

[54] **LIQUID RELIEF VALVE IN CYLINDER FOR COMPRESSOR**

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[58] Field of Search **417/310; 418/97, 99, 100**

[56] **References Cited**

UNITED STATES PATENTS

1,781,073 11/1930 Nielson 418/99

2,117,468	5/1938	Wolcott	417/310
2,303,589	12/1942	Sullivan	417/310
2,493,929	1/1950	Rittenhouse et al.	417/310
3,214,087	10/1965	Luck	417/310

FOREIGN PATENTS OR APPLICATIONS

222,096	2/1925	United Kingdom.....	417/310
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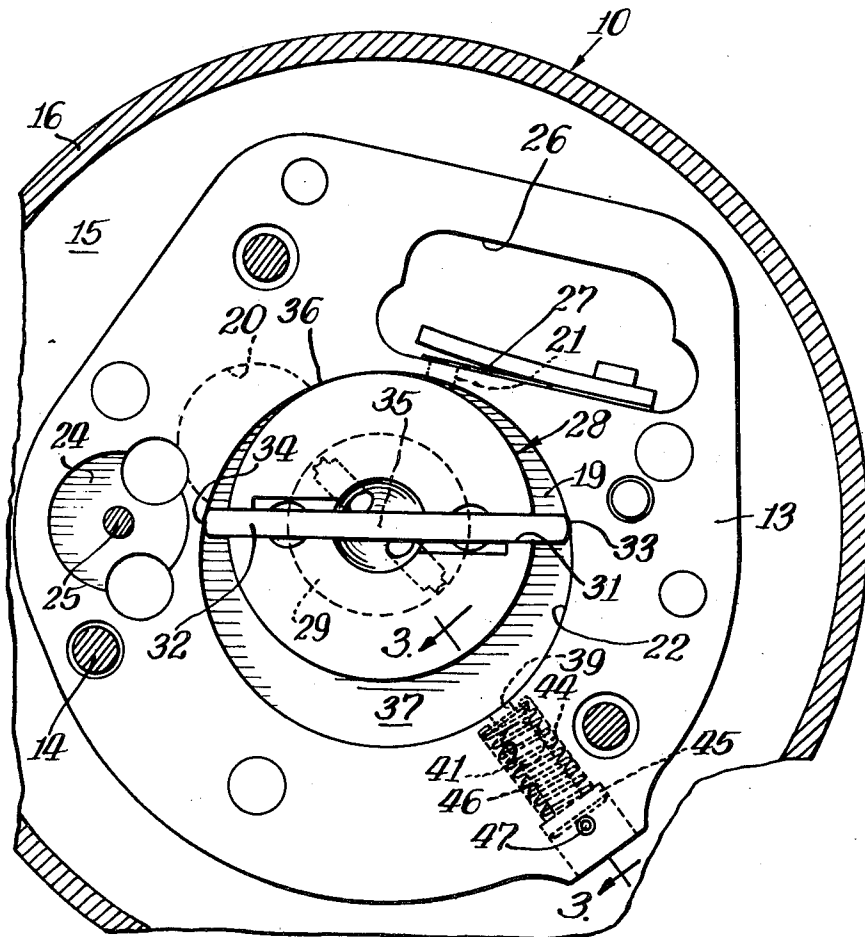
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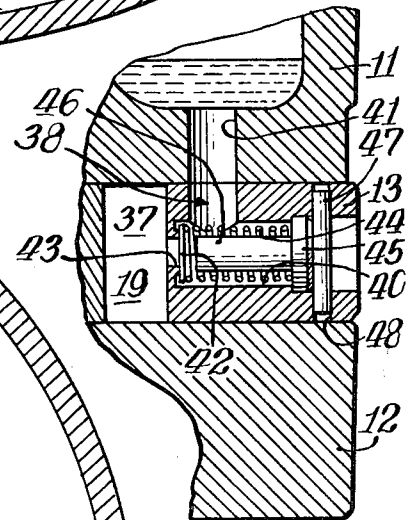
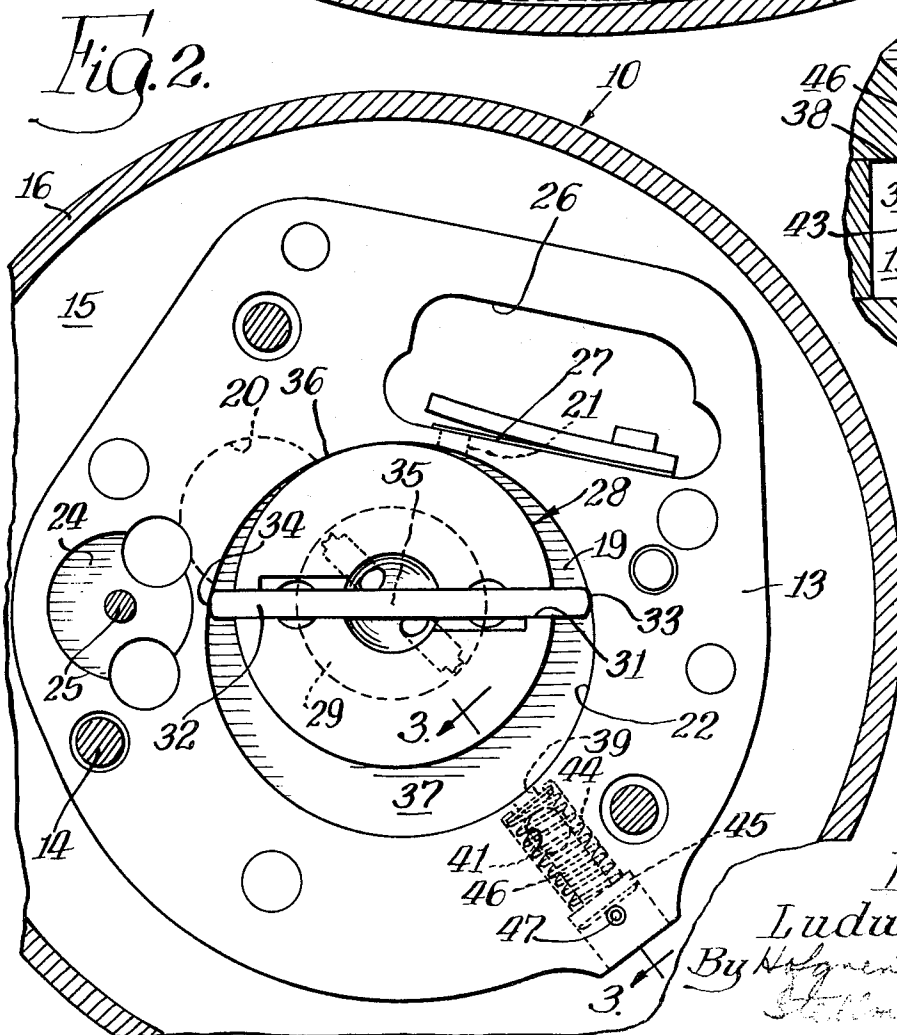
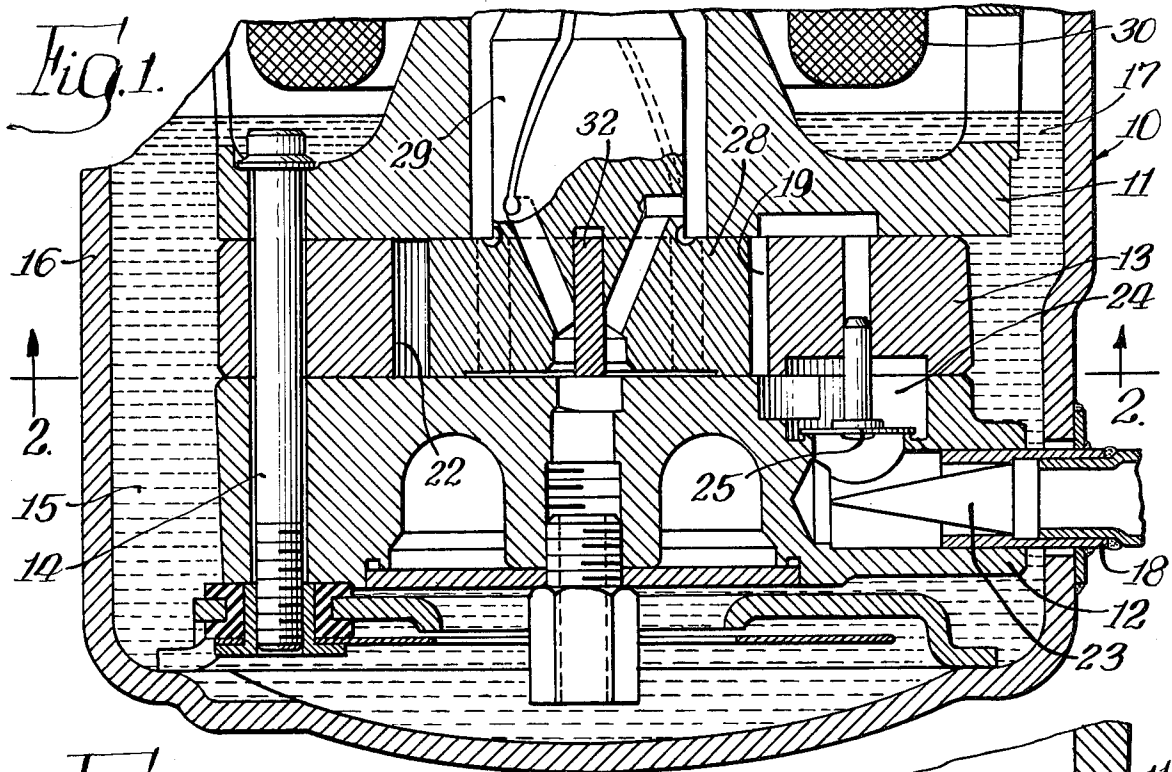
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ABSTRACT

