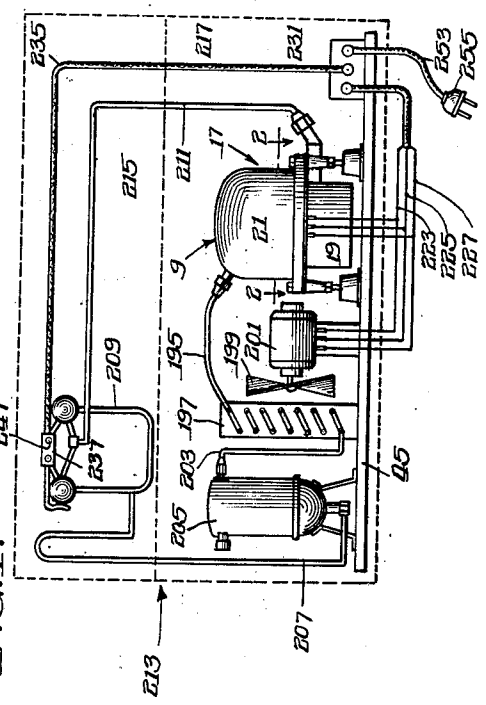


FIG. 1.

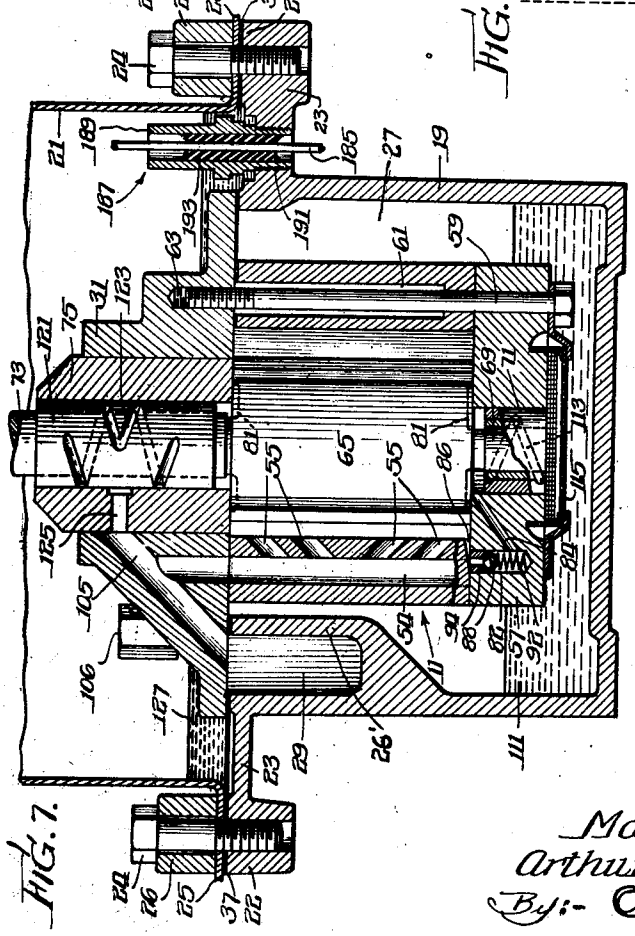


FIG. 7.

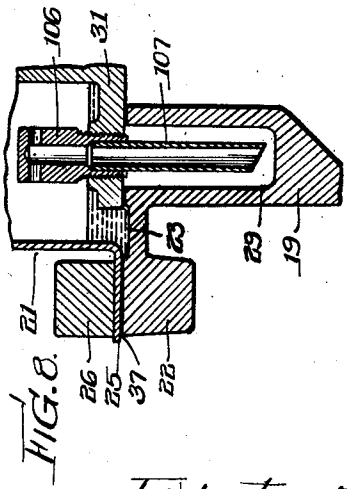


FIG. 6.

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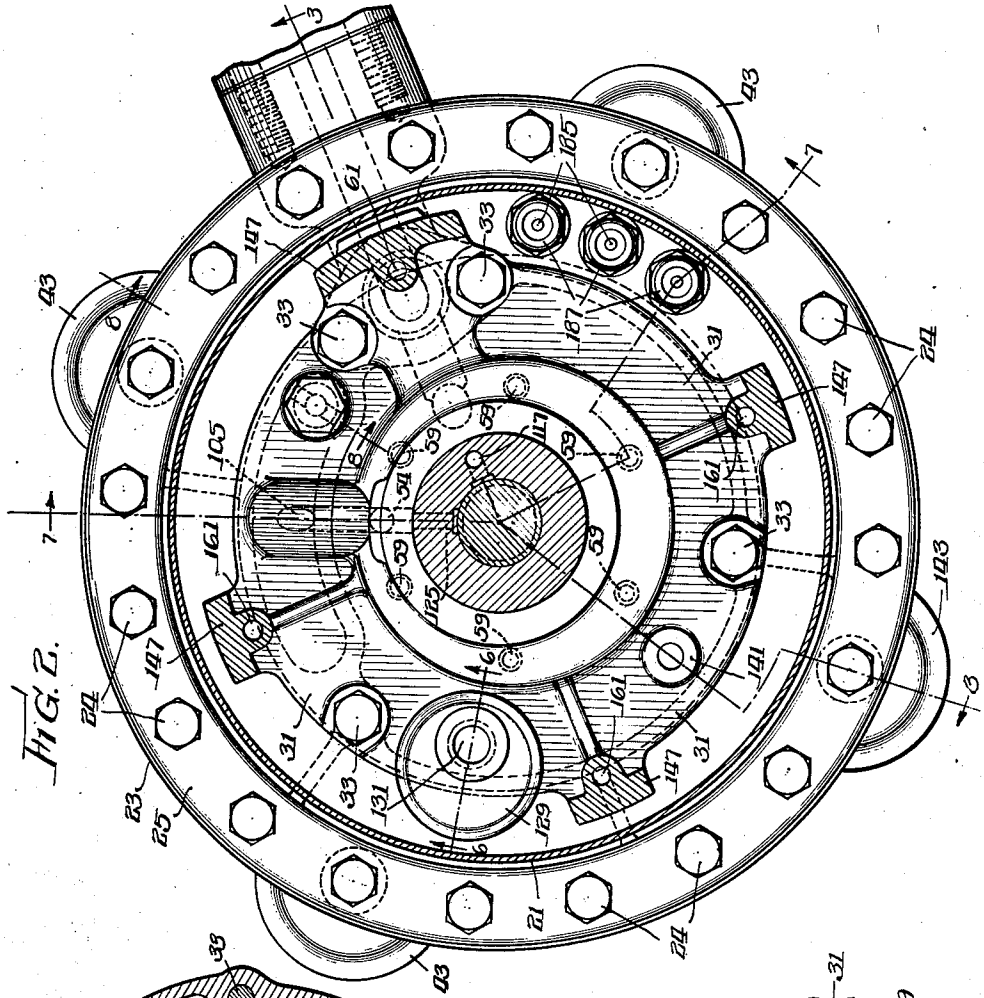


