Oct. 1, 1929. C. P. BROCKWAY 1,730,116

COMPRESSOR FOR REFRIGERATING MACHINES

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Fig. 1.

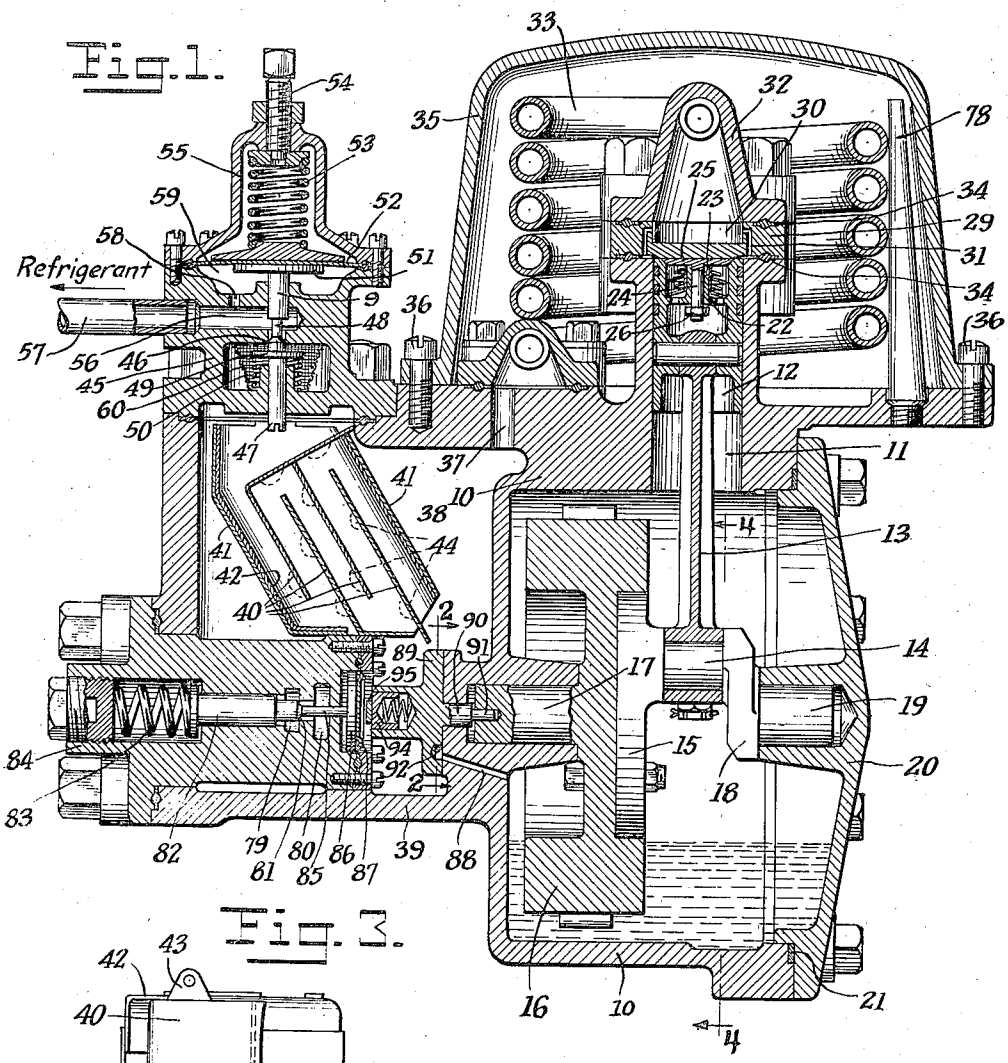


Fig. 3.

Fig. 2.

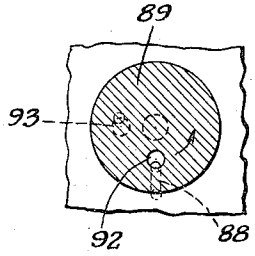
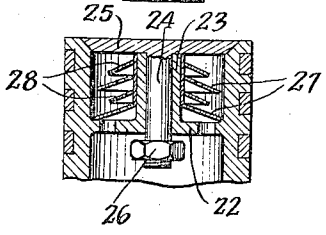


Fig. 4.



