

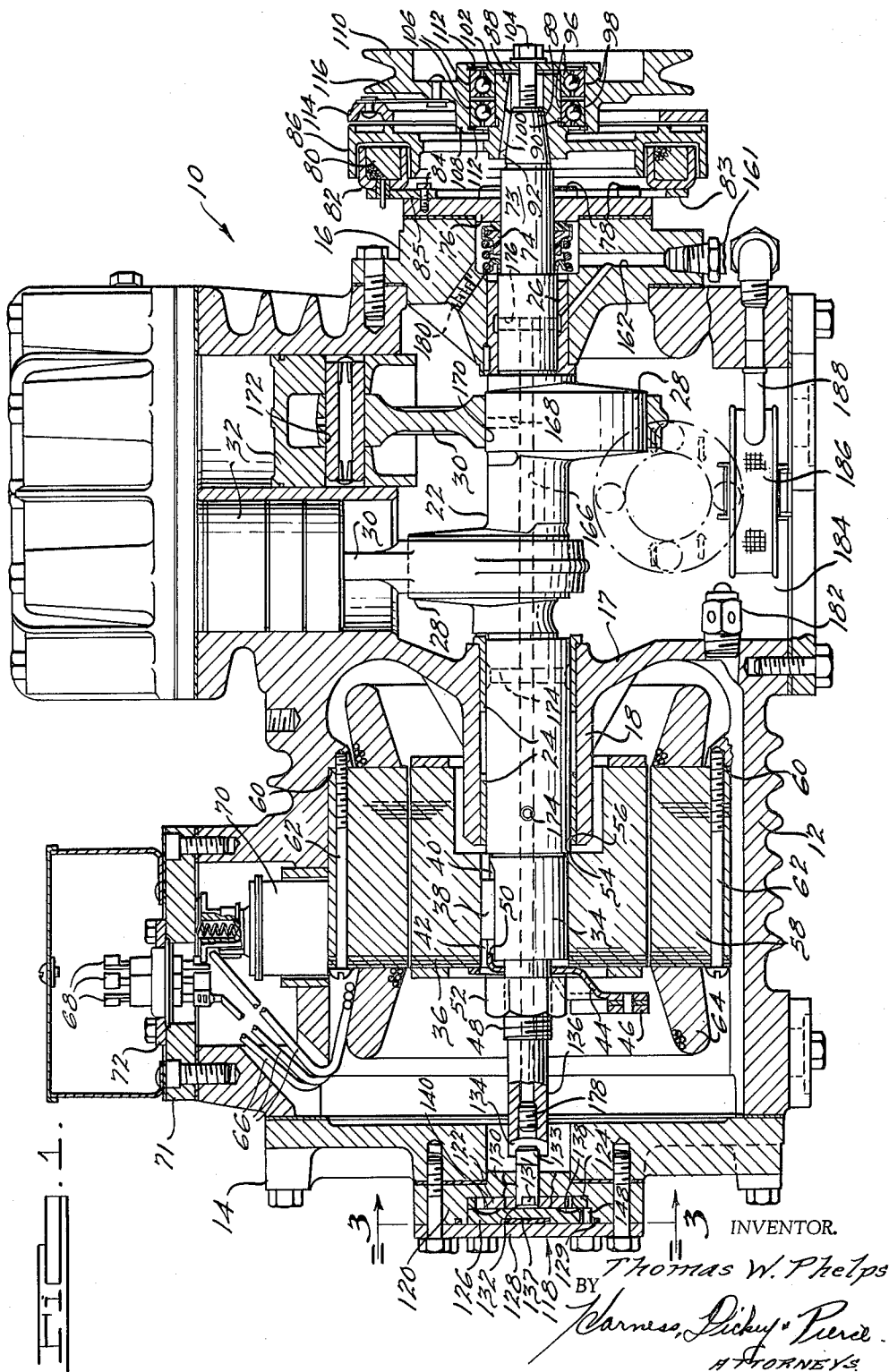
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T. W. PHELPS
COMPRESSOR STRUCTURE