[57] A rotary compressor having a one piece blade rotary pump member disposed in a compression chamber for pumping fluid from a suction inlet to a discharge outlet. Means are provided for alleviating an incompressible fluid block condition in the compression chamber.

7 Claims, 3 Drawing Figures





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LIQUID RELIEF VALVE IN CYLINDER FOR COMPRESSOR

This is a continuation of application Ser. No. 103,386 filed Jan. 4, 1971.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to rotary compressors of the one piece blade type and in particular to means for alleviating an incompressible fluid block condition in such compressors.

2. Description of the Prior Art

In the conventional rotary compressors, a rotor blade sweeps about a compression chamber to compress gas, such as refrigerant gas, delivered to the chamber through an inlet opening. The compressed gas is discharged from the chamber through an outlet opening spaced circumferentially from the inlet opening of the cylindrical chamber.

At times, liquid collects in the compression chamber. Such liquid may comprise lubricating oil and liquid refrigerant which may pass into the chamber during an inoperative period.

The inlet and outlet openings are conventionally positioned so that a substantial portion of the chamber at one side of the rotor blade is at times completely closed by the blade. Where this portion of the chamber is filled with liquid, a block occurs, due to the incompressible nature of the liquid, preventing rotation of the rotor. One solution to this problem has been to subject the rotor to repeated force impulses tending to slowly incrementally force the rotor from the blocked condition to effect discharge of the incompressible liquid through the outlet opening. Such impulsive forcing of the rotor provides substantial shocks to the apparatus which may damage the apparatus as by deformation or breakage.

SUMMARY OF THE INVENTION

The present invention comprehends an improved rotary compressor structure of the one piece blade type having means for alleviating such an incompressible fluid block condition.

More specifically, the invention comprehends such a fluid pressure relief means including a relief passage opening from the compression chamber at a position intermediate the inlet and outlet openings and check valve means controlling the relief passage to permit fluid flow only outwardly therethrough at a preselected high pressure above the normal maximum pressure of compressible fluid being compressed by the apparatus. Thus, the pressure alleviating means permits incompressible liquids trapped in the compression chamber to pass outwardly through the relief passage while preventing compressible fluids from passing outwardly through the relief passage and thereby permitting the compressor to function in the normal manner whereby the compressible fluids are discharged through the outlet opening.

The compressor structure of the present invention is extremely simple and economical of construction while yet providing the highly desirable pressure alleviating function discussed above.

BRIEF DESCRIPTION OF THE DRAWING

Other features and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawing wherein:

FIG. 1 is a fragmentary diametric section of a rotary compressor embodying the invention;

FIG. 2 is a transverse section thereof taken substantially along the line 2—2 of FIG. 1; and

FIG. 3 is a fragmentary enlarged vertical section taken substantially along the line 3—3 of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the exemplary embodiment of the invention as shown in the drawing, a rotary compressor generally designated 10 is shown to comprise a front head 11, a rear head 12, and a cylinder 13 which may be secured together by suitable means such as bolts 14. The assembly is carried in a lower sump portion 15 defined by an outer hermetically sealed housing 16 adapted to hold a body of lubricating fluid such as lubricating oil 17 for lubricating the running parts of the compressor in the conventional manner.

In the illustrated embodiment, compressor 10 comprises a rotary compressor for use in compressing refrigerant gas and the like. The gas to be compressed is delivered to the compressor through an inlet conduit 18.

