Jan. 9, 1934. P. S. MORGAN 1,942,441

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Original Filed June 9, 1927 5 Sheets-Sheet 1

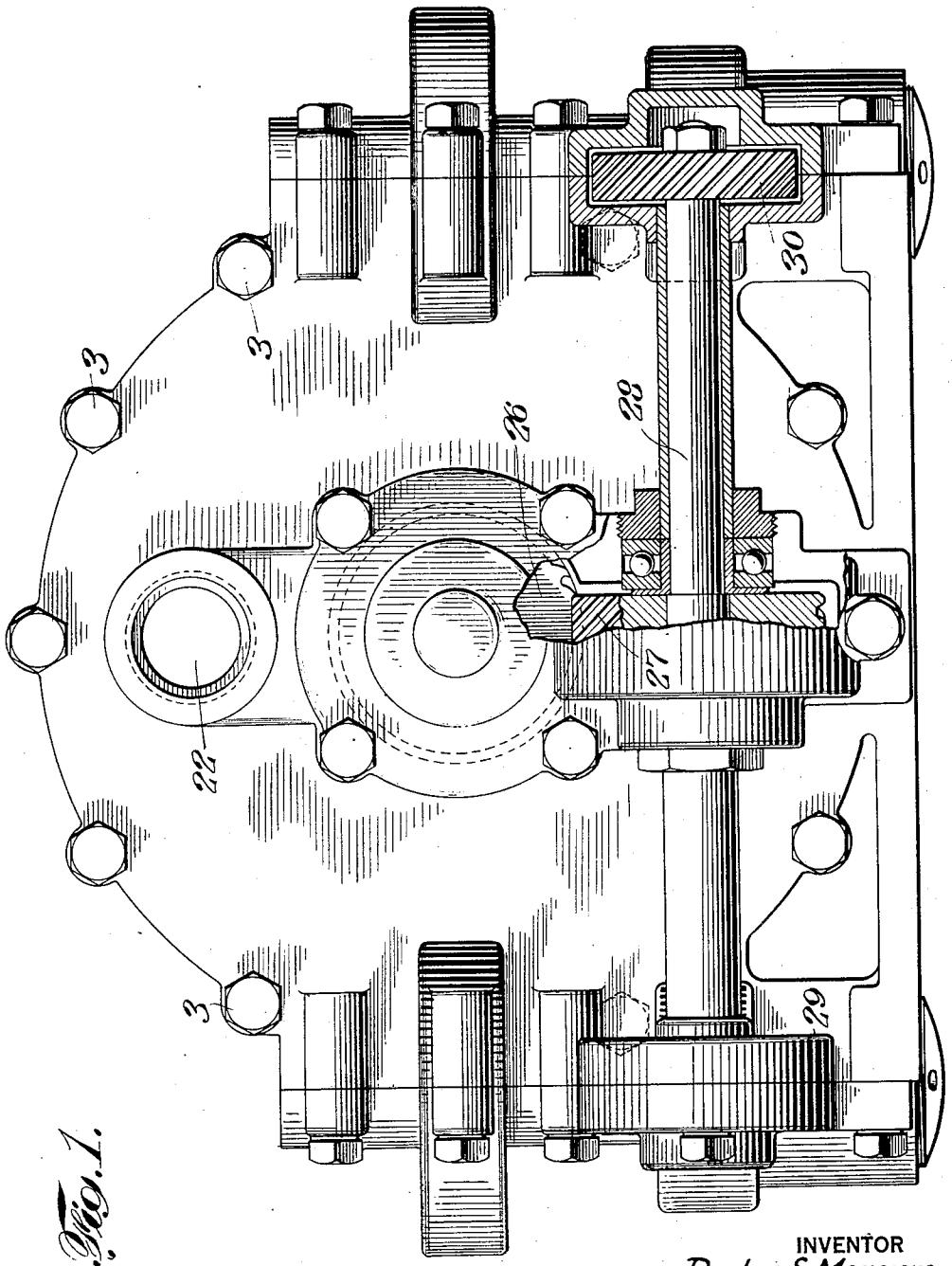


Fig. 1.

