REFRIGERANT COMPRESSORS HAVING VERTICAL CRANKSHAFTS

Filed Oct. 17, 1966

FIG.1.

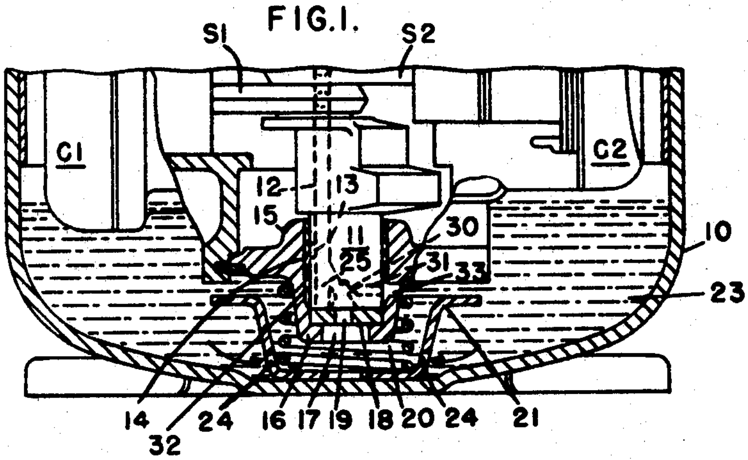


FIG.2.

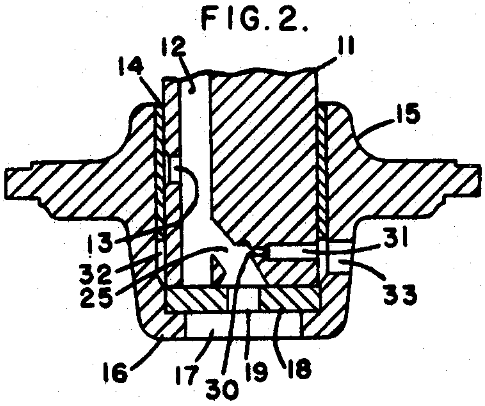
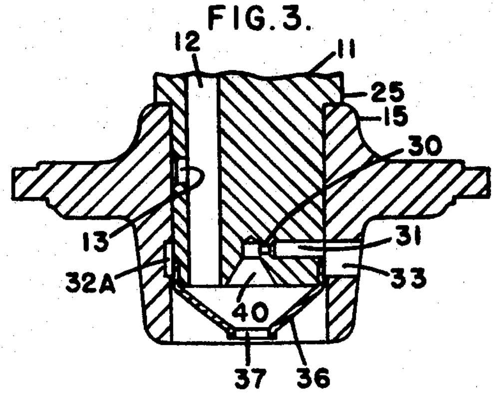


FIG.3.



INVENTORS:
ROBERT W. AYLING,
PAUL G. THAYER,
BY Robert T. Palmer
ATTORNEY

3,388,855
REFRIGERANT COMPRESSORS HAVING VERTICAL CRANKSHAFTS

Robert W. Ayling and Paul G. Thayer, Staunton, Va., assignors to Westinghouse Electric Corporation, Pittsburgh, Pa., a corporation of Pennsylvania
Filed Oct. 17, 1966, Ser. No. 587,295
5 Claims. (Cl. 230—206)

ABSTRACT OF THE DISCLOSURE

A refrigerant compressor has a vertical crankshaft with an off-center bore for supplying oil to bearings. The bore is connected by an oil pump passage to a central oil inlet opening in the bottom of the crankshaft. The pump passage is connected through a gas vent orifice and a gas vent passage larger than the orifice to the surface of the crankshaft which is connected by a gas outlet passage to the oil sump of the compressor.

This invention relates to refrigerant compressors having vertical crankshafts, and having oil pumping means at the bottoms of such crankshafts.

The patents of R. W. Ayling, Nos. 3,171,588 and 3,-259,307 disclose refrigerant compressors having vertical crankshafts with vertical, off-center bores therein connecting with bearings, such bores connecting with radial bores near the bottoms of the crankshafts, such radial bores connecting through central bores in the bottoms of the crankshafts, with the oil sumps of the compressors. The radial bores act as centrifugal pumps, pumping oil from the oil sumps through the off-center bores to the bearings. Since, in such compressors, refrigerant liquid is mixed with the oil, when pressure changes and heating occur, refrigerant gas is produced which interferes with the flow of oil. The previously mentioned Patent No. 3,-259,307 discloses how such gas can be vented at the discharge side of the oil pump.

