April 26, 1949. V. S. MAKAROFF 2,468,373

ROTARY COMPRESSOR AND FLUID SEAL THEREFOR

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FIG. 1

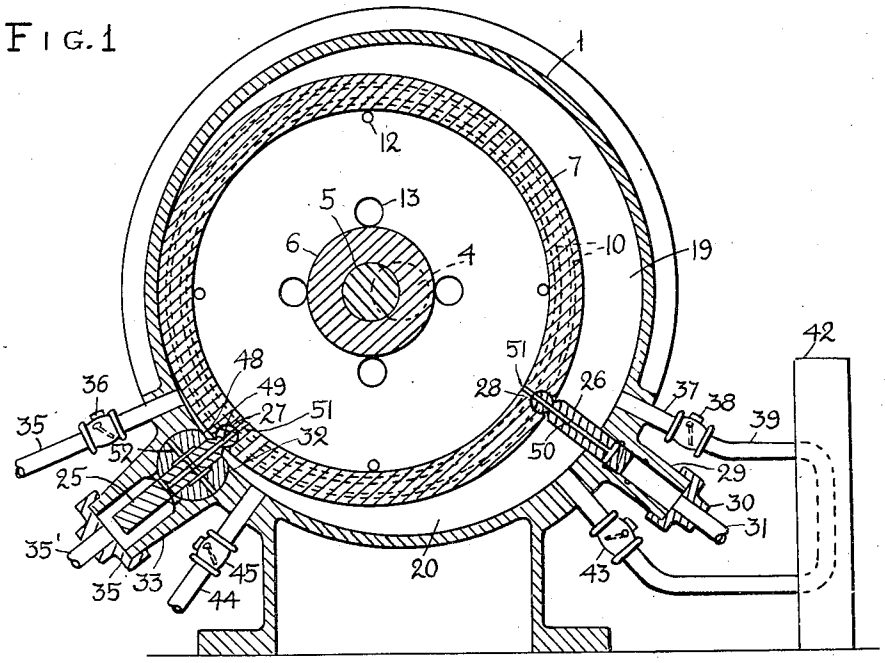


FIG. 3

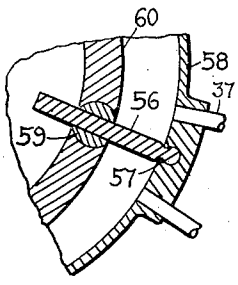
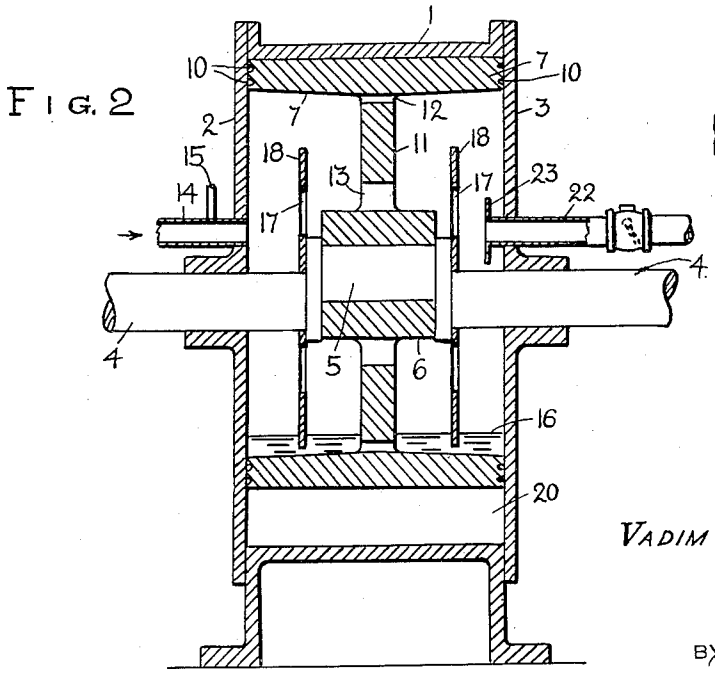


FIG. 2



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ROTARY COMPRESSOR AND FLUID SEAL THEREFOR

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6 Claims. (Cl. 230—147)

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My invention relates to rotary compressors or engines and has particular reference to compressors or engines employing eccentrically rotating rotors in cylindrical stators.