INVENTOR
Porter S. Morgan.
BY
Emery Booth Janney & Vamey
ATTORNEYS

Jan. 9, 1934. P. S. MORGAN 1,942,441

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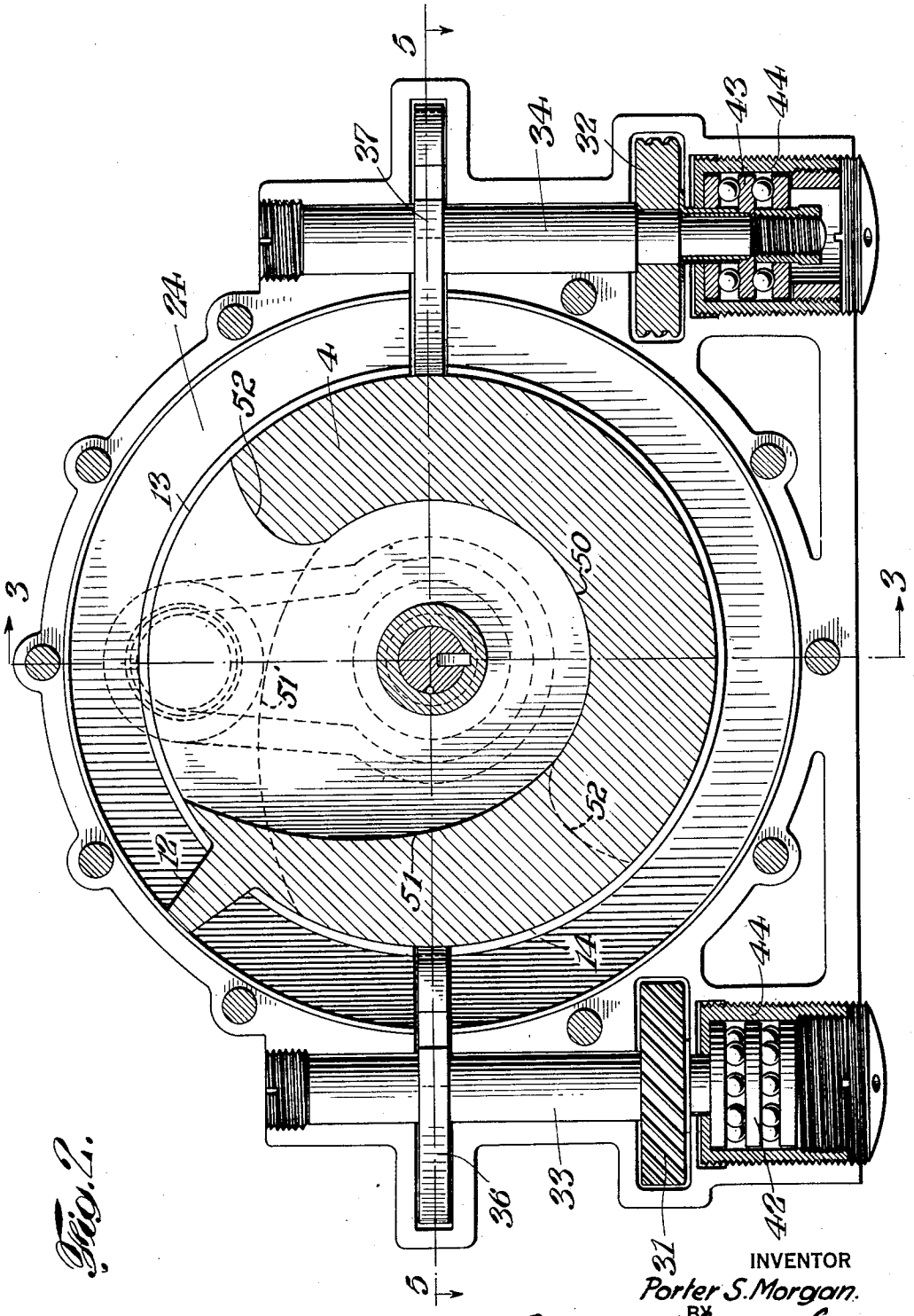


Fig. 2.

INVENTOR
Porter S. Morgan.
BY
ATTORNEYS

Jan. 9, 1934. P. S. MORGAN 1,942,441

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Fig. 4.

