

April 7, 1942.

A. C. ROESSLER

2,278,740

ROTARY PUMP

Filed May 16, 1939

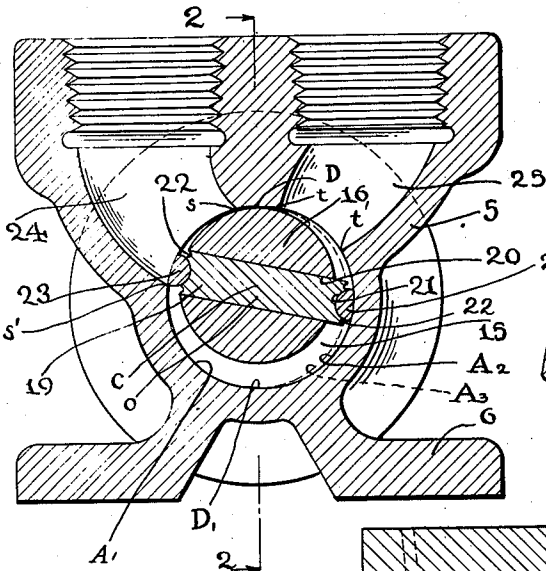


Fig. 1.

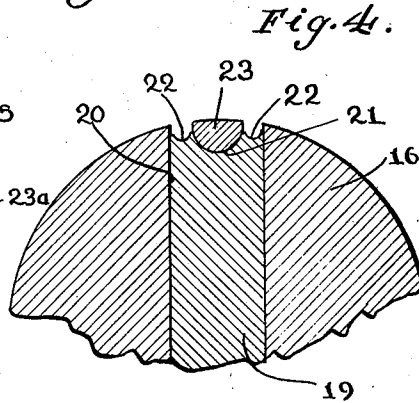


Fig. 4.

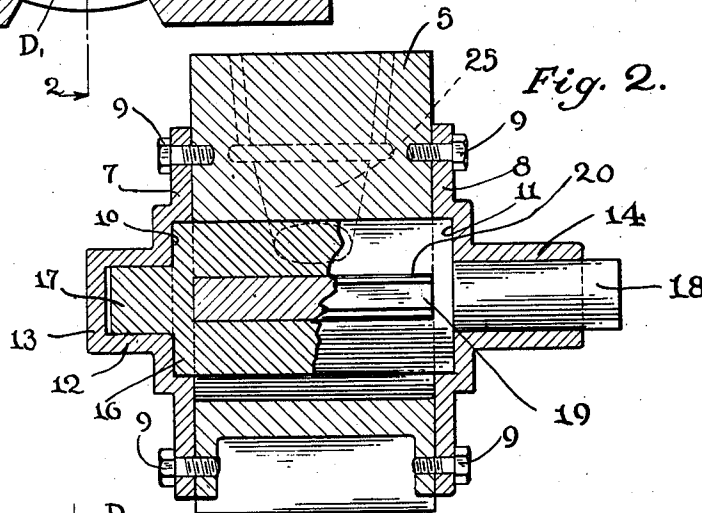


Fig. 2.

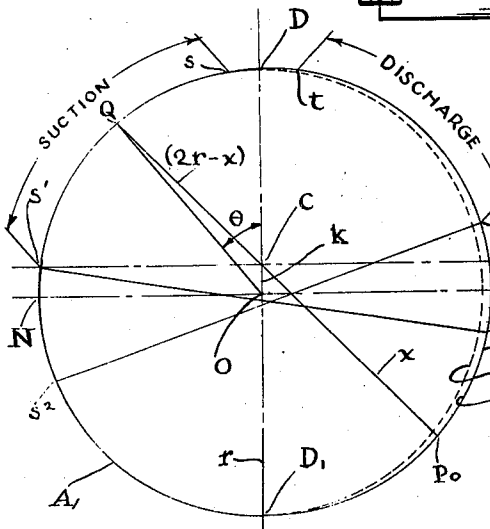


Fig. 3.