The main object of my invention is to provide a rotary compressor or engine of the general type indicated above in which compression or expansion chambers in the stator are separated by vanes pivotally connected to the peripheral portion of the rotor and slidably fitted in the stator so that the vanes do not have any independent reciprocating motion as is usually the case with conventional rotary compressors or engines. Such an arrangement practically eliminates large friction losses inherent to the construction in which the vanes bear against the inner surface of the rotor and are pressed thereto by springs and centrifugal force. My construction also provides for a better sealing between the relatively movable surfaces and for better lubrication.

Another object of my invention is to provide means to seal clearances between the relatively movable parts by lubricating oil which is introduced into the rotor from the inside of the rotor, means being provided to force the oil through the working clearances thereby lubricating oil which is introduced into the rotor from the inside of the rotor, means being provided to force the oil through the working clearances thereby lubricating and sealing them.

With my improved sealing and lubricating system it is possible to reduce the manufacturing cost by increasing working tolerances and also to render the construction more rugged and less affected by wear.

My invention is more fully described in the accompanying specification and drawings in which:

Fig. 1 is a transverse sectional view of my engine or compressor;

Fig. 2 is a sectional elevational view of the compressor or engine;

Fig. 3 is a fractional view of a compressor or engine with a modified vane.

My compressor or engine as shown in Figs. 1 and 2 comprises a stator 1 of a tubular cylindrical shape having open ends closed by end plates or covers 2, 3 with bearings for a shaft 4. The shaft 4 has a crank 5 for a hub 6 of a rotor 7. The latter is mounted concentrically on the crank 5. The eccentricity of the latter is such that the rotor at its outermost point contacts the inner surface of the stator or approaches the same with a small clearance. The rotor is of a smaller outside diameter than the diameter of the bore of

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the stator and is mounted eccentrically on the shaft 4 in such a manner that the outermost portion of the rotor approaches the inner surface of the stator and is separated therefrom by a small clearance of the order of a few thousandths of an inch, the clearance being, however, sufficient to prevent actual metallic contact between the rotor and the stator. A similar small clearance separates each end of the rotor from the inner sides of the end plates 2, 3. Sealing concentric grooves 10 are provided in the end surfaces of the rotor for holding a sealing liquid therein. The rotor and the hub 6 are connected by a central web 11 having transverse openings 12 near its peripheral portion, and similar openings 13 near the hub.

Exhaust (or compressed) gases from the apparatus are delivered into the space inside the rotor by an intake pipe 14 into which a certain amount of a sealing liquid such as lubricating oil, is delivered by a small feed pipe 15. Baffle discs 18 on the hub 7 deflect the gases with the oil outwards, against the inner surface of the rotor. The oil collected at the bottom of the rotor is carried around and sprayed by the baffles 18.

The oil particles become sepaarted from the gases in the space inside the rotor by the centrifugal force, due to the rotation of the baffle discs, the effect being similar to the separation in ordinary centrifugal separators. The oil, collected in the peripheral portion of the rotor, is forced through the holes 12 to the other side of the web 11. The layer of oil 16 is indicated in Fig. 2. The oil is further forced into the end clearance between the rotor and the plates 2, 3 where the speed of its movement is checked by the concentric grooves 10. A certain amount of the oil passes into the expansion (or compression, as the same may be) chambers 19, 20 and is collected on the inner surface of the stator, sealing the clearance between the rotor and the stator. The excess from the stator is entrained with the exhaust gases which are directed through the intake pipe 14 into the space inside the rotor as was mentioned above. The same oil is therefore circulated through the engine and any loss of the oil is compensated by the added supply through the feed pipe 15.

