Oct. 23, 1934. O. O. STAGEBERG 1,977,780

FLUID PUMP AND MOTOR

Original Filed May 28, 1931

Fig. 1.

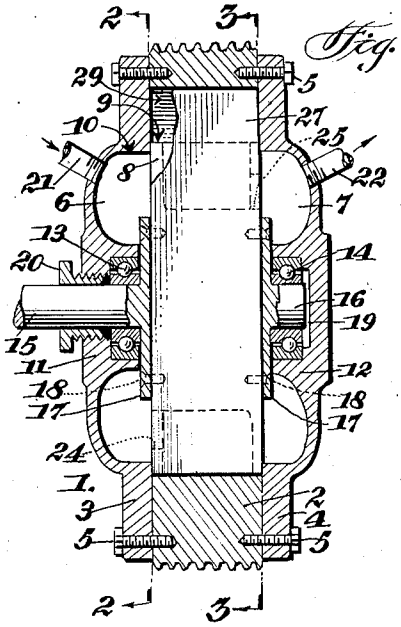


Fig. 2.

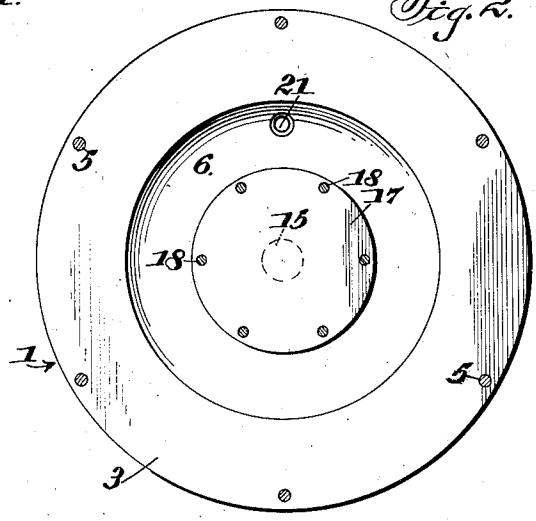


Fig. 3.

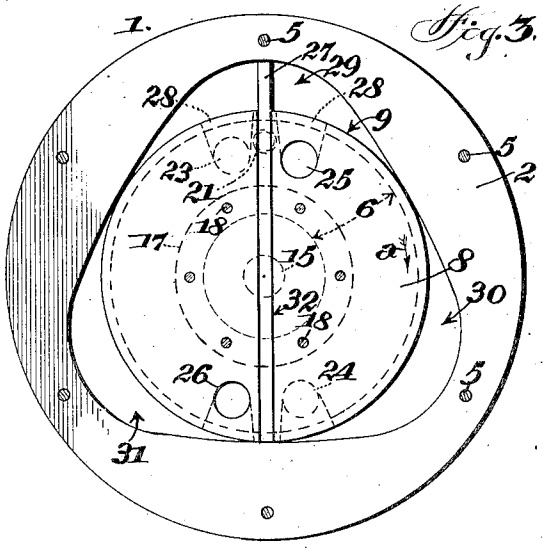
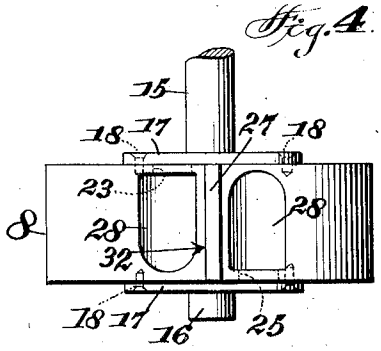


Fig. 4.



WITNESSES

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FLUID PUMP AND MOTOR

Olaf O. Stageberg, Red Wing, Minn.

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2 Claims. (Cl. 103—137)

This invention relates to improvements in engines, pumps, compressors and the like and it consists of the constructions, combinations and arrangements herein described and claimed.

An object of the invention is to provide a device which is primarily intended for use either as a fluid pump or motor, one of the outstanding features being a piston that is rigid or fixed insofar as its dimensions are concerned, this piston being carried by a rotor in which it is slidable by virtue of the novel form of the working chamber in which the ends of the piston are operable.

Another object of the invention, and one bearing directly on the foregoing statement, is to provide a piston which never shortens or lengthens in the carrying out of its rotor impelling function, sliding motion of the piston being solely dependent on the shape of the working chamber of the stator casting in which the rotor revolves.

Another object of the invention is to employ a peculiar symmetrical contour for the working chamber, which contour has the property of compelling simultaneous action at the projecting ends of the unit piston thus insuring an absolutely uniform fluid stream from the device when used as a pump, and continuous power impluses when used as a motor.