Cylinder 13 defines a cylindrical compression chamber 19, an inlet 20 opening to chamber 19 and an outlet 21 opening from the chamber 19 at a position spaced from inlet 20 circumferentially of the side wall 22 of chamber 19. The compressible gas is delivered from inlet conduit 18 to inlet 20 through a conventional filter 23 and an inlet passage 24 provided with a conventional check valve 25. Outlet 21 communicates with a muffler chamber 26 provided with a discharge valve 27 for controlling delivery of the compressed gas in the conventional manner.

Pumping of the compressible gas in chamber 19 is effected by a rotor generally designated 28 provided at one end of a shaft 29 driven by a suitable electric motor 30 within housing 16. As best seen in FIG. 2, rotor 28 may be provided with a diametric slot 31 in which a one piece blade 32 is slidably fitted. The configuration of the cylindrical chamber side wall 22, the length of blade 32 between the opposite ends 33 and 34 thereof, and the location of the axis 35 of rotor 28 are selected so as to cause the blade ends 33 and 34 to engage chamber side wall 22 in all rotational positions of the rotor. Rotor axis 35 is eccentrically positioned relative to the cylindrical chamber 19 with the rotor substantially engaging the side wall 22 at the upstream end 36 of inlet opening 20. Thus, as seen in FIG. 2, as the rotor blade 32 sweeps about chamber 19, a portion 37 of chamber 19 between the blade and side wall 22 spaced from both inlet 20 and outlet 21 is completely enclosed so that fluid therein is trapped. Where the fluid comprises compressible gas, the gas is compressed in the normal manner for discharge through the outlet 21 when the blade end 33, as seen in FIG. 2, moves in a counterclockwise direction to provide communication between chamber portion 37 and the outlet. Where the fluid in portion 37 is incompressible fluid, a serious problem arises in the conventional rotary compressor apparatus of this type in that the fluid, by precluding

compression thereof, effectively prevents rotation of the rotor as a result of the incompressible fluid block produced. Such a liquid block, for example, may occur where the lubricating liquid 17 slowly fills the chamber portion 37 during an inoperative period. Such passage of the lubricating liquid into chamber portion 37 has been found to occur particularly where variations in the ambient temperature or pressure conditions occur during the inoperation of the compressor.

As indicated briefly above, the present invention comprehends providing means for relieving, or alleviating, the incompressible fluid block. The means for relieving, or alleviating, the incompressible fluid block includes a relief passage opening from the chamber portion 37 at the continuous portion of the chamber wall between inlet 20 and outlet 21. The aforementioned relief passage may be provided through cylinder 13, front head 11, rear head 12 or through cylinder 13 and either the front head 11 or rear head 12. In the illustrated embodiment, as best seen in FIGS. 2 and 3, the relief passage according to the invention is a passage generally designated 38 communicating with chamber portion 37 through an opening 39 in side wall 22 intermediate the positions of inlet 20 and outlet 21. The relief passage is positioned so that regardless of the position of the rotor 28 and blade 32, portion 37 is in communication with the relief passage 38 or the outlet 21. The passage 38 includes a bore 40 extending laterally outwardly from chamber 19 and portion 37 and a transverse bore 41 extending parallel to the axis 35 of rotor 28 through front head 11 and cylinder 13 to intersect bore 40 as best seen in FIG. 3. Passage 38 is selectively closed by a movable valve member 42 engaging a valve seat 43 coaxially of bore 40 in cylinder 13 outwardly adjacent opening 39. Valve member 42 is biased to the closed position by a coil spring 44 compressed between the head 45 of a spring retainer 46 and valve member 42. Retainer 46 may be held in bore 40 by means of a pin 47 received in a hole 48 extending through cylinder 13 parallel to rotor axis 35. Thus, pin 47 is captured in the cylinder by front head 11 and rear head 12 respectively, in the assembled arrangement of the compressor.

Spring 44 is preselected to maintain valve member 42 seated in valve seat 43 during all normal operation of the compressor. Thus, the spring maintains the valve closed against the normal maximum pressure applied by the rotor 32 to compressible fluid in chamber portion 37. However, when incompressible fluid is disposed in chamber portion 37, a pressure condition substantially higher than the normal maximum pressure of compressible fluid produced therein results thereby overcoming the biasing of spring 44 and permitting the incompressible fluid to be discharged through the relief passage back to the sump 15 of the compressor.

Thus, under all normal operating conditions, the compressor functions in the normal manner. When, however, a condition arises which would normally result in a fluid block condition of the compressor, the relief means effectively alleviates this condition, thereby avoiding shock stresses in the compressor substantially lengthening the useful life thereof.