3,211,365

Filed Oct. 16, 1961

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

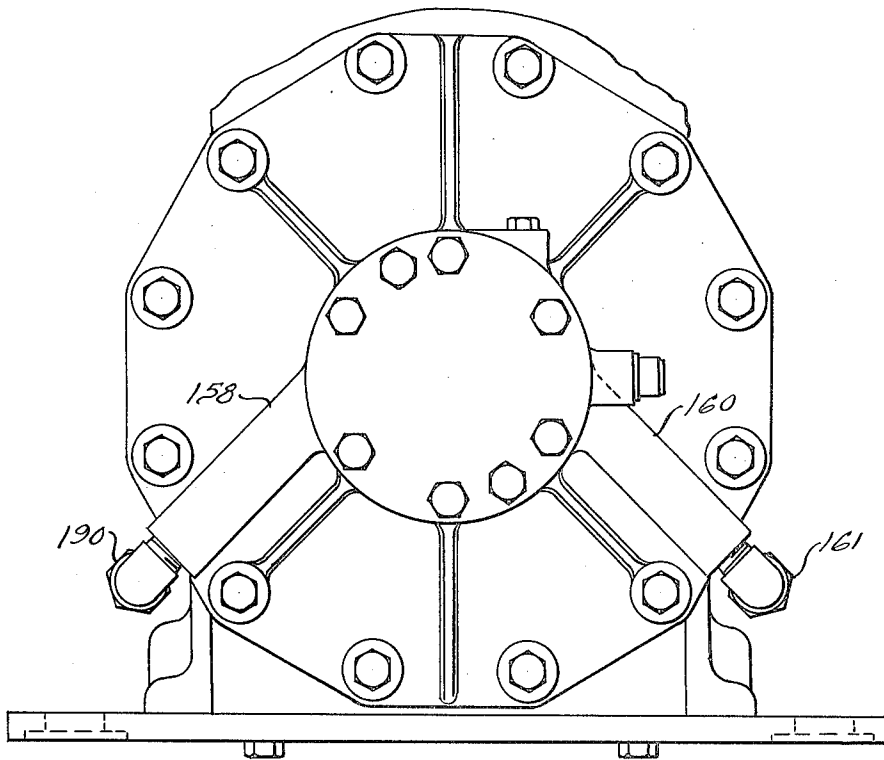


FIG. 2.

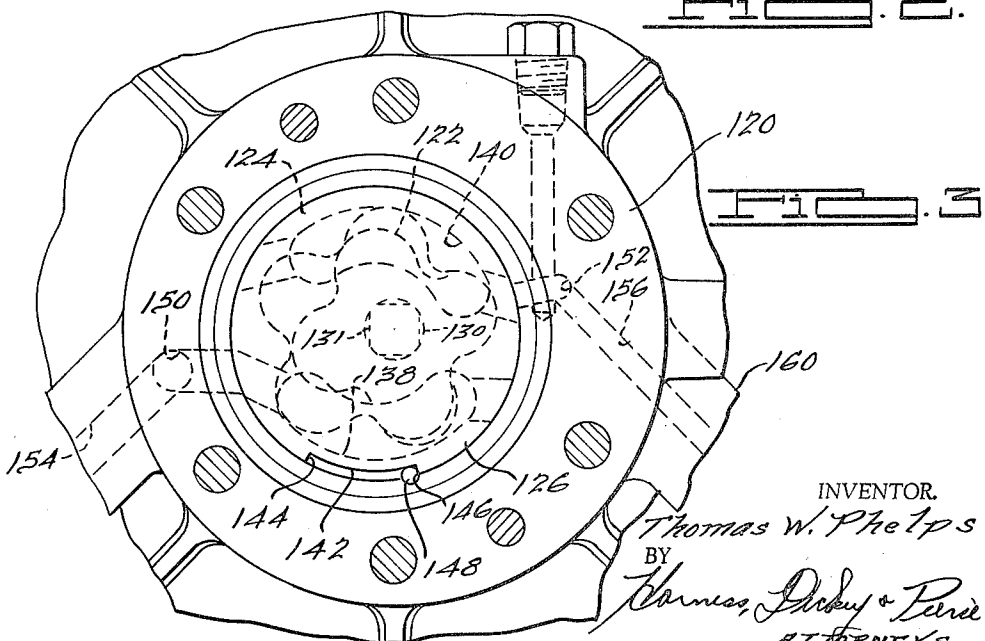


FIG. 3.