A further object of the invention resides in the novel arrangement of ports or passages in the rotor which coact with the working chamber in such a manner as to achieve the results last named.

Other objects and advantages will appear in the following specification, reference being had to the accompanying drawing in which

Figure 1 is a vertical section of the convertable pump and motor, parts being shown in elevation.

Figure 2 is a vertical section taken on the line 2—2 of Figure 1.

Figure 3 is a vertical section taken on the line 3—3 of Figure 1.

Figure 4 is a detail edge view of the rotor.

In carrying out the invention, provision is made of a stator, generally denoted 1, which comprises a block or casting 2 and end plates 3, 4 which are secured to the block 2 at opposite sides by means 5 (Fig. 1). In practice the stator will be mounted on an appropriate base or foundation so that it can be stood fixedly or movably, in any desired location.

The end plates 3, 4 are bulged (Fig. 1) to provide annular fluid chambers 6, 7 (Fig. 2). These chambers would be open at the places where they confront the rotor 8 (Figs. 3 and 4), but the sides of the rotor provide closures which complete the fluid chambers as plainly seen in Figure 1. The perimeter 9 of the rotor 8 overlaps the largest diameter 10 of the chambers 6, 7 (Figure 1), thus insuring an outer edge closure.

The respective end plates 3, 4 have central hubs 11, 12 around which the chambers 6, 7 are formed (Fig. 1). These hubs provide the supports for ball or other bearings 13, 14 of an axle which comprises components 15, 16. Each of these has a face plate 17 that is secured to the rotor 8 at 18. It is by virtue of the connection of the face plates with the rotor 8 that motion is imparted to the rotor 8 as when operating the device as a pump, or to the axle as when operating the device as a motor.

A recess 19 houses the bearing 14. This recess is open internally only, leaving the outer surface of the plate 4 solid and continuous. The stub component 16 of the axle is thus concealed from view, minimizing the chance of foreign matter reaching the bearing 14. On the other side the bearing 13 is protected by a gland 20 that compresses a packing in a well known manner.

Inlet and outlet pipes 21, 22 (Fig. 1) function either for the introduction of pressure fluid and the exhaust in the event of operating the device as a motor, or for the induction and discharge of the fluid to be pumped when operating the device as a pump. These pipes communicate with the chambers 6, 7 which will always be full of the respective fluids. Since these chambers are annular (Fig. 2), it follows that there is a complete annular body of fluid adjacent to each side of the rotor 8.

The rotor 8 has intake ports 23, 24 (Fig. 3) and exhaust ports 25, 26. The ports 23, 24 open into the chamber 6 (Fig. 1), in other words to the chamber at the far side of the structure as viewed in Figure 3. The ports 25 and 26 open into the chamber 7 (Fig. 1), in other words to the annular chamber (not shown) at the near side of the structure in Figure 3.

These two kinds of ports are located at the opposite sides of the piston 27 which comprises a dividing element between the ports so that an intake and exhaust port adjoin each other (for example 23, 25) and an intake and an exhaust port (for example 23, 26) become segregated to one side of the piston.

Each of the ports has a radially directed but flaring opening 28 (Fig. 4) communicating with the perimeter 9 of the rotor, hence communicable with any one of a series of pockets 29, 30, 31 (Fig. 3) comprising the working chamber. The exposed ends of the piston 27 operate in these

pockets. The working chamber is equal in depth (Fig. 1) to the thickness of the stator casting 2, and since the rotor 8 accurately fits the distance between the end plates 3, 4, it follows that the thickness of the rotor and the depth of the working chamber are approximately the same.

Much importance is attached to the shape of the foregoing working chamber. The contour is on such an order that a rigid plate can be employed as the piston 27. By "rigid" is meant that the piston comprises a single, integral piece, with no compensating connections of any sort that would be intended to keep the exposed ends in contact with the periphery of the working chamber.

The piston 27 is slidable through the middle of the rotor 8. Since the piston, rotor and working chamber are all of the same dimension in the axial direction it becomes apparent that the rotor must be cut in half and shaved off enough on the confronting faces to produce the channel 32 (Fig. 3) for the piston and at the same time preserve the necessary roundness of the rotor. The face plates 17 are secured to the approximate halves in the manner already pointed out, and it is these plates that hold the halves in spaced relationship.

The form of the working chamber adopted for illustration is that of a geometrical figure having three equidistantly spaced lobes or pockets 29, 30, 31. It is only a form such as this, or a form possessing similar pockets in any power of three, that will enable the maintenance of contact of the extremities of a single one-piece reciprocable piston. There must never be any space between either end of the piston and the periphery of the working chamber, and only a working chamber of the form herein shown will accomplish the purpose.

