United States Patent

Harlin et al.

[15] **3,684,412**

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[54] **OIL SEPARATOR FOR ROTARY COMPRESSOR**

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[52] **U.S. Cl.** **418/89,** 418/97

[51] **Int. Cl.** **F04c 29/02,** F04c 17/00, F04d 29/06

[58] **Field of Search** 418/89, 97; 55/320, 467, 327; 62/470

[56] **References Cited**

UNITED STATES PATENTS

3,478,957	11/1969	Harlin et al.	418/89
2,289,441	7/1942	Le Valley	418/89 X
346,038	7/1886	Goldschmid	62/470 X

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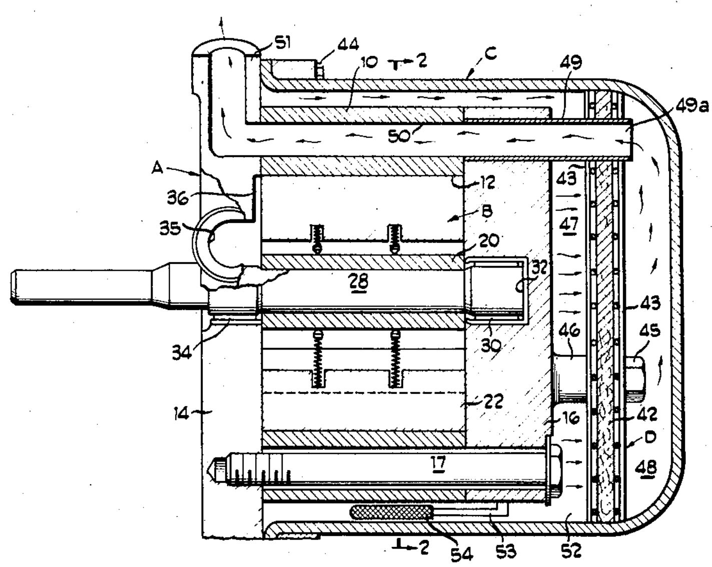
[57] **ABSTRACT**

Apparatus for separating oil entrained in the discharge refrigerant gas of a rotary compressor. This oil-laden refrigerant gas is discharged into a shell surrounding the compressor casing. An oil coalescing medium extends across and adjacent an end of the shell dividing the shell into large and small chambers with the compressor casing located entirely within the large chamber. The coalescing medium confines the turbulent volume of the refrigerant-oil mixture in the large chamber so that the oil impinges on the shell and medium and separates from the gas and collects in the shell bottom while the gas passes through the medium and into the small chamber. A discharge line has its entrance disposed in the top of the small chamber so that it is isolated from the turbulent movement of the oil-refrigerant mixture in the large chamber.