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3,211,365

COMPRESSOR STRUCTURE

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1 Claim. (Cl. 230—206)

This invention relates generally to gas compressors and particularly concerns improvements in sealed types of motor compressor units in which the electric motor prime mover, compressor, oil sump and other portions of the unit are contained and sealed in a common housing. The improvements of this invention concern structural modifications which adapt these sealed units for selective operation by either their own electric motor or a separate prime mover located externally of the unit.

In the use of these motor-compressor units for refrigerating trucks, railroad cars, and other vehicles, it is customary to extend the compressor crankshaft through the housing and provide it with suitable pulley means for connection to the vehicle motor or a driven portion of the vehicle such as a propeller shaft or axle. Moreover, when the vehicle arrives at its destination such as a loading or unloading terminal and its motor is shut down, it is customary to disconnect the crankshaft of the unit from the motor or driven portion of the vehicle and connect the electric motor prime mover of the unit to a source of electrical power for continuing the operation of the compressor and the refrigeration system.

Heretofore, these units have been supplied by the industry in relatively low horsepower units which allows the use of oil slinger rings which can operate in either rotative direction to splash or throw the oil to the compressor bearings.

Present day refrigeration capacity demands such as in the larger trucks and railroad cars, however, are not satisfactorily met by these low horsepower units, and it has become necessary to go to larger capacity units having positive displacement lubricating oil pumps and oil conduit systems for feeding the bearings thereof.

A problem which is encountered when using positive displacement oil pumps connected to the compressor crankshaft is that if the oil pump is not a reversible acting one, and the extended drive shaft pulley is connected to external power which rotates the crankshaft and oil pump in the opposite direction to that required by the pump, the bearings and other lubricated parts of the unit will become dry and burned out. Since the rotation of the extended shaft pulley is determined by the manner in which it is connected to the motor or other portions of the vehicle, special care and mounting construction for the unit must be employed to insure that the compressor crankshaft is always driven in the same direction. Moreover, when three phase current is employed to operate the compressor motor such as during loading and unloading periods when the vehicle is stationary, the direction of rotation of the motor and compressor crankshaft is uncertain and dependent upon the manner in which the electrical connections are made.

Attempts have been made to provide these units with a reversible type of positive displacement oil pump. The pump was positioned adjacent the compressor end of the housing and the crankshaft was extended through the oil pump and the compressor end of the housing which created serious alignment problems for the crankshaft and pump assembly and the seals therefor which resulted in excessive costs and an inferior unit. On the other hand, if the crankshaft were not extended through the pump, but instead were extended through the motor end of the

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housing, serious sealing and bearing wear problems would arise due to the existence of the relatively long unsupported portion of the crankshaft which extends from the rear main bearing to and through the motor end of the housing. It is readily apparent to one skilled in the art that this unsupported crankshaft portion would be laterally deflected to an intolerable degree by the lateral pressure on the pulley caused by the belt connecting the pulley to the motor or other movable portion of the vehicle.

A main object therefore is to provide at reasonable cost a relatively high capacity extended shaft sealed motor-compressor unit which is of relatively simple construction and which may be alternatively driven in either a clockwise or a counterclockwise direction.

Another object is to provide positive displacement oil pump means mounted in a relatively simple and inexpensive manner within extended shaft-motor-compressor units of relatively high capacity for adapting the units for actuation in either direction by external prime means connected to the extended shaft, or by the electric motor of the unit.

Structural features which have contributed to realizing these objects in accordance with the present invention are the provision in high capacity sealed motor-compressor units of positive displacement reversible oil pumps mounted on the inside of the housing and coupled with the compressor crankshaft by self-aligning coupling means, and wherein the crankshaft is sealingly extended through an opposite end of the housing for rotation in either direction by external prime mover means. Moreover, these units are provided with a reversible acting type of clutch and pulley assembly having portions thereof mounted on an end of the housing and on the end of the crankshaft extending through said end of the housing, whereby the unit may be connected to a vehicle power plant regardless of the direction of rotation of the power output shaft of the power plant.

Further objects, advantages and novel features of the invention will become apparent from the following description taken in conjunction with the drawings wherein:

FIGURE 1 is a longitudinal sectional view of the sealed motor-compressor unit;

FIGURE 2 is an end view of the unit looking toward the motor end thereof; and

FIGURE 3 is a sectional view of the oil pump mechanism taken along the line 3—3 of FIGURE 1.

