Feb. 14, 1933. F. L. BUENGER 1,897,547

VACUUM PUMP

Filed May 25, 1929 2 Sheets-Sheet 1

FIG - 1 -

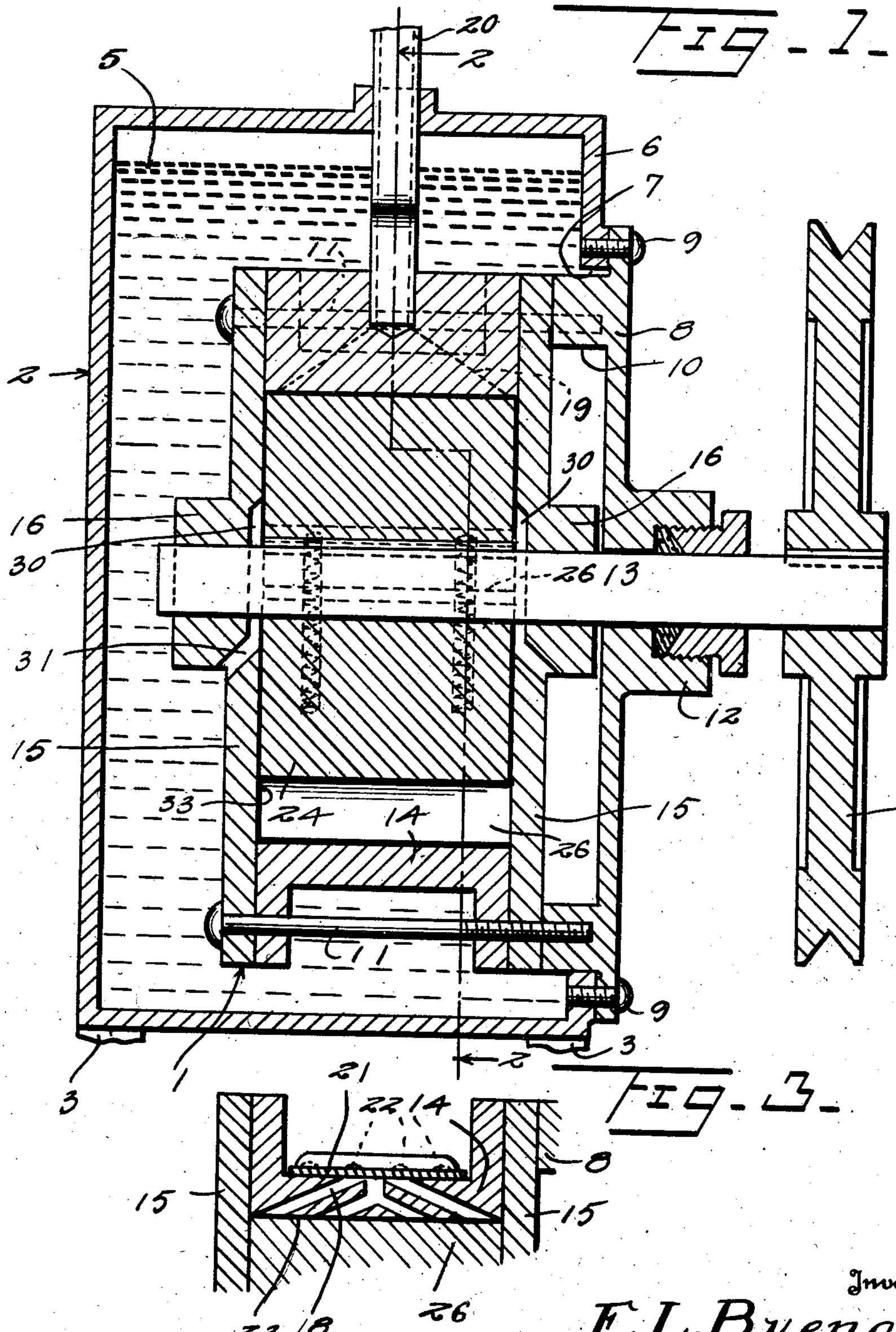

FIG - 3 -

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FIG. 2.