Gases from which the oil has been removed by the centrifugal force in the rotor, pass through openings 17 in the baffle discs 18 and through the openings 13 near the hub to the other side of the rotor and are exhausted through a pipe 22. A disc-shaped deflector 23 at the inner end of

the pipe 22 prevents any oil from escaping through this pipe.

The rotor is provided with radially extending vanes 25, 26 pivotally connected to the rotor at 27, 28. The vane 26 slides in a slotted extension 29 closed by a cover or cap 30 with a pipe 31 which may be connected to the intake of the compressor. The vane 25 slides in a slotted cylinder 32 rotatively supported in an extension 33 of the stator. The extension 33 is closed by a cover or cap 35 with a pipe 35' which also may be connected to the intake of the compressor. The cylinder 32 partly extends into the space in the stator and has a concave surface at 48 conforming to the inner surface of the rotor when the latter engages the stator at the vane 27. The vanes are provided with oil ducts 49, 50 in communication with ducts 51 in the rotor. The cylinder 32 is also provided with oil ducts 52. It may be noted that the connection 27 may be made rigid.

The device, when used as a compressor, may be made for a two stage compression, as shown in Fig. 1. The first compression stage is in the upper portion of the stator and is relatively larger than the second stage, which is in the lower portion of the stator, the difference in the volumes being accomplished by placing the vanes at an angle to each other as shown. Air or other gas is delivered to the first stage 19 by an intake pipe 35 with a check valve 36, and the compressed air or other gas is exhausted through a pipe 37 with a check valve 38 into a pipe 39 passing through an intercooler 42 and a check valve 43 into the intake portion of the second stage 20, from which the finally compressed air or other gas is exhausted by a pipe 44 with a check valve 45.

It may be noted that the vanes 25, 26 prevent true rolling of the rotor over the inner surface of the stator, the rotor merely rocking, the points of its periphery successively approaching the inner surface of the stator. The wear therefore is equally distributed over the entire surface of the rotor, unlike the cases when the rotor is keyed on the shaft. Moreover, the rotor does not rub the stator but merely touches successive portions of its surface, so that the wear of the contacting surfaces is greatly reduced.

It is evident that my sealing and lubricating system can be also applied to other types of rotary compressors or engines, including such as employ vanes in the rotor.

The device can be also used as a steam engine. Steam may be admitted in a reversed direction through the rotor, and thus condensation collected in the rotor due to the drop in temperature, will produce the same sealing effect as the oil 10.

A modified construction of the vanes is shown in Fig. 3, the vane 56 is secured at 57 in the stator 58, either pivotally, as shown, or rigidly, and slides in a rotary cylindrical bearing 59 mounted in the wall of the rotor 60, the discs 18 may be correspondingly reduced in diameter or even omitted entirely.

While the invention has been described in detail with respect to certain particular preferred examples, it will be understood by those skilled in the art after understanding the invention, that various changes and further modifications may be made without departing from the spirit and scope of the invention, and it is intended therefore in the appended claims to cover all such changes and modifications.

What is claimed as new and desired to be secured by Letters Patent is:

1. In a rotary compressor, in combination, a tubular stator member; a crank shaft rotatively supported in the stator; a rotor member of a smaller diameter than the stator rotatively mounted on the shaft, the outermost portion of the rotor being separated from the inner surface of the stator by a small clearance; means to admit gases with oil into a space inside the rotor for separating the oil from the gases by centrifugal force, the separated oil forming a sealing film in the clearances between the rotor and the stator; means to exhaust the oil-free gases from the space in the rotor; and vanes supported on one member and sliding in the other member separating the space between the rotor and the stator into compression chambers.