In the drawings:

The motor-compressor unit 10 comprises a housing having a main section 12 and bolted-on end sections 14 and 16. Suitable gaskets are provided to seal the end sections to section 12. Main section 12 is provided with a radially inwardly directed portion 17 providing a main bearing 18, and end section 16 is formed to provide a bearing 20. The compressor crankshaft 22 is rotatably mounted in suitable bearing inserts 24 and 26 secured in bearings 18 and 20 respectively and is provided with eccentric portions 28 upon which the connecting rods 30 of the pistons 32 are mounted.

The crankshaft 22 is integrally formed with a motor drive shaft portion 34 which is locked onto the armature 36 of the compressor motor (prime mover) by means of a key 38 inserted in a keyway 40 in portion 34 and in a keyway 42 in armature 36. A counterweight plate 44 having properly selected counterweights 46 secured thereon is received over a threaded extension 48 of shaft portion 34 and is provided with a projection 50 which extends into the keyway 40 in portion 34 to prevent relative rotation between counterweight plate 44 and shaft 22. A nut 52 is received on shaft extension 48 and when tightened against the plate 44 draws the annular shoulder

54 on the crankshaft tightly against the annular shoulder 56 on the armature 36.

The stator lamination stack 58 is tightly clamped against abutments 60 on the inside of housing section 12 by means of screws 62 threaded into the abutments. The motor as shown employs three-phase windings although other types of motors may be used and the stator windings 64 are connected through their leads 66 to suitable terminals 68 for connection to three-phase current. A motor protector unit 70 which is commonly provided on compressors is secured in the housing section 12 and is electrically connected in such a way to the stator leads and the source of current that it will cut off current flow to the motor when the motor becomes overloaded. It is noted that the electrical connectors for the motor and the motor protector are hermetically sealed within housing section 12 by bolted-on caps 71 and 72 and suitable gasket means.

The crankshaft 22 is provided with an extension 73 passing through a shaft seal 74 of any suitable construction which is retained in position by a plate 76 secured to section 16 by bolts 78. A magnetic clutch winding 80 and magnetic core 82 are supported on a plate 83 which is secured in any suitable manner to plate 76 such as by screws 84 extending through inwardly extending arms 85 of plate 83 and threadedly received into plate 76. The rotating core 86 for the magnetic clutch is provided with a hub portion 88 which is secured to tapered shaft portion 89 by a key 90 inserted in keyway 92 in the hub and a suitable keyway in shaft portion 89. The inner races 96 of a pair of ball bearings 98 are clamped between a shoulder 100 on the hub 88 and a washer 102 which is forced radially inwardly of the shaft extension 73 by means of a bolt 104 threaded into the end of shaft portion 89. The outer races 106 of the bearings 98 are frictionally received in a hub portion 108 integrally formed with a belt pulley 110 and are locked in the hub portion 108 by suitable retaining ring means 112. The magnetic armature ring 114 is secured to the pulley 110 by flexible arms 116 which allow the ring 114 to be snapped into frictional engagement with the rotating core 86 when the current is supplied to the coil 80. With the current on the coil 80, the rotation of pulley 110 will therefore drive the compressor crankshaft 22 through the arms 116, ring 114, and core 86. It is obvious that when the current is off of the coil 80, pulley 110 may be rotated in either direction without causing any rotation of the shaft 22. The particular reversible acting type of clutch and pulley assembly shown and described herein is intended to be merely representative of the large variety of such assemblies which could be used in practicing the present invention.