FIG. 2.

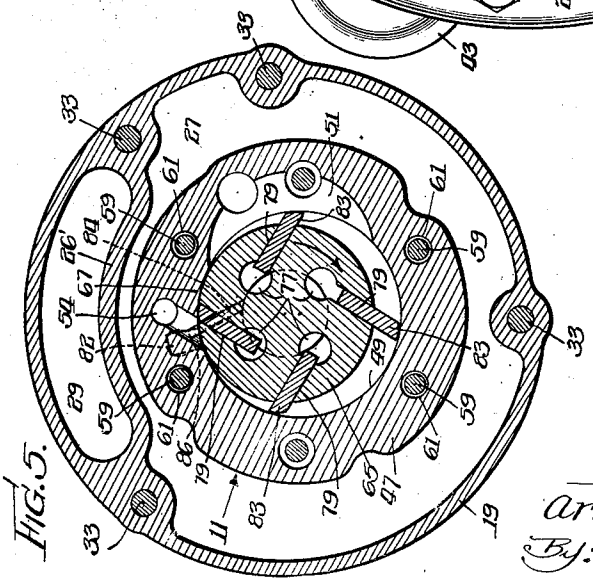


FIG. 5.

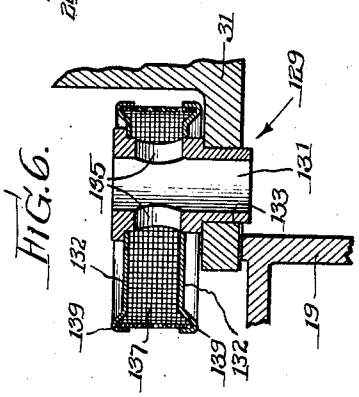


FIG. 6.

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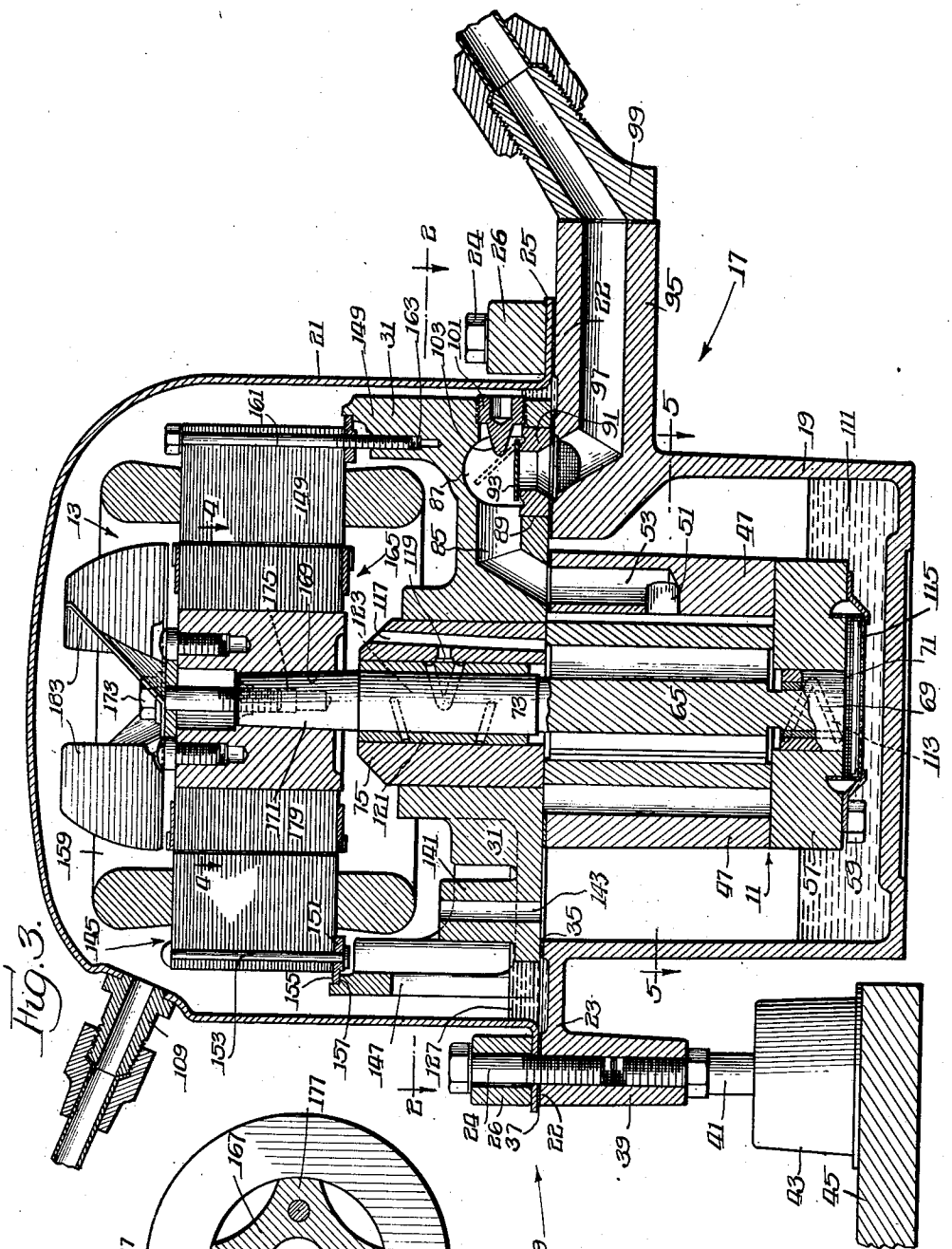


