

July 8, 1941.

O. L. ERICKSON

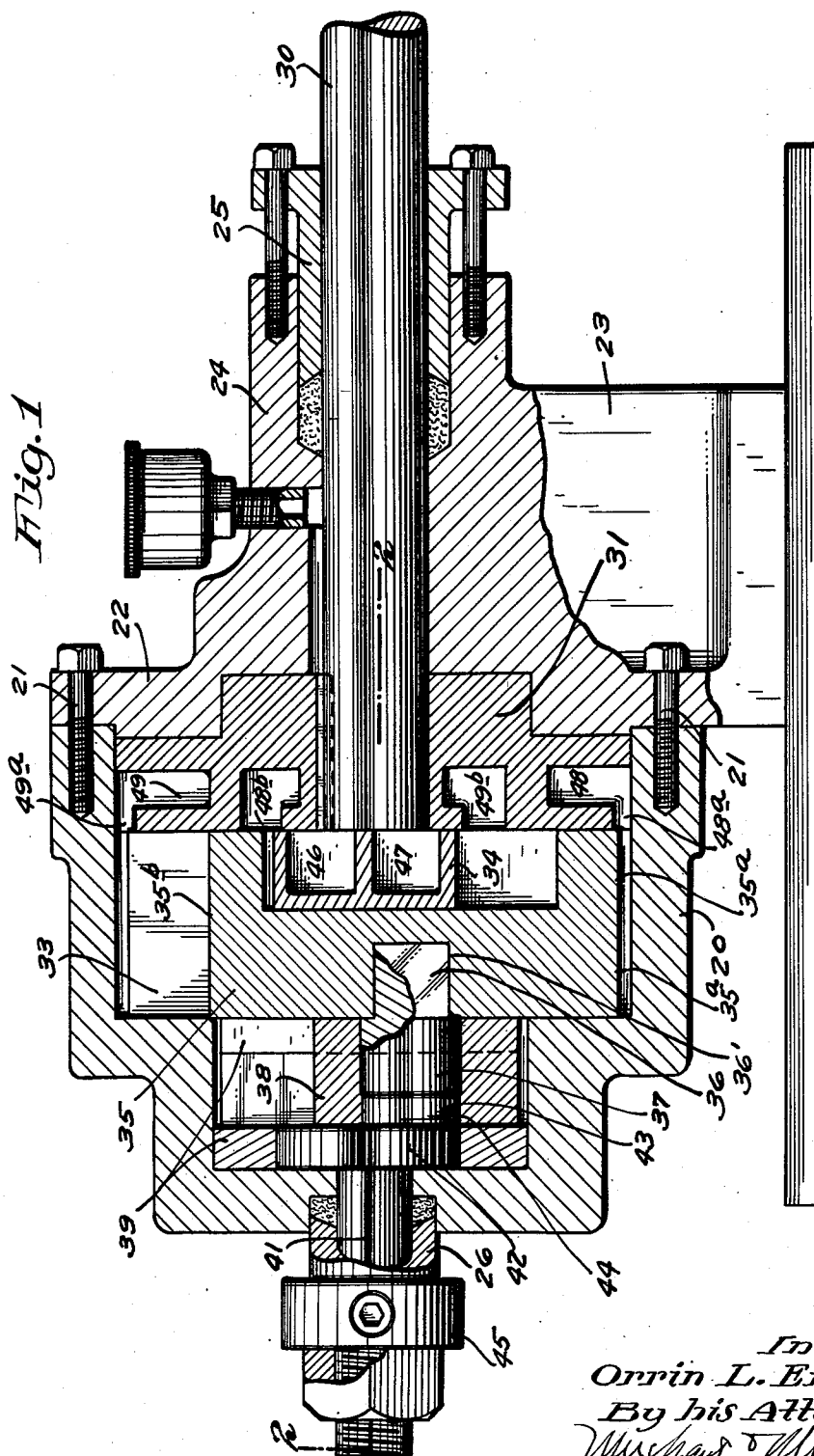
2,248,452

ROTARY PUMP

Filed May 4, 1939

7 Sheets-Sheet 1

Fig. 1



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