2. In a rotary compressor, in combination, a tubular stator member; end plates closing the ends of the stator; a crank shaft rotatively supported in the end plates concentrically with the stator; a rotor member of a diameter smaller than the inside diameter of the stator rotatively mounted on the shaft in such a manner that the outermost portion of the rotor is separated from the stator by a small clearance, the rotor having a separating chamber inside; means to admit exhaust gases with a sealing liquid from the stator into the separating chamber for separating the sealing liquid; means to exhaust the liquid-free gases from the rotor; and vanes pivotally and slidably supported in one member and secured in the other member separating the space between the rotor and the stator into compression chambers.

3. In a rotary compressor, in combination, a tubular stator; a crank shaft rotatively supported in the stator; a rotor of a smaller diameter than the stator rotatingly mounted on the shaft, the outermost portion of the rotor being separated from the inner surface of the stator by a small clearance; means to admit gases with oil into a space inside the rotor for separating the oil from the gases by centrifugal force, the separated oil forming a sealing film in the clearances between the rotor and the stator; means to exhaust the oil-free gases from the space in the rotor; and movable elements pivotally supported on the rotor and sliding in the stator separating the space between the rotor and the stator into compression chambers.

4. A rotary compressor comprising a tubular stator open at the ends and having two sets of inlet and outlet ports; end plates closing the ends of the stator; a crank shaft rotatively supported in the central portions of the end plates; a rotor of a diameter smaller than the inner diameter of the stator rotatively mounted on the shaft in such a manner that the outermost portion of the rotor is separated from the inner surface of the stator by a small clearance; a pair of radially extending vanes pivotally supported at their inner ends in the peripheral portion of the rotor, the outer portions of the vanes being slidably fitted in the stator, each of said vanes being disposed between the inlet and outlet ports of one of each of said sets, the vanes forming and separating compression chambers in the stator; means to admit compressed gas with oil from the stator into the space inside the rotor between the end plates for separating the oil from the gas by centrifugal force and for admitting the separated oil into the clearances between the rotor and the stator for sealing the same; and

means to exhaust the oil-free gas from the rotor.

5. A rotary compressor comprising a tubular stator open at the ends and having two sets of inlet and outlet ports; end plates closing the ends of the stator; a crank shaft mounted for rotation in the end plates concentrically with the stator; a tubular rotor having a central web and a hub rotatively mounted on the shaft, the diameter of the rotor being smaller than the inside diameter of the stator, the outermost portion of the rotor being separated from the inner wall of the stator by a small clearance; two radially extending vanes pivotally connected at the inner ends thereof to the peripheral portion of the rotor, the outer portion of one of the vanes being slidably supported in the stator, the outer portion of the other vane being slidably supported in a cylinder rotatively mounted in the stator, each of said vanes being disposed between the inlet and outlet ports of one of each of said sets; means to admit compressed air with oil into the space in the rotor, the web having holes near its periphery for passage of the oil therethrough and holes near the hub for passage therethrough of the gas; means to add the oil to the compressed gas; means to separate the oil from the gas in the rotor by centrifugal force thereby admitting the oil into the clearances between the rotor and the stator; and means to exhaust the oil-free gas from the stator.

6. A rotary compressor comprising a tubular stator open at the ends and having an inlet and an outlet port; end plates closing the ends of the stator; a crank shaft mounted for rotation in the end plates concentrically with the stator; a tubular rotor having a central web and a hub rotatively mounted on the shaft, the diameter of the rotor being smaller than the inside diameter of the stator; the outermost portion of the rotor being separated from the inner wall of the stator by a small clearance; a radial vane pivotally connected at the inner end thereof to the peripheral portion of the rotor, the outer portion of the vane sliding in the stator between the inlet and outlet ports; means to admit compressed gas with oil into the space within the rotor, the web having transverse holes near its periphery for the oil and near the hub for the gas; means to add the oil to the compressed gas; baffle discs mounted on the shaft for separating the gas from the oil in the rotor by centrifugal force and for forcing the oil into the clearances between the rotor and the stator; and means to exhaust the oil-free gas from the stator.

VADIM S. MAKAROFF.

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