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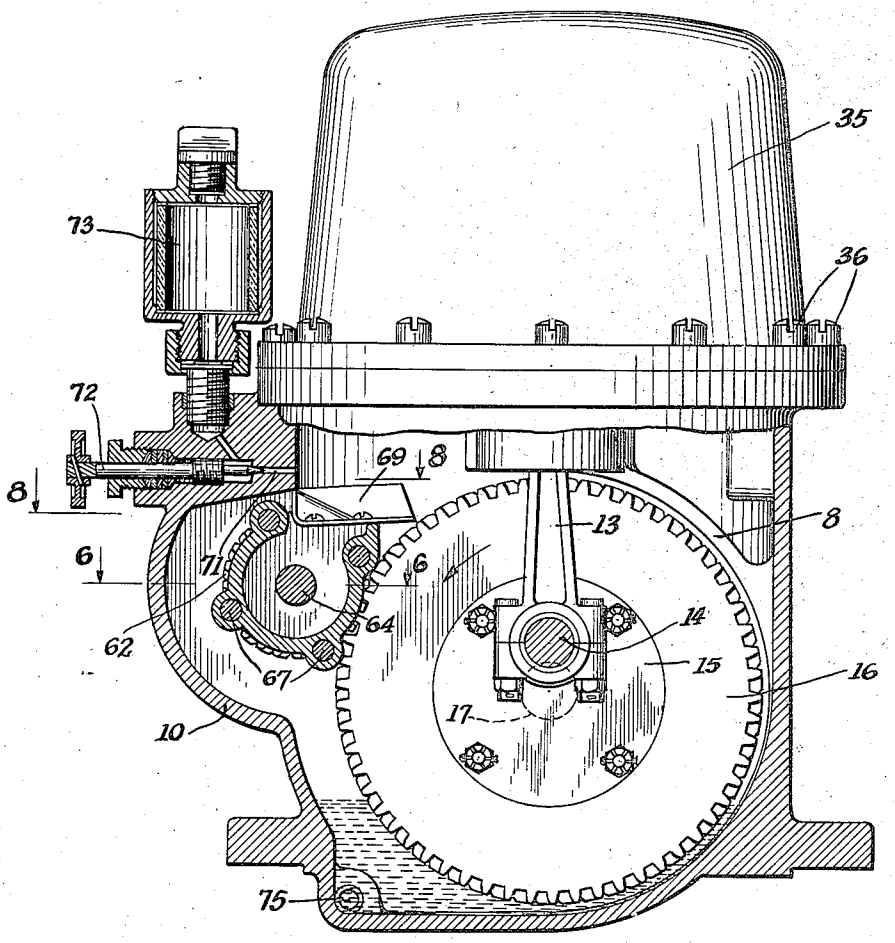
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Fig. 4.



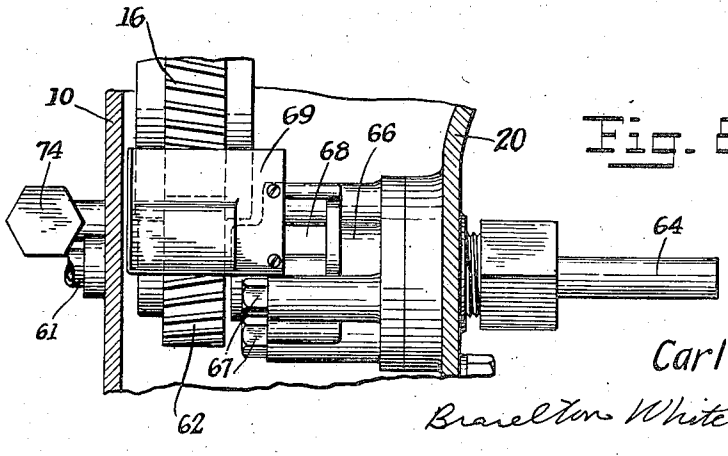


Fig. 8.

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COMPRESSOR FOR REFRIGERATING MACHINES

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Fig. 5.

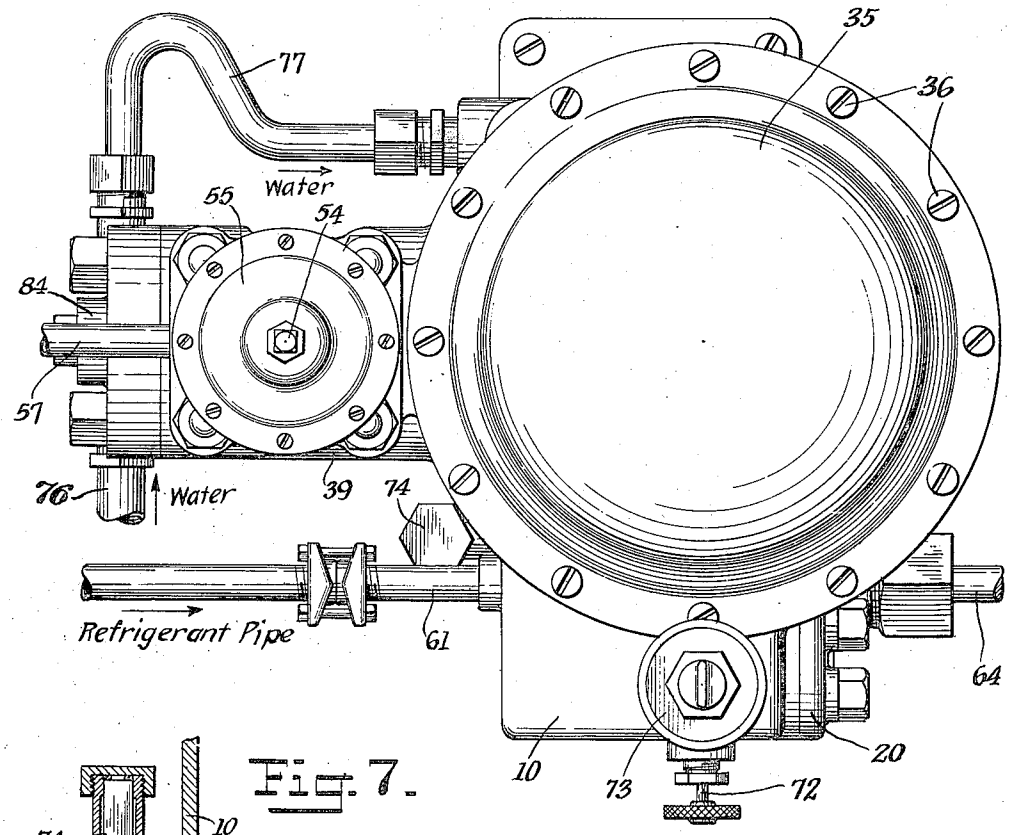


Fig. 7.

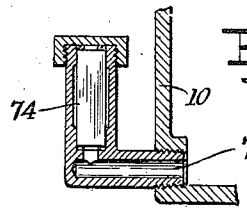
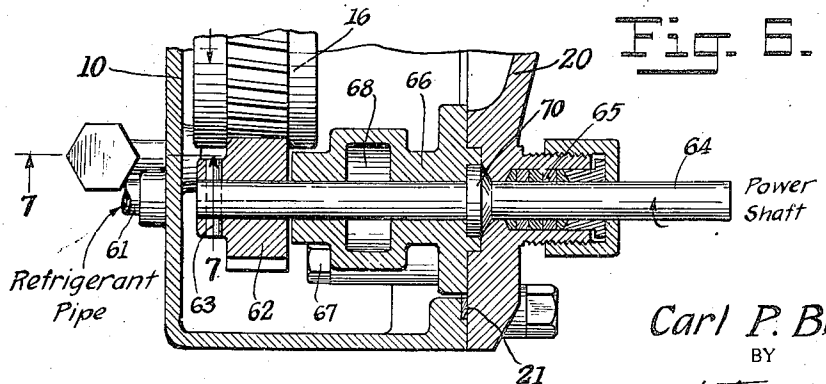


Fig. 6.



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UNITED STATES PATENT OFFICE

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COMPRESSOR FOR REFRIGERATING MACHINES

Application filed June 6, 1924. Serial No. 718,189.

This invention relates to improvements in pump mechanism relating to refrigerating machines, particularly such as are adapted for use in plants of small size.

One of the objects of the invention is the arrangement of the compressor, condenser, oil separators, reducing valve, and automatic cooling water controller into a unit, which is compact, and the different parts of which are easily assembled and readily accessible.

Another object of the invention is the provision of means for sealing the bearing in the machine casing, through which the power shaft extends, said means comprising both a liquid seal and a thrust bearing, the parts of which are held in close contact by the reaction of a large spiral driven gear against a small spiral driving gear.

A further object is the provision of means for transferring oil collected in the high pressure side of the apparatus to the low pressure side without permitting leakage of gas.