Fig. 3.

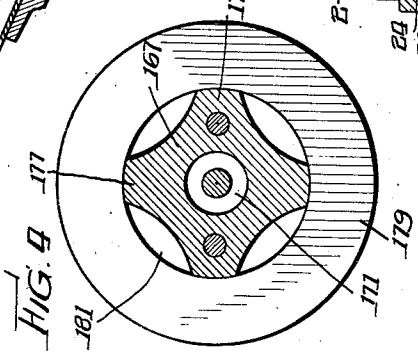


Fig. 4

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UNITED STATES PATENT OFFICE

2,152,056

SEALED UNIT

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Application May 10, 1934, Serial No. 724,894

2 Claims. (Cl. 230—139)

Our invention relates in general to fluid forcing devices, and has more particular reference to rotary compressors.

The invention has for an important object the provision of an improved device particularly well adapted for incorporation as fluid forcing or compressing means in a refrigerating system more especially a system of the so-called compression-evaporation type, wherein a suitable refrigerating medium in gaseous condition is compressed, then liquefied by condensation, and finally evaporated for the absorption of heat, the gases evolved by the evaporation of the refrigerating medium being then returned to the compressor for a repetition of the refrigerating cycle.

Another important object is to provide fluid forcing mechanism of the character mentioned which is compact, efficient, and substantially noiseless in operation, and completely sealed against the escape of the working medium, the device having self-contained means for adequately lubricating the mechanism, whereby the same is adapted for continuous operation over long periods of time without attention, and hence may be used to advantage in domestic refrigerators.

Another object is to provide a motor-compressor unit enclosed in a hermetic housing forming a compressor compartment and an adjacent motor compartment into which the compressor delivers the working medium and from which the working medium is discharged from the unit.

Another object is to provide a motor-compressor unit of the character mentioned wherein the compressor is formed with means for circulating a lubricating medium to the working parts of the compressor as well as to the journals of the motor, and wherein the working medium is circulated in the motor housing during the operation of the unit.

Another object is to provide a motor-compressor unit including a compressor and an adjacent motor enclosed in a hermetic casing forming a sealed housing for the unit, and having internal partition means defining, in the housing, a motor compartment and a compressor compartment, wherein said partition affords a bearing for a shaft to which the rotating compressor and motor elements are drivingly connected; a further object being to provide a lubricant reservoir in the compressor compartment, and to provide the partition with lubricant channels through which lubricant from the reservoir may be forced through the bearing and into the motor compartment; and a still further object being to form said partition with means forming an overflow return from the motor compartment to the lubricant reservoir in the compressor compartment.

Another object is to provide a motor-compressor unit including a compressor and an adjacent motor enclosed in a hermetic casing forming a sealed housing for the unit, and having an internal partition defining in the housing a motor compartment and a compressor compartment wherein said partition contains a channel forming an inlet for the working medium to the suction side of the compressor; a further object being to provide valve means at said channel in the partition, permitting the working medium to flow through said channel in one direction only.

Another object is to provide a motor-compressor unit including a compressor and an adjacent motor enclosed in a hermetic casing forming a sealed housing for the unit, and having an internal partition defining, in the housing, a motor compartment and a compressor compartment wherein said partition provides a support on which stationary portions of the motor are mounted within the motor compartment; a further object being to journal the rotating portions of the motor and compressor in said partition and to support the stationary portions of the compressor on said partition; a still further object being to journal the rotating part of the compressor at one end in the stationary part of the compressor, and to immerse the lower portion of the compressor in a lubricant bath contained in the compressor casing, and to form said journal as a pumping means for delivering lubricant from said bath to the working parts of the compressor.

Another important object is to provide a fluid forcing device or compressor having a relatively stationary casing and a movable fluid-forcing element in said casing wherein the casing is formed with an internal chamber providing a muffler into which the working medium is delivered under pressure by the fluid forcing element; a further object being to form the muffler as a chamber cored in the compressor casing.

Another object is to provide a fluid forcing device or compressor comprising a casing open at one end and having a partition affording a compressor chamber and a muffler chamber, a cover for said chambers, and means in said compressor chamber forming a compressor comprising a cylinder formed with a discharge manifold and a fluid-forcing element in said cylinder, wherein said cover is provided with a channel connecting the muffler chamber with the discharge manifold; a further object being to provide means affording an outlet from the muffler chamber through said

cover; and a still further object being to form said outlet as a pipe carried in and extending through said cover, and having an end extending adjacent the bottom of said manifold chamber.

