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ROTARY COMPRESSOR

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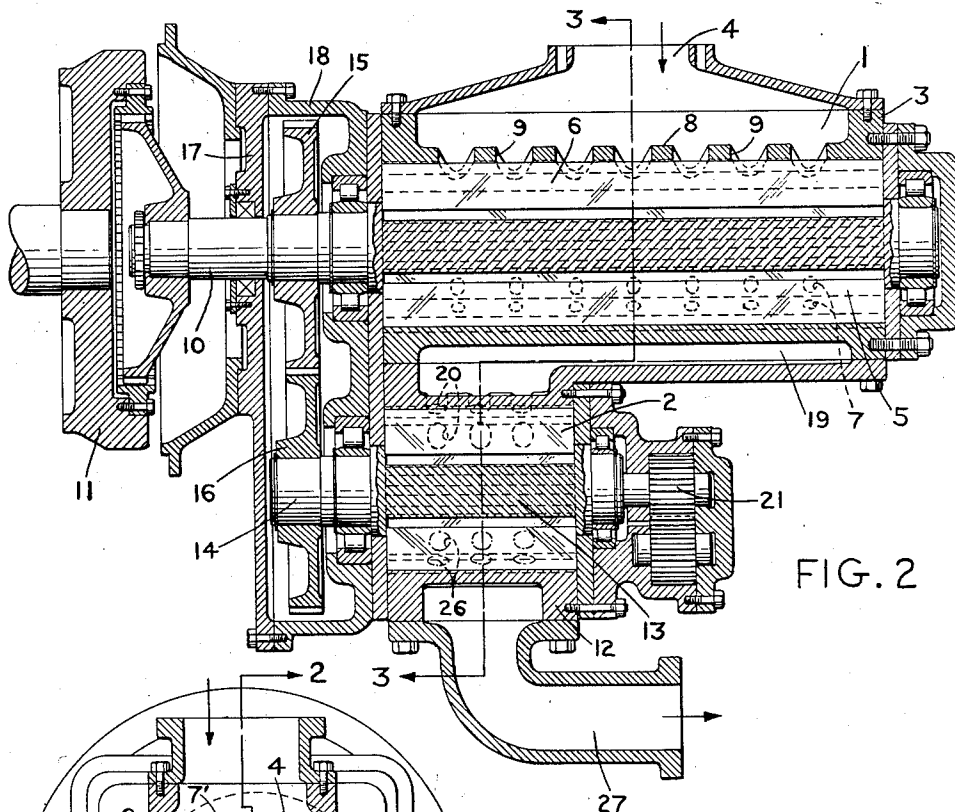


FIG. 2

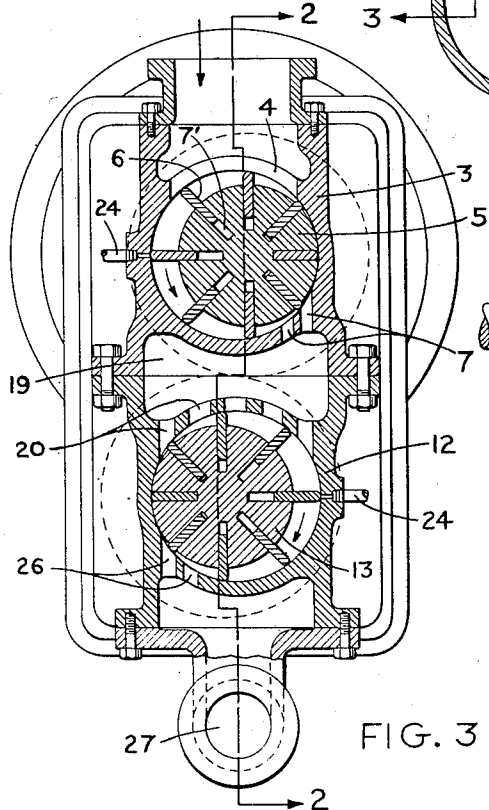


FIG. 3

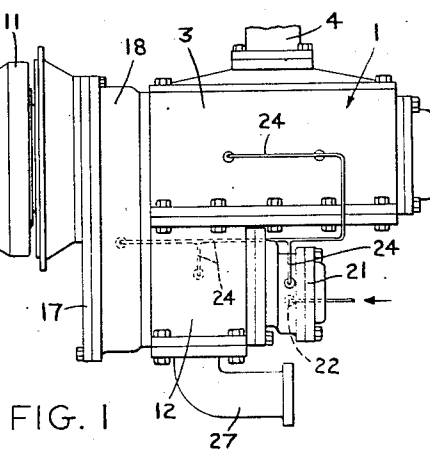


FIG. 1

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ROTARY COMPRESSOR

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5 Claims. (Cl. 230—158)