This invention vents trapped gas at the suction side of such an oil pump. At the center of rotation where the axis of such a crankshaft crosses the radial bore operating as an oil pump, gas bubbles are formed as the oil is centrifuged outwardly by centrifugal force, and in the usual compressor, may grow to such sizes that the entrance of oil into the radial pump bore is seriously restricted, preventing the bearings from being supplied with sufficient oil. This invention provides in such a crankshaft, an orifice having an inlet close to the axis of the crankshaft, connecting with the inlet of the oil pump, and having an outlet connecting through an annular passage, and an opening in the surrounding bearing housing, with the oil sump. Gas bubbles formed at the pump inlet are pumped out through the orifice, preventing the growth of such bubbles in the pump inlet. The orifice permits only a relatively small amount of oil to be pumped out with the vented gas.

An object of this invention is to improve the oil pumping means of refrigerant compressors having vertical crankshafts.

Another object of this invention is to vent trapped gas at the inlet of the oil pumping means of a refrigerant compressor having a vertical crankshaft.

This invention will now be described with reference to the annexed drawings, of which:

FIG. 1 is a fragmentary sectional view of a refrigerant compressor embodying this invention;

FIG. 2 is an enlarged sectional view of the oil pumping and gas venting means of FIG. 1, and

FIG. 3 is an enlarged sectional view of another oil pumping and gas venting means that can be used to replace that shown by FIGS. 1 and 2.

FIG. 1, except for the gas venting means at the inlet of the oil pumping means, is the bottom portion of FIG. 1 of the previously mentioned Patent No. 3,259,307 which may be referred to for information as to the remainder of the compressor.

Referring now to FIGS. 1 and 2, a refrigerant compressor has an outer shell **10** within which are cylinders **C1** and **C2** having eccentric straps **S1** and **S2** respectively, connected to throws of vertically extending crankshaft **11**. The latter has a vertically extending, off-center bore **12** therein, connecting at its upper portion with bearings which are not shown, and connecting at its lower portion, through opening **13** with a bearing **14**. A bearing housing **15** extends around the bearing **14** and a portion of the crankshaft **11** below the bearing **14**, and has an inturned lower portion **16** around a central opening **17**. A thrust washer **18** having a central opening **19** coaxial with the opening **17**, is seated on the housing portion **16**. The bottom of the crankshaft **11** is seated on the washer **18**. The housing **15** is supported above the bottom of the shell **10** by a coiled spring **20** that is supported on the center of the bottom of a cup **21**, which, in turn, is supported on the bottom of the shell **10**. The lower portion of the crankshaft **11**, the housing **15**, and the cup **21** are immersed in oil in sump **23**. The cup **21** has openings **24** connecting with the sump **23**. The bottom portion of the off-center bore **12** connects with a bore **25** within the crankshaft **11**, which connects with the opening **19** in the thrust washer **18**.

The construction described so far in connection with FIGS. 1 and 2, is essentially that disclosed in the previously mentioned patents. The bore **25** acts as a centrifugal pump, drawing oil through the openings **17** and **19**, and forcing it through the bore **12** to the bearings.

Due to heat generated by the operation of the compressor, and to changes in pressure, gas is evaporated from the refrigerant liquid mixed with the oil, and appears at the bottom of the bore **25** where, due to the rotation of the crankshaft **11**, bubbles accumulate, and which may increase in size sufficiently to seriously restrict the oil flowing through the opening **19** into the bore **25**.

This invention vents such a bubble before its size can increase sufficiently to seriously restrict the oil flowing through the opening **19** into the bore **25**. A radial orifice **30** is formed in the crankshaft **11**, with its inner end connecting with the bore **25** close to the axis of the crankshaft, and with its outer end connecting with a larger radial bore **31** which extends through the crankshaft **11** to its outer surface opposite annular space **32** below the bearing **14**. The annular space **32** connects with opening **33** which extends through the bearing housing **15**, and connects with the oil sump **23**.