Another object is to provide a fluid-forcing device or compressor having a casing containing a channel for a fluid working medium communicating with said compressor, and a valve operatively arranged in said channel and adapted to permit the working medium to flow through the channel in one direction only; a further object being to form said valve as a disk loosely confined in said channel in position to overlie a valve seat, said channel being enlarged in the vicinity of said valve seat to receive said disk and said valve structure including adjustable means to restrict the movement of said disk away from said valve seat; and a still further object being to form said seat to permit said disk to tilt thereon and to form the seat as a readily removable and replaceable fitting mounted in the compressor casing.

Another important object is to provide a compression expansion refrigerating system including a sealed motor compressor unit having the functional and structural advantages and characteristics hereinafter set forth.

These and numerous other objects, inherent advantages and functions of the invention will be apparent as the same is more fully understood from the following description, which, taken in connection with the accompanying drawings, discloses a preferred embodiment of the invention.

Referring to the drawings:

Figure 1 is a diagrammatic view of a compressor evaporation refrigerating system having a sealed motor-compressor unit embodying our present invention;

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

Figure 3 is a view in vertical section taken substantially along the line 3—3 in Figure 2;

Figure 4 is a view in horizontal section taken substantially along the line 4—4 in Figure 3;

Figure 5 is a view in horizontal section taken substantially along the line 5—5 in Figure 3;

Figure 6 is a view in vertical section taken substantially along the line 6—6 in Figure 2;

Figure 7 is a view in vertical section taken substantially along the line 7—7 in Figure 2;

Figure 8 is a view in vertical section taken substantially along the line 8—8 in Figure 2; and

Figure 9 is a diagrammatic view of an electrical system which may be used to supply power for operating a refrigerating system embodying our invention.

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 to compressors or devices used in refrigerating systems. On the contrary, our present invention includes features which may be incorporated in hydraulic devices other than compressors and adapted for other uses than fluid-forcing means in a refrigerating system. We propose the devices of our present invention, however, as more particularly applicable as fluid-forcing means adapted for substantially noiseless, leakproof and efficient operation over long periods of time without attention, whereby the same is particularly well adapted for use in refrigerating systems wherein the stated characteristics are desirable. To provide the foregoing characteristics, we form the compressor as a sealed unit 9 including fluid-forcing means 11 and driving means 13 comprising an electric motor, housed in a substantially hermetic casing 17. The casing may of course be formed in any suitable or preferred fashion, but we prefer to form the casing in sections, one of which 19, is preferably formed as a casting having an outstanding peripheral flange 23 and providing a receptacle for the fluid-forcing element of the unit while the other casing section 21 is formed preferably of sheet metal and is of dome-like form affording a closure for the motor, said casing portion 21 having a peripheral flange 25 fastened as by a holding ring 26 and bolts 24 to a seat 22 formed in the flange 23 with an annular gasket 37 extending between the flanges whereby the casing portions are sealingly secured together in position to enclose the fluid-forcing and driving elements.

The casing portion 19 is formed with a partition 26' defining a chamber 27 adapted to receive the fluid-forcing or compressor mechanism 11 and a second chamber 29 forming a muffler, both of said chambers opening at one end of the casing portion. The casing portion 19 also carries a cover member 31, which extends across and closes the open ends of the chambers 27 and 29, said cover member being secured in place on the casing portion 19 by means of bolts 33, suitable gasket means 35 extending between and being clampingly secured by and between the facing surfaces of the cover and the end of the portion 19 on which it is mounted. The flange 23 extends outwardly of the walls of the casing 19 at or near its open end and is provided at intervals with depending portions 39 formed to receive bolts 41, which are preferably provided with resilient or yielding feet 43 by which the unit may be mounted in shock-absorbing fashion on a supporting base 45. Obviously any suitable or preferred means may be employed for mounting the unit. It is obvious also that the fluid-forcing and driving means 11 and 13 may be mounted in the casing in any suitable or preferred fashion, but we prefer to mount them on the cover 31, which, as will be apparent, forms a partition separating the casing into an upper and lower chamber in which the driving means and the fluid-forcing mechanism are respectively mounted so that the former is superposed upon the latter, the driving means being mounted on and supported by and above the cover 31, while the fluid-forcing means 11 is suspended on and supported by and below the cover 31, said superposed arrangement being particularly well adapted to our purpose in that it facilitates assembly and lubrication of the operating parts.

The fluid-forcing mechanism 11 comprises a stationary element 47, which is preferably formed as an open ended sleeve, having an internal cylindrical bore 49, relieved as at 51 to form an inlet port. A duct 53 is formed in the walls of the member 47 between said inlet port and an end of the member. The walls of the element 47 are also formed with a channel 54 preferably extending parallel with the axis of the bore 49 and opening at the opposite ends of element 47, said channel 54 having communication with the bore 49 through ducts 55, which are drilled through the intervening portions of the element 47 at angles as shown in Figure 7, an expedient permitting the ducts 55 to be formed easily by means of a drill applied through the opposite ends of the bore 49.

