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3,565,550

COMPRESSOR AND PUMP COMBINATION

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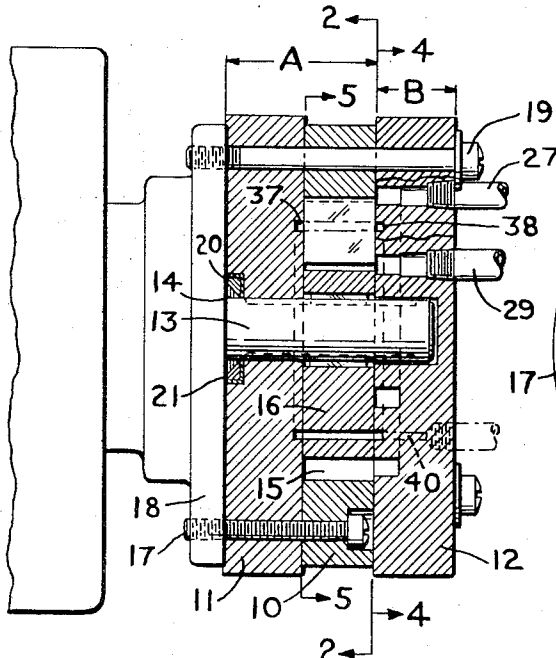


FIG. 1

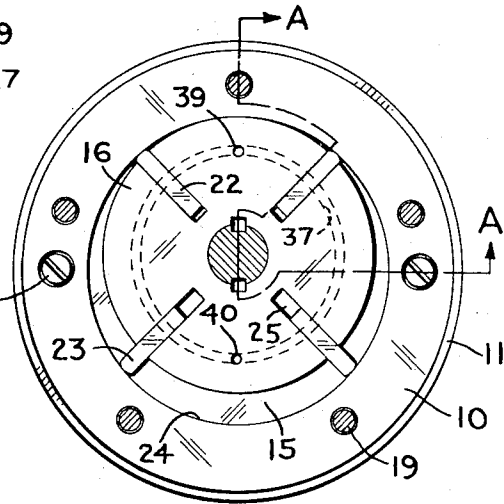


FIG. 2

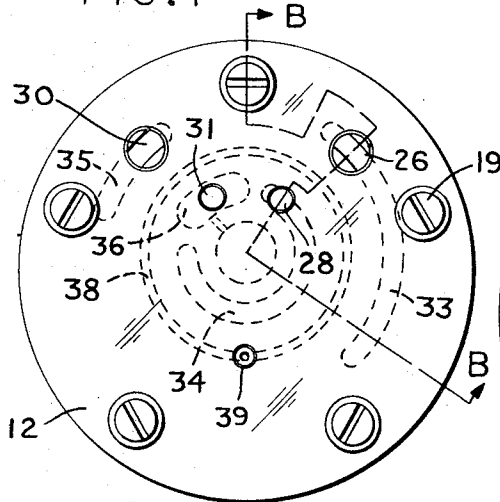


FIG. 3

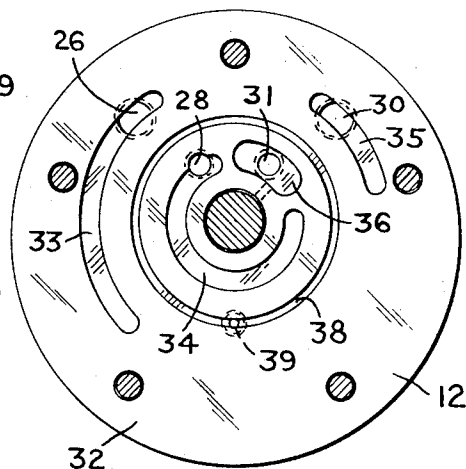


FIG. 4

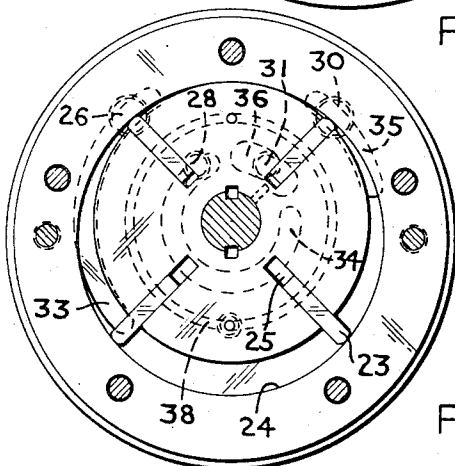


FIG. 5

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1

3,565,550

COMPRESSOR AND PUMP COMBINATION

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1 Claim

ABSTRACT OF THE DISCLOSURE

A sliding vane rotary device which performs simultaneously as a gas compressor and as a hydraulic pump having separate inlets and outlets for the gas being compressed and the liquid being pumped. In addition, the unit end plate has grooves formed therein communicating with the inlet and outlet ports which function as internal flow passages for the gas being compressed and the liquid being pumped.