1 Claim, 2 Drawing Figures



PATENTED AUG 15 1972 3,684,412

Fig 1

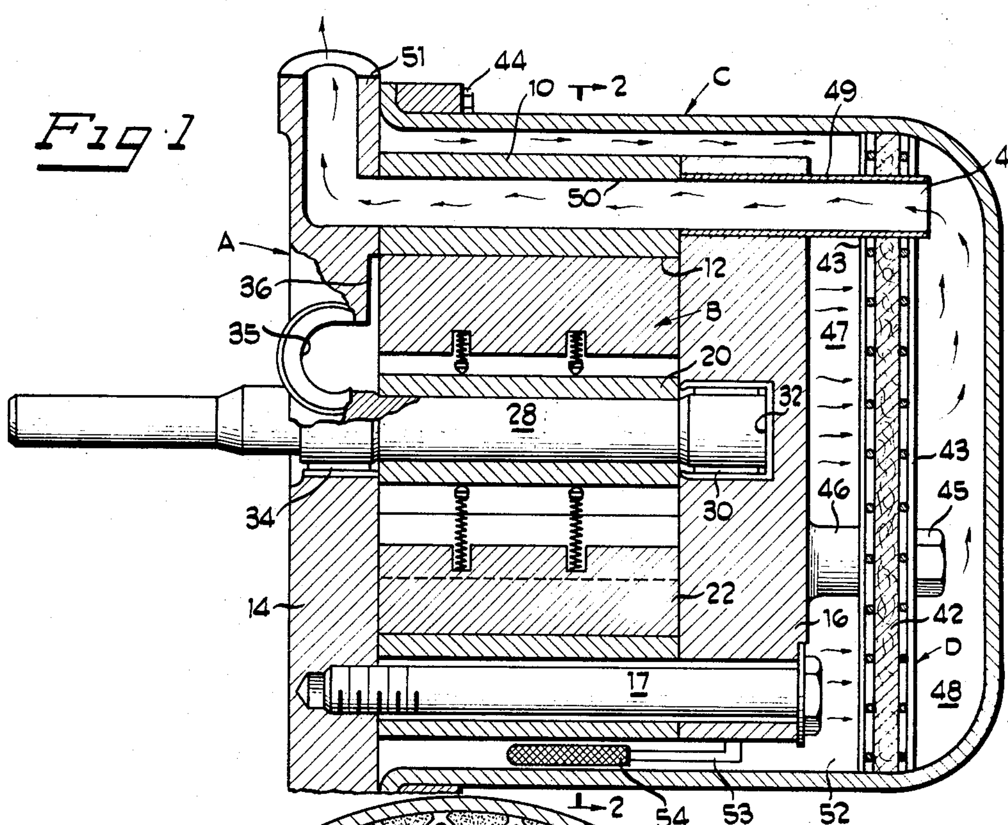
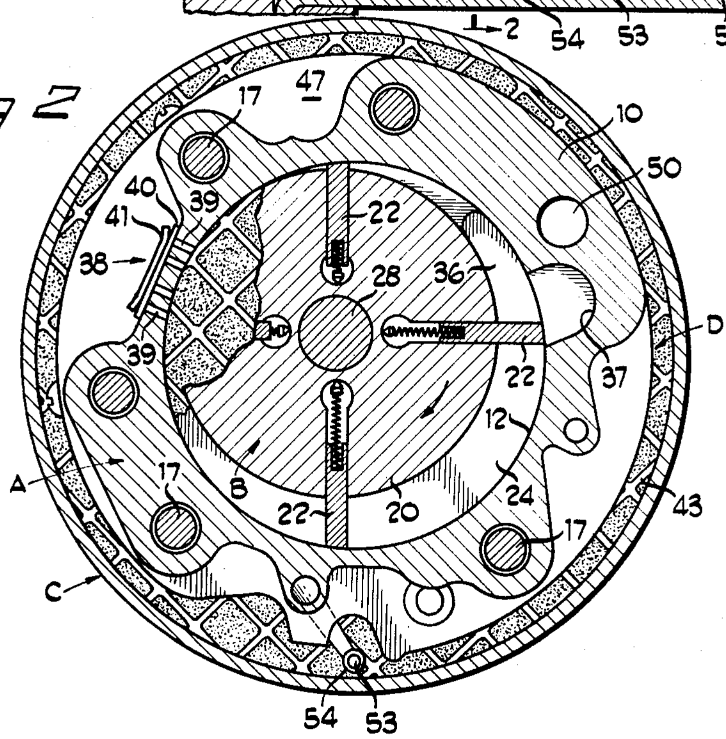


Fig 2



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OIL SEPARATOR FOR ROTARY COMPRESSOR

BACKGROUND AND SUMMARY OF THE INVENTION

This invention relates to an improved oil separator for a rotary compressor.

In the rotary compressor art, lubricating oil is generally provided in the compressor casing for lubricating the moving components of the compressor and for sealing purposes between the high and low pressure sides of the compressor. In operation, refrigerant gas is compressed by the compressor and is then discharged into a hollow shell enclosing the compressor. Since the internal operating components of the compressor are sealed with oil, the refrigerant gas is heavily laden with oil when it is discharged into the shell. It is necessary to remove the oil entrained in the gas, because substantial quantities of oil flowing out with the refrigerant reduces the heat transfer in the condenser and evaporator; and, in addition, renders it difficult to supply a sufficient amount of oil to the compression chamber to attain the necessary sealing between the rotor and chamber surfaces.

One solution to this problem is described in U.S. Pat. No. 3,478,957 issued to Lester E. Harlin and Walter C. Moore on Nov. 18, 1969, and is directed to providing an oil coalescing medium in the form of coarse mesh metal fibers extending across a shell enclosing the compressor casing and forming a partition to define large and small chambers, with the casing being located entirely within the large chamber. Discharge gas is delivered directly into the small chamber between the coalescing medium and the end of the shell so that it expands in this small chamber and the drop of velocity accompanying its release tends to free the oil in the gas. All of the gas sweeps through the coalescing medium which releases some of the oil remaining in the gas. The gas flows into the large chamber and passes into entrance of a discharge conduit located in the large chamber.