The ducts 55 and the channel 54 form an ex-

haust manifold into which a work medium, such as refrigerant or other fluid, introduced into the cylinder through the inlet port 51, may be expelled by the action of a fluid-forcing element 65 mounted in the bore 49. One end of the element 47 is closed by means of a cover 57 which, with the element 47, is supported upon the underside of the cover 31 by means of studs 59 which extend through the cover 57 and through bolt holes 61 formed in the element 47 and thread into sockets 63 formed in the cover 31. The fluid-forcing element 65 comprises a cylindrical rotor which is mounted within the work chamber formed by the bore 49 between the facing surfaces of the cover members 31 and 57. This rotor is of less diameter than the interior of the bore 49 and is journaled for rotation within the work chamber about an axis eccentric with respect to the axis of the work chamber, the rotor being so positioned in the chamber that it forms running contact as at 67 with the walls of the work chamber between the inlet port 51 and the exhaust manifold 54. The rotor is formed with an axial projection 69 at one end by which it is journaled in the cover plate 57, said cover plate being formed with bearing means 71 for journaling said projection 69. The rotor also, at its opposite end, is provided with an axial projection forming a shaft 73 extending through and journaled in the cover 31, which is formed with suitable bearing means 75 for receiving said shaft. The rotor 65 is provided with a plurality of channels 77 extending parallel with and spaced from the axis of the rotor and slots 79 are formed in the body of the rotor radially of said channels and tangential to a circle concentric with the axis of the rotor and connecting the channels within the surface of the rotor 65, said slots extending from end to end of said rotor. The rotor also is undercut at its opposite ends to form annular channels 81 encircling the shaft projections and communicating with said channels 77. A fluid-forcing vane or blade 83 is arranged in each of the slots 79, said blades being long enough to engage the facing surfaces of the cover members 31 and 57 at their opposite ends and being slidable in the slots 79 in a tangential direction so that their outer edges, which are slightly rounded (as shown in Figure 5) may engage and press upon the inner surface of the bore 49 at all times during the rotation of the element 65 within the working cylinder. The driving means 13 is operatively connected with the shaft 73, and is adapted to rotate the member 65 within the working chamber in the direction illustrated by the arrow in Figure 5, so that the blades 83, in traveling with the rotating element, will force fluid, delivered in the working chamber at the inlet 51, through the chamber and deliver the same under pressure at the discharge manifold 54. The blades 83, however, are freely depressible in the slots 79 in order to permit fluid slippage at any time when abnormal pressures develop as where incompressible liquids enter the cylinder. This construction is adapted to relieve locking of the device and the consequent strain set up in the apparatus under such conditions. The blade construction, which we have provided, also is adapted to relieve back pressure upon the rotor when the same is initially started in operation from rest. When the rotor commences to move, the inertia of the blades, together with the tangential arrangement of the same, causes the blades to slide inwardly in the slots 79, thus providing a space between the outer edges of the blades and the inner working surface of the work cylinder, which unloads the pump at the instant of starting. As the speed of the rotor increases, centrifugal action expels the blades outwardly in the slot 79 into working contact with the cylinder walls so that the device becomes loaded as it reaches normal operating speed.

The lower edge of the sleeve 47 is relieved opposite the ducts 55 to provide a space 86 between the plate 57 and the abutting end of the sleeve 47. This space is exposed to the outlet pressure developed in the work space by the rotation of the element 65. The plate 57 also is provided with a socket 82 which communicates with the space 86 and which is connected with the annular space 81 at the lower end of the rotor 65 by means of a duct 84. By means of this arrangement outlet pressure may be applied in the channels 77 behind the blades in order to assist the centrifugal action, particularly when the rotor is turning at low speed, in holding the blades out against the wall 41. If desired, a valve seat 94, ball valve 88 and spring 92 may be arranged in the socket to prevent the application of pressure behind the blades until the pressure developed at the discharge is sufficient to depress the check valve 88 whereby pressure is not applied behind the blades at starting.

The cover plate 31 is formed with an inlet duct 85 which is positioned to communicate with the channel 53 leading to the inlet port. The channel 85 extends radially outwardly in the cover 31 and opens at the edge of the cover member. The channel 85 is enlarged inwardly of its open end to provide a substantially spherical valve chamber 87, a substantially circular opening 89 being formed between the valve chamber 87 and the lower surface of the plate 31, which is in contact with the casing portion 19. An annular valve seat 91 facing into the chamber 87 is secured in any suitable fashion in the opening 89, and a preferably circular disk 93 having a dimension substantially in excess of the dimension of the channel 85 is arranged in the valve chamber 87 in position to overlie the valve seat. The disk 93 is loosely confined within the chamber 87 and may move upwardly to uncover the valve seat and permit the passage of a working medium through the annular seat and into the channel 85. The disk, however, is normally gravity-actuated toward valve closing position on the seat and serves to prevent the passage of the work medium in a reverse direction. The casing 19 is provided with a neck 95 having a channel 97 communicating at one end with the annular valve seat and the neck 95 is provided with means 99 for connecting the channel 97 with a source of working fluid to be forced by the device of our present invention. The open end of the channel 85 is or may be closed by means of a plug 101 which preferably has a projection 103 extending into the valve chamber 87 in position to restrict the movement of the valve disk 93 and to limit its opening movement to the position shown in dotted lines in Figure 3.

The cover plate 31 is also formed with channel means 105 communicating the exhaust manifold 54 with the muffler chamber 29 so that the fluid, delivered in the manifold by the forcing element 65, may be discharged into the manifold, and the cover 31 is provided with a fitting comprising a pipe 107 and a nipple 106 having an end opening near the bottom of the muffler chamber and affording a conduit connecting the muffler chamber with the interior of the casing portion 21 whereby the work material delivered under pres-

sure into the muffler, through the exhaust manifold and the connecting conduit 105, may escape into the casing portion 21 above the cover 31. The casing portion 21 is provided with means forming an outlet fitting 109 through which the compressed medium may leave the unit.