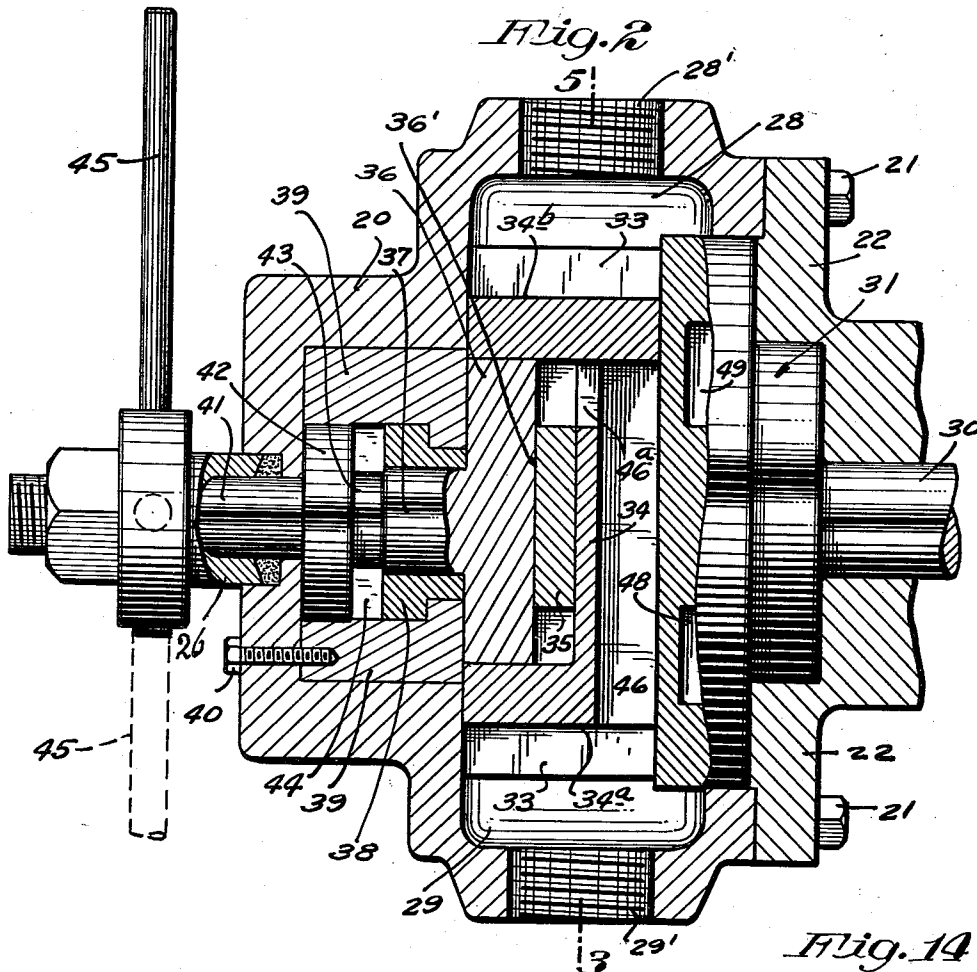


Fig. 14

Fig. 15

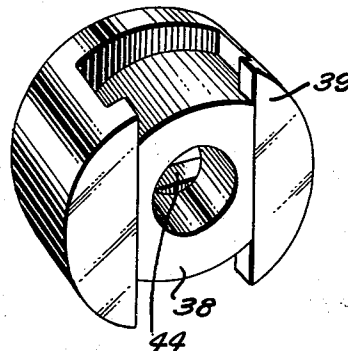
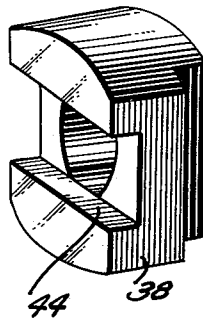
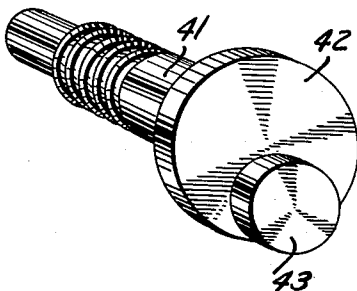