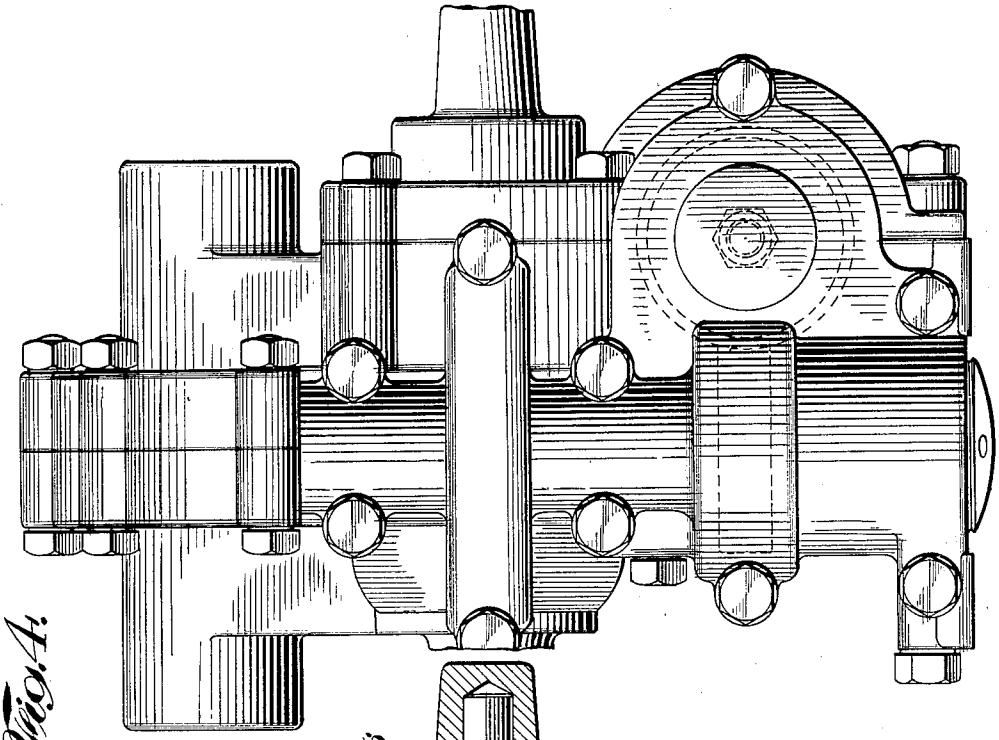
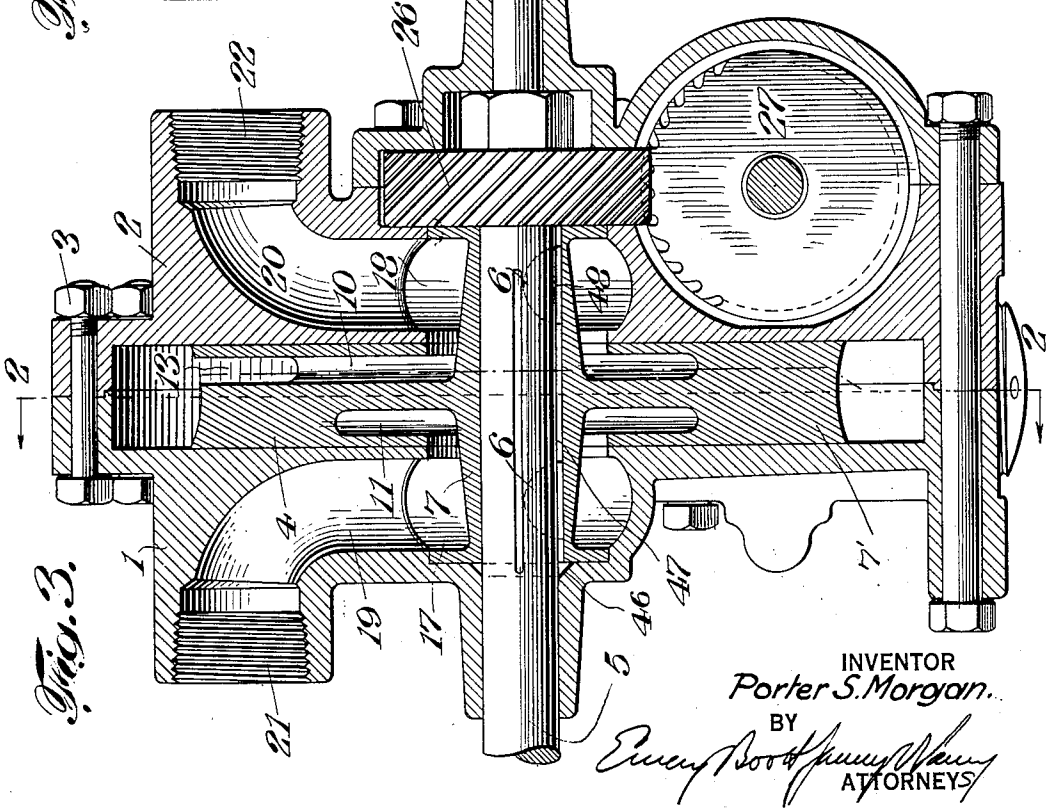


Fig. 3.