In order to provide adequate lubrication for the operating parts of the compressor, the same may be assembled with a quantity of a suitable fluid lubricant forming a lubricant pool 111 within the casing 19, said pool being so arranged that the lower end of the fluid forcing element 11 is immersed therein. The bearing 71 is formed with an internal spiral groove 113 communicating at one end with the lubricant pool, and at the other with the interior of the cylinder in the vicinity of the annular groove 81 at the lower end of the rotor 65. A suitable screen 115 is mounted on the cover plate 57 in position to overlie the end of the groove 113 in order to strain the lubricant delivered from the pool to the groove. As soon as the fluid forcing element starts in operation, the suction created thereby will become effective in the groove 113 and will draw lubricant into the chamber at the lower end of the rotor. The groove 113 need not necessarily be formed in the bearing 71, but may be formed as a separate channel through the body of the plate 57, the advantage of forming the groove in the bearing being that the passage of the lubricant therethrough will also lubricat the bearing. The lubricant thus delivered at the lower end of the rotor in the vicinity of the groove 81 will pass upwardly through the channels 77 of the rotor into the annular groove 81 at the upper end thereof. The cover plate 31 is provided with a lubricant duct 117, one end of which communicates with the upper groove 81 of the rotor and the other end of which communicates with the interior of the casing 21. The duct 117 is preferably formed in the bearing 75 and a perforation 119 communicates the channel 117 with the interior of said bearing. The shaft 73 is preferably provided with a bushing 121 where it extends through the bearing 75, the outer surfaces of said bushing having a groove 123 formed so as to pump the lubricant received in the bearing at the groove 119 toward the opposite ends of the bearing 75 in order to provide adequate bearing lubrication. Some of the oil thus pumped through the bearing overflows into the space within the casing 21 at the upper end of the bearing, while the remainder passes from the lower end of the bearing into the upper groove 81 of the rotor.

Some of the lubricant, in passing through the channels 77, flows outwardly through the slots 79, enters the working chamber and lubricates the blades 83 in order to reduce friction between the blades and the sides of the slots 79 and between the blades and the walls of the bore 49 as well as to form a fluid seal at these points. Some of the lubricant, thus delivered from the working chamber, will be delivered in the exhaust manifold with the compressed working medium. Where the working medium is in gaseous form, as in the case when the device of our invention is used as a part of a compression evaporation refrigerating system, the lubricant forced to the discharge manifold may be in finely divided condition entrained with the compressed gases. We prefer to use dichloromethane as a refrigerant working medium, and the lubricant, especially if a mineral oil is used, will not dissolve to any appreciable extent in this refrigerating medium. The finely divided lubricant, received in the exhaust manifold, is carried thence into the conduit means 105 and collects in the upper portions thereof. A duct 125 is formed in the bearing 75 in position to communicate the upper portion of the conduit means 105 with the interior of the bearing in the vicinity of the oil pumping grooves 123, so that the pumping action exerted by said grooves will draw the lubricant, collecting in the upper portion of the channel means 105, into the bearing for assisting in the lubrication of the same. The lubricant delivered in the bearing through the duct 125 is pumped in opposite directions through the bearing by the action of the grooves 123 and is discharged at the opposite ends of the bearing as previously described. The lubricant delivered into the interior of the casing portion 21 through the channel 117 and through the upper end of the bearing 75, collects in a pool, as indicated at 127, above the flange 23 and the peripheral portions of the plate 31. The plate 31 is provided with a return drain 129, shown in Figure 6, through which the lubricant may be conducted from tne pool 127 back to the reservoir 111, within the casing 19, whenever the lubricant in the pool 127 rises above a predetermined level. The drain 129 comprises a preferably cylindrical fitting having an axial channel 131, said fitting being mounted at its lower end in a perforation 133 formed in the peripheral portions of the plate 31. The fitting also has radial channels 135 formed in its sides above the plate 31 and a strainer, comprising a preferably cylindrical screen of pervious material, such as wire net 137, is secured in position on the fitting to cover the perforations 135, said screen being held in place on the fitting between the grooved peripheral edges 139 of spaced imperforate preferably sheet metal disks 132 mounted on and secured to the fitting above and below its perforations 135. As long as the level of the lubricant pool 127 is between the disks 132, lubricant will be strained through the screen 137 and passing the perforations 135 will drain through the channel 131 into the reservoir 111 in the casing portion 19. Should the level of the pool 127, for any reason, rise above the fitting 129, as for instance, because of the clogging of the screen 137, the lubricant may return to the reservoir 111 directly through the channel 131 which opens at its upper end into the interior of the casing 21, whereby to afford a direct communication between the casing 21 and the interior of the casing portion 19. We also provide the cover plate 31 with an embossment 141 having a channel 143 opening within the casing 19 at one end and within the casing 121 at the other at an elevation substantially above that at which the channel 131 of the drain fitting opens into the casing 21, said channel 143 being for the purpose of equalizing the pressure within the casing portions 19 and 21.