The operation is readily understood. Consider the device first as a pump. Power is applied to the axle 15 (Fig. 1) and the rotor 8 is turned in the direction of arrow *a* (Fig. 3). The upper end of the piston 27 creates a partial vacuum in the left side of the pocket 29 (Fig. 3), the effects of which vacuum are communicated to the pipe 21 through the opening 28 and intake port 23, thus drawing fluid into the chamber 6, through the port 23 and opening 28 and continuously filling the chamber 29 at the left side of the piston as the latter proceeds out of the chamber. In other words, each chamber is filled with fluid as the piston advances to the right.

But simultaneously with the drawing in operation, the fluid previously introduced into the chamber 29 is expelled through the opening 28 at the right and exhaust port 25 into the chamber 7 (Fig. 1) whence it is conducted by means of the outlet pipe 22. This action is repeated in every one of the chambers 29, 30, 31 by each end of the piston 27 in turn. The bottom end of the piston will begin its expulsion of fluid from the pocket 31 before the top end has stopped its expulsion of fluid from the pocket 29. There is thus an overlapping of the expelling effort, resulting in a steady discharge of fluid.

Since the chamber 6 (Fig. 1) has communication with the pockets 29, 30, 31 at the suction side of the piston 27 only, and the pressure side of the piston communicates only with the chamber 7 and not with the chamber 6, it follows that the inlet pipe 21 has no need for a back check valve. On the same principle the outlet pipe 22 has no need for a back check valve.

Now consider the device as a motor. Pressure fluid is introduced into the chamber 6 by way of the inlet pipe 21 and reaches the pocket 29 by way of the port 23 and opening 28, filling the left side of the pocket 29. The left wall of the pocket now becomes the abutment against which the fluid expands toward the exposed piston end, driving the latter toward the right and the rotor 8 in the direction of arrow *a*.

The same thing happens in the other pockets 30, 31, and in each instance the exposed end of the piston drives the residual fluid of a previously expanded charge out of the pocket and through the ports 25 or 26 into the fluid chamber 7 whence it is exhausted by way of the outlet pipe 22. The bottom end of the piston 27 will enter the pocket 31 before the top end departs from the pocket 29 so that an application of power occurs at the bottom of the piston before the cessation of power against the top end.

This overlapping in the application of power results in a continuous and steady revolution of the rotor. There are no dead centers.

It is important to observe that there is no possibility whatever of the rotor 8 or piston 27 having to act against back pressure. This is explained thus:—Follow the top end of the piston 27 out of the pocket 29. Pressure fluid, fresh from the chamber 6, expends its energy against the top end of the piston 27 as long as any of it is exposed in the pocket, and pressure fluid will continue to flow into the pocket 29 as long as the opening 28 of the port 23 remains uncovered by the right peripheral wall of the pocket 29.

This means that the pocket 29 will end up filled with fluid under pressure. But as soon as the rotor 8 revolves far enough to bring the opening 28 of the exhaust port 26 into communication with the pocket 29, there will be an instant release of the entrapped pressure fluid into the chamber 7 so that by the time the present bottom end of the piston 27 enters the pocket 29 there will be hardly more than an atmosphere or so of fluid pressure which is quickly and completely discharged by the advancing piston. It is equally important to note that the discharge of the residual fluid ahead of the advancing piston continues for practically the entire length of the pocket 29. This is due to the proximity of the exhaust port 25.

While the construction and arrangement of the improved fluid pump and motor is that of a generally preferred form, obviously modifications and changes may be made without departing from the spirit of the invention or the scope of the claims.

I claim:—

1. A machine comprising a stator having fluid inlet and outlet chambers and a pocketed working chamber having regularly spaced intermediate rotor contact points, a single piece plate piston fitting the working chamber at every diametrical position, and a rotor concentric to the working chamber, slidably carrying the piston and having side ports in constant communication with the respective fluid chambers with connected peripheral openings periodically communicable with the successive pockets and periodically cut off by riding across said contact points.

2. A machine comprising a rotor, a portless stator block having a working chamber respecting which the rotor is concentrically mounted, said working chamber consisting of a symmetrical arrangement of pockets connected by relatively long, sweeping and slightly outwardly cur-

vilinear surfaces providing contact points for the rotor at places medially of the pockets, a single, unitarily constructed piston slidably carried by the rotor and accurately fitting the working chamber at every diametrical position, said rotor having a pair of peripheral openings closely adjacent to the piston at diametrically opposite sides, the respective openings of each pair communicating with oppositely directed ports in the rotor which ports open on opposite faces of the rotor, and end plates attached to opposite sides of the stator providing side closures for the pockets and having annular, uninterrupted inlet and outlet fluid chambers in constant communication with said ports.

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