The present invention is an improvement of the oil separator arrangement for a rotary compressor disclosed in the Harlin patent and is particularly directed to a simple and novel modification of this oil separator resulting in significant performance differences. According to the present invention, while the oil-coalescing medium similarly partitions the shell into large and small chambers as in the Hardin patent, the refrigerant, compressed by the compressor, and heavily laden with oil, is discharged directly into the large chamber causing oil separation to be considerably facilitated by the substantial and drastic velocity drop of the refrigerant and oil mixture entering the large shell volume, and also by impingement of the gas and oil on the extensive surface area of the shell, and, thereafter, by the coalescing of the oil droplets in the oil separator medium when the gas flows from the large chamber through the oil separator medium into the small chamber. The gas then flows into the entrance of a discharge tube located in the small chamber and through the tube to the exterior of the compressor. The coalescing medium is instrumental in isolating the tube entrance from the turbulent movement of the refrigerant-oil mixture in the large chamber. The oil collects in the bottom of the shell which serves as an oil sump and then returns through a pickup tube to lubricate and seal the compressor. To minimize the possibility of oil entering the discharge tube, the tube+s entrance is located at the top of the small chamber.

It is a principal object of this invention to provide a refrigeration rotary compressor including an improved oil separator.

Another object of the invention is to provide an oil separator for a rotary compressor and having an improved arrangement for recovering oil from the oil-laden refrigerant gas discharged from the compressor for use in lubricating and sealing the compressor.

A specific object of the invention is to provide an improved oil separator for use in a rotary compressor and in which the compressed oil-laden refrigerant gas is discharged into a comressor-enclosing shell having a large volume to provide a substantial and drastic velocity drop of the mixture effective to separate the oil from the gas; further separation occurring upon impingement of the mixture on an extensive surface area of the shell; then passing the gas through an oil coalescing medium to coalesce oil droplets, the coalescing medium being also arranged to isolate the entrance of a discharge tube, located at the top of the compressor, from the turbulent movement of the gas and oil mixture in the shell.

DESCRIPTION OF THE DRAWING

FIG. **1** is a view, with portions broken away and partly in cross-section, of a compressor showing the improved oil separator constructed in accordance with the present invention.

FIG. **2** is a cross-section view taken along the plane of line **2—2** in FIG. **1**.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing and more particularly to FIG. **1**, the compressor constructed in accordance with the principles of the present invention comprises a generally cylindrical housing A containing the rotor assembly B, a hermetic shell C surrounding the compressor and attached to the front bearing plate providing one part of the housing.

The compressor housing A includes a casing **10** having a cylindrical bore **12** extending therethrough, a front bearing plate **14**, and a rear bearing plate **16** all secured by cap screws **17**. The rotor assembly B is received within the casing bore **12** and includes a slotted rotor **20** which carries a plurality of substantially radially extending and reciprocating vanes **22**. The axis of rotor **20** is offset or eccentrically arranged with respect to the axis of the bore **12** so that the bore, the front bearing plate **14**, the rear baring plate **16**, and the rotor **20** cooperate to provide a crescent-shaped compression chamber or cavity **24**. Rotor **20** is driven by shaft **28** journaled in a bearing **30** supported by the rear bearing plate **16** in recessed portion **32** and a bearing **34** supported by the front bearing plate **14**.

Suction gas from the evaporator (not shown) is admitted to a passage **35** formed in the front bearing plate **14**. Both the front bearing plate and the rear bearing plate are provided with generally crescent shaped recesses **36** (only one of which is shown in FIG. **2**) to admit the suction gas into the suction stage of the compressor cavity **24**. The recesses are fluidly interconnected by a channel **37** in the casing body **10**.

As the rotor is driven in the direction of the arrow (FIG. 2), the suction gas is trapped between two vanes and carried forward towards the discharge area. On this occurrence, the volume between the adjacent vanes is reduced thereby resulting in a corresponding increase in pressure of the gas. A discharge valve assembly **38** is located in the discharge zone for assuring proper compression of the gases issuing from the outlet or discharge ports **39** and for preventing reverse flow of gases back into the compression chamber. The valve assembly **38** is of the reed type and comprises the valve reed **40** held in place by a valve guard or stop **41**.