The driving means 13 may be of any suitable form or construction, but we have, to illustrate our invention, shown an electric motor having a stator 145 carried on upstanding arms 147 formed at the peripheral portions of the plate 31. The stator 145 may comprise a laminated annular core 149 secured on a support ring 151 by means of circularly arranged clamping members 153, said ring 151 having an edge 155 seating in grooves 157 formed in the upper end of the arms 147. The stator core is provided with suitable windings 159 and is secured to the plate 31 by means of fastening studs 161 extending through the laminations of the core 149 and the support ring

151 and threaded into sockets 163 tapped into the cover plate 31. The driving means has a rotor 165 drivingly connected to the shaft 73, the motor rotor 165 being preferably secured directly on the end of the shaft projecting upwardly of the bearing 75 in co-axial alignment with the annular stator 145. The rotor 165 comprises a central spider 167 having an axial tapered socket 169 for receiving the correspondingly tapered end 171 of the shaft, the stator being secured in place on the shaft by means of the fastening bolt 173 having a head engaging the spider and a threaded shank engaging in an axial socket 175 formed in the end of the shaft. The spider 167 has radially extending arms 177 and the rotor includes an annular laminated rim 179 encircling the spider and secured on the extremities of the arms 177, thus providing air channels 181 through the rotor in an axial direction. The rotor also carries fan blades 183 preferably stamped from a suitable lightweight sheet metal stock and secured on the rotor by means of the bolt 173. Obviously any suitable or preferred motor construction may be employed, but we have shown and prefer to use an alternating current capacitor motor and to power the same by means of conductors 185 adapted for connection with an external source of electrical power and entering the sealed unit through sealed inlet plugs 187 mounted in the flange 23 between the outer edge of the plate 31 and the seat 22 on which the edges of the casing 21 are secured. The inlet plugs 187 may comprise substantially cylindrical sleeves 189 having externally threaded ends 191 fitting into internally threaded perforations formed in the flange 23, the conductors 185 extending through said sleeves, the interior of which around said conductors is filled with a suitable sealing and insulating material 193.

When the device is in operation, the rotation of the rotor 165 will cause a circulation, within the casing 21, of the compressed gases delivered therein by the fluid-forcing mechanism, which circulation is assisted by the fan 183. The compressed gases are thus caused to travel in and around the operating parts of the motor and sweep across the interior surfaces of the casing portion 21 passing through the channels 181 and operating as a heat-transfer medium to absorb heat generated by the motor and deliver the absorbed heat to the casing 21, which being of heat conducting character will dissipate heat readily into the surrounding atmosphere. We may, of course, provide the casing 21 with means, such as fins for increasing the heat dissipated by the casing 21, but find that this is not essential to satisfactory operation of the device.

As heretofore mentioned, the device of our present invention is particularly well adapted for use as a compressor in a refrigerating system. To this end, the outlet fitting 109 may be connected as by a pipe or conduit 195 with a condenser 197 in which the compressed gaseous refrigerating medium delivered from the sealed unit is or may be condensed to liquid form, said condenser being of any suitable or preferred construction and preferably cooled by forced drafts of air created by means of a fan 199 powered by an electric motor 201, which preferably is of character similar to the motor 13 and which is connected for operation in parallel therewith as shown in Figure 1. The liquid refrigerant delivered from the condenser may be conducted through a conduit 203 to an expansion valve 205, preferably float controlled, from which valve the refrigerant is or may be delivered through a conduit 207 to a refrigerant evaporator or boiler 209 of any suitable or preferred construction, in which the liquid refrigerant is evaporated to gaseous form, heat being absorbed at the boiler during the evaporating process. The evaporated refrigerant may be returned from the evaporator to the inlet connection 99 of the sealed unit through a suitable conduit 211, thus completing the refrigerating cycle. Such a system is particularly adapted for use in domestic refrigerators in which the elements of the system are mounted in a suitable cabinet indicated generally at 213, which cabinet includes a refrigerating compartment 215 and a mechanism compartment 217, the evaporator 209 being located in heat exchange relationship with the atmosphere of the refrigerating compartment, while the unit 9, the condenser 197 and its cooling fan motor 201 and the float control expansion valve 205 being located in the mechanism chamber 217, the devices so located in the mechanism chamber being preferably mounted on a common support 45 to be assembled in or removed from the mechanism chamber as a single assembly unit, in order to facilitate manufacture of the refrigerator and the repair and replacement of the operating parts of the system. With such an arrangement, the conduits 207 and 211 may be permanently built into the walls of the cabinet during the course of its construction and the boiler 209 and the parts mounted on the support 45 assembled in place after the cabinet has been fabricated.

Where the unit 9 is incorporated in a refrigerating system, as aforesaid, we prefer to operate the motors 13 and 201 in parallel by means of an electrical control system substantially as shown in Figure 2 of the drawings. To this end, we prefer to form the motors so that the same may be operated in parallel, each motor preferably having a plurality of like windings 219 and 221. The windings of each motor are connected together at one end to a common conductor 223. The opposite ends of the windings 219 of each motor also are connected together by a common conductor and the free ends of the windings 221 of each motor are likewise connected to a common conductor 227. The common conductor 223 is connected to a terminal 229 located in a casing 231, which is or may be located in any convenient preferred position as on the support 45. From the terminal 229 the conductor 223 is connected by means of a conductor 233 forming a part of a cable 235 which extends in the refrigerator cabinet from the casing 231 to a thermostat control casing 237 located adjacent the evaporator 209. The opposite ends of the cable 235 may be provided with detachable connections 239 and 241 to facilitate the assembly of the parts in the cabinet. The conductor 233 when the parts are assembled and connected for operation, is connected to one side of a switch 243 preferably located in the casing 237 which switch is opened and closed in response to thermostat means manually adjustable as by means of the control knob 244 preferably mounted on the casing 237, and including the thermostatic element 245, which extends in heat exchange relationship with the atmosphere of the refrigerating compartment 215, so that the switch 243 is opened and closed automatically in response to temperature variations within the refrigerating chamber. The other side of the switch 243 is connected through a manually operable switch 247 preferably mounted on the casing 237 and

