Dec. 13, 1932. J. DUBROVIN 1,890,572

PUMP

Filed Dec. 5, 1929 2 Sheets-Sheet 1

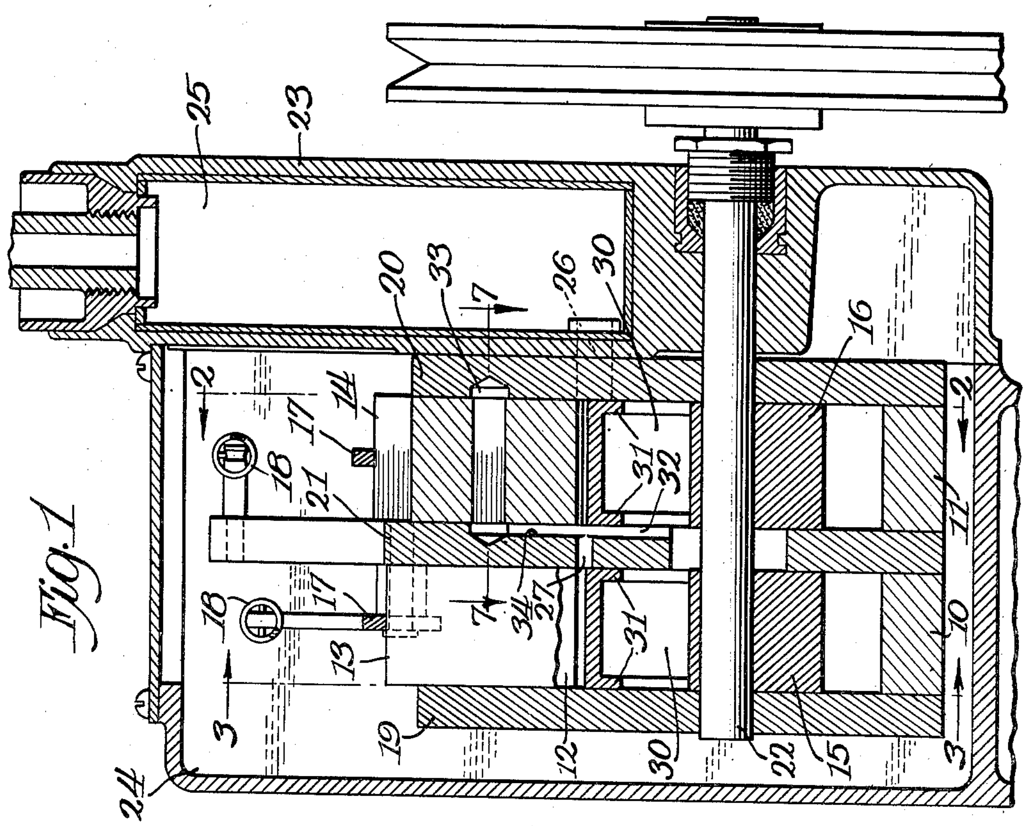


Fig. 1

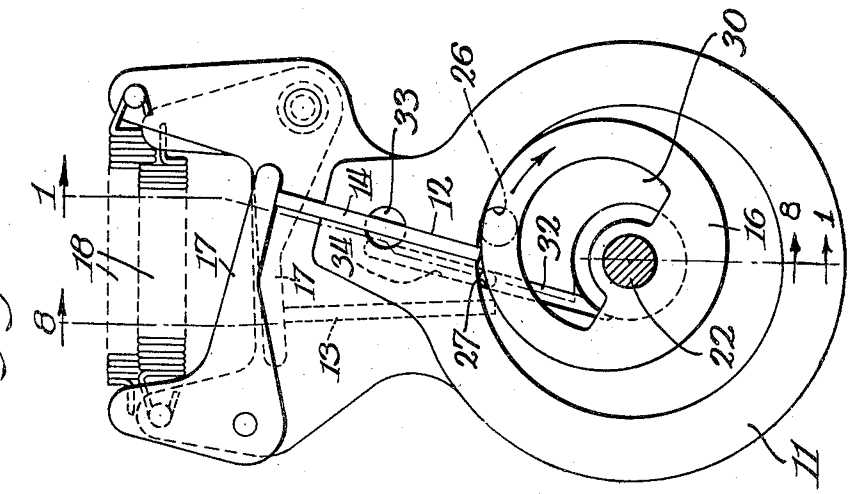


Fig. 2

Inventor
John Dubrovin
By Gillson, Mann & Cox
Attys

Dec. 13, 1932.