When blade 32 is rotated from the position of FIG. 2 to a position wherein chamber portion 37 communicates with outlet 21, the remaining incompressible fluid may be discharged directly through outlet 21. Thus, the relief means functions to permit the rotation of the

blade to this normal discharge position whereupon the incompressible fluid is quickly eliminated from compression chamber 19 so that the compressor substantially immediately functions in the normal manner.

The pressure relief means is extremely simple and economical of construction while yet providing the highly desirable pressure alleviating functioning described above. The pressure relief means may be readily installed in existing rotary compressors as it involves the simple boring of the existing cylinder and front head structures and a simple installation of the valve means therein with the valve means being retained by the readily installable pin 47.

The foregoing disclosure of specific embodiments is illustrative of the broad inventive concepts comprehended by the invention.

I claim:

1. In a rotary compressor having front and rear heads and a cylinder cooperatively defining a cylindrical pressure chamber having a circumferential side wall, a suction inlet opening to said chamber, a discharge outlet opening from said chamber at a position spaced circumferentially of said chamber from said inlet, and a rotor rotatably mounted in said chamber and having a one piece blade extending diametrically through said rotor engaging substantially opposite portions of the chamber side wall, means for alleviating an incompressible fluid block condition of the compressor wherein liquid fills a portion of the chamber between the blade and a continuous portion of said chamber side wall free of said inlet and outlet openings, comprising: a relief passage opening from said chamber at said continuous portion of said chamber side wall; and check valve means permitting fluid flow only outwardly through said relief passage at a preselected high pressure above the normal maximum pressure of compressible fluid being compressed in said chamber by said compressor, whereby incompressible fluid trapped in said chamber portion is permitted to pass outwardly through said relief passage and compressible fluid compressed in said chamber portion is prevented from passing outwardly through said relief passage and caused to flow outwardly from said chamber through said outlet, said check valve means comprising a valve seat coaxially about said relief passage, a movable valve member seated on said seat and spring means in said relief passage biasing the movable valve member against said seat for closing the relief passage, and said relief passage comprising a bore in said cylinder and an intersecting bore in one of said compressor heads, said pressure alleviating means further including means for retaining the biasing means in said relief passage comprising a hole in said cylinder extending between said front and rear heads and intersecting said relief passage, and a pin received in said hole and extending across said relief passage, whereby said pin is captured in said hole by said front and rear heads.

2. In a rotary compressor having a front head element, a rear head element, and a cylinder element cooperatively defining a cylindrical pressure chamber having a circumferential side wall, a suction inlet opening to said chamber, a discharge outlet opening from said chamber at a position spaced circumferentially of said chamber from said inlet, and a rotor rotatably mounted in said chamber and having a one piece blade extending diametrically through said rotor engaging substantially opposite portions of the chamber side

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wall, means for alleviating an incompressible fluid block condition of the compressor wherein liquid fills a portion of the chamber between the blade and a continuous portion of said chamber side wall free of said inlet and outlet openings, comprising: a relief passage opening from said chamber at said continuous portion of said chamber side wall; and check valve means permitting fluid flow only outwardly through said relief passage at a preselected high pressure above the normal maximum pressure of compressible fluid being compressed in said chamber by said compressor, whereby incompressible fluid trapped in said chamber portion is permitted to pass outwardly through said relief passage and compressible fluid compressed in said chamber portion is prevented from passing outwardly through said relief passage and caused to flow outwardly from said chamber through said outlet, said check valve means comprising a valve seat coaxially about said relief passage, a movable valve member seated on said seat and spring means in said relief passage biasing the movable valve member against said seat for closing the relief passage, and said relief passage comprising a bore in one of said elements opening to said chamber and an intersecting bore, said pressure

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alleviating means further including means for retaining the biasing means in said relief passage comprising a hole in said one element intersecting said relief passage, and a pin received in said hole and extending across said relief passage, said pin being captured in said hole by removable hole-end closing means.

3. The rotary compressor means of claim 2 wherein said hole extends fully through said one element and said hole-end closing means closes both ends of the hole.

4. The rotary compressor means of claim 2 wherein said hole-end closing means comprises at least one of said elements overlying the hole.

5. The rotary compressor means of claim 2 wherein said hole comprises a cylindrical bore extending axially parallel to said intersecting bore.

6. The rotary compressor means of claim 2 wherein said hole is closely adjacent an outer edge portion of said one element.

7. The rotary compressor means of claim 2 wherein said biasing means includes a helical spring and a spring retainer having a head portion abutting said pin.

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