Amandus C. Roessler
INVENTOR
BY Walter C. Kelsey
ATTORNEY

UNITED STATES PATENT OFFICE

2,278,740

ROTARY PUMP

Amandus C. Roessler, Berea, Ohio, assignor to
Bosco Company, Limited, Cuyahoga County,
Ohio, a limited partnership

Application May 16, 1939, Serial No. 273,953

2 Claims. (Cl. 103—137)

This invention relates to improvements in pumps, and more particularly, to the type of pump having a rotor provided with a sliding blade.

An object of this invention is to provide a rotary pump, which will be smooth in action and free from objectionable pulsation and vibration.

Another object is to provide a pump in which the head pressure is prevented from surging against the incoming fluid in the suction line, thereby providing smooth and efficient action.

Another object is to provide a pump bore, having a curvature which is constructed and arranged in such manner, that deviation from a true circle is practically imperceptible, thereby insuring smooth travel of the rotating blade.

Another object of this invention is to provide a rotary pump with the parts positioned and arranged in such manner that the discharge port may be opened after the suction port has been closed, the same being accomplished without danger of liquid from the discharge port causing hammering in the partially evacuated space.

Another object is to provide means for preventing foreign matter such as grit or sand, carried into the fluid being pumped, from catching in the wedged portion between the forward end of the blade and the point of rotor and bore contact.

Other objects are to provide a pump adapted to be produced at a relatively low cost, the same being durable and efficient in operation.

Another object is to provide a rotary pump, of more than fractional size, capable of being operated at motor speed, which is approximately 1750 R. P. M.

Other and further objects of the invention will become apparent during the course of the following description.

In the drawing forming a part of this application, Figure 1 is a central vertical sectional view of a pump embodying my invention,

Figure 2 is a sectional view taken on the line 2—2 of Figure 1,

Figure 3 is a diagrammatic view illustrating the generation of the curvature of the casing, while

Figure 4 is an enlarged fragmentary end view of rotor shown in Figure 1.

In the drawing the numeral 5 refers to the casing of the pump which is mounted on an integrally formed base 6. End plates or cylinder heads 7 and 8 are secured to the casing 5 by means of bolts 9 which are screw-threadedly received in the casing 5.

The inner faces of the end plates 7 and 8 are

provided with seats 10 and 11 respectively. Centrally, seat 10 is provided with a blind bearing 12, closed at its outer end as indicated at 13, this construction eliminating the necessity of packing the bearing 12, while seat 11 is provided with an open bearing 14.

The pump chamber, indicated by the numeral 15, is positioned and arranged, as hereinafter described, while a cylindrical rotor 16, extending from one side to the other of the pump chamber 15 has its ends fitted snugly into the seats 10 and 11 of the casing 5. One end of the rotor 16 is provided with a stud shaft 17 extending into the closed bearing 12, while the other end of the rotor 16 is provided with a driving shaft 18, extending through the bearing 14, and adapted to be driven by any suitable means, not shown herein, for actuating the herein disclosed pump in an obvious manner.

A slidably mounted blade assembly 19 is mounted in a slot 20, passing through the axis of the rotor 16 and corresponding in axial length to the axial length of the pump chamber 15. The blade 19 is preferably made of steel and in each end thereof a concave seat 21 is provided, while a smaller groove 22 is provided on each side of the seat 21, forming a depression in advance of the blade into which any small foreign matter will fall, and be carried over the point of rotor and pump chamber contact, to be discharged into the fluid cavity and pass out at the discharge port.

Rockers 23, 23a are arranged in each seat 21. The rockers 23, 23a may be formed of rods of packing material, circular in cross-section, having approximately the same radius as the arc of the seat 21 at the blade end. A portion of the material at one side of the rod curvature is then formed on the face thereof, corresponding to the average curvature of the wall of the pump chamber 15.

The rockers thus formed are then set into the seats 21 respectively in such manner that the face portion of the rocker contacts the wall of the pump chamber 15 and the side portions project beyond the seat 21. Due to this construction, the rockers are free to rock in the seats 21 as the blade 19 revolves, in order that the face of the rockers will at all times conform and tightly press against the wall of the pump chamber 15.