A reversible-type positive displacement oil pump 118 is mounted on end section 14 and comprises a body 120, an inner gear 122, an outer gear 124, a reversing disc 126, and a cover plate 128 bolted onto and sealed against body 120 by an O-ring seal 129. The inner gear 122 is fixed to a pump drive shaft 130 by flat portions 121 thereon engaging corresponding flat portions forming the aperture 132 in the gear 122. Drive shaft 130 is provided with a flattened end 133 slidably and fairly loosely received in a slot 134 in the end of an extension 136 of the motor drive shaft 34. This means of coupling drive shaft 34 to the pump impeller 122 does not require any precise alignment of the shaft 22 with portions of the pump. Moreover, a standard type of positive displacement oil pump may be readily used since the crankshaft does not extend therethrough. The cost advantages of using the standard pump construction at once become obvious and the elimination of the need for special machining of the housing to accommodate the pump assembly through which the compressor crankshaft would extend obviates excessive costs, alignment and sealing problems. A disc-type of spring 137 holds the reversing disc 126 slidably but tightly against the impeller gears 122 and 124. Refer-

ring to FIGURE 3, reversing disc 126 is provided with fluid-flow grooves 138 and 140, and a recess 142 in its periphery to provide stop shoulders 144 and 146. A stop pin 148 is secured between the body 120 and disc 126 and allows rotation of the disc through an angle.

The pump body 120 is formed with suitable passageways providing a pump inlet 150 and a pump outlet 152. Inlet 150 and outlet 152 may extend axially inwardly through the pump body 120 to connect to outlet passages 154 and 156 respectively, provided in a pair of bosses 158 and 160 provided on the end section 14. It is seen that when the crankshaft 22 and pump impeller 122 are rotating in a clockwise direction as shown in FIGURE 3, the reversing disc 126 is also rotated in its clockwise direction to abut pin 148 against stop 146. The groove 140 is in the reversing disc will thereby be aligned with the pump outlet 152, and the groove 138 will be aligned with the pump inlet 150. When the direction of rotation of the crankshaft 22 and the impeller 122 is reversed to a counterclockwise direction in FIGURE 3, the reversing disc 126 will rotate in a counterclockwise direction to abut stop 144 against pin 148 and align groove 140 with inlet 150 and align groove 138 with outlet 152. It is therefore seen that regardless of the direction of rotation of the crankshaft and the pump impeller, the pump inlet 150 and outlet 152 will remain in the same location.

Passage 156 connected to the oil pump discharge or outlet 152 is connected by suitable piping 161 to the oil passage 162 which branches to communicate with the seal 74 and a passage 166 extending through the compressor crankshaft 22. Passage 166 communicates through suitable passages 168 in the connecting rods 30 to the lower and upper connecting rod bearings 170 and 172 respectively. Passage 166 is also provided with branch passages 174 and 176 communicating with the bushings 24 and 26 respectively. The opposite end of passage 166 is plugged as at 178. The end section 16 is provided with a restricted passage 180 communicating with the seal 74 to maintain sufficient oil pressure on the seal 74 during compressor operation. A check valve 182 passes the oil which drips from the bearings 24 into the sump 184 which also receives the oil which drips from the connecting rod bearings 170 and 172, shaft bearing 26 and seal 74. Check valve 182 prevents the flow of oil from sump 184 into the motor compartment. A filter 186 of any suitable type is supported in the sump 184 and is provided with an outlet 188 which is connected through suitable piping 190 into the passage 154 and hence into the pump inlet 150.

While it will be apparent that the embodiment of the invention herein disclosed is well calculated to fulfill the objects of the invention, it will be appreciated that the invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the subjoined claim.

What is claimed is:

In combination, a motor-compressor unit having a compressor with a crankshaft, a reversible electric motor on one side of said compressor having a rotor keyed to said crankshaft, the electric motor having one end facing said compressor and the other end facing away from said compressor, a housing enclosing said compressor and electric motor and having a first end wall outwardly of said electric motor and a second end wall outwardly of said compressor, a reversible operating positive displacement oil pump mounted in said first end wall, a first extension on said crankshaft extending from the side of said electric motor facing away from said compressor toward said pump, a self-aligning coupling between said first crankshaft extension and said pump, a bearing for said crankshaft carried by said second housing end wall, oil conduit means leading from said pump to said bearing, a second extension on said crankshaft extending through said second end wall, a pulley freely rotatably mounted on said second crankshaft extension outwardly of said second

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end wall, and a selectively actuatable clutch operative to connect said pulley to said second crankshaft extension.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,211,365

October 12, 1965

Thomas W. Phelps

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 2, line 19, after "prime" insert -- mover --;
column 4, line 16, strike out "is"; line 73, for "extention"
read -- extension --.

Signed and sealed this 21st day of June 1966.

(SEAL)

Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents