March 22, 1960 J. H. HEIDORN 2,929,551

REFRIGERATING APPARATUS

Filed Sept. 17, 1956 2 Sheets-Sheet 1

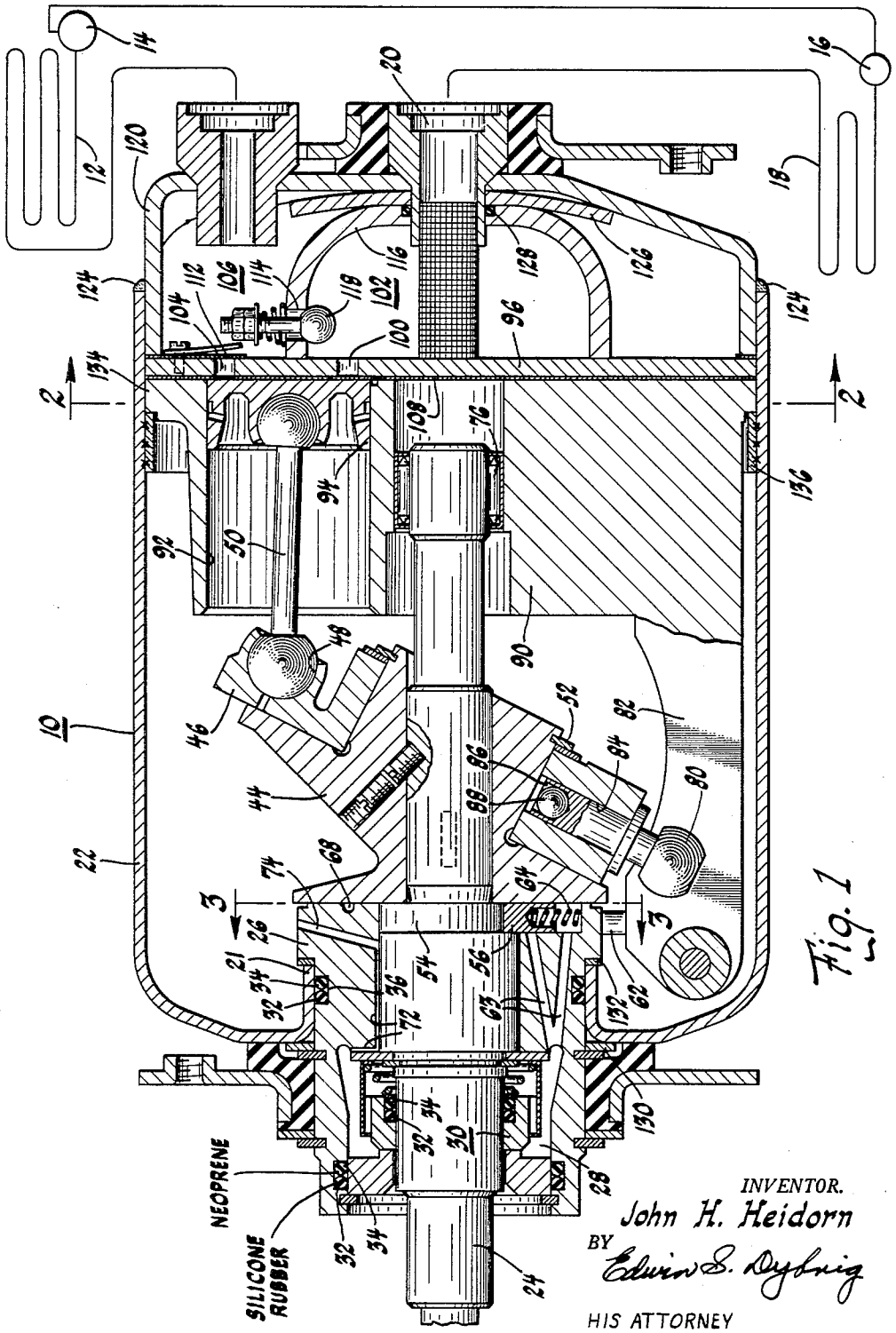


Fig. 1

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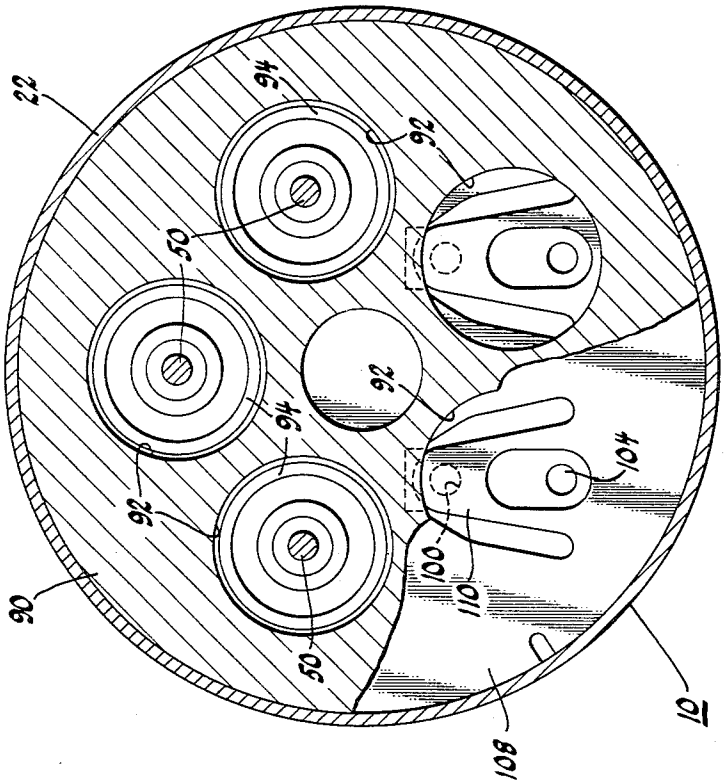


Fig. 2

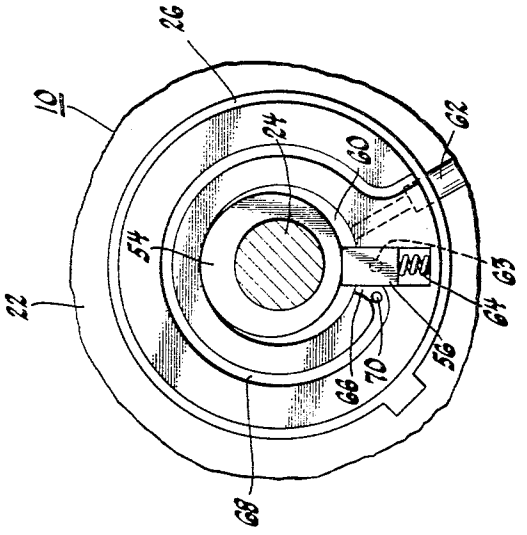


Fig. 3

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2,929,551

REFRIGERATING APPARATUS

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Application September 17, 1956, Serial No. 610,361

8 Claims. (Cl. 230—186)

This invention relates to refrigerating apparatus and more particularly to a refrigerant compressor of the axial type.

It is an object of this invention to provide an improved arrangement for holding the various compressor parts in assembled relationship.

Still another object of this invention is to provide improved means for sealing joints in refrigerating systems such as the joints between a compressor shell and a shaft bearing carried by the compressor shell.

Another object is to provide a compressor which may be manufactured at a low cost and which is capable of being driven at widely varying speeds without danger of damage to the compressor.

Still another object of this invention is to provide an improved means for separating the incoming refrigerant from the outgoing refrigerant.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Figure 1 is a vertical sectional view showing a preferred embodiment of the invention;

Figure 2 is a sectional view taken substantially on line 2—2 of Figure 1 showing a part of the main cylinder casting broken away so as to expose a portion of the suction valve plate;

Figure 3 is a fragmentary sectional view taken substantially on line 3—3 of Figure 1.

Referring now to the drawing, wherein a preferred embodiment of the invention has been shown, reference numeral 10 generally designates a refrigerant compressor which is adapted to discharge compressed refrigerant into a condenser 12 wherein the compressed refrigerant is condensed before entering a receiver 14. The liquefied refrigerant flows from the receiver 14 through a pressure regulating device 16 into an evaporator 18 in which the liquid refrigerant is converted into vapor before returning to the compressor through the compressor inlet fitting 20.

The compressor 10 includes a stamped sheet metal outer casing element 22 which serves to enclose the main working parts of the compressor. The compressor includes a main drive shaft 24 which has its one end journalled in an aluminum bearing insert 26 which is supported by the casing 22, as shown. The bearing insert 26 is provided with a shaft seal cavity 28 which serves to enclose a conventional shaft seal mechanism generally designated by the reference numeral 30.

To prevent the escape of refrigerant and lubricant from the compressor housing where the shaft passes through the housing and where the bearing insert passes through the wall of the housing, an improved type of joint or seal has been provided which employs two O rings of unlike materials at each point of possible leakage. Thus, at the joint between the bearing insert 26 and the inturned flange 21 of the outer housing 22 there is provided a pair of O rings 32 and 34 which are disposed within a circumferentially extending groove 36 formed in the bearing insert 26. Single O rings of the neoprene type have formerly been used for this purpose but neoprene O rings do not stand up well when the one side of the O ring is exposed to air at high temperatures such as encountered in a compressor driven by a car engine. The neoprene material tends to deteriorate when subjected to air at such high temperatures. Silicone rubber O rings stand up very well at these high temperatures when subjected to air but are unsuitable for use in those installations where the silicone rubber comes in contact with refrigerants and lubricants. In each of the seals used in the compressor shown in the drawing, the one seal ring 32 is made of silicone rubber and the other seal ring 34 is made of neoprene. It will be noted that the construction is such that each neoprene ring 34 seals against the escape of lubricant and refrigerant and is exposed to the lubricant and refrigerant, whereas a silicone rubber ring 32 is arranged to be exposed only to air. Thus, neither of the seal rings is subjected in any appreciable degree to any substance which would cause deterioration of the rings.

The drive shaft 24 has secured thereto a wobble plate 44 which rotates in unison with the drive shaft 24. The wobble plate rotatably supports an aluminum socket plate 46 having a plurality of sockets 48 in which the spherical ends of the piston rods 50 operate. The socket plate is cast with the spherical portion of the piston rod in place so as to eliminate the need for machining the sockets. The piston rods are made of steel and therefore can stand the temperature of the molten aluminum during the casting operation without any adverse effects. The socket plate 46 is held in place on the main body of the wobble plate by means of retainer rings 52 and is prevented from rotating with the shaft by means of the guide pin 80 which moves in a conventional guide 82 formed integrally with the cylinder casting 90.

The drive shaft 24 is provided with an eccentric portion 54 which cooperates with a spring-pressed divider block 56 so as to form a vane type oil pump for supplying lubricant to the shaft bearing and the shaft seal cavity. Oil from the bottom of the compressor housing 22 enters the oil pump chamber 60 through the line 62. It will be noted that the vane 56 is sandwiched in between the wobble plate assembly 44 and the bearing insert 26 and that a spring 64 biases it against the eccentric portion 54. The bearing insert 26 is provided with oil passages 63 which supply oil under pressure to the one side of the vane 56 so as to press it against the wobble plate assembly 44 and to a point behind the divider block so as to assist the spring 64 in holding the divider block against the eccentric portion 54 of the shaft. The oil leaves the pumping chamber 60 through various oil distributing passages such as the passage means 66 which serves to feed into a groove 68 formed in the one face of the bearing insert 26 and some of the oil through a passage 70 which leads into the shaft seal cavity. It will be noted that the main bearing insert 26 is provided with oil feed grooves 72 which serve to provide lubrication for the main shaft bearing. Excess oil is fed from the oil feed slot 72 into an overflow outlet passage 74 which serves to return the excess lubricant to the main casing 22.

The inner end of the drive shaft 24 is journaled in a needle bearing 76 carried by the main cylinder block or casting 90. Suitable driving means such as a pulley (not shown) or the like could be attached to the outer end of the drive shaft for operating the compressor.

The socket plate 46 is prevented from rotating in unison with the shaft by means of the guide pin 80 which has its lower end arranged to be guided by the conventional

guide 82. The guide pin is made of steel and is arranged in a recess 84 provided in one edge of the socket plate, as shown in Fig. 1 of the drawing. Prior to applicant's invention considerable difficulty was experienced in fastening the steel guide pin within the aluminum socket plate and in order to overcome this difficulty the inner end of the guide pin has been counterbored as indicated at 86 so as to receive a hardened steel ball 88. The steel ball 88 is made slightly larger than the counterbore 86 so that when the steel ball is forced into the bore 86 the surrounding walls of the steel pin are forced outwardly into firm engagement with walls of the bore 84 in the aluminum socket plate.

As best shown in Fig. 2 of the drawing, the cylinder block 90 is provided with five cylinder bores 92 in which pistons 94 reciprocate. These pistons are each connected to one of five piston rods such as the rod 50 shown in Fig. 1 of the drawing. For purposes of simplification, only one of the piston rods has been shown in Fig. 1 as all are alike. A valve plate 96 fits up against the one end of cylinder block 90 and this plate is provided with a series of inlet and outlet ports which communicate with the cylinders 92. Thus, as shown in Fig. 1 of the drawing, each cylinder is provided with an inlet port 100 which communicates with the inlet chamber 102 which, in turn, communicates with the inlet fitting 20 through which the refrigerant to be compressed enters the compressor housing. The valve plate 96 is also provided with discharge ports 104 through which the compressed refrigerant flows from the compression chambers into the high pressure outlet chamber 106. As best shown in Fig. 2 of the drawing, a reed-type valve plate 108 is arranged between the cylinder block 90 and the plate 96 and this valve plate is provided with a plurality of integral reed valves 110. A separate discharge valve such as the valve 112 shown in Fig. 1 is provided for each of the outlet ports.

Compressors of this type are designed to operate at widely varying speeds, if necessary, and are designed to operate under widely varying load conditions. Accordingly, it is desirable to provide some means for preventing the excessive head pressures at light loads and during high speed operation of the compressor. This means consists of a high pressure relief port 114 which is provided in the wall of the cup-shaped stamping 116 which serves to separate the suction chamber 102 from the discharge chamber 106. A spring-pressed relief valve 118 is arranged to normally seal the port 114 at all times except when excessive pressure develops in the chamber 106, at which time the valve 118 will open so as to prevent the head pressure from becoming excessive.

In assembling the compressor, the bearing insert 26 is first secured to the casing 22 and then the compressor is mounted in place through the large open end of the casing 22. The valves and valve plate are then installed after which the cup-shaped sheet metal stampings 116 and 120 are assembled in the manner shown. The stamping 120 is then welded to the outer casing 22, as indicated at 124, so as to seal the compressor housing. A Belleville washer 126 is provided between the stampings 116 and 120 so as to at all times press the stamping 116 into firm sealing engagement with the plate 96. The inlet fitting 20 is brazed or otherwise secured to the stamping 120 and the stamping 116 is slidably supported on the inner end of the fitting 20, as shown. An O ring seal 128 is provided for preventing the leakage of refrigerant from the high pressure chamber 106 into the lower pressure chamber 102.

The cylinder head clearance is determined by the thickness of the shims 130 and 132 which serve to locate the bearing insert 26 relative to the casing 22. The flange 134 on the cylinder block 90 holds the block 90 in place between the internal ring 136 which is welded to the inner wall of the housing 22 and the valve plate 96.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, as may come within the scope of the claims which follow.

What is claimed is as follows:

1. In a refrigerant compressor, a cylindrical casing element having openings in the ends thereof, a shaft bearing assembly removably disposed in one of said openings, seal means between said assembly and said casing element for preventing the escape of refrigerant from said casing or the introduction of air into said casing, said seal means comprising a first neoprene O ring seal disposed adjacent the refrigerant side and a second silicone rubber O ring seal disposed adjacent the outside of said casing, compressor means within said casing including a drive shaft supported by said shaft bearing and projecting through said one opening, said compressor means including a multiplicity of cylinders having a common valve plate, said valve plate being disposed adjacent the other of said openings and having a plurality of inlet and outlet ports, cylinder head means including inlet and outlet chambers communicating with said inlet and outlet ports respectively and comprising a pair of telescoped cup-shaped members having their rims pressed against said valve plate, and means for securing a first one of said cup-shaped members to said cylindrical casing element so as to close the opening in the one end of said casing.

2. In a refrigerant compressor, a cylindrical casing element having openings in the ends thereof, a shaft bearing assembly removably disposed in one of said openings, seal means between said assembly and said casing element for preventing the escape of refrigerant from said casing or the introduction of air into said casing, said seal means comprising a first neoprene O ring seal disposed adjacent the refrigerant side and a second silicone rubber O ring seal disposed adjacent the outside of said casing, compressor means within said casing including a drive shaft supported by said shaft bearing and projecting through said one opening, said compressor means including a cylinder and a valve plate, said valve plate being disposed adjacent the other of said openings and having inlet and outlet ports, cylinder head means including inlet and outlet chambers communicating with said inlet and outlet ports respectively and comprising a pair of telescoped cup-shaped members having their rims pressed against said valve plate, and means for securing one of said cup-shaped members to said cylindrical casing element so as to close the opening in the one end of said casing.