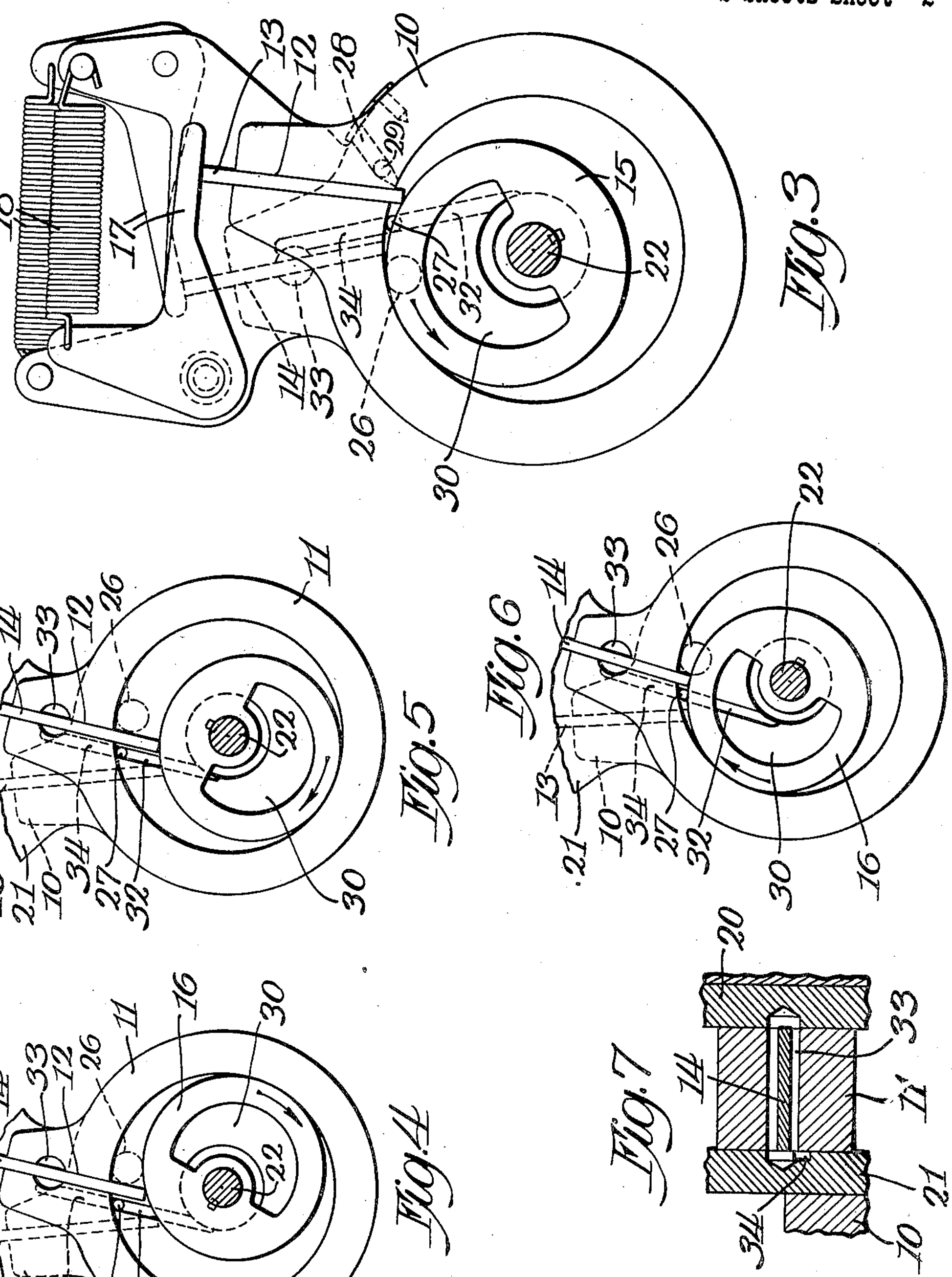
J. DUBROVIN

1,890,572

PUMP

Filed Dec. 5, 1929

2 Sheets-Sheet 2



Inventor
John Dubrovin
By Gilson, Mann & Cox
Attys.

Patented Dec. 13, 1932

1,890,572

UNITED STATES PATENT OFFICE

JOHN DUBROVIN, OF CHICAGO, ILLINOIS, ASSIGNOR TO CENTRAL SCIENTIFIC COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS

PUMP

Application filed December 5, 1929. Serial No. 411,754.