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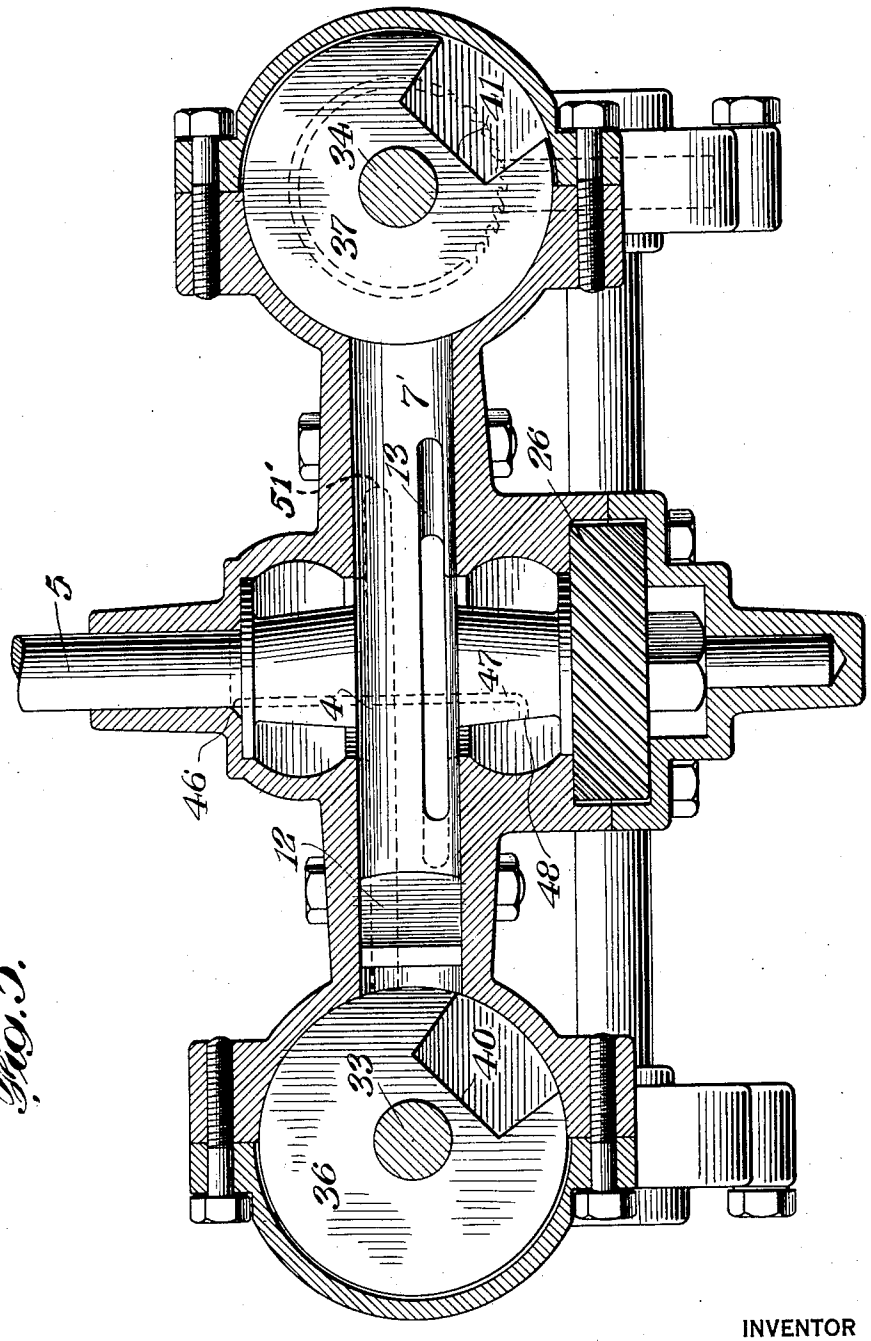


Fig. 5.

INVENTOR
Porter S. Morgan.
BY
Emery Booth Janney Varney
ATTORNEYS

Jan. 9, 1934. P. S. MORGAN 1,942,441

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Fig. 6.

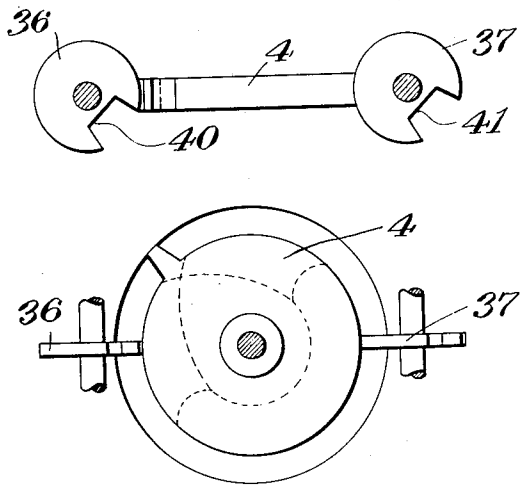


Fig. 7.