3. In a compressor; a casing; multiple cylinder compressor means within said casing; said compressor means including a valve plate having a first series of inlet ports communicating with said cylinders and a second series of outlet ports communicating with said cylinders; and means cooperating with said valve plate to form a compressor inlet chamber and a compressor outlet chamber; said last-named means comprising a first stamped sheet metal cup rigidly secured to said casing and having an inwardly projecting boss forming a first refrigerant passage, a second cup means slidably supported on said inwardly extending boss, and spring means between said first and second cup means for biasing the rim of said second cup means into sealing engagement with said valve plate.

4. In a compressor; a casing; multiple cylinder compressor means within said casing; said compressor means including a valve plate having a first series of inlet ports communicating with said cylinders and a second series of outlet ports communicating with said cylinders; and means cooperating with said valve plate to form a compressor inlet chamber and a compressor outlet chamber; said last-named means comprising a first stamped sheet metal cup rigidly secured to said casing and having an inwardly projecting boss forming a first refrigerant passage; a second cup means slidably supported on said inwardly extending boss, and spring means between said

first and second cup means for biasing the rim of said second cup means into sealing engagement with said valve plate, the space between said cup means forming an outlet chamber and the space within said second cup means forming an inlet chamber.

5. In a compressor; a casing; multiple cylinder compressor means within said casing; said compressor means including a valve plate having a first series of inlet ports communicating with said cylinders and a second series of outlet ports communicating with said cylinders; means cooperating with said valve plate to form a compressor inlet chamber and a compressor outlet chamber; said last named means comprising a first stamped sheet metal cup rigidly secured to said casing and having an inwardly projecting boss forming a first refrigerant passage, a second cup means slidably supported on said inwardly extending boss, and spring means between said first and second cup means for biasing the rim of said second cup means into sealing engagement with said valve plate; the space between said first and second cup means forming an outlet chamber and the space within said second cup means forming an inlet chamber; said second cup means having an aperture in one wall portion thereof for connecting said inlet and outlet chambers; and a pressure relief valve cooperating with said aperture and arranged to be opened in response to a predetermined pressure differential between said chambers.

6. In a multiple cylinder compressor; a cylinder block, a valve plate secured to said block; a multiple compartment cylinder head assembly secured to said block and including means whereby one compartment forms a common inlet chamber for all of the cylinders and another of said compartments forms a common outlet chamber for all of the cylinders, said head assembly including a first cup-shaped element having a reentrant boss portion and a second cup-shaped element slidably disposed on said boss portion, the rims of said cup-shaped elements being arranged to abut said valve plate, and spring means between said cup-shaped elements for biasing said second cup-shaped element into sealing engagement with said valve plate.

7. In a multiple cylinder compressor, a cylinder block having a plurality of cylinder bores therein, piston means operable in said bores, a valve plate secured to said block and having inlet and outlet ports communicating with said bores, a multiple compartment cylinder head assembly wherein one compartment forms a common inlet chamber for each of said inlet ports and another of said chambers forms a common outlet compartment for each of said outlet ports, said assembly including a first cup-shaped element and a second cup-shaped element movable relative to said first cup-shaped element, the rims of said cup-shaped elements being arranged to abut said valve plate, and spring means between said cup-shaped elements for biasing said second cup-shaped element into sealing engagement with said valve plate.

8. In a multiple cylinder compressor, a cylinder block having a plurality of cylinder bores therein, piston means operable in said bores, a valve plate secured to said block and having inlet and outlet ports communicating with said bores, a multiple compartment cylinder head assembly wherein one compartment forms a common inlet chamber for each of said inlet ports and another of said chambers forms a common outlet compartment for each of said outlet ports, said assembly including a first cup-shaped element and a second cup-shaped element movable relative to said first cup-shaped element, the rims of said cup-shaped elements being arranged to abut said valve plate, and spring means between said cup-shaped elements for biasing said second cup-shaped element into sealing engagement with said valve plate, said spring means comprising a Belleville washer.

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