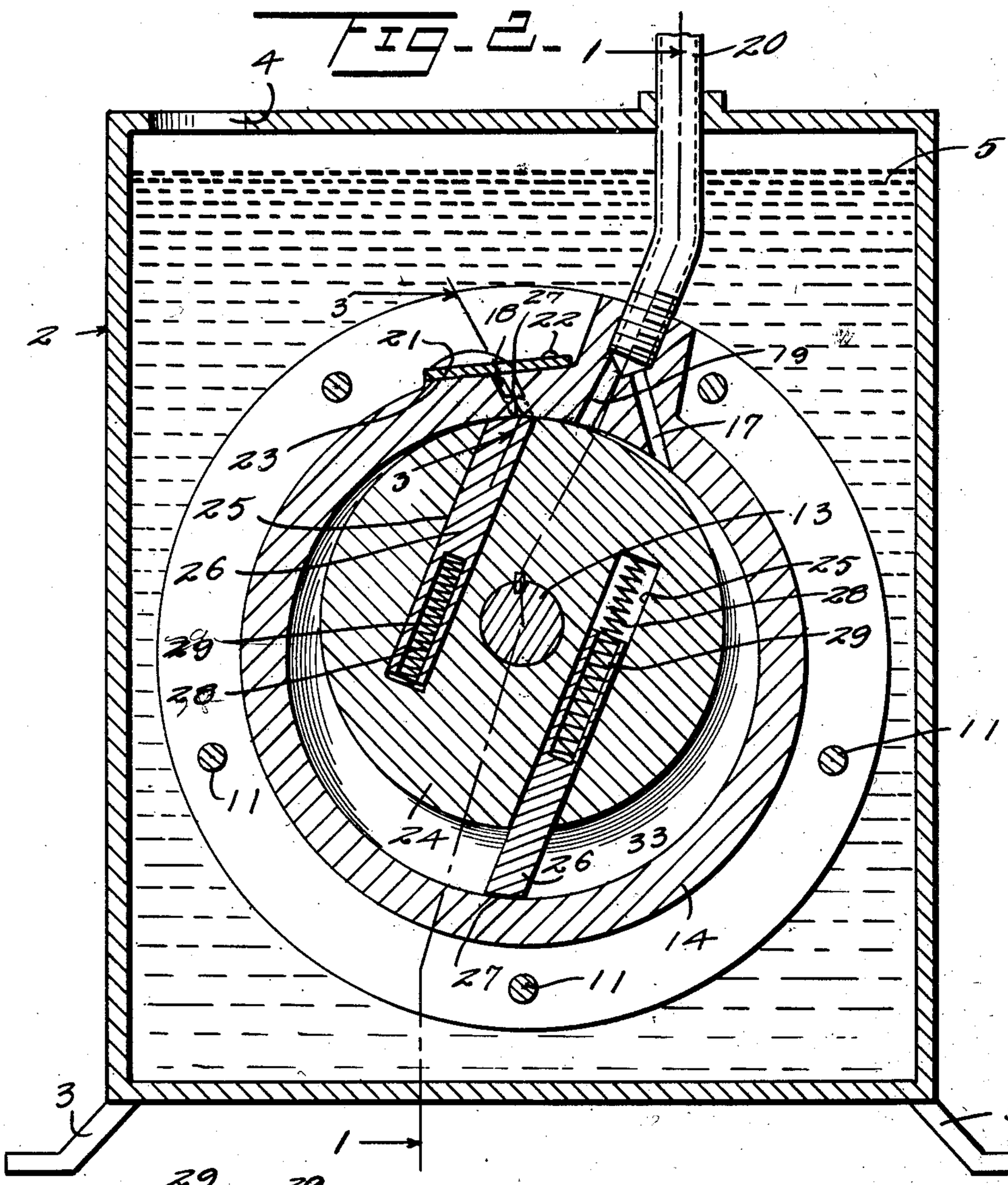
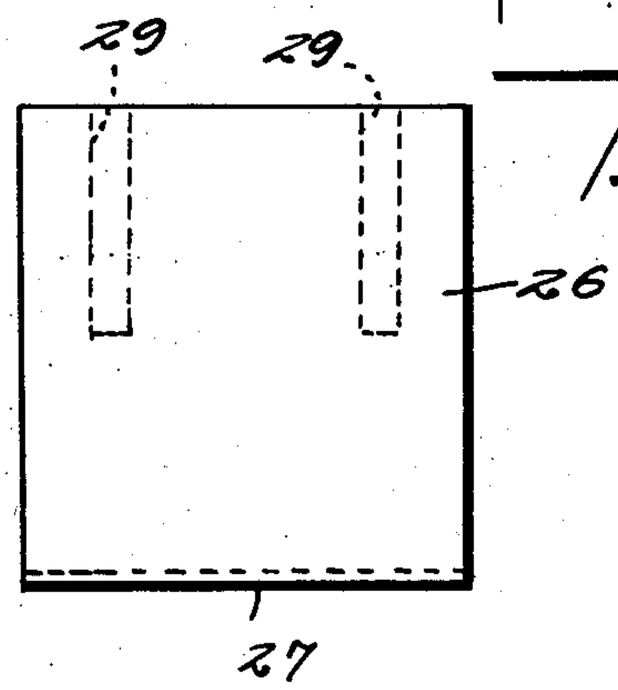