Fig. 16



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Fig. 3

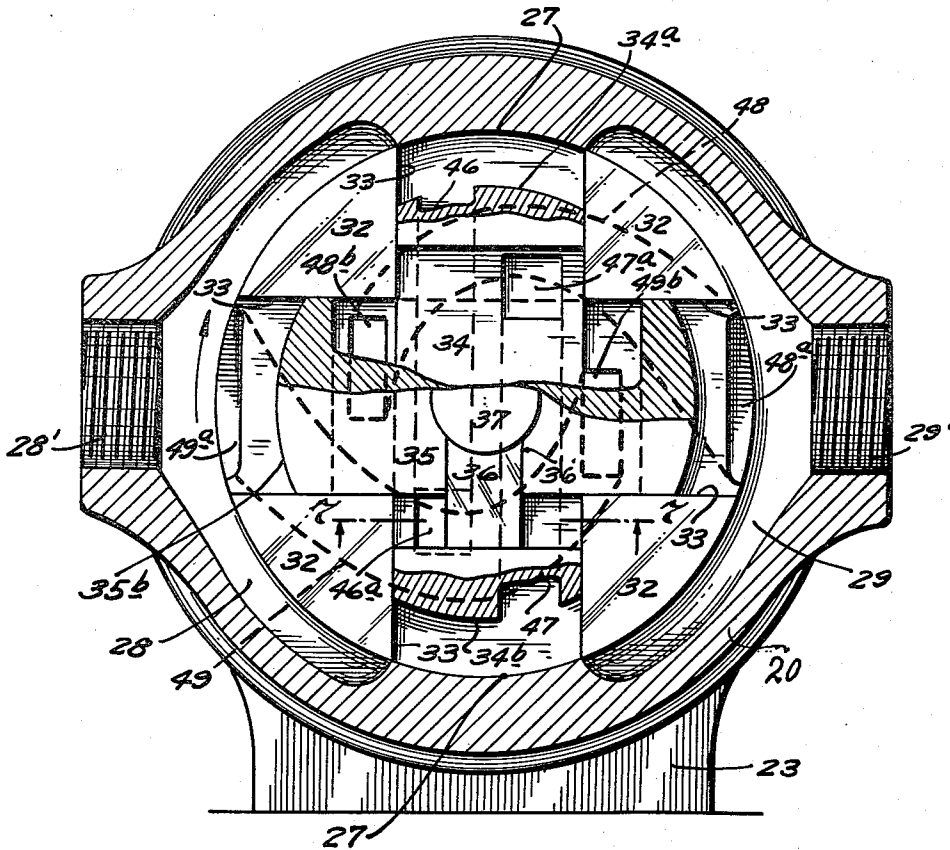
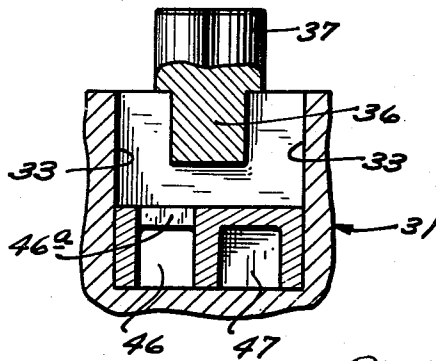