BACKGROUND OF THE INVENTION

This invention relates generally to gas compressors and more particularly to sliding vane rotary compressors for simultaneously compressing gas and pumping liquid.

Heretofore, the compressing of gas and the pumping of liquid had to be carried out in two separate units. Further, the compressor required a make-up supply of lubricant or alternatively the use of carbon vanes with their notorious short life. In addition, carbon blades give off carbon dust which under most operating conditions must be filtered out of the compressed gas before the gas can be used.

The present invention overcomes the above outlined problems by providing combined gas compressor and liquid pump in a single unit by a unique arrangement of flow passages within the unit. Since the unit is pumping liquid a ready supply of lubricant is available thus allowing the use of blades having a longer life than carbon blades and obviating the problem of carbon dust.

PRIOR ART

Pertinent prior art patents are U.S. Pats. 1,093,005; 2,688,924; and 3,108,541.

Pat. No. 1,093,005 discloses a rotary pump having a rotatable drum having radial movable pistons or wings, a plurality of radial guideways, and a crescent shaped liquid space. The liquid is in communication with both the crescent shaped space and the space in the rear of the several pistons or wings. While FIG. 2 discloses a separate inlet and outlet pipe in communication with depressions in the heads of the casing which in turn communicate with the space in the rear of the several pistons or wings through distributing passages, all the distributing passages communicate with a central annular chamber 16 which serves simply as a fluid or pressure reservoir. Thus, no fluid is pumped by the rear of the pistons or wings to a point external of the pump.

Pat. No. 2,688,924 discloses an eccentric rotary pump having annular grooves in communication with pump space 17 behind piston 7. Also disclosed are circumferential grooves 11 and 13 in communication with inlet and outlet ports 12 and 14, and outside pump spaces 9 and 10 which in turn communicates with the circumferential grooves. This reference teaches the use of pump pistons and springs rather than sliding vanes and is directed toward pumping a hydraulic fluid only rather than compressing a gas and pumping a liquid.

Pat. No. 3,108,541 discloses arcuate surface passages 78, 80 and 89 in a cover plate 76 as shown in FIG. 3.

2

Arcuate passage 78 provides communication with the spaces behind the vanes during the time they move outwardly. As shown in FIG. 1, fluid is supplied to passage 78 from a circuit 93 and not from the main pump inlet 12. However, the discharge from spaces 82 is into the main inlet and outlet sections of the proportioner and in this regard can be distinguished from the present invention.

SUMMARY OF THE INVENTION

Thus, the present invention covers a rotary device for simultaneously compressing gas and pumping liquid including a cylinder having a pumping chamber formed therein, closure members for said cylinder, a shaft rotatably mounted and extending through one of the closure members into the pumping chamber, a slotted rotor rotatably mounted on the shaft and disposed eccentrically within the pumping chamber thus providing a compression space between the rotor and cylinder, and vanes dimensioned to slidably engage the slots in the rotor upon rotation of the shaft.

The closure member opposite the one through which the shaft extends has bores extending therethrough communicating with the pumping chamber which serve as the inlet and outlet ports for the gas and the liquid. In addition, this closure member has grooves formed therein communicating with the ports and the pumping chamber which function as internal flow passages for the gas being compressed and liquid being pumped.

Accordingly, it is an object of this invention to provide a rotary device for simultaneously compressing gas and pumping liquid.

Another object of the invention is to provide a sliding vane rotary device wherein the vanes can be lubricated by the liquid being pumped thereby obviating the need for a make-up supply of lubricant.

Another object of the invention is to provide a sliding vane rotary device wherein the vane life is greatly increased.

These and other objects and advantages of the invention are believed made clear by the following description thereof taken in conjunction with the accompanying drawings wherein:

IN THE DRAWINGS

FIG. 1 is a side view of the rotary device shown in staggered section. "A" shown in FIG. 1 is a staggered section taken along line A—A of FIG. 2. "B" shown in FIG. 1 is a staggered section taken along line B—B of FIG. 3.

FIG. 2 is a view taken on line 2—2 of FIG. 1.

FIG. 3 is an end view of the member "B" indicated in FIG. 1.

FIG. 4 is a view taken on line 4—4 of FIG. 1.

FIG. 5 is a view taken on line 5—5 of FIG. 1.