FIG. 4.



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Patented Feb. 14, 1933 1,897,547

UNITED STATES PATENT OFFICE

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VACUUM PUMP

Application filed May 25, 1929. Serial No. 365,960.

This invention relates to vacuum pumps of that type submerged in oil and embodying a housing provided in its upper side with inlet and outlet ports, a rotor eccentrically journaled in the housing, and a vane cooperating with the housing and rotor to prevent direct communication between the ports.

This invention has for one of its objects to provide a novel, simple and inexpensive vacuum pump of the character stated, through the medium of which a practically perfect vacuum may be obtained.

To attain the foregoing and other objects, the invention comprehends the provision of a pump of the character stated wherein the rotor shall be so arranged as to constantly press against the lateral wall of the housing adjacent the forward edge of the outlet port, and wherein the vane, carried by the rotor, shall be provided with an outer edge exactly similar in radius to that of the rotor, so that the periphery of the rotor and the outer edge of the vane, which is fully retracted immediately before approaching the exhaust port, shall in effect form a solid perfect circle to perfectly seal the exhaust port, as such vane passes the port, and thus render it impossible for any air to continue past the port or trap itself anywhere within the pump.

The invention also comprehends the provision of a pump of the character stated wherein the solid portion of the rotor in rear of the vane shall continue to seal the exhaust port as the vane passes the intake port, to trap the air, and during the forcing of the air through the exhaust port by the vane.

The invention also comprehends the provision of a pump of the character stated wherein the housing shall be provided with an intake channel extending from the outer end of the intake port to a point between the inner ends of the exhaust and intake ports, and wherein the inner end of said channel shall be spaced from the intake port for a distance substantially equal to the thickness of the vane whereby to prevent any suction at the rear side of the vane and to avoid hollow spaces without access to the exhaust port.

The invention also comprehends the provision of a pump of the character stated wherein the exhaust port shall be of double-V-form, so as to cause the air to be forced therethrough for the entire width of the vane so as to prevent the trapping of air in the corners of the port.

The invention also comprehends the provision of a pump of the character stated wherein the vanes, preferably two, shall be arranged in the rotor at opposite sides of the axis thereof, whereby to permit the use of comparatively long vanes and permit them to slide inwardly and outwardly beyond the periphery of the rotor for a comparatively great distance, and thus provide a comparatively large expansion chamber and render the pump highly efficient.

The invention also comprehends the provision of a pump of the character stated wherein the vanes shall be slidably mounted in the rotor in a manner to prevent them from tilting, and thus increase the durability of the pump.

The invention also comprehends the provision of a pump of the character stated wherein the vanes shall be arranged in slots formed in the rotor and extending from the periphery of the rotor to points at opposite sides of the axis thereof, and wherein the vanes shall be yieldingly held in contact with the housing by coil springs arranged between the vanes and the inner ends of the slots.

The invention also comprehends the provision of a pump of the character stated wherein the vane receiving slots shall be in communication with the oil in which the pump is submerged in order to permit the oil to enter the slots as the vanes move outwardly and thus prevent the formation of air pockets, the oil lubricating the vanes and establishing an air-tight seal between them and the rotor.