Fig. 2



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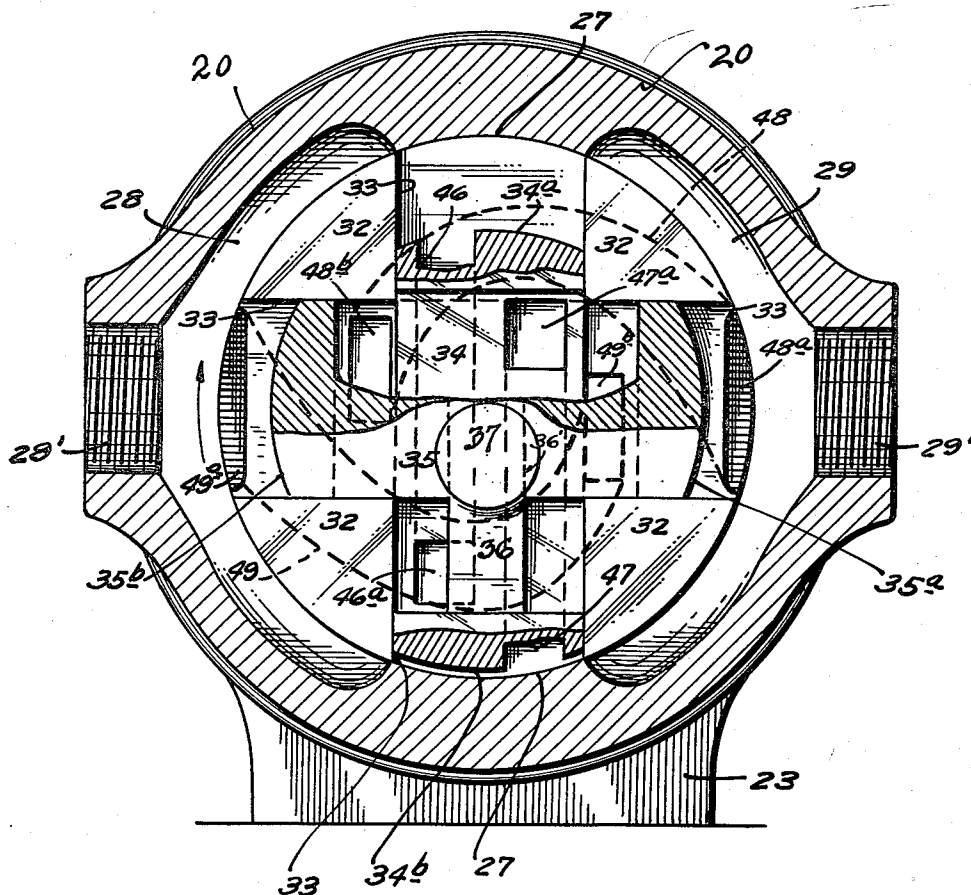
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Fig. 4



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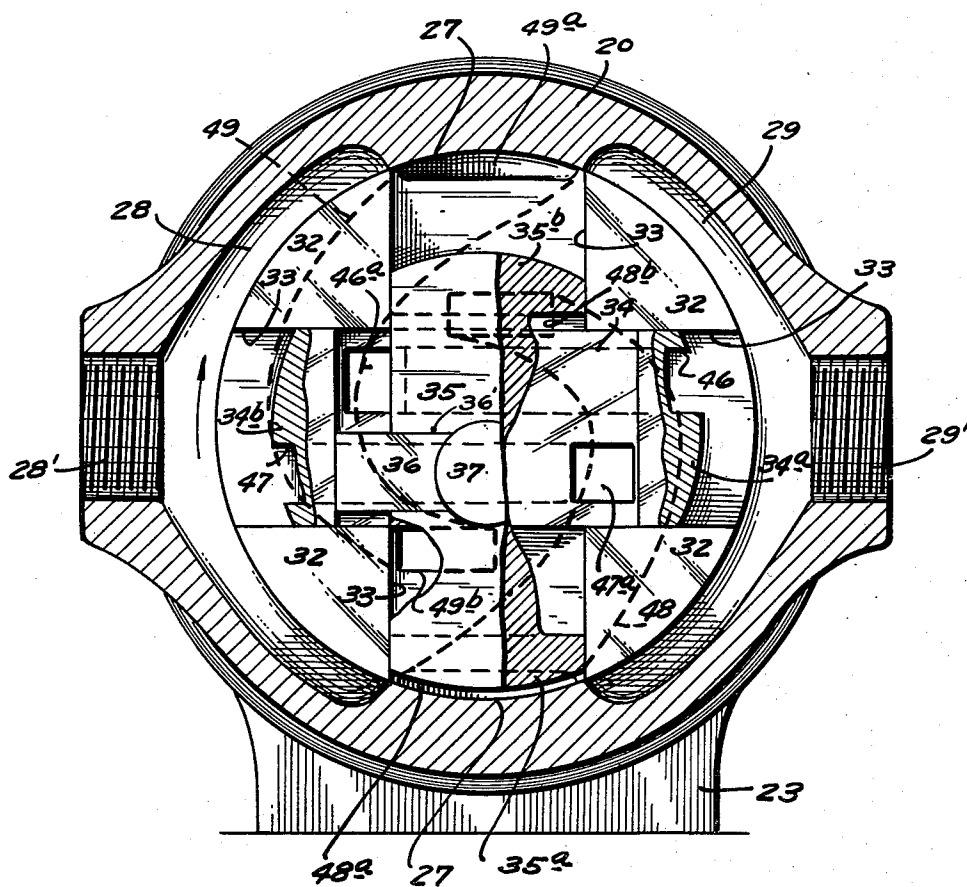
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Fig. 5