Referring now to FIG. 1 the rotary device is seen comprising essentially cylinder 10, a closure member or face plate 11, a second closure member or end plate 12, a rotatable shaft 13 extending from a driver such as an electric motor through a bore 14 in face plate 11 and into pumping chamber 15 formed in cylinder 10, and a rotor 16 disposed about shaft 13 for rotation therewith in chamber 15.

A plurality of fasteners such as cap screws 17 extend through cylinder 10, face plate 11, and into a mounting bracket 18 formed as part of the driver for mounting the unit on the driver, and fasteners such as cap screws 19 extend through end plate 12, cylinder 10, face plate 11, and into mounting bracket 18, thus allowing removal of the end plate 12 from the unit without the necessity of removing the unit from the driver.

An annular recess 20 formed in face plate 11 is dimensioned to receive a lip seal 21 to prevent leakage of fluid from chamber 15 along shaft 13.

As best seen in FIG. 2 rotor 16 has a plurality of arcuately spaced slots 22 formed therein dimensioned to slidably receive fluid moving means or vanes 23. The horizontal center line of shaft 13 is offset vertically from the horizontal center line of cylinder 10 thereby allowing the rotor 16 to rotate eccentrically with respect to the cylinder 10. Thus, the interior surface 24 of cylinder 10 acts as a cam surface upon rotation of rotor 16, forcing vanes 23 into slots 22 during 180 degrees of rotation. During the other 180 degrees of rotation the vanes 23 are, due to gravity and centrifugal force, partially ejected from slots 22 thereby leaving a cavity 25 between vanes 23 and slots 22 which function as pumping chambers for the liquid being pumped as will be more fully described below.

Referring now to FIGS. 1, 3 and 4 a gas inlet 26 is shown as a bore through end plate 12 threaded to receive a fitting 27 connected to a source of gas to be compressed (not shown) and similarly a liquid inlet 28 is shown as a bore through end plate 12 threaded to receive a fitting 29 connected to a source of liquid to be pumped (not shown). Bores 30 and 31 through end plate 12 function respectively as an outlet for the compressed gas and an outlet for the liquid pumped both of which are delivered to a point exterior of the rotary device.

Formed on interior surface 32 of end plate 12 are four arcuate grooves 33, 34, 35 and 36 communicating respectively with gas inlet 26, liquid inlet 28, gas outlet 30 and liquid outlet 31 for purposes now to be described.

Referring now to FIG. 5 it is clearly shown that groove 33 in addition to communicating with gas inlet 26 also communicates with chamber 15 such that upon rotation of rotor 16, as vanes 23 pass over gas inlet 26, gas will be drawn into groove 33 and swept into chamber 15 for compression therein. Trapped between successive vanes the gas is compressed and delivered to groove 35 which also communicates with chamber 15 and is thus discharged through bore 30. This system of gas intake, compression, and delivery of compressed gas to the discharge occurs in the conventional way as will be familiar to those skilled in this art and therefore will need no further explanation.

Groove 34 in addition to communicating with liquid inlet 28 also communicates with cavity 25 between vanes 23 and rotor slots 22 whereby upon rotation of the rotor as vanes 23 pass over liquid inlet 28 liquid is sucked into groove 34 and thus into cavity 25. Upon continued rotation of the rotor as vanes 23 are projected out of slots 22 the volume of cavity 25 increases and is filled with the liquid to be pumped. With further rotation, after the vane has reached the vertical center line of the unit, liquid is being pushed back into suction channel or groove 34 until the vane has reached the end of this groove. At this point, cavity 25 begins to communicate with groove 36 and thus liquid is discharged into this groove and out through liquid outlet bore 31.

By the above description and referring particularly to FIG. 5 it can be seen that the liquid pump capacity can be altered by varying the angle during which the suction channel or groove 34 communicates with cavity 25 between vanes 23 and rotor slots 22.

For a given position of the liquid inlet, if the angle is decreased to the point at which vanes 23 are at their maximum projection out of slots 22 the capacity will be proportionately increased. Further reduction of this angle will obviously decrease the liquid pump capacity since the volume of cavity 25 will also be decreased since the vanes 23 will not be fully projected out of slots 22.

By increasing the angle during which the suction channel or groove 34 communicates with cavity 25 passed the point at which vanes 23 are at the maximum projection out of slots 22 the liquid pump capacity will be correspondingly decreased since some of the liquid will be

pushed back into groove 34 by the action of the vanes 23 being pushed back into slots 22 by cam surface 24.