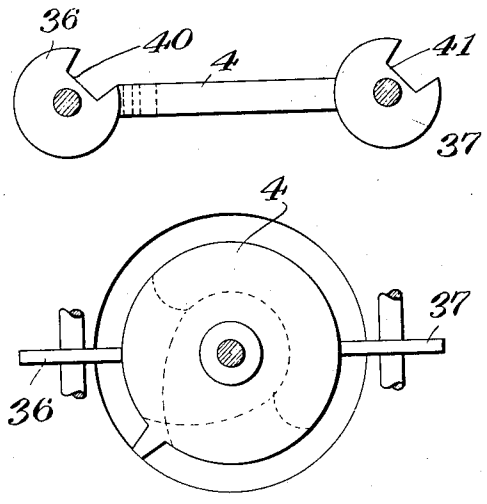


Fig. 8.

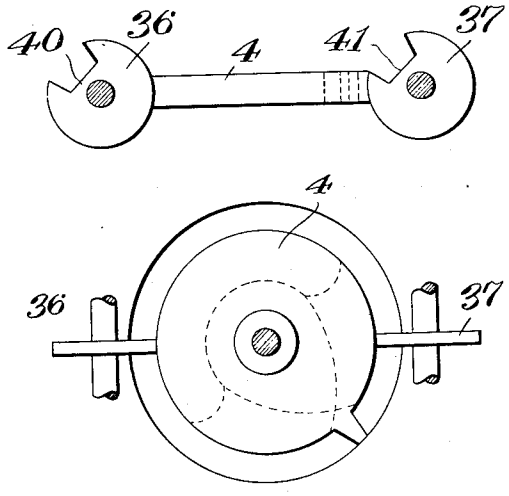
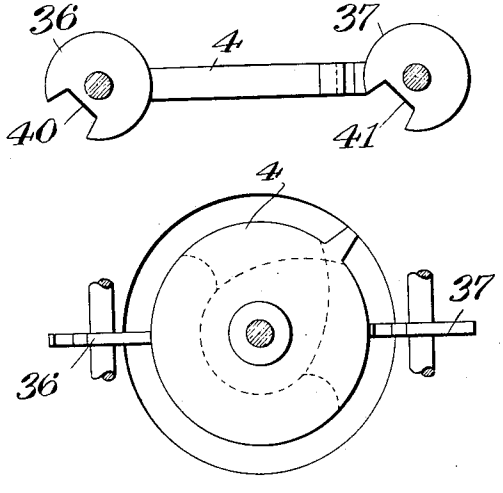


Fig. 9.



INVENTOR
Porter S. Morgan.
BY
Emery Booth Janney & Varney
ATTORNEYS

Patented Jan. 9, 1934 1,942,441

UNITED STATES PATENT OFFICE

1,942,441

PUMP

Porter S. Morgan, Darien, Conn., assignor to John B. Russell, New York, N. Y.; John B. Russell, Jr., and Joseph E. Russell also known as Joseph B. Russell, executors of said John B. Russell, deceased

Application June 9, 1927, Serial No. 197,729
Renewed February 11, 1933

7 Claims. (Cl. 103—125)

This invention relates to pumps and has as an object to provide a rotary, positive pressure pump of high efficiency and uniform flow.

Other objects and advantages of the invention will appear hereinafter.

A preferred embodiment of the invention selected for purposes of illustration is shown in the accompanying drawings, in which,

Figure 1 is a side elevation, parts of the casing being broken away.

Figure 2 is a section on the line 2—2 of Figure 3.

Figure 3 is a section on the line 3—3 of Figure 2.

Figure 4 is an end elevation.

Figure 5 is a section on the line 5—5 of Figure 2, and

Figures 6, 7, 8 and 9 are composite semidiagrammatic views illustrating the cycle of operations.

Referring to the drawings, and particularly to Figures 3 and 5, the apparatus comprises a casing including two mating sections 1 and 2 which are secured together as by means of bolts 3 to form a housing for the rotor 4. The rotor 4 is mounted on the driven shaft 5 and may be secured thereto by means of the keys 6 to rotate therewith and be driven thereby at all times.

As illustrated in Figures 2, 3 and 5, the rotor 4 comprises the hub portion 7 surrounding the shaft 5 and a disk portion 7′ preferably formed integrally therewith, and lying in a plane at right angles to the axis of the shaft 5. The said disk portion has two radially extending channels 10 and 11 formed therein, the said channels extending from the area around the hub to the periphery of the disk of the rotor and being disposed in adjacent parallel planes. The peculiar formation of the radially extending channels 10 and 11 is shown more clearly in Figure 2. It is desirable that the channels 10 and 11 be formed to reduce the frictional resistance between the fluid flowing therethrough and the sides of the channels and also to reduce the centrifugal force with which the fluid being pumped is thrown from the intake channel, namely, the channel which is following a piston or bulkhead 12 which is carried by the rotor. In the present embodiment I obtain the desired action by employing a channel such as the channel 10 which is shown in full lines in Figure 2. The channel 10 may be described as having a bottom or base portion 50 which is curved concentrically about the shaft 5, and which has, for example, a radius r; a leading side 51 which is curved eccentrically about the shaft 5 and which has a radius greater than radius r centered as shown in Figure 2; and, a following side 52 which is flared in such a way that its surface is a compound curve which intersects the periphery of the rotor at an angle substantially less than 90°. As shown in dotted lines in Figure 2, the outlet channel 11 has the same formation as the channel 10, and has sides 50′, 51′ and 52′ corresponding respectively to sides 50, 51 and 52.