The rockers 23 and 23a having a definite side area projecting beyond the end of the blade, it follows that when fluid is being forced through the pump, the pressure of the fluid will act against the sides of the rockers and cramp them

against the respective seats 21, thereby greatly increasing the efficiency of the rockers.

A suction port 24 and a discharge port 25 are provided, and are positioned and arranged as shown in Figure 1 and are related to the rotor as will hereinafter appear.

Referring to Figure 1, D represents the point of contact between the bore of the pump chamber and the rotor 16 while C indicates the center of rotation of the rotor 16, and O indicates the center of the semi-circle A₁, defining the left-hand half of the pump chamber 15 as viewed in Figure 1. The diameter chord of the semi-circle A₁ is indicated by D, D₁ and it will be noted that the center of rotation C is on that chord but is eccentric of the center O. For reasons which will appear, the right-hand half of the pump chamber bore is not made semi-circular but is such that the volume of the right-hand half is greater than that of the left-hand half, as viewed in Figure 1.

The effective chord length of the blade 19, by which is meant its dimension from the surface of the rocker 23 to the surface of the rocker 23a, is equal to 2r, where r is the radius of the semi-circle A₁, and the nature of the curve A₂ defining the right-hand half of the pump bore is such that as the blade 19 rotates its effective chord length at all times defines the distance between the opposite surfaces of the pump bore contacted by the rockers 23, 23a.

Let it be assumed that the parts are in the position shown in Figure 1, so that the leading edge of the rocker 23 is at the point s', just closing the suction port 24. Then referring to Figure 3, the line s'-u represents a line from the leading edge of the rocker 23 to the trailing edge of the rocker 23a. As the leading edge of the rocker 23 moves from the point s' to the point s², the trailing edge of the rocker 23a moves from the point u to the point t' and further movement will, of course, begin to open the discharge port. The position of the point t' relatively to the other parts is so selected that when the rocker 23a moves from u to t' the volume in the arcuate pump-space between u and t' is equal to the volume of the arcuate pump-space between s' and s². Consequently when the discharge port opens the total volume in the pump-space on the pressure side is the same as when the suction port was just closed. It will be apparent that if the discharge port were opened at some intermediate point such as P the foregoing would not be true but, on the contrary, the volume in the pressure space would be larger than when the suction port was closed, so thus there would be a partial volume or air space, into which liquid from the discharge pipe would rush and cause hammer as the discharge port was opened.

In prior pump constructions the discharge port is so disposed that it is opened at the same time or slightly before the suction port closes in order to avoid compression, for example the discharge port would open at the point u, or at u', respectively. This disposition of the ports results in back pressure from the discharge line directly into the suction line, causing a backward surge and consequent vibration and noise. If, on the other hand, in order to overcome this objectionable feature the point of discharge opening is set back to say P, a backward surge of fluid takes place due to the fact that the position of the blade results in slightly increasing the cubical capacity of the fluid cavity thus forming a partial vacuum or air pocket into which the

fluid rushes upon opening of the discharge port, causing vibration and uneven flow.

My invention avoids all of these objectionable features, by so constructing and arranging the ports that the discharge port is opened after the suction port, thereby avoiding surge into the suction line, and though the discharge port is opened after the suction port is closed, there will be neither undesired compression nor a partial vacuum, but, on the contrary, the volume of the pressure space of the pump will be the same when the discharge port opens as it was when the suction port closed.

The character of the curve A₂ may be determined mathematically, as follows. Referring to Figure 3, P₀ represents a point on the desired curve. The line QP₀ has a length of 2r and it passes through the center of rotation C so that the line QP₀ represents the effective chord length of the blade 19. Assume first that the blade 19 is in the vertical position so that its effective chord length QP₀ coincides with the diameter D, D'. Now if we move the point Q along the semi-circle A, while the line QP₀ always passes through the center of rotation C, the end of the chord opposite from Q will describe the desired curve A₂.