The oil separator arrangement includes an element D formed of gas permeable material **42**, for example, one made of coarse mesh metal fibers, such as used in a scouring pad, held between retainers or support members **43**. The support members **43** comprise a pair of screen-like elements fabricated from heavy metal wire. The periphery of the element D has the same contour as that of the shell so that its edges fit against the internal diameter of the shell, the shell being connected to the periphery of the front bearing plate by a series of cap screws **44** to provide a fluid-tight connection between the shell and the front bearing plate. The element D is secured in spaced relation to the compressor by cap screws **45** attached to bosses **46** extending axially from the rear bearing plate **16** and providing a partition separating the space enclosed by the shell into a large chamber **47** and a small chamber **48**, the larger chamber enclosing the compressor housing A so that it is located entirely within the large chamber.

The compressor housing A is provided with a gas discharge tube or conduit **49** extending within and forming a continuation of an axially extending passage **50** in the top of the rear plate **16**, casing **10** and front plate **14**, the passage terminating in a fitting **51** on the front plate for flow of gas from the compressor to a condenser (not shown). The tube **49** also extends through a portion of chamber **47** and through element D, having its entrance end **49***a* disposed within the small chamber **48** so that gas from chamber A must pass through the oil-coalescing material of element D before entering chamber **48** for upward flow into the gas discharge tube **49**.

Oil collects in a sump portion **52** in the lower portion of the shell and is circulated through a lubrication system. Oil is caused to flow through a pick-up tube **53** having a strainer **54** to a series of passages in the front and rear bearing plates and the casing body.

OPERATION

The oil separator of the present invention provides a simplified and improved arrangement having performance advantages readily apparent in the light of the following description of the operation of the oil separator.

The hot discharge gas, together with the entrained oil, passes from the discharge valve assembly **38** and flows into the large chamber **47**. Since the internal running parts of the compressor are sealed with oil, the refrigerant gas is heavily laden with oil when it is discharged at high velocity into chamber **47**. A novel and important feature of the arrangement is that, due to the substantially large shell volume defining the chamber **47**, a drastic velocity drop of the refrigerant and oil mixture occurs to slow down the velocity of the gas, although considerable turbulence is had in the vicinity of the gas-permeable element D but which subsides to a low value. Oil separation is not only achieved rapidly by the velocity drop of the mixture, but by impingement of the gas and oil on the substantially larger surface area of the shell, and by the coalescing of oil droplets in the gas-permeable material **42** of the element D. Since the element D separates the chambers **47** and **48**, the element also isolates the entrance **49***a* of the discharge tube **49** from the turbulent movement of the refrigerant-oil mixture in the chamber **47**. Furthermore, all of the gas must pass from chamber **47** through the element D to chamber **48** so that additional amounts of oil are separated from the gas prior to flow of the gas into the discharge tube **49**. After passing through the element D, the gas also strikes the end wall of the shell and reverses direction such that some of any remaining oil adheres to the wall and flows down to the sump. Passage of oil from chamber **48** into the discharge tube **49** is minimized as the entrance of the tube **49** is disposed at the top of the chamber **48** in a position remote from the level of the oil collected in the chamber **49**.

What is claimed is:

1. A refrigerant compressor comprising a housing having a compression cavity formed therein; suction and discharge ports communicating with said cavity; a rotor in said compression cavity adapted to compress a refrigerant fluid introduced through said suction port and discharge said fluid, together with a liquid lubricant entrained therewith, through said discharge port at a higher pressure; a closed shell having a generally circular cross-section enveloping said housing and spaced therefrom to provide a substantially annular fluid passage between the inside surface of said shell and the outside surface of said housing, said shell having an end wall axially spaced from said housing, said discharge port being located with respect to said shell to deliver the discharge gas directly from said discharge port against the inside surface of said shell whereby a portion of any lubricant entrained in said discharge gas coalesces on said inside surface; a gas permeable coalescing medium arranged within said shell and having its marginal edges closely conforming with the inside diameter of said shell, said coalescing medium being spaced from the end of said shell to provide a partition separating the space enclosed by said shell into first and second chambers such that said housing is located entirely within said first chamber and the discharge gas flows from said annular fluid passage into said first chamber; and a discharge gas conduit having its entrance end located in said second chamber whereby the gas delivered into said second chamber must flow through said coalescing medium to reach said entrance end.

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