April 6, 1948. M. MATRICON 2,439,258

VACUUM PUMP

Filed Dec. 19, 1946

Fig. 1.

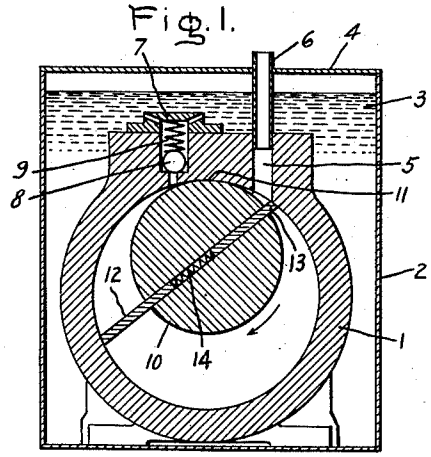


Fig. 2.

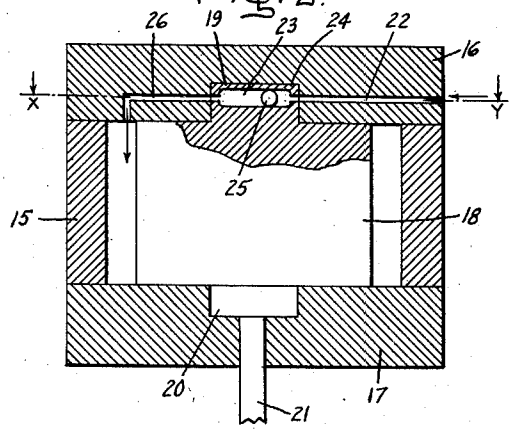


Fig. 4.

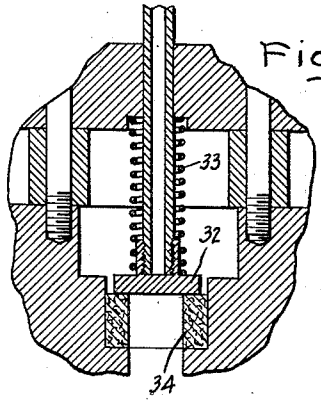


Fig. 3.

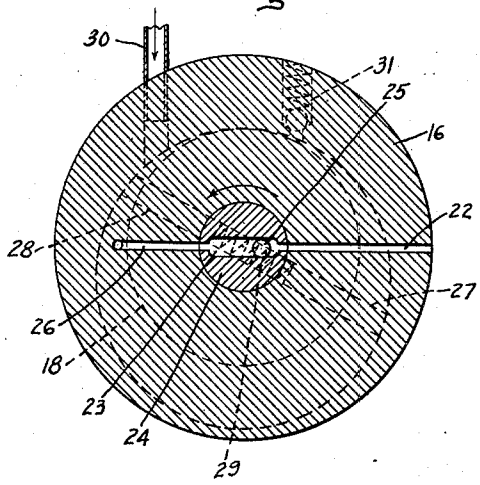


Fig. 6.

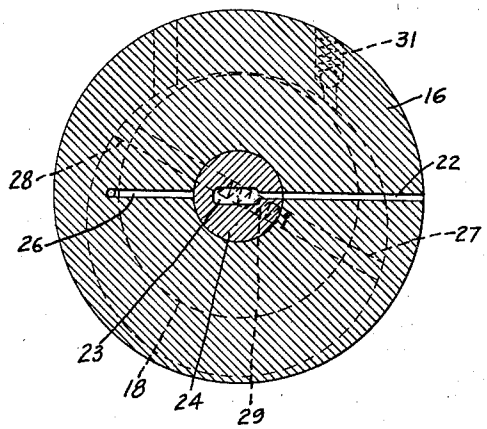
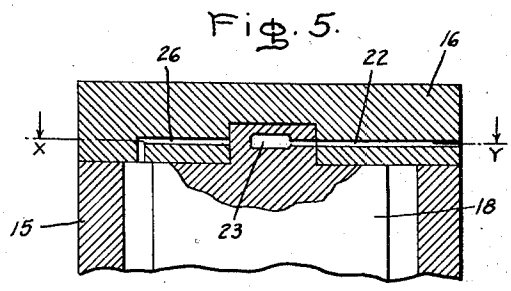


Fig. 5.



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UNITED STATES PATENT OFFICE

2,439,258

VACUUM PUMP

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4 Claims. (Cl. 230—205)

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The present invention relates to improvements in vacuum pumps such as those of the rotary blade type.

It is known that the performance of pumps of this type involves certain features which could advantageously be improved and among which may be cited particularly the following:

Improved adjustment of the exhaust valve to minimize its open time thereby to obtain a higher degree of vacuum;

Improvement of irregularities in the operation of the valve during the starting period of the pump and during the time necessary for attaining the steady-state temperature of the oil (these two factors tend to increase the time required to evacuate a given volume);

Improved stability in the limit vacuum which is obtained;

Minimization of noise caused by the valve;

Minimization of back-rising of the oil, when the pump is not operating into the space to be evacuated.