As above pointed out (and as illustrated in Figures 2 and 5), the rotor carries a wing or piston 12, and the channel 10 so opens along the periphery of the rotor as to form a slot 13, the leading edge 51 of which is disposed on one side of the piston 12, while the channel 11 so opens along the periphery of the rotor as to form a slot 14, the following edge 51′ of the channel 11 being disposed on the opposite side of the piston 12.

Each of the casing members 1 and 2 is provided with an annular chamber 17 and 18 (see Figures 3 and 5) respectively, surrounding the hub 7 of the rotor 4 which said chambers communicate with passages 19 and 20 respectively which terminate in internally threaded openings 21 and 22 respectively. The channel 10 of the rotor is in communication with the annular chamber 18 and passage 20 and opening 22 while the channel 11 is in communication with the chamber 17 and with passage 19 and opening 21. Communication between the channels 10 and 11 is permitted, however, only through the annular piston chamber 24 which is formed between the outer periphery of the rotor and the inner walls of the housing against which the piston 12 operates. As will be observed, a fluid passage is thus provided from the opening 22, which may be referred to as the intake opening, through the passage 20 to the chamber 18, and thence through the channel 10 and slot 13 to the chamber 24. If, for the moment, it be assumed that the chamber 24 is open from one face of the piston 12 around to the other face thereof, fluid may enter the slot 14 and pass through the channel 11, and thence through the chamber 17 and passage 19 to the opening 21

which may be referred to as the discharge opening.

Also mounted on the shaft 5 and secured thereto in any suitable manner is a spiral gear 26 which meshes with a second spiral gear 27 secured to the counter shaft 28. On the ends of the shaft 28 are secured the spiral gears 29 and 30 which mesh with spiral gears 31 and 32 which are secured respectively to the shafts 33 and 34. The sizes of the gears 26, 27, 29, 30, 31 and 32 are such that for each complete revolution of the shaft 5, a complete revolution is imparted to the shafts 33 and 34, the gear ratio thus being one to one.

Mounted on the shafts 33 and 34 to rotate therewith are disk valves 36 and 37 which project into the chamber 24 at diametrically opposite points, and fit against the peripheral face of the rotor to form a seal in the manner illustrated in Figure 5. Each of the valves 36 and 37 is cut away to form notches 40 and 41, and the said valves are mounted upon the shafts 33 and 34 in such manner that upon rotation of the rotor in either direction the notches in the valves will permit passage therethrough of the piston 12 in order that the rotor 4 may be rotated continuously without obstruction.

The shafts 33 and 34 are carried in bearings 42 and 43, the said bearings being carried in threaded housings 44 by means of which the entire bearing and shaft may be adjusted in order that the valves 36 and 37 may rotate without friction against the sides of the casing.

In order to prevent leakage of fluid along the shaft 5 the trap 46 is provided which communicates with a slot 47 formed in the shaft, the said slot having a discharge opening 48 to the chamber 18. Thus any fluid which is forced out of the chamber 17 is collected in the trap 46 and is returned to the chamber 18 through the duct 47 and opening 48.

The operation of the pump may be understood by reference to diagrammatic Figures 6, 7, 8 and 9. If it be assumed that the piston 12 is in the position illustrated in Figures 2 and 6, and if from this position, the rotor is caused to rotate in counter-clockwise direction, it will be observed that while the rotor 4 is moving through a 45 degree angle, the disk valves also move through a 45 degree angle so that the notch 40 of the valve 36 is presented to the piston when it arrives opposite the valve, and the piston is therefore permitted to pass the valve without obstruction. Similarly after rotating through an additional 180 degrees the notch 41 of the valve 37 is presented to the piston 12 and the rotor is thus permitted to rotate continuously without obstruction.