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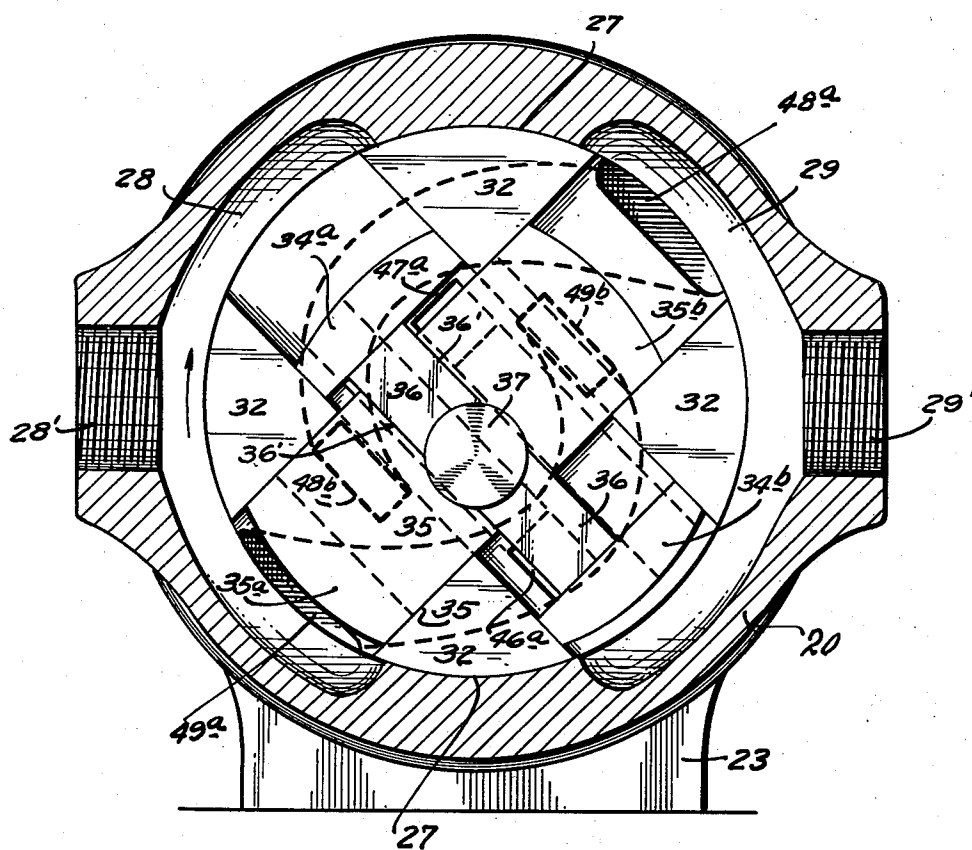
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Fig. 6