This invention relates to pumps, and particularly those eccentric pumps commonly used for producing high vacua. Such pumps frequently include a cylindrical pump chamber closed except for intake and exhaust ports, an eccentric rotor having a relatively long zone of contact with the wall of the chamber, and a blade bearing on the periphery of the rotor and dividing the intake from the exhaust side of the pump.

The blades, of course, must be properly lubricated and due to the pressure differential between the pump chamber and the atmosphere, the lubricant tends to feed along the blade into the pump chamber releasing to that chamber dissolved air, adsorbed gases, and volatiles which tend to increase the pressure therein and to that extent reduce the efficiency of the pump.

Among the principal objects of the invention are to outgas whatever oil finds access to the pump chamber and to reduce the quantity of oil entering therein.

In two stage pumps, of which the structure shown in the accompanying drawings is one illustration, these results are accomplished by intercepting the oil which is being forced because of the pressure differential along the blade into the pump chamber, and subjecting it to a partial vacuum which, in this instance, is obtained from a connection with the intake side of the roughing stage. By intercepting and treating the oil in this manner, the harmful effect of that which remains is practically negligible because most of the dissolved and adsorbed gases have been released by vacuum treatment and much of the oil which otherwise would be forced by the pressure differential into the pump chamber has been carried away into the roughing stage. Enough, however, reaches the chamber to seal and lubricate the pump thoroughly. In effect what is done is to provide an oil outgassing pocket and to provide the valve with a vacuum stuffing box.

The rotors in pumps of this type are inherently out of balance, and as ordinarily constructed, rotation at high speed results in excessive vibration.

By coring out, or otherwise hollowing the eccentric sides of the rotors, they can be accurately balanced with respect to the axis of rotation, but this provides a considerable quantity of air at atmospheric pressure that tends to leak into the pump chamber as the pressure differential increases unless provision is made for exhausting the interior of the rotors at substantially the same rate as the system is being evacuated.

In the structure here illustrated the hollows of two eccentric rotors are continuously in communication through a connecting passage in the intermediate plate of the pump casing, and this passage is, in turn, in continuous communication with the intake of the roughing stage, which, of course, is at substantially the same pressure as the exhaust of the finishing stage.

In the drawings,

Fig. 1 is a vertical section of a two stage eccentric pump mounted in an oil bath, the section through the finishing stage and the intermediate plate 21 being taken on the line 1—1 of Fig. 2, and that through the roughing stage being taken on the line 8—8 of Fig. 2;

Fig. 2 is a sectional view taken on the line 2—2 of Fig. 1 and showing particularly the position of the eccentric rotor of the finishing stage and its associated parts at the beginning of a pumping cycle;

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 1 showing particularly the location and arrangement of the various parts of the roughing stage at a given position of the rotor;

Figs. 4, 5 and 6 are views similar to Fig. 2 showing the positions of the various parts at intermediate points of the cycle; and

Fig. 7 is an enlarged detailed section of the vacuum stuffing box taken on the line 7—7 of Fig. 1.

However, this specific illustration, and the correspondingly specific description are intended for the purpose of disclosure only, and are not intended to indicate the scope of the invention, or impose limitations on the claims beyond what is made necessary by the prior art.

The pump casing comprises a pair of cylindrical rings 10 and 11 split at 12 to provide cavities for receiving blades 13 and 14 which are constantly urged into contact with the periphery of the eccentric rotors 15 and 16 by means of levers 17 and springs 18. The cylinders are closed by plates 19 and 20 and by the intermediate plate 21. The rotors are fixed to a shaft 22 which is carried by the removable wall 23 of the oil bath 24.

Inasmuch as the pumping unit adjacent to the vessel to be exhausted is always at a lower pressure, for convenience it will be termed the finishing stage of the pump, while the other stage farthest removed from the vessel will be termed the roughing stage.

The removable wall 23 of the oil bath is provided with an enlarged chamber 25 communicating at its upper end with the vessel to be exhausted and having a passageway 26 located adjacent its lower end, which serves as an intake port for the finishing stage. The enlarged chamber 25 also acts as an oil trap in case there is a tendency for oil to be drawn therein when the pump is idle.

The intake port 26 of the finishing stage is conveniently made by drilling through the plate 20 in appropriate relation with the blade 14. On the opposite side of the blade and in the intermediate plate 21 a small bore 27 serves as the exhaust port of the finishing stage and the intake port of the roughing stage.