In the position illustrated in Figure 7 the valve 37 is closed and as the piston is rotated in counterclockwise direction fluid in the chamber 24 between the valve and piston is forced through the slot 14 and into the channel 11 and thence through the chamber 17 and passage 19 to the discharge opening 21. At the same time, the same motion of the piston 12 causes fluid to be drawn into that part of the chamber 24 on the other side of the piston, such fluid being admitted through the slot 13 and channel 10 passing from the chamber 18 and passage 20 from the intake opening 22. As the piston 12 advances from the position shown in Figure 6, the valve 36 begins to open, but the valve 37 has closed previously and remains closed during the entire interval that the valve 36 is open, the effect being that as the piston rotates, the fluid in the chamber 24 which is ahead of the piston is forced continuously through the slot 14. Similarly before the valve 37 is opened by continued rotation of the piston the valve 36 is closed. Thus the fluid which is contained in the chamber 24 is constantly forced through the slot 14 because one of the valves 36 or 37 is always closed ahead of the piston, and similarly fluid is constantly drawn into the chamber 24 behind the piston because one of the valves 36 or 37 is always closed behind the piston.

Thus as the shaft 5 is driven at a constant rate of speed, fluid is drawn in and discharged from the pump at a constant rate of speed, an amount of fluid equal to the entire contents of the chamber 24 being discharged during each revolution of the shaft 5. As the rotor 4 rotates, and the piston 12 forces a discharge of the fluid being pumped through the exhaust channel 11 the fluid is drawn in behind the following surface of the piston through the intake 22, the annular chamber 18 and the channel 10. As the intake fluid passes through the channel 10, as the rotor 4 is rotating at a high speed, such as 2000 to 3600 R. P. M., there is a great tendency for the fluid being drawn in to be swung against the periphery of the annular piston chamber 24 by the centrifugal force created by the rapidly rotating rotor. If this operation is allowed, although the piston 12 may create a vacuum substantially equal to the existing barometric pressure, the friction created by the turbulence and force with which the intake fluid is slung against the outer periphery of the chamber 24 may become so great as to equal the vacuum obtained by the piston 12, in which event the pump may become vapor bound and its capacity and efficiency cut down. This difficulty exists in the usual rotary pumps, which though they may not be limited in speed or capacity by the mechanical construction, are limited because of the vapor binding effect created by the force with which the incoming fluid is thrown against the outer periphery of the chambers. In my present invention, I have overcome these difficulties, common to rotary pumps, by the peculiar construction of my inlet channel or passageway 10 hereinbefore described, which has the effect of "laying" the incoming fluid around the outer periphery of the chamber 24 rather than slinging it thereagainst. In operation the fluid being forced in by the atmospheric pressure to fill the vacuum created by the piston 12 is forced through the inlet 22 and the chamber 18, into the lower portion of the channel 10, and then through the channel 10 into the piston chamber 24. However, as the fluid moves toward the periphery of the rapidly rotating rotor 4 it is forced by the leading side 51 to enter the chamber 24 tangentially, and as it moves forward the sloping side 52 acts to push the fluid the remainder of the way into the chamber 24. The sides 51 and 52 coact with the rotary motion of the rotor 4 to deflect the entering fluid from the rotor, or to lay the entering fluid along the piston chamber 24, rather than to sling it against the outer periphery of the piston chamber 24. In this way, the amount of friction between the fluid and the sides of the channel, and between the sides of the chamber 24 is cut down to the extent that the pump may be rotated at 3600 R. P. M. without any vapor binding. To reiterate, the inflowing fluid may be considered as a continuous stream which is forced through the intake 22 and the chamber 18 into the concentric portion 50 of the channel 10 in which position it is not forced to

rotate with the rotor 4 because of the concentrically curved side 50. Further, even as the stream moves to the periphery of the chamber 24 it is not forced to rotate about the shaft 5 with the rotor because as it moves into a position opposite the sides 51 and 52 it is allowed to fall away from the piston 12 and the slot 13 and is in fact lifted away from the rotor 4 by the peculiar slant of the side 52.

Thus by this peculiar construction of intake channel 10 I am able to obtain many thoroughly practical results such as, for example, a rotary pump in which the friction between the intake fluid and the various parts of the pump is reduced to the extent that the operation of the pump is practically insured against vapor binding.

Another result obtained by the construction of the channels 10 and 11 is that the amount of friction between the exhaust fluid, the pumped fluid, and the parts of the pump, is reduced, the exhaust channel acting to scoop up the exhaust fluid to carry it to the exhaust chamber 19. In this connection it is to be noted that the following side 51' of the exhaust channel 11 serves to counteract the rotary motion given to the exhaust fluid by the rotor 4, and hence reduces the amount of work required to pump the fluid.