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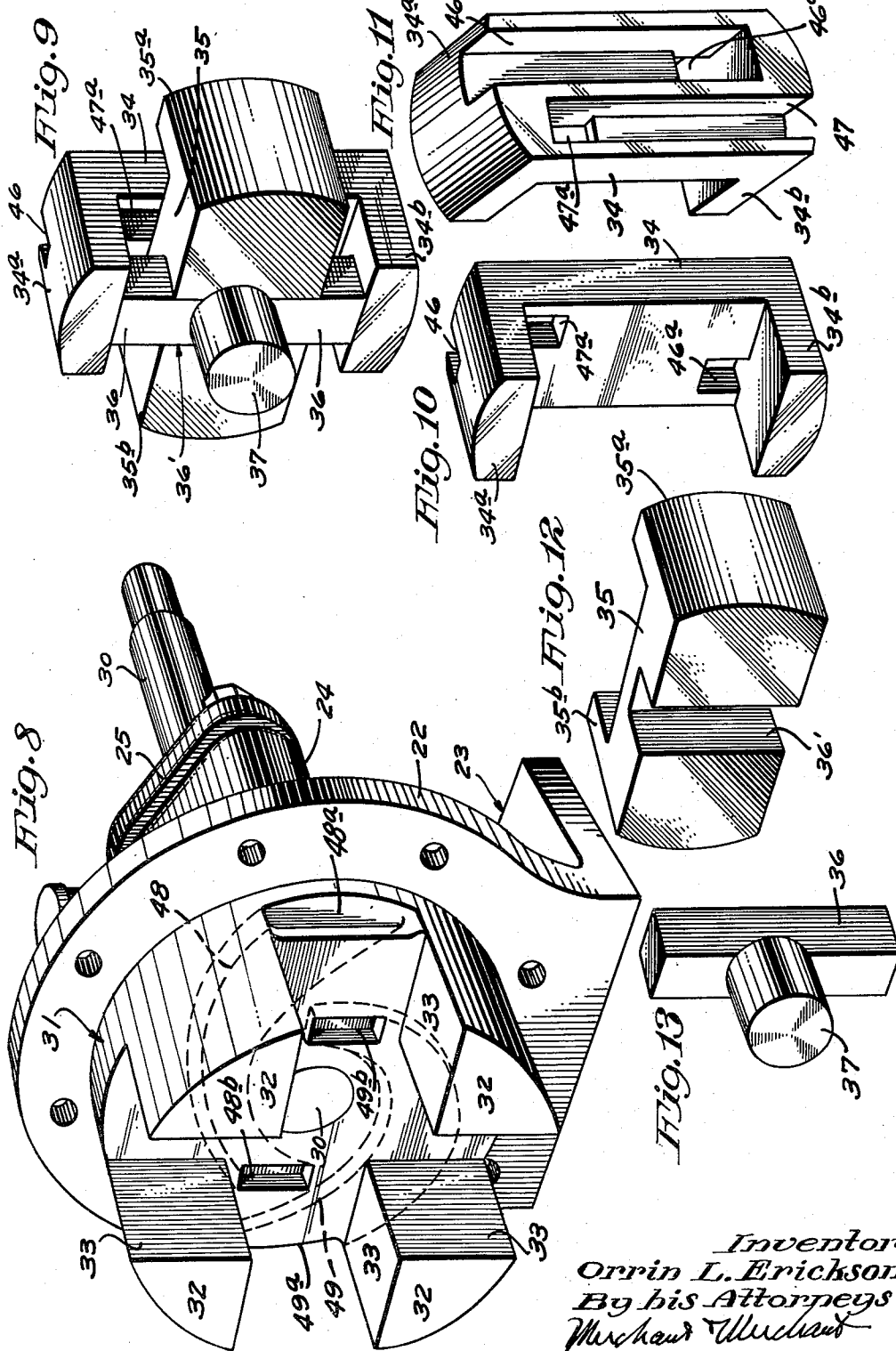
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ROTARY PUMP

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UNITED STATES PATENT OFFICE

2,248,452

ROTARY PUMP

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Application May 4, 1939, Serial No. 271,687

3 Claims. (Cl. 103—161)

My invention provides an improved rotary pump and, generally stated, consists of the novel devices, combination of devices and arrangement of parts hereinafter described and defined in the claims.

In this application I have disclosed a commercial form of the invention wherein, under constant rotation of the rotor or power element of the pump, the pump action is not only reversible but may be varied from minimum to maximum and conversely with the power transmitting factor in which the speed and power are inversely proportional. Also, this improved pump is made readily reversible in its pumping action without changing the direction of rotation of the power producing elements.