A principal object of the present invention is to provide a vacuum pump improved in the above respects and capable of producing a higher degree of vacuum and having various important advantages, to wit:

Improved lubrication and cooling of the pump body and

The possibility of introducing into the pump, oil which has been particularly treated, permitting the attainment of a very high degree of vacuum.

The present invention is especially characterized by means which during pump operation permits the cyclic admission into the interior of the pump body of a considerable quantity of oil which may either come from the tank in which the pump is immersed or from another reservoir in which the oil is freed from gases. It is also characterized by the fact that the exhaust valve rests elastically on its seat, the latter consisting preferably of a non-metallic material, such as a material having a textile base impregnated with a Bakelite or the like.

The invention will best be understood by referring to the following description and to the accompanying drawing in which Fig. 1 represents schematically a conventional vacuum pump, for example a two-blade pump; Fig. 2 is a horizontal section through the bearing of a pump embodying the invention; Fig. 3 is a section through Fig. 2 along the line $x—y$; Fig. 4 represents an exhaust employed with the present invention;

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while Figs. 5 and 6 represent a modification of the embodiment of Figs. 2 and 3.

The preferably cylindrical closed pump chamber 1 in Fig. 1 is immersed in tank 2 filled with oil 3 and covered by lid 4. The pump chamber 1 has an inlet port 5 through which the pump interior may communicate with the receptacle which is to be evacuated by means of an appropriate pipe 6. An exhaust valve 7 positioned in the outlet port permits communication between the inside of the pump and the outside. This exhaust valve may comprise a ball 8, which is forced against its seat by its own weight or through a spring arrangement 9 which can be adjusted so as to prevent too high a pressure against the exhaust end.

Within the pump chamber, a cylindrical rotor 10 rotatable about its axis rests tangentially against the wall of the pump chamber 1 at point 11. The rotor may comprise two resiliently mounted blades 12 and 13 which are forced against the inside walls of the pump chamber by a spring 14. The rotor and the blades rotate in a direction indicated by the arrow.

In Figs. 2 and 3, a pump embodying the invention is shown as comprising a cylinder 15 closed at its ends by end plates 16 and 17. A cylindrical rotor 18 journaled in bearings 19 and 20 in end plates 16 and 17 respectively, is mounted for rotation about its axis in close tangential contact with the inner wall of cylinder 15. Rotation in the direction indicated by the arrow may be effected by any suitable means such as a power source (not shown) applied to shaft 21.

A duct or canal 22 is drilled into plate 16 through which duct communication is established between the outside and a radial duct 23 within the hub or journal 24 of the rotor 18. In duct 23, a closely fitting ball 25 is placed. Said duct 23 communicates also with duct 26 terminating within the pump cylinder 15. Duct 22 may be connected to the oil 3 (Fig. 1) of tank 2 or to a tank filled with specially treated oil. To simplify the figure, the duct 26 is shown diametrically opposite duct 22. However, this duct 26 could be at any angle with respect to duct 22. Rotor 18 is provided with blades 27 and 28, and spring 29 all having the same function as their counterparts in Fig. 1.

Pumps embodying the present invention may also comprise pipe 30 connecting the inside of cylinder 15 to the receptacle to be evacuated and an exhaust valve 31 similar to those in Fig. 1. Fig. 4 shows in greater detail a suitable exhaust valve comprising valve head 32 subjected to the

pressure of a relatively powerful spring **33** and resting against the resilient seat **34** which consists of a material that will prevent noise during the pump operation. This material may be any suitable material such as textile impregnated with Bakelite.

These various arrangements operate as follows:

During the rotation of the rotor **18**, the inside of the pump cylinder **15** is evacuated, so that oil may be drawn through duct **22** to fill the duct **23** of hub or journal **24** when one of its openings is aligned with duct **22**. One half revolution of rotor **18** later, the quantity of oil is drawn through the duct **26** and penetrates into the pump cylinder. The process is repeated cyclically. The admitted oil is expelled when the blades **27** and **28** traverse the cylinder and is compressed into the dead space, i. e., the space between the valve seat and the blades which would normally contain small pockets of air not completely expressed from the pump. The oil then lifts the valve **31** to evacuate the trapped air and a certain amount of the oil itself.

When one of the blades passes in front of the suction port from pipe **30**, it separates a certain volume of air V at the pressure P. If v is the dead space, and if

$$k=\frac{V}{v}$$

is the compression ratio, the limit pressure which the pumps can attain will be

$$P_1=\frac{H}{k}$$

where H is the external pressure to which the valve is subjected, a pressure which is almost equal to atmospheric pressure.