The exhaust port 28 of the roughing stage may be in the form of a bore through the cylindrical ring 10 and provided with a ball check valve 29. The blade 13 of the roughing stage is suitably located with respect to the intake and exhaust ports in a manner similar to that of the finishing stage.

The eccentric rotors 15 and 16 which revolve at a high speed cause excessive vibration when cast solid. They are, therefore, advantageously cored out preferably semilunar in form, as at 30, so as to balance the rotor with respect to its axis of rotation. The best results may be obtained when the hollows of the rotor are provided with flanges 31 which furnish greater contact with the end walls of the pump and which facilitate the removal of small amounts of metal necessary to the accurate balancing of the rotors.

The efficiency of pumps of this character is greatly lessened because of the pressure differential existing betwen the pump chambers and the atmosphere. At the beginning the differential is low, but rapidly increases as the vessel approaches a high degree of exhaustion. Because of this high pressure differential, there is a tendency for the oil from the oil bath to be forced into the pump chambers along the reciprocating blades, carrying with it dissolved air and volatiles, and for the air within the rotor hollows to leak past the flanges 31 into the pump chambers, thereby greatly decreasing the efficiency of the pump. Means are, therefore, provided for remedying this situation.

The intermediate plate 21 is provided with an aperture concentric with the shaft 22 and of sufficient diameter as to register with the semilunar hollows 30 of the rotors. A channel 32 in the plate 21 connects with the intake port 27 of the roughing stage which has the effect of adding the volumes of the rotor hollows to the volume of the roughing stage pump chamber. In this way, the pressure differential between the pump chambers and the rotor hollows is kept very low and as a consequence, the efficiency of the pump is greatly increased. The rotor hollows could be connected with the intake of the finishing stage, but the results obtained by such construction would not be as satisfactory as where the connection is made to the roughing stage.

As stated before, there is a tendency for oil from the oil bath to find its way along the blades into the pump chambers and this is particularly true with respect to the finishing stage, because of the higher pressure differential existing. The situation is remedied in this invention by intercepting the oil as it travels down the blade 14 and subjecting it to a partial vacuum which, in this instance, is secured by connection with the intake of the roughing stage. More specifically, the blade cavity of the finishing stage is provided with an alined bore 33 forming a pocket which extends into the plates 20 and 21 and which is connected to the intake of the roughing stage by the channel 34 which for convenience is an extension of the channel 32. In this way the reciprocating blade 14 is encircled by a partial vacuum which tends to draw a greater part of the oil finding its way along the blade into the pump chamber of the roughing stage.

The oil which remains will not materially decrease the efficiency of the pump inasmuch as a greater part of the dissolved air, adsorbed gases, and volatiles have been removed by the vacuum treatment; and also because there is little tendency for the remaining oil to be drawn into the pump chamber of the finishing stage by reason of the low pressure differential existing between the vacuum stuffing box and the pump chamber volatiles are permanently initially removed from the oil by the vacuum treatment whenever a fresh supply is added to the pump. The oil, however, continually dissolves and adsorbs gas and this is continually removed.

It is unnecessary for the inner end of the shaft 22 to be provided with a seal or packing for the reason that any oil which works its way along the shaft to the side walls of the pump chambers must traverse the zone swept by the hollows 30 before it can reach the actual pump chambers. Since the hollows 30 are constantly in communication with the intake of the roughing stage, the oil, for the most part, will be removed from the side walls of the pump, and that which remains will not produce deleterious effects having been subjected to the vacuum treatment. The treatment of the oil in this manner is in all ways similar to that described with reference to the vacuum stuffing box for the blade.

The effectiveness of the improvements disclosed is well demonstrated by the fact that it is now possible to obtain a pressure of one-tenth of a micron, with a pump constructed according to the teachings of this invention, in a shorter time than it was theretofore possible to obtain one micron with the old form of pump.

It will be understood that the advantageous results of this invention may be obtained in a variety of ways, all of which are within the scope of this invention.

For example, the particular arrangement of the passageways, which serve to maintain the rotor hollows at substantially the same pressure as the pump chambers, is but illustrative of the many ways in which this result can be obtained. The same is true with respect to the manner in which the blade of the finishing stage is provided with a vacuum stuffing box.

It is possible, also that in certain constructions it may be desirable to employ a separate pump unit to exhaust the stuffing box and rotor hollows, or to obtain the low pressures desired therein by connections to the system other than those specifically illustrated and described. Such modifications are all within the purview of this invention.