To prevent a hydraulic lock in cavity 25 which will prevent the vanes 23 from being pushed back into slots 22 by cam surface 24 the arc length between the end of suction channel or groove 34 and the beginning of discharge channel or groove 36 must be equal to or less than the thickness of slots 22.

The liquid pump capacity can also be altered by changing the vane and hence the rotor slot thickness. By increasing or decreasing the rotor slot thickness the volume of cavity 25 will be proportionately increased or decreased and the liquid pump capacity will be altered accordingly.

In certain systems it is important to prevent any leakage of the gas being compressed into the liquid being pumped. For example, in a system where the unit is used to supply compressed air and fuel oil to an oil combustion system the oil flow must, for good combustion, be established in some exact proportion to the compressed air flow. It is necessary therefor to supply oil without entrained air so that the oil flow can be effectively controlled.

To accomplish this objective, the unit is provided with circular rings 37 and 38 respectively formed in face plate 11 and end plate 12 having a larger radius than liquid grooves 34 and 36 and a smaller radius than gas grooves 33 and 35. Circular rings 37 and 38 are of the same diameter and communicate with each other through small axial bores 39 and 40 extending through rotor 16. Liquid, at a pressure higher than the compressed discharge gas, is provided to ring 38 through a liquid connection or bore 39 through end plate 12 which, in turn, communicates with ring 38. Thus, a guard ring is established between the gas grooves and the liquid grooves to prevent gas leakage into the liquid being pumped.

Thus, we have disclosed a combined gas compressor and liquid pump which serves to eliminate the need for two separate units in a system where both compressed gas and a supply of liquid are required.

It will be understood that the invention is not to be limited to the specific construction or arrangement of parts shown but that they may be widely modified within the invention defined by the claim.

What is claimed is:

1. A rotary device for simultaneously compressing gas and pumping liquids comprising:

a cylinder;

closure means operatively associated with one end of said cylinder having a bore therethrough for receiving a rotatable shaft;

a second closure means operatively associated with the other end of said cylinder, having an annular opening therein for rotatably receiving said shaft;

rotor means eccentrically mounted in said cylinder, disposed about said shaft, for rotation with said shaft; gas inlet means and gas outlet means communicating with said cylinder;

liquid inlet means and liquid outlet means communicating with said cylinder; and

fluid moving means operatively associated with said rotor means for compressing and moving said inlet gas to said gas outlet and moving said inlet liquid to said liquid outlet;

said rotor means having a plurality of arcuately spaced slots formed therein for slidably receiving said fluid moving means;

the interior surface of said cylinder acting as a cam surface for said fluid moving means whereby upon said eccentric rotation of said rotor means said fluid moving means will be caused to move into and out of said slots;

said fluid moving means being vanes dimensioned to slidably engage said slots;

said gas inlet means, said gas outlet means, said liquid

5

inlet means, and said liquid outlet means being bores extending through said second closure means;
 further including an arcuate groove formed in said second closure means operatively associated with said gas inlet means and communicating with the space formed between said cylinder and said rotor means whereby said inlet gas is transmitted to said space for compression therein, and a second arcuate groove formed in second closure means operatively associated with said gas outlet means and communicating with said space formed between said cylinder and said rotor means for transmitting said compressed gas to said gas outlet means;
 including a third arcuate groove formed in said second closure means operatively associated with said liquid inlet means and communicating with said slots formed in said rotor means whereby upon rotation of said rotor means said liquid is caused to be drawn into said arcuate groove by action of the fluid moving means sliding out of said slots in said rotor means as said fluid moving means rotate past said liquid inlet means and said fluid is thus transmitted to the space in said slots vacated by said fluid moving means, and a fourth arcuate groove formed in said second closure means operatively associated with said liquid outlet means and communicating with said slots formed in said rotor means whereby upon continued rotation of said rotor means whereupon said fluid moving means are caused to slide back into said slots formed in said rotor said liquid is forced out of said slots, into said second arcuate groove and into said liquid outlet means;
 including means to prevent said gas in said first and

6

said second arcuate grooves from contacting said liquid in said third and said fourth arcuate grooves in said cylinder; and
 wherein said means to prevent said gas in said first and said second arcuate grooves from contacting said liquid in said third and said fourth arcuate grooves in said cylinder comprises:
 a circular groove formed in said first closure means;
 a circular groove formed in said second closure means communicating with said circular groove in said first closure means;
 both of said circular grooves being of the same diameter and said circular groove formed in said second closure means being disposed radially between said second arcuate groove and said fourth arcuate groove; means to provide fluid pressure to said circular groove formed in said second closure means and thus to said circular groove formed in said first closure means, said fluid pressure to be greater than the pressure of said gas in said cylinder.
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