through a conductor 249 forming a part of the cable 235 to a terminal 251 in the casing 231. The terminal 251 is connected by a conductor forming a part of a cable 253 with means 255 preferably in the form of an electric plug of ordinary construction, and adapted for removable insertion in a power outlet socket such as is usually provided in commercial or domestic electric power systems. The cable 253 has another conductor adapted for detachable connection in the external power delivery circuit, which conductor is connected with a terminal 257 in the casing 231. This terminal 257 is electrically connected with one end of a solenoid 259 which is also located within the casing 231, the other end of the solenoid being connected with a terminal 261 arranged within the casing 231, and to which the common conductor 227 is connected. When the plug 255 is connected to an external circuit, power will be delivered between the terminals 251 and 257 to energize a circuit extending between said terminals, and including in series the coil 259, the conductor 227, the windings 221 of the motors 13 and 201 arranged in parallel, the conductor 223, the conductor 233, the switches 243 and 247, and the conductor 249. In parallel with the portion of this circuit, which includes the solenoid winding 259 and the motor windings 221, is an additional circuit including a winding comprising an induction coil 263, the opposite ends of which are connected together through a condenser 265, and by means of a conductor 267 to the terminal 257 on one side of the solenoid 259, the induction coil 263 having taps 269 and 271 connected to stationary contacts 273 and 275 and a shiftable blade 277, which is movable in response to the current flowing through the solenoid 259 and is adapted to selectively connect the contacts 273 and 275 to the conductor 225, and thence through the windings 219 of the motors in parallel to the common conductor 223.

The blade 277 is adapted to vary the reactive effect of the net work comprising the induction coil 263 and the condenser 265 in the circuit, including the motor windings 219. The motors preferably employed are of the so-called capacitor-induction motors, the windings comprising split phase windings whereby the motors may be started in operation from standstill position when energized with single phase alternating current applied between the terminals 251 and 257. It will be noted that both of the parallel circuits including the motor windings 219 and 221 are controlled by the switches 243 and 247 so that when the plug 255 is connected to a power outlet, the motors will remain inactive until both of the switches 243 and 247 are closed. The switch 247, being manually operable, affords manual control for the motor, while the switch 243 provides for automatic control so that the motors may be placed in operation when the temperature within the refrigerating compartment 215 rises above a predetermined value, which may be determined by means of the knob 244. When the plug 255 is connected with an external power source, alternating current will be delivered through the parallel circuits heretofore mentioned, and which include the several windings of the motors. The current delivered to the windings 219, however, will have a different phase relationship with respect to that delivered to the windings 221, because of the reactive effect provided by the induction coil 263 and the condenser 265 so that a rotating field may be created in the motor for the purpose of starting the same. At the instant of starting, the switch 277 will engage one or other of the contacts 273, 275 so that the proper phase relationship to start the motors will exist between the current delivered to the motor windings 219 and 221. As the motors reach normal operating speed, the switch 277 will be moved under the influence of the coil 259, and will engage the other of said contacts 273, 275, in order to alter the reactive effect provided in the current flowing to the motor windings 219 in order to afford a desired phase relationship between the current flowing to the windings 219 and 221, it being understood that the phase relationship required for maximum efficiency during starting is different from that required after the motors have reached normal operating speed.

The electrical system also includes a circuit 279 including a lamp 281 and a switch 283, said circuit being connected between the conductor 249 of the cable 235 and another conductor 285 contained in said cable and connected to the terminal 257 so that whenever the plug 255 is connected to the external power source, the lamp 281 will be energized providing the switch 283 is closed. The lamp 281 is or may be arranged in any suitable or convenient position within the compartment 215 while the switch 283 is arranged to cooperate with the doors usually provided in domestic refrigerators for giving access to the compartment 215. The door, when closed, cooperates with the switch to hold the same in open position. When the door is open, however, the switch is permitted to close so that the lamp 231 will illuminate the interior of the compartment 215 whenever the door is open.

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 without departing from the spirit or scope of my invention, or sacrificing any of its attendant advantages; the forms herein described being preferred embodiments for the purpose of illustrating my 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 pair of casing elements, means to secure said elements together to form a housing, partition means forming a support in said housing and defining compartments on opposite sides of the partition means, relatively movable fluid-forcing elements carried by said partition within one of the compartments, and motor means carried by the partition within the other compartment, a drive shaft journalled in and extending through said partition and operatively connected with the motor means and the fluid-forcing means on opposite sides of the partition, means for admitting fluid through the walls of said casing to said fluid-forcing means, including a duct in a wall of one of the casing elements communicating with a duct in said partition, the latter duct in turn connecting with the suction side of the fluid-forcing means, means forming a check valve in said partition substantially at the point of communication of said ducts, one of the ducts opening upon a surface of a casing element formed as a seat to receive a surface of the partition in which the other duct opens, a fitting forming a valve seat mounted in the partition at the duct opening therein, a chamber in said partition enclosing said

seat, and a disk in said chamber adapted to overlie the seat provided by said fitting.

2. In a device of the class described, a pair of casing elements, means to secure said elements together to form a housing, partition means forming a support in said housing and defining compartments on opposite sides of the partition, relatively movable fluid-forcing elements carried by said partition within one of the compartments, and motor means carried by the partition within the other compartment, said fluid-forcing means being adapted upon operation of the motor to deliver a fluid work medium, under pressure, and a lubricating medium into said motor compartment, said motor compartment having an outlet for said work medium, and means forming a drain in said partition for returning the lubricating medium to the compartment housing the fluid-forcing means, said drain comprising a tubular element mounted on the partition and extending a substantial distance within the motor compartment, the opposed ends of said tubular element opening one in the motor compartment and the other in the chamber containing the fluid-forcing means, lateral openings in said tubular element within the motor compartment and screen means covering said lateral openings.

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