Furthermore, the invention is not limited to a two-stage eccentric pump. The same advantages could be obtained where any number of units are included, and it is not necessary that each unit be of the eccentric type.

Reference is made to a copending application, Serial No. 311,733, filed Oct. 11, 1928, entitled Pumps, which discloses a form of high vacuum pump in which the second stage is a reciprocating pump operated by the blade of the eccentric unit, and it is obvious that in this type of pump the rotor hollow could be evacuated and the blade equipped with a vacuum stuffing box in a manner similar to that disclosed above. That application also discloses other advantageous uses of vacuum in connection with shafts entering the pump casings and joints in the pump casings proper.

Therefore, in seeking the scope of the invention it will be necessary to look beyond these specific disclosures to the substance of the improvements disclosed.

I claim as my invention:—

1. A vacuum pump comprising, in combination, a first stage including a casing and a pump chamber with intake and exhaust ports and a blade cavity therein, a rotor in the chamber and a blade movably mounted in the blade cavity, and cooperating with the periphery of the rotor to divide the intake from the exhaust, means to lubricate the blade, means to extract gas from the lubricant in the blade cavity and means for supplying oil to said blade.

2. A vacuum pump comprising, in combination, a first stage including a casing and a pump chamber with intake and exhaust ports and a blade cavity therein, a rotor in the chamber and a blade movably mounted in the blade cavity, and cooperating with the periphery of the rotor to divide the intake from the exhaust, means for supplying oil to the blade cavity, and means to reduce the pressure in the blade cavity in an area spaced from the pump chamber.

3. A vacuum pump comprising, in combination, a pump chamber, means for evacuating the chamber, a slide member in communication with the pump chamber and having a portion exposed to a relatively high pressure, means for supplying a sealing fluid to said slide member, and means for outgassing the sealing fluid supplied to said slide member.

4. A plural stage eccentric vacuum pump comprising, in combination, a casing provided with a first pump chamber and a second pump chamber and an intake and exhaust port for each chamber, a hollow eccentric rotor in each pump chamber, said casing being provided with blade cavities, a blade in each cavity and projecting into each chamber and cooperating with the periphery of the corresponding rotor, and means for evacuating said cavities and the hollows in the rotor.

5. A plural stage eccentric vacuum pump comprising, in combination, a casing provided with a first pump chamber and a second pump chamber and an intake and exhaust port for each chamber, an eccentric rotor in each pump chamber, a shaft for the rotors, and a blade projecting into each chamber and cooperating with the periphery of the corresponding rotor, means for lubricating the shaft, the interior of said chambers and the blades, and vacuum means for treating the lubricant prior to its entry into the pump chambers.

6. A high vacuum pump comprising, in combination, a casing provided with a pump chamber having intake and exhaust ports and a blade cavity communicating with the chamber, an eccentric rotor in the pump chamber, a blade moving back and forth in the blade cavity and cooperating with the periphery of the rotor, a sealing liquid within the casing subject to atmospheric pressure and gaining entrance to the pump chamber through the clearance around the blade, and means to prevent gases entrained and ad-

sorbed in the sealing liquid from entering the pump chamber which includes a pocket surrounding the blade spaced from the pump chamber and connected to a vacuum pump wherein the gases are separated from the sealing fluid.

7. A vacuum pump comprising, in combination, a casing provided with a pump chamber and intake and exhaust ports for the chamber, an eccentric rotor in the chamber, a slide member projecting through the casing into contact with the rotor, said casing also provided with a passage within which said slide member reciprocates, said passage having an enlargement between its ends, separate pumping means for producing a partial vacuum in said enlargement and means for continuously supplying oil through said passage to said chamber during the operation of the pump.

8. A liquid sealed vacuum pump having a casing adapted to contain a sealing liquid, a vacuum cylinder within the casing having inlet and exhaust ports, a piston for said cylinder, a passage for conducting sealing liquid to said cylinder and separate pumping means acting upon the sealing fluid just prior to its entry into said cylinder for out-gassing the oil in said passage.

9. A high vacuum pump comprising, in combination, a pump chamber adapted to contain a sealing liquid having inlet and exhaust passages, moving means within the chamber to exhaust the atmosphere therefrom and separate pumping means operative during the operation of the pump to out-gas whatever sealing fluid is admitted to the pump chamber prior to its entry thereinto and simultaneously receive and discharge gases discharged from said chamber.

In testimony whereof I affix my signature.

JOHN DUBROVIN.