This invention relates to rotary fluid compressors embodying a rotor carrying sliding vanes which rotates in an off-center or eccentric cylinder to compress the fluid, and more particular to multi-stage compressors of this type which are substantially flooded with oil or other suitable coolant to provide lubrication of the compressor, maintenance of the compression temperature within desired limits and below the flash point of the lubricating oil or coolant to eliminate breakdown and carbonization as well as reducing the compression temperature to permit the maintaining of the temperature of the discharged compressed fluid within a desirable range, and also to provide an efficient seal between the walls of the cylinder and the sliding vanes to provide high efficiency for such compressors.

More specifically, the present invention comprises a rotary compressor of the type specified wherein the high pressure rotor and the low pressure rotor are arranged one to the other and one of the rotors is driven directly from a prime mover through gearing or other suitable power transmitting means thus making it possible to adjust any two-stage compressor of a given length and diameter to a higher or lower compression range than that for which it had been designed, by changing the speed ratio only. Similarly, it is possible to run the high compression stage of the compressor at different and more favorable speeds than the low pressure stage and thereby increase the overall efficiency of the compressor and by running the two stages at different speeds it is possible to vary the discharge pressure of the compressor over a fairly wide range without adversely affecting the efficiency of the compressor.

Other advantages of the compressor of the present invention are: that by the arrangement of the compressor stages in axially parallel relation a compressor of comparable capacity which is shorter in length than those embodying axially aligned stages is provided, as well as a compressor of the liquid-flooded type which is self-draining, i. e., the air-fluid mixture flows downward and the flow is supported by gravity.

Compressors of this type are generally equipped with unloading valves, which permit unloading and loading of the compressor in accordance with demand for pressure air, and an advantage of the present compressor structure embodying the self-draining feature above referred to will permit complete closure of the unloading valve which operation cannot be resorted to in rotary compressors of this type which are not self-draining.

Another advantage is that under standstill conditions the liquid pump will be submerged in liquid and secure immediate suction from the very first moment when the compressor is started, thus insuring instant and proper flow of coolant liquid during the operation of the unit.

With these and other objects in view, as may appear from the accompanying specification, the invention consists of various features of construction and combination of parts, which will be first described in connection with

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the accompanying drawings, showing a rotary compressor of a preferred form embodying the invention, and the features forming the invention will be specifically pointed out in the claims.

In the drawings:

Figure 1 is a side elevation of the improved compressor.

Figure 2 is a longitudinal section through the compressor taken on the line 2—2 of Figure 3.

Figure 3 is a vertical cross-section through the compressor taken on the line 3—3 of Figure 2.

Referring more particularly to the drawings, the improved compressor comprises a multi-stage compressor having the low compression stage axially parallel to and placed above the high compression stage 2 of the compressor as clearly shown in Figures 2 and 3 of the drawings.

The low compression stage of the compressor comprises a housing 3 having an inlet 4 through which the fluid to be compressed enters. The fluid to be compressed is compressed by the rotor 5 which is rotatably mounted within the cylinder 3 eccentrically of the axis of the cylinder as clearly shown in Figure 3 of the drawings. In other words, the cylinder is offset relative to the circumference of the rotor 5. The rotor 5 carries a plurality of radially extending vanes 6 which are slidable in grooves 7' formed in the rotor. This construction of sliding vane rotor is not new in compressors of this type and the operation of such compressors is that the vanes being thrown outwardly by centrifugal force engage the inner wall of the cylinder 3 and form pockets between the vanes which gradually increases in cross-sectional area for a predetermined distance after the pockets pass the inlet 4 to the cylinder. Between the inlet 4 and the discharge openings 7 of the cylinder the vanes move inwardly to decrease the cross-sectional area of the pockets thereby compressing the fluid and forcing the fluid at the higher degree of compression outwardly through the discharge openings 7.