The invention is hereinafter fully described and claimed, and illustrated in the accompanying drawings, wherein:—

Figure 1 is a sectional view of a vacuum pump constructed in accordance with my in-

vention, the section being taken on the planes indicated by the line 1—1 of Figure 2;

Figure 2 is a sectional view taken on the vertical planes indicated by the line 2—2 of Figure 1;

Figure 3 is a detailed sectional view taken on the plane indicated by the line 3—3 of Figure 2; and

Figure 4 is an elevational view of one of the vanes of the pump.

Referring in detail to the drawings 1 designates the pump and 2 a case within which the pump is arranged. The case 2 is provided at its lower end with supporting and anchoring lugs or feet 3, and it is provided in its upper end wall with an air escape port 4. The case 2 contains oil, designated 5, in which the pump 1 is submerged. The lateral or side wall 6 of the case 2 is provided with a circular opening 7 which is diametrically larger than the pump 1. A cover 8 is provided for the opening 7 and it is secured in place by machine screws 9. The cover 8 is provided at its inner side with an annular rib or flange 10, which extends through the opening 7 and to which the pump 1 is secured by machine screws 11. A stuffing box 12, through which the shaft 13 of the pump 1 extends, is carried by the cover 8 to prevent the oil from leaking from the case 2 about the shaft.

The pump 1 comprises a cylinder, which consists of a lateral wall 14 and heads 15 which are secured in assembled relation by the screws 11. The heads 15 are provided with bearings 16 for the shaft 13, and the bearings are arranged to support the shaft eccentrically within the cylinder.

The cylinder is provided in the upper side of its lateral wall 14 with an intake port 17, which is arranged forwardly beyond the vertical center of the cylinder and with an exhaust port 18 which is arranged rearwardly beyond said center. An inlet channel 19 has its upper end arranged in communication with inlet port 17 and has its lower end positioned between said port and the exhaust port 18. A tube 20, with which the vessel to be exhausted is connected, communicates with the intake port 17 and intake channel 19. The exhaust or outlet port 18 consists of inner and outer channels of inverted V-form and having their inner ends alined transversely of the cylinder, as shown in Figure 3. The outer and longer channel of the exhaust or outlet port 18 communicates at its ends with the interior of the cylinder at the inner corners of the cylinder, and the apex thereof is open to provide for the discharge of air from the cylinder. The shorter and inner channel of the exhaust or outlet port 18 communicates at its ends with the interior of the cylinder between the ends of the longer and outer channel, and it communicates at its apex with the open apex of the longer and outer channel. A flap valve 21 is provided for the exhaust port 18 and is secured to the outer side of the cylinder wall 14 by screws 22, said wall of the cylinder being formed to provide a flat seat 23 for the valve.

A cylindrical rotor 24 is concentrically mounted upon the shaft 13, and is fixedly secured thereto. The rotor 24 is supported within the cylinder in such manner that it is held under pressure in contact with the inner surface of the wall 14 in alinement with the front edge of the exhaust port 18. The rotor 24 is provided at opposite sides of the shaft 13 with parallel slots 25 which extend from opposite sides of the periphery of the rotor to points inwardly beyond the shaft. Vanes 26 are slidably arranged in the slots 25, and are provided with outer curved edges 27 which are exactly similar in radius to that of the rotor 24. The vanes 26 are constantly urged outwardly with respect to the rotor 24, with their curved ends 27 in contact with the inner surface of the cylinder wall 14, by coil springs 28 which are arranged between the vanes and the inner end walls of the slots 25.

The vanes 26 are provided with recesses 29 which receive portions of the springs 28 when the vanes are projected and which receive the springs entirely when the vanes are fully retracted.

The heads 15 are provided in their inner sides with recesses 30 which surround the shaft 13 and communicate with the open sides of the vane receiving slots 25, and passages 31 extend downwardly and outwardly from the lower portions of the recess and establish communication between the interior of the case 2 and the recess. The recesses 30 and passages 31 permit the oil in the case 2 to flow into the vane receiving slots 25 as the vanes 26 are forced outwardly from the slots, with the result that the outer movement of the vanes does not form an air pocket within rotor 24, the vanes contacting with the inner end walls of the slots when in fully retracted position. The oil entering the slots 25 lubricates the vanes 26 and establishes an air-tight contact between the vanes and the rotor 24. The rotor 24 and the vanes 26 contact with the inner sides of the heads 15, and an air-tight connection between these parts is established by the oil in the recess 30. Furthermore, the recess 30 facilitates the proper lubrication of the bearings 16 by the oil.