The principles involved in this pump will be more readily understood after having first described a commercially tested pump illustrated in the accompanying drawings wherein like characters indicate like parts throughout the several views.

Referring to the drawings:

Fig. 1 is a view chiefly in vertical axial section showing the improved pump, some parts being in full;

Fig. 2 is a horizontal section taken on the line 2—2 of Fig. 1, some parts being broken away;

Figs. 3, 4, and 5 show the pump with the casing thereof sectioned on the line 3—5 of Fig. 2, the interior movable elements of the pump being shown chiefly in side elevation but with some parts broken away and sectioned;

Fig. 6 is a view corresponding in the line of section to Figs. 3, 4 and 5 but showing the rotary parts in different positions and in full elevation;

Fig. 7 is a fragmentary section taken on the line 7—7 of Fig. 3;

Fig. 8 is a perspective showing the head plate of the pump casing and the rotor head of the pump;

Fig. 9 is a perspective showing the assembled piston-acting plungers removed from the rotor head;

Fig. 10 is a perspective showing one of the piston-acting plungers looking at the same from the front face thereof;

Fig. 11 is a perspective of the plungers shown in Fig. 10 looking at the same from the rear face;

Fig. 12 is a perspective showing the second or co-operating piston-acting plunger;

Fig. 13 is a perspective showing a plunger shifting slide or head;

Fig. 14 is a perspective showing a pump-adjust-

ing cross-head and cross-head guide in which it is mounted to slide;

Fig. 15 is a perspective showing the cross-head removed from its guide; and

Fig. 16 is a perspective showing the rotary or oscillatory crank for adjusting the cross-head vertically or diametrically in respect to the rotor head.

The pump involves an outer casing 20 which in the structure illustrated is detachably secured by machine screws 21, or the like, to a head plate 22, which, in this preferred arrangement, is cast integral with an anchoring base 23. The anchoring base 23, and hence the head 22, is shown as provided with a long bearing sleeve or hub 24 fitted with a stuffing box 25, that is axially aligned with a bearing and stuffing box 26 formed on the casing 20. The casing 20 is internally formed with diametrically opposite cylindrical sealing surfaces 27 that are concentric to the axis of the bearing sleeves or hubs 24 and 26 and are interposed between chambers 28 and 29 formed on the interior of the casing. For the purposes of our early illustration, we will assume that the chamber 28 is an intake chamber and that the chamber 29 is an outlet or discharge chamber. The chambers 28 and 29 respectively are shown as provided with tapped inlet passage 28' and 29' that are adapted to be tapped or otherwise connected to pipes or other conduits, not shown.

A power driven shaft 30 is journaled in the hub or sleeve 24 and stuffing box 25 and is extended into the casing. To the inner end of this driving shaft 30 is keyed or otherwise rigidly secured a rotor head 31, the cylindrical body of which is of the same diameter and runs in concentric contact with the cylindrical sealing surfaces 27.

This rotor head 31 is provided with circumferentially spaced valve acting cylindrical segments 32 that extend the full width of the cylindrical chamber of the casing. These valve-acting segments 32 in the pump illustrated, as best shown in Fig. 8, are four in number and they are spaced circumferentially to form transversely intersecting cylinder-acting piston seats or passages 33, which, in the preferred structure, intersect the one the other at 90°. These cylindrical-acting segments, for convenience in construction and for other reasons that will hereinafter appear, are rectangular in cross section. The cylindrical surface of the valve-acting segments 32 run in close contact with the cylindrical sealing surfaces 27. The flat ends of the segments 32 run in close contact with the adjacent flat

wall or interior surface of the casing 20 so that said seats 33 are closed at all four sides but open at both ends, until co-operating piston-acting plungers are placed therein.