The cylinder 3 has an inlet fluid distributor 8 along the inlet to the cylinder which distributor is provided with a plurality of serrations or cutouts 9 to facilitate the proper distribution of the incoming fluid along the rotor.

The rotor 5 is mounted upon a driving shaft 10 which is connected in any suitable manner such as by the coupling 11 to a prime mover (not shown) and thus the rotor 5 of the low compression stage of the compressor is driven directly from the prime mover.

The high compression stage 2 of the compressor includes the cylinder 12 in which is mounted a rotor 13. The rotor 13 is of the same construction and operates in the same manner as the rotor 5 and it is disposed in parallel axial relation with the rotor 5 and below the rotor 5. The rotor 13 is rotated by means of a shaft 14 through the medium of gears 15 and 16, the driving gear 15 being mounted upon the shaft 10 and the driving gear 16 being mounted upon the shaft 14. The side 17 of the gear casing 18 enclosing the gears 15 and 16 is removable so that the gears 15 and 16 may be removed for changing the gear ratio and consequently changing the speed of rotation of one of the rotors with respect to the other. This gear drive construction and the placing of the rotors in parallel relation makes it possible to vary the ratio of the speed rotation between the two rotors as desired for varying the discharge pressure of the compressor without adversely affecting the compressor efficiency and also permits the running of the rotor 13 of the high stage of compression at a different and more favorable speed than the low pressure stage rotor 5 and thereby increase the overall efficiency of the compressor.

A liquid passage or conveying space 19 is provided be-

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tween the discharge opening 7 of the low pressure compression stage of the compressor and the inlet openings 20 of the high compression stage of the compressor is also to provide thorough and adequate passage of the compressed fluid and coolant liquid from the first or low compression stage of the compressor into the second or high compression stage.

A liquid pump structure 21 is connected to the cylinder 12 of the high compression stage. While in the drawings this pump is shown as of the rotary gear type it is understood that any suitable type of pump may be provided and it is driven by the shaft 14. The pump 21 has its inlet 22 connected with any source of supply of lubricating oil or coolant liquid which in a flooded compressor of the present type will be a reservoir (not shown) which receives the liquid from a separator (not shown) which separates the liquid from the compressed fluid after leaving the compressor. Liquid pumped by the pump 21 is distributed through suitable conduits 24 to predetermined desirable points of the two stages of the compressor and as shown in Figure 3 of the drawings some of this liquid is delivered directly into the cylinders 3 and 12 where it will serve to thoroughly lubricate the moving parts of the rotor, such as the sides of the vanes 6 and will form a fluid tight seal between the outer ends of the vanes 6 and the cylinder wall. This liquid will naturally under such conditions become mixed with the fluid being compressed and will be discharged through the discharge openings 7, conveying space 19 and inlets 20 into the second stage of the compressor where the fluid will be compressed to a higher degree of compression. Further liquid will be mixed with the fluid as it is compressed in the high compression stage and this mixture will be discharged through the discharge openings 26 into the discharge outlet 27 of the compressor.

By particular reference to Figure 3 of the drawings it will be noted that the discharge openings 7, inlet openings 20 and discharge openings 26 are all straight and substantially perpendicular so as to provide downward flow passages for the mixture of liquid and compressed fluid and thus the flow of this mixture through the compressor will be aided by gravity and when the compressor is stopped or at a standstill condition the liquid will drain downwardly into the lower cylinder 12 where by the proper positioning of the reservoir (not shown) a liquid level will be maintained in the cylinder 12 and the pump 21 will always be flooded with liquid so that upon starting of the compressor liquid will be instantly delivered to the various parts of the compressor.

While in the drawings gears are shown as the power transmission means from one rotor to the other it is to be understood that any suitable type of power transmission means may be employed and either the high pressure rotor or the low pressure rotor may be driven one from the other. Also the two stage cylinders may be arranged in any suitable relation other than that shown in the drawings just so long as the self-draining relationship between them is maintained.