In the operation of the gas venting means of FIGS. 1 and 2, centrifugal force causes the refrigerant-oil mixture to pass through the opening **19** into the bore **25**, and gas bubbles evolving from such mixture to flow through the orifice **30**, the bore **31**, the annular space **32**, and the opening **33** into the sump **23**. By making use of the full radius of the crankshaft **11** for the vent system **30–31**, and by keeping the inlet of the orifice **30** as close to the center of rotation as possible, the suction produced by the gas expelled through the vent system will be sufficient to overcome the reduction in pressure produced at the inlet of the orifice **30** by the effect of centrifugal force on the denser liquid in the bore **25**, and each gas bubble will be drawn off by the vent system. Because of the small diameter and short radial length of the orifice **30**, it can never become an oil pump of large capacity or high head, and the loss of oil through it will be insignificant. The relatively small amount of oil pumped through the vent system will usefully entrain bubbles as they are formed.

FIG. 3 shows another form of combined oil pumping and gas venting means, of which the oil pumping means as well as the gas venting means are believed to be novel. In FIG. 3, the thrust washer **18** is omitted, and the crankshaft **11** is provided with a shoulder **35** which rests on the top of the housing **15** which would be aluminum. Also, the bore **25** is omitted, and a metal guide **36** formed as the frustum of an inverted cone, is pressed onto the bottom of the crankshaft **11**. The guide **36** has in its bottom, an oil inlet opening **37**. The off-center bore **12** connects with the space within the interior of the guide **36**. Also, a central bore **40** which converges from the bottom of the crankshaft **11** towards the orifice **30**, is formed within the crankshaft, with its upper end connecting with the inner end of the orifice **30**, the outer end of which connects with the inner end of larger radial bore **31** which extends to the outer surface of the crankshaft **11** opposite annular slot **32A** in the housing **15**. The bearing **14** is omitted, opening **13** connecting the off-center bore **12** with the surface of the housing **15** which is in contact with the crankshaft.

In the operation of FIG. 3, when part of a compressor, oil is drawn through the opening **37** into the guide **36** by centrifugal force, and is supplied through the bore **12** to the bearings of the compressor. Gas entering the opening **37** or evolved within the guide **36** is vented through the bore **40**, the orifice **30**, the bore **31**, the annular slot **32A**, and the opening **33** into the sump of the compressor. As in the case of FIG. 2, only a small amount of oil is vented with the gas, and such vented oil tends to entrain gas bubbles as they are formed.

What is claimed is:

1. In a refrigerant compressor having a vertical crankshaft, having a relatively large, vertical, off-center bore in said crankshaft, having means forming a relatively large oil inlet opening below the center of the bottom of said crankshaft, having an oil sump with a level above said opening, and having means forming a relatively large passage connecting said opening and said bore, the improvement comprising the provision of substantially

radially extending passage means in said crankshaft, said passage means including an orifice having a relatively small length and having its inner end connected to said large passage near the axis of said crankshaft, and having its outlet connected through the remainder of said passage means to the outer surface of said crankshaft, said remainder of said passage means having a passage larger and longer than said orifice, and means connecting said passage means at said outer surface to said sump.

2. The invention claimed in claim **1** in which a housing extends around the lower portion of said crankshaft, and in which said means connecting said passage means to said sump comprises an annular passage in said housing around said crankshaft opposite said passage means, and an opening in said housing connecting said annular passage to said sump.

3. The invention claimed in claim **1** in which said means forming a relatively large passage connecting said opening and said bore, comprises a guide formed as a frustum of an inverted cone, with its top around said bottom of said crankshaft, and in which said oil inlet opening is an opening in the bottom of said guide.

4. The invention claimed in claim **3** in which there is provided in said crankshaft a bore that connects with said inner end of said relatively small passage and which diverges therefrom to said crankshaft bottom.

5. The invention claimed in claim **4** in which a housing extends around the lower portion of said crankshaft, and in which said means connecting said passage means to said sump comprises an annular passage in said housing around said crankshaft opposite said passage means, and an opening in said housing connecting said annular passage to said sump.

References Cited

UNITED STATES PATENTS

2,287,203	6/1942	Smith	230—206
2,898,072	8/1959	Buschmann	230—206
3,049,285	8/1962	Doeg	230—206
3,279,683	10/1966	Kleinlein	230—58
3,285,504	11/1966	Smith	230—207

ROBERT M. WALKER, *Primary Examiner.*