In practice, the rotor 24 turns in a clockwise direction as viewed in Figure 2, and to permit of its being operated, the shaft 13 has a pulley 32 fixed thereto.

When one of the vanes 26 is fully retracted, which will occur when it contacts with the cylinder wall 14 at the front edge of the outlet port 18, the outer edge of the vane and the periphery of the rotor 24 forms in effect a solid perfect circle, with the result that a

perfect seal of the outlet port 18 is effected. It will thus be apparent that it is impossible for any air to continue past the outlet port 18 or trap itself anywhere within the cylinder. As the vane 26 approaches the inlet port 17, and until the vane has forced the air in advance of it through the outlet port 18, the solid portion of the rotor 24 in rear of the vane will continue the seal of the outlet port. The inner end of the air inlet channel 19 is spaced from the corresponding end of the outlet port 18 for a distance substantially equal to the thickness of the vanes 26, and such channel prevents any suction on the rear side of the vane, with the result that no hollow space without access to the outlet port 18 is possible. The formation of the outlet port 18, and particularly the location of the inner ends of its outer and longer channel, prevents air from being trapped at any point in the cylinder and especially in the corners of the cylinder, and the formation of the exhaust port also prevents wear in any one spot of the annular wall of the cylinder.

The arrangement of the slots 25 at opposite sides of the shaft 13 permits the formation of comparatively deep slots. This enables comparatively long vanes to be used, and permits the vanes to slide in and out of the rotor 24 for a comparatively great distance, with the result that a comparatively large expansion chamber 33 is provided. The side walls of the slots 25 support the vanes 26 against tipping. After the pump is in operation long enough to create a partial vacuum, the atmospheric pressure on the surface of the oil in the case 2 forces the oil into the slots 25 behind the vanes 26, and forces them outwardly against the annular wall of the cylinder.

The oil enters the slots 25 by way of the passages 31 and recesses 30, and holds the vanes against the wall of the cylinder under equal pressure.

While I have described the principle of the invention, together with the structure which I now consider the preferred embodiment thereof, I wish it understood that the structure shown is merely illustrative and that such changes may be made, when desired, as fall within the scope of the invention as claimed.

I claim:—

1. A vacuum pump, comprising a cylinder provided in its annular wall with an inlet and an outlet port, a cylindrical rotor eccentrically supported within the cylinder and having its periphery constantly contacting with said wall in alinement with the front edge of the outlet port, vanes slidably arranged in the rotor and provided with curved outer edges having a radius similar to that of the rotor, the outer edges of the vanes and the periphery of the rotor alining and forming in effect a solid circle when said edges reach the point of contact between the rotor and cylinder to effect a perfect sealing of the outlet port, means yieldingly holding the vanes with said edges thereof in contact with said wall during the starting of the rotor, and means coacting with said yielding means to hold the vanes into contact with the cylinder wall when a substantial vacuum has been created within a member connected to the intake port.

2. A vacuum pump comprising a cylinder provided in its annular wall with an inlet and an outlet port, the outlet port consisting of inner and outer channels of inverted V-form with their inner ends alined transversely of the cylinder and with the inner ends of the outer channel located close to the inner corners of the cylinder to prevent the trapping of air in the corners of the cylinder, a cylindrical rotor eccentrically supported within the cylinder and having its periphery constantly contacting with said cylinder wall in alinement with the front edges of the outlet port, vanes slidably arranged in the rotor and provided with curved outer edges having a radius similar to that of the rotor, the outer edges of the vanes and the periphery of the rotor alining and forming in effect a solid circle when said edges reach the point of contact between the rotor and said cylinder wall to effect a perfect sealing of the outlet port, means yieldingly holding the vanes with said edges thereof in contact with said cylinder wall during the starting of the rotor, and means coacting with said yielding means to hold the vanes into contact with the cylinder wall when a substantial vacuum has been created within a member connected to the intake port.

In testimony whereof I hereunto affix my signature.

FREDERICK L. BUENGER.