Lubricating oil, or any suitable liquid coolant solution, which will provide cooling, sealing and lubrication of the compressor parts may be employed for flooding the compressor.

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 claims.

What is claimed is:

1. In a flooded type rotary compressor utilizing lubricant fluid as the cooling medium for the fluid to be compressed, a low compression stage including a cylinder, a rotor eccentrically mounted therein, and slidable vanes carried by said low stage rotor, a high compression stage including a cylinder, a rotor eccentrically mounted therein, and slidable vanes carried by said high stage rotor, and means for rotating said rotors; said cylinders spaced from each other and in superposed parallel axial relation, op-

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positely spaced walls between said cylinders, an interstage pressure fluid chamber formed by the outer surfaces of said cylinders and said spaced walls, said low compression stage cylinder having a downwardly disposed discharge opening communicating between a lower portion thereof and the interstage pressure fluid chamber and said high compression stage cylinder having a downwardly disposed inlet opening communicating between the lower portion of said interstage pressure fluid chamber and said high compression stage cylinder, said high compression stage cylinder having a downwardly disposed outlet means for conveying compressed fluid and to collect any accumulated cooling fluid from said compressor by gravity.

2. In a rotary compressor utilizing lubricant fluid as the cooling medium for the fluid to be compressed, a low compression stage including a cylinder, a rotor eccentrically mounted therein, and slidable vanes carried by said low stage rotor, a high compression stage including a cylinder, a rotor eccentrically mounted therein, and slidable vanes carried by said high stage rotor, and means for rotating said rotors; means operated by said rotors and connected to said cylinders for introducing a cooling fluid into the fluid to be compressed, said cylinders spaced from each other and in superposed parallel axial relation, oppositely spaced walls between said cylinders, an interstage pressure fluid chamber formed by the outer surfaces of said cylinders and said spaced walls, said low compression stage cylinder having a downwardly disposed discharge opening communicating between a lower portion thereof and the interstage pressure fluid chamber and said high compression stage cylinder having a downwardly disposed inlet opening communicating between the lower portion of said interstage pressure fluid chamber and said high compression stage cylinder, said high compression stage cylinder having a downwardly disposed outlet means for conveying compressed fluid and to collect any accumulated cooling fluid from said compressor by gravity.

3. In a rotary compressor as claimed in claim 2 wherein means are provided to rotate the rotors at different speeds.

4. In a flooded type rotary compressor utilizing lubricant fluid as the cooling medium for the fluid to be compressed, a low compression stage including a cylinder, a rotor eccentrically mounted therein and slidable vanes carried by said low stage rotor, a high compression stage including a cylinder, a rotor eccentrically mounted therein, and slidable vanes carried by said high stage rotor, and means for rotating said rotors; said cylinders spaced from each other and in superposed parallel axial relation, oppositely spaced walls between said cylinders, an interstage pressure fluid chamber formed by the outer surfaces of said cylinders and said spaced walls, said low compression stage cylinder having a downwardly disposed discharge opening communicating between a lower portion thereof and the interstage pressure fluid chamber and said high compression stage cylinder having a downwardly disposed inlet opening communicating between the lower portion of said interstage pressure fluid chamber and said high compression stage cylinder, said high compression stage cylinder having an outlet means for conveying compressed fluid.

5. In a rotary compressor utilizing lubricant fluid as the cooling medium for the fluid to be compressed, a low compression stage including a cylinder, a rotor eccentrically mounted therein, and slidable vanes carried by said low stage rotor, a high compression stage including a cylinder, a rotor eccentrically mounted therein, and slidable vanes carried by said high stage rotor, and means for rotating said rotors; means operated by said rotors and connected to said cylinders for introducing a cooling fluid into the fluid to be compressed, said cylinders spaced from each other and in superposed parallel axial relation, oppositely spaced walls between said cylinders, an interstage pressure fluid chamber formed by the outer surfaces of said cylinders and said spaced walls, said low compression stage cylinder having a downwardly disposed dis-

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charge opening communicating between a lower portion thereof and the interstage pressure fluid chamber and said high compression stage cylinder having a downwardly disposed inlet opening communicating between the lower portion of said interstage pressure fluid chamber and said high compression stage cylinder, said high compression stage cylinder having an outlet means for conveying compressed fluid.

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