It will be seen that by considerably decreasing the effect of the dead space by filling it with an appreciable quantity of oil, one can obtain very low limit pressures and by use of the present invention there may be admitted to the cylinder during each revolution a quantity of oil which is just necessary to make the dead space practically zero.

Pumps constructed in accordance with the present invention operate very evenly in the cold as well as in the hot state, since the quantity of oil admitted is constant and does not depend on the exhaust valve pressure or on the viscosity of the oil.

The advantages offered by pumps constructed in accordance with the invention become very apparent when one considers the conventional pumps in which only a very slight quantity of oil is introduced into the pump cylinder in order to insure the lubrication of the frictional surfaces. This slight admission of oil takes place, to a slight extent, by way of the leakage paths along the bearings or flanges, and especially through the entrance of oil during the downward stroke of the exhaust valve. Adjustment of the latter, limiting the time during which it is open, permits a variation in the quantity of oil admitted; however, if the valve is left open for too long a time, the air and oil which had been previously expelled by the blade re-enter the pump cylinder after the blade has passed. In the latter event the emulsion of air and oil admitted into the pump impairs the vacuum and limits the degree of vacuum which can be obtained. It is for this reason that only a slight re-entrance of oil has been allowed into these pumps heretofore, since

the problem of air evacuation is connected to that of oil admission. By means of the present invention these two factors are made completely independent of each other.

Another advantage of the present invention lies in the fact that the oil admitted to the vacuum chamber of the pump may be one which does not contain air bubbles since this oil may be drawn from a tank at a point remote from the exhaust or may be taken from a container in which the oil is especially treated to degas it. Thereby one may take advantage of the great avidity with which degassed oil may absorb air. In this way a much better vacuum is attained.

Finally, the relatively powerful spring **33** (Fig. 4) suppresses the rising of oil, owing to the high pressure with which it rests against valve head **32** and forces the latter on its seat **34**, quite in contrast to the light spring **9**, which was used formerly, as was shown in Fig. 1.

In Figs. 5 and 6 there is shown a variant form in which the duct **23** consists simply of a single ended hole without ball and which operates on the same principle as that already described. In all other respects the construction of Figs. 5 and 6 is the same as that of Figs. 2 and 3, and like numerals have been used to designate like parts.

While particular embodiments of the invention have been shown and described, it will be obvious to those skilled in the art that various changes and modifications may be made without departing from the invention in its broader aspects and, therefore, it is the aim of the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A pump for gaseous fluids comprising a closed cylindrical pump chamber including a cylindrical wall and end plates constituting end walls, inlet and outlet ports positioned at different points on the periphery of said cylindrical wall, a cylindrical rotor of diameter less than that of said cylindrical wall tangentially engaging the said cylindrical wall between said ports and having a journal in one of said end plates, resilient blades on said rotor for pumping gaseous fluid from said inlet to said outlet port, and means within said journal and said one of said end plates for cyclicly injecting a quantity of oil into said chamber, said last mentioned means comprising a first duct within said one of said end plates having an externally accessible opening and terminating in an opening juxtaposed to said journal, a second duct having an opening into said chamber and terminating in an opening juxtaposed to said journal, and a duct within said journal alignable with said first and second ducts at predetermined angular positions of said rotor.

2. A pump for gaseous fluids comprising a closed cylindrical pump chamber including a cylindrical wall and end plates constituting end walls, inlet and outlet ports positioned at different points on the periphery of said cylindrical wall, a cylindrical rotor of diameter less than that of said cylindrical wall tangentially engaging the said cylindrical wall between said ports and having a journal in one of said end plates, resilient blades on said rotor for pumping gaseous fluid from said inlet to said outlet port, means within said journal and said one of said end plates for cyclicly injecting a quantity of oil into

said chamber, said last mentioned means comprising a first duct within said one of said end plates having an externally accessible opening and terminating in an opening juxtaposed to said journal, a second duct having an opening into said chamber and terminating in an opening juxtaposed to said journal, and a duct within said journal alignable with said first and second ducts at predetermined angular positions of said rotor, and means within said duct within said journal for interrupting continuous flow of oil through said ducts.

3. A pump as in claim 2 in which said last mentioned means comprises a flow blocking member having a cross section conforming substantially to that of said duct within said journal and moveable from one end thereof to the other whereby said duct may receive a charge of oil when aligned with said first duct and may deliver said charge to said chamber when aligned with said second duct.

4. A pump as in claim 2 in which said last mentioned means comprises an end wall closing one end of said duct within said journal whereby said duct may receive a charge of oil when aligned with said first duct and may deliver said charge to said chamber when aligned with said second duct.

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