For any position of the chord QP₀ we may assign the value x to that part of the chord between the points C and P₀. Then that part between the points C and Q is equal to 2r-x since the length of the chord QP₀ is equal to 2r. We may draw a radius r from the center O of the semi-circle A, to the point Q, and define the variable angle between the radius r and the diameter D, D₁ as θ. The distance between the center of rotation C and the center O of the semi-circle A, is a constant K.

From the triangle OQCO we may obtain an expression for x since one of the sides of this triangle contains x as a term. From plane trigonometry, in any triangle the square of any side is equal to the sums of the squares of the other two sides, minus twice their product into the cosine of their included angle. Hence the square of the side QC is equal to the square of the side QO plus the square of the side CO minus twice the product CO times QO into the cosine θ. Solving this equation for x it can be shown that

$$x = 2r - \sqrt{r^2 + k^2 - 2kr \cos \theta}$$

The values of r and k are of course known, so that it is only necessary to assign any desired number of different values to the angle θ to determine any desired number of points P₀ or the curve A₂.

The effect of back pressure upon the projecting portion of the blade is minimized by correct proportioning of the bore of the pump chamber and the rotor diameters with respect to each other. Such proportioning is also imperative for satisfactory high speed operation. Satisfactory results are obtained when the pump chamber bore diameter does not exceed that of the rotor diameter by more than approximately fifteen per cent. In other words, fifteen per cent of the rotor diameter added to this diameter results in a bore diameter of smooth and quiet operation at high speed of pumps of greater than fractional capacity.

It will be apparent to those skilled in the art that the invention herein disclosed, may be variously changed, used or modified, without departing from the spirit of the invention or sacrificing the advantages thereof, and that the embodiments of the invention herein disclosed

are illustrative only and that my invention is not limited thereto.

I claim:

1. A rotary fluid pressure machine comprising a casing, a chamber positioned within said casing and comprising halves of different form at opposite sides of a chamber diametrical chord, the chamber on one side of the chord being circular and on the opposite side of the chord being enlarged beyond a true circle, a rotor positioned eccentrically within said chamber and in contact therewith at the upper intersection of the chord with said chamber, a single blade reciprocable diametrically within said rotor and adapted to make sealing contact with said chamber in all blade positions, a suction port in communication with the chamber through the circular half thereof at one side of the point of rotor contact, a discharge port in communication with the chamber through the enlarged half thereof at the other side of the point of rotor contact, and said ports being arranged so that when one end of the rotor blade closes the suction port the blade travels a sufficient distance before the other end of the blade opens the discharge port to restore the volume confined between the ends of the blade to the same value attained when the suction port was closed whereby partial vacuum or compression in the pump space is prevented.

2. A rotary fluid pressure machine comprising a casing, a chamber positioned within said casing and comprising halves of different form at opposite sides of a chamber diametrical chord, the chamber on one side of the chord being circular and on the opposite side of the chord

being enlarged beyond a true circle, said chamber on the opposite side of the chord being constructed and arranged in such manner that it is defined by the end of a vector of variable length whose origin is disposed eccentrically on said diametrical chord, the length of said vector is measured by the formula

$$X = 2r - \sqrt{r^2 + k^2 - 2kr \cos \theta},$$

10 in which r is the radius of said semi-circle, and k is the eccentricity of said origin and θ is the angle between said diametrical chord and a radius of said semi-circle, the position of said radius being determined by the intersection of the rearward projection of said vector with said semi-circle, a rotor positioned eccentrically within said chamber and in contact therewith at the upper intersection of the chord with said chamber, a single blade reciprocable diametrically within said rotor and adapted to make sealing contact with said chamber in all blade positions, a suction port in communication with the chamber through the circular half thereof at one side of the point of rotor contact, a discharge port in communication with the chamber through the enlarged half thereof at the other side of the point of rotor contact, and said ports being arranged so that when one end of the rotor blade closes the suction port the blade travels a sufficient distance before the other end of the blade opens the discharge port to restore the volume confined between the ends of the blade to the same value attained when the suction port was closed whereby partial vacuum or compression in the pump space is prevented.

AMANDUS C. ROESSLER.