Another result which I accomplish by the construction of the channel 11 is most clearly illustrated in Figures 6 through 9, in which it is to be noted that as the piston 12 of the rotor 4 approaches one of the valves 36 or 37, the pressure on the sides of the valves 36 or 37 is equalized, and hence as the edges of the valves enter the chamber 24, there is no tendency for the edges to strike against corners or edges of the casing 1 and 2. This result is obtained because the leading side 52' of the channel 11 passes the valve being approached by the piston 12 before the key portions 40 or 41 of the valves enter the chamber 24. As the slot 14 of the channel 11 passes either of the valves the pressure created by the forwardly moving piston 12 is transferred to both sides of the valve.

It is to be noted that although the pump has been described as operating in a counter-clockwise direction, it is reversible and will operate in the opposite direction with equal facility, in which event the channel 10 will act as the exhaust channel and the channel 11 as the intake channel. Inasmuch as the channels 10 and 11 are complementary to each other the operation in either direction is identical in efficiency and capacity.

It is to be understood that, although the construction of the channels 10 and 11 shown and described in the present embodiment is entirely practical and attains the desired results, the construction may be varied as practice might require, without departing from the scope of the present invention.

It will be understood that the invention may be variously modified and embodied within the scope of the subjoined claims.

I claim as my invention:

1. In a pump, in combination, a casing having an annular piston chamber, a rotor rotatable in said casing, a piston on said rotor adapted to move in said chamber as said rotor rotates, and means including a pair of rotary valves for providing a fixed closure in said chamber ahead of said piston at all times; said rotor having an intake opening on one side thereof, and a discharge opening on the other side, said intake opening comprising a bottom semi-circular side concentric with an axis of said rotor, a leading side, and a following side, said following side being radially flared, whereby the fluid entering said chamber through said intake opening is deflected by said following side from said rotor.

2. In a pump, in combination, a casing having an annular piston chamber, a rotor rotatable in said casing, a piston on said rotor adapted to move in said chamber as said rotor rotates, and means including a pair of rotary valves for providing a fixed closure in said chamber ahead of said piston at all times; said rotor having an intake opening on one side thereof, and a discharge opening on the other side, and said intake opening having a leading side and a following side which is substantially flared to fall away from the leading side whereby fluid entering said chamber through said intake opening is not given the speed of rotation of the rotor.

3. In a pump, in combination, a casing having an annular piston chamber, a rotor rotatable in said casing, a piston on said rotor adapted to move in said chamber as said rotor rotates, and means including a pair of rotary valves for providing a fixed closure in said chamber ahead of said piston at all times; said rotor having an intake opening on one side thereof, and a discharge opening on the other side, and said intake opening having a leading and following side, said leading side being curved eccentrically with an axis of said rotor, and said following side being substantially shorter than said leading side and falling away from said leading side, whereby fluid entering said chamber through said intake is deflected by said following side from said rotor.

4. In a pump, in combination, a casing having an annular piston chamber, a rotor rotatable in said casing, a piston on said rotor adapted to move in said chamber as said rotor rotates, and means including a pair of rotary valves for providing a closure in said chamber ahead of said piston at all times; said rotor having a flat intake channel on one side thereof, and a flat discharge channel on the other side, and said intake and discharge channels being disposed on opposite sides of said piston, and the side of said intake channel being curved away from the direction of rotation of said rotor and being substantially flared whereby the fluid entering said chamber through said intake opening is deflected from said rotor.

5. In a rotary pump, in combination, a casing having an annular piston chamber, a rotor rotatable in said casing, the piston on said rotor adapted to move in said chamber as said rotor rotates, and rotary valves for providing fixed closures in said chamber ahead of said piston at all times; said rotor having an intake channel on one side thereof, and a discharge chamber on the other side, and the sides of said intake channel having leading and following sides, said sides being curved away from the direction of rotation of the rotor, and being flared, to prevent vapor binding of said intake when said rotor operates at high speeds.

6. In a rotary pump, in combination, a casing having an annular piston chamber, a rotor rotatable in said casing, a piston on said rotor adapted to move in said chamber as said rotor rotates, and valves for providing fixed closures in said chamber ahead of said piston at all times, said rotor having an intake channel on one side of said piston, and a discharge chamber on the other side thereof, and the sides of said intake channel having leading and following sides, said

sides being curved away from the direction of rotation of the rotor, and being flared, whereby fluid entering said chamber through said intake is not given the speed of rotation of the rotor.

7. In a pump, in combination, a casing having an annular piston chamber, a rotor rotatable in said casing, a piston on said rotor adapted to move in said chamber as said rotor rotates, and means including valves for providing a fixed closure in said chamber ahead of said piston at all times; said rotor having an intake opening on one side thereof, and a discharge opening on the other side, said intake opening having a bottom semi-circular side concentric with an axis of said rotor, a leading side, and a following side, said following side being radially flared, whereby the fluid entering said chamber through said intake opening is deflected by said following side from said rotor.

PORTER S. MORGAN.