Still another object is the provision of an oil separator in the piston of the compressor pump, the parts being so arranged that the oil thus collected will return by gravity to the bottom of the casing.

Other objects, and objects relating to details of construction and economies of manufacture, will appear as I proceed with the description of that embodiment of the invention, which, for the purposes of the present application, I have illustrated in the accompanying drawings, in which:

Figure 1 is a vertical sectional view through a machine embodying my invention.

Fig. 2 is a detail sectional view of the rotating element of my oil transferring device.

Fig. 3 is a plan view of an oil separator employed in my invention.

Fig. 4 is a view partly in elevation and partly in section on the line 4—4, Fig. 1.

Fig. 5 is a plan view of the complete machine.

Fig. 6 is a horizontal sectional view taken substantially on the line 6—6, Fig. 4, showing the means employed for maintaining the thrust bearing seated.

Fig. 7 is a detail vertical section taken on line 7—7, Fig. 6 showing an oil gauge.

Fig. 8 is a sectional view taken substantially on the line 8—8, Fig. 4, and

Fig. 9 is a detail view on a large scale showing in section the piston check valve and the oil separator located in the piston.

Similar reference characters refer to like parts throughout the views.

In the drawings, 10 represents a casting which constitutes the principal part of the casing of the machine. In the upper part of the casting there is formed a cylinder 11 of the compressor pump. A piston 12 slides within the cylinder, being pivoted to a connecting rod 13, which is journalled at its lower end upon a crank pin 14 integral with a plate 15, which is bolted to a fly-wheel 16. On the side of the latter, opposite the plate 15, is a concentric projection 17, rotatably mounted in a bearing in the casting 10. The crank pin 14 is integral with a crank 18 and a short shaft 19 journalled in a plate 20 which is secured to the casting by means of bolts, a packing ring 21 serving to seal the joint. The chamber enclosed between the casting 10 and the plate 20 will be referred to hereinafter as the low pressure chamber.

The piston 12 above the piston pin has a spider 22 with a central cylindrical extension 23, in which slides the stem 24 of a check valve 25. A nut 26 is threaded upon the lower end of valve stem 24 to limit the movement of the valve. Around the cylindrical extension 23 is mounted an oil separator consisting of a series of alternatively large and small conical plates 27 and 28 respectively, the large plates having openings therethrough near the center so that the gases in passing through the separator are forced to take a tortuous path. The oil particles collected upon the plate run down the latter and pass off their lower edges, whence they return into the low pressure chamber.

The upper end of the cylinder 11 of the compressor pump is outwardly flanged and supports a block 29, the upper part of which is cored out centrally to receive a spring metal ring 30, constituting a check valve. The ring 30 closes normally one or more by-

passes 31, which communicate with the upper end of the cylinder 11. Superposed upon the block 29 is a dome 32, from the top of which extends the condenser pipe 33. In the joints between the cylinder 11, block 29, and dome 32 are packing rings 34. The coil of condenser pipe 33 is enclosed by a dome shaped cover 35 which is held tightly to the flat top of casting 10 by screws 36.

The lower end of pipe 33 is in communication through a hole 37 with a high pressure chamber 38, which is formed by a continuation 39 of the casting 10. Within the chamber 38 is an oil separator having a series of inclined deflecting plates 40 as clearly shown in Fig. 1. These plates are mounted in a pair of overlapping body members 41 and 42, having attaching tabs 43, by which the separator is supported. The plates 40 are held in position by means of tabs 44 integral with the plates, which extend through slots in the body member, and are then bent down against the latter.

A portion of a top of the chamber 38 is closed by a casting 45, in which is formed the seat of the reducing valve 46. The valve itself has a downwardly extending stem 47 and an upwardly extending stem 48. On the stem 47 is a collar 49, against which bears a coil spring 50 tending to hold the valve seated. The top of the stem 48 bears against and supports a slidable solid cylinder 9 integral with a disk 51, upon which rests a diaphragm 52 that is resiliently pressed down by a relatively large coil spring 53, the compression of which may be regulated by means of an adjusting screw 54 mounted in the top of a dome shaped cover 55 fastened by screws to the top of casting 45. It will be observed that the valve seat is in communication with the high pressure chamber 38, and with a passage 56 on the other side, to which passage is connected the pipe 57 leading to the refrigerating coil, not shown. A small opening 58 connects the low pressure passage 56 with a chamber 59, across the top of which the diaphragm 52 is mounted. Below the valve seat and around the collar 49 and spring 50 is a wire screen 60, shaped like an inverted frustum of a cone, which is placed here for the purpose of collecting oil particles from the gas passing therethrough.