In this preferred arrangement of the pump, two piston-acting plungers are employed. These piston-acting plungers are best shown in detail in Figs. 9 to 12 inclusive and in Fig. 9 the two piston-acting plungers and co-operating shifter head assembled, but removed from the pump casing, are best shown. One of these plungers is indicated as an entirety by the numeral 34 and the other is indicated as an entirety by the numeral 35. These two plungers have relatively thin overlapping intermediate portions capable of sliding movements one on the other. Plunger 34 is provided at its opposite ends with piston heads 34a and 34b, while plunger 35 is provided at its opposite ends with piston heads 35a and 35b. The said heads 35a and 35b and 34a and 34b are the full width of the cylindrical-acting seats 33, and the said heads, of course, work with close engagement with all four walls of said seats 33.

Plunger 35 at its intermediate portion is provided with a transverse groove 36' in which works slidably, a bar-like shifter head 36 provided with a projecting trunnion 37. The said plungers and shifter head assembled as shown in Fig. 9 are adapted to be inserted into working engagement with the seats 33, between the valve-acting segments 32, and to be carried rotatively with the rotor head 31. The plungers 34 and 35 are much shorter than the diameter of the rotor head and length of the intersecting cylinder-acting plunger seats, so that the said plungers are capable of endwise reciprocation in the said seats, without ever coming into contact with the sealing surfaces or interior of the casing. It is important to note that the ends of the bar-like shifter head not only slide in the groove of the plunger 35 but slip laterally between the heads of the plunger 34.

Figs. 1, 2, 3, 4, 5 and 6 show the rotary elements of the pump, to wit; the rotor head, the piston-acting plungers and shifter head assembled in the casing. At this time attention is simply called to the fact that if the shifter head 36 be set with its crank pin 37 co-incident with the axis of shaft 30 and rotor head 31, there will be no endwise movements of the piston-acting plungers in their seats, but that if said wrist pin be set eccentric to the axis of said rotor head, in a direction toward or from one or the other of the sealing surfaces, there will be endwise movements of the piston-acting plungers in said seats, when the rotor head is rotated; but this is a matter that will be more fully discussed in the description of the operation.

In the pump design illustrated in the drawings the sealing surfaces 27 are at the top and bottom of the casing, and hence the movements of the crank pin 37 and sliding shifter head 36, to vary eccentrically of the axis of rotation of the plungers, is in a vertical direction.

As an efficient means for accomplishing these adjustments, the crank pin 37 is journaled in a hub-like cross head 38, see particularly Fig. 14, that is mounted for vertical sliding movements in guide block 39, which latter happens to be of hub-like form that is counter sunk into the hub of the casing and is anchored thereto by suitable means such as cap screws 40, best shown in Fig. 2. As a means for vertically adjusting cross head 38, I have shown a crank shaft 41

extended through the stuffing box 26 and into the top of the casing and within the guide block 39 and therein provided with a disc-like head 42 that carries a crank pin 43. This crank pin 43 works in a horizontal groove 44 formed in the adjacent face of the cross head 38. For rotating or oscillating the crank shaft 40 it is provided at its outer end with a handle 45.

By rotation or oscillation of the crank shaft 41 and resulting movements of crank pin 43, the cross head 38 can be moved to position crank pin 37 of shifter head or slide 36, at will, concentric to the axis of the rotor head or to eccentric or offset position either below or above the axis of said rotor.

As will hereafter appear, by these adjustments the pump can be set neutral, so that no fluid will be pumped in either direction under rotation of the rotor head, or the fluid can be pumped through the casing in either direction, at infinitesimally varying rate of speed and with inversely proportional power producing pressure.

The mechanism designed as so far described makes a completely operative pump, but as will hereinafter appear, this pump action is further augmented and efficiency of the pump increased by certain additional features which will now be described.

By reference particularly to Figs. 9, 10 and 11 it will be noted that the plunger 34 at its back or outer face is formed with channels 46 and 47. The channel 46 at one end opens through the piston head 34a and at its other end terminates in a lateral port 46a that extends completely through the body of said plunger 34 just inward of the piston head 34b. The channel 47 at one end opens through the piston head 34b and at its other end leads to a port 47a that opens through body of plunger 34 just inward of piston head 34a.

The body of the rotor head 31 is formed with two fluid channels or by-passes 48 and 49 which at their outer extremities 48a and 49a open into outer extremities of the plunger seats 33, at diametrically opposite