The gas returning to the machine from the refrigerating coil is admitted to the low pressure chamber through a pipe 61.

The fly-wheel 16 has spiral gear teeth upon its periphery, with which mesh the teeth of a relatively small spiral gear 62 fastened by means of a pin 63 to a power shaft 64, which extends into the casing through one side wall. The opening between the shaft and wall is sealed as well as such means will permit by a packing gland 65. In order to prevent any possibility of leakage of the gas however, I employ additional means to insure a tight joint, comprising a liquid seal and a solid thrust bearing. The radial bearing consists of a casting 66 of any suitable material, secured tightly to the casing wall by means of screw bolts 67. In the casting is formed an oil receptacle 68 adapted to contain oil to a level well above the top of the shaft 64. In order to insure a full charge of oil in the receptacle 68 at all times, I provide a pan 69 (see Figs. 4 and 8) which is so arranged as to catch oil thrown by the fly-wheel 16 and deflect it sidewise into the receptacle 68. In order to hold the oil in the fly-wheel teeth until it is in a position to be thrown into the pan, I provide the casing with an inwardly extending curved wall 8 which approaches closely the periphery of the wheel. The seat for the thrust bearing is preferably a ground conical surface formed in the casing wall, although surfaces of other kinds may be employed without departing from the spirit of the invention. A collar 70 with a complementary conical ground surface is so mounted upon the shaft 64 as to be substantially integral therewith. When pressure is applied to the shaft in the direction of the broken arrow, Fig. 6, the two parts of the thrust bearing are forced into close engagement and prevent the passage of any gas, which by any chance might have leaked past the oil seal or through the joint between the casing and the casting 66. While the plant is in operation, longitudinal pressure in the direction of the broken arrow is transmitted to the shaft 64 by reason of the reaction of the teeth on the fly-wheel against the teeth on the pinion 62, it being observed that the weight of the fly-wheel is greatly in excess of the weight of the pinion.

It is important that the oil collected in the high pressure chamber 38 be returned to the low pressure chamber where it is needed for lubricating purposes. The means which I have provided for accomplishing this function constitute an important part of my invention. The duct between the two chambers is indicated at 88. This duct is closed during the greater part of the time by a rotating element 89, which has a short shaft 90 journalled in and extending through the wall between the two chambers with a driving pin 91 joined to the shaft 17 of the flywheel in such a manner as to provide a slidable, but non-rotatable connection. For this purpose it is convenient to flatten one side of the pin 91 and to provide a similarly shaped socket in the shaft 17. The rotating element has an oil pocket 92 in its face so positioned radially as to register with the mouth of the duct 88 and also with an opening 93 (see Fig. 2) in the wall between the two chambers, which opening is in constant communication with the high pressure chamber. When the machine is in operation, the high pressure in chamber 38 acts upon the rear surface of the

rotating element 89 to hold it in close engagement with the wall, the two faces being preferably ground so as to present absolutely smooth contact surfaces. These surfaces I have shown flat, but this is by way of illustration only, as surfaces of other shapes could well be employed without departing from the spirit of the invention. A spring pressure plunger 94 bearing against a bar 95 upon the water valve casing assists in holding the rotating element 89 in place.

The machine may be charged with lubricating oil through a duct 71 which is normally closed by a screw-threaded needle valve 72. A supply of oil may be carried in an oil cup 73 which is in communication with the duct 71 when the needle valve 72 is retracted. The amount of oil in the bottom of the low pressure chamber may be ascertained by inspection of a gauge 74, Fig. 7, which is threaded into an opening 75 in the base of the casing.

A cooling fluid, such as water, enters the machine under pressure through a pipe 76, passes thence through an automatic regulating valve and through pipe 77 into the base of the condensing chamber. The cooling fluid is drawn off through a drain pipe 78 extending upwardly to near the top of the condensing chamber. While the water regulating valve forms no part of the present invention, it will be briefly described.

Water enters the valve chamber by way of a passage 79 and leaves by way of a passage 80. The seat for the valve 81 lies between and is in communication with both of these passages. The valve has a double ended stem, one portion of which is arranged to receive longitudinal pressure from a plunger 82 acted upon by a spring 83, the compression of which may be adjusted by means of a nut 84. The opposite end 85 of the valve stem abuts upon a disk 86 bearing against the diaphragm 87. As will be readily understood the diaphragm 87, which is exposed to the pressure in the high pressure chamber 38 will press upon disk 86 against the pressure of spring 83 with a degree of intensity varying with the degree of compression of the gases in the chamber 38. Hence the valve 81 will be entirely closed or opened to a greater or less extent depending upon the condition of operation of the machine.

Operation

The operation of my invention will be obvious to those skilled in this art. The refrigerant which I prefer to employ is ammonia gas, although I do not desire to be limited in this respect. The gas enters the low pressure chamber from the refrigerating chamber, not shown, through pipe 61. Upon the down stroke of the piston 12 the valve 25 opens and allows a quantity of gas to pass through the space above the piston head. On the up stroke valve 25 closes and the charge of gas is compressed until it overcomes the pressure in the dome 32 acting upon the inside of ring check valve 30, when the latter flexes sufficiently to permit the compressed charge to enter the dome. In this manner pressure is built up in the dome, in the pipe 33 and in the high pressure chamber 38. In passing through the pipe 33 the gas gives off some of its heat to the water surrounding the pipe. From the chamber 38 it passes through reducing valve 46 and out through pipe 57 to the refrigerating chamber. The difference in compression between the high pressure side and the low pressure side of the apparatus may be regulated by adjustment of the screw 54.

A cloud of oil spray is maintained in the low pressure chamber continuously because of the churning of the oil at the bottom of the chamber by the fly-wheel and the lower end of the connecting rod. By this means the piston and cylinder wall are satisfactorily lubricated. The removal of this oil from the gas being compressed is accomplished in the first instance by the separator in the piston. Further oil is removed by the large separator in the high pressure chamber 38, while the final separation is made by the screen 60 surrounding the reducing valve. The oil which is taken from the gas by the two separators last mentioned collects in the bottom of the chamber 38 and when it reaches the level of the opening 93 it fills that opening. Thereafter, at each revolution of the rotary element 89 a charge of oil is forced from the opening 93 into pocket 92, from which it is discharged into the duct 80 when the pocket comes into registration therewith. The sliding surfaces between the rotating element 89 and the wall between the chambers must be so accurately ground as to prevent any substantial leakage of gas from the high to the low pressure chamber.

I am aware that the particular embodiment of my invention above described, and illustrated in the accompanying drawing is susceptible of considerable variation without departing from the spirit thereof, and therefore I desire to claim my invention broadly as well as specifically as indicated by the appended claims.

I claim:

1. In a refrigerating machine, a casing, a compressor therein, a relatively large spiral gear within said casing, a driving connection between said gear and compressor, a power shaft extending through one wall of said casing, a relatively small spiral gear fixed to said shaft meshing with said first named gear, and a solid thrust bearing between said shaft and wall, whereby the reaction of the teeth on the large gear against the teeth on the small gear holds the parts of said thrust bearing in close engagement to form a seal

in the wall about said shaft while the compressor is being operated.

2. In a refrigerating machine, a casing, a compressor therein comprising a fly-wheel, spiral teeth upon the periphery of said fly-wheel, a power shaft extending through one wall of said casing, a spiral gear fixed to said shaft meshing with the fly-wheel gear, and a solid conical thrust bearing between said shaft and wall, whereby the reaction of the teeth on the fly-wheel gear against the teeth on the power shaft gear holds the parts of said trust bearing in close engagement to form a seal in the wall about said shaft, while the compressor is being operated.

3. In a refrigerating machine, a casing containing oil, a compressor in the casing, a relatively large spiral gear dipping into the oil, a driving connection between said gear and compressor, a power shaft extending through one wall of said casing, a relatively small spiral gear fixed to said shaft meshing with said first named gear, a solid thrust bearing between said shaft and wall, whereby the reaction of the teeth on the large gear against the teeth on the small gear holds the parts of said thrust bearing in close engagement, and a radial bearing supported from said wall extending inwardly from said thrust bearing, said radial bearing including an oil receptacle adapted to contain oil to a level above the shaft, and a pan arranged to collect oil thrown from said large gear and deflect it into said receptacle.

In testimony whereof, I affix my signature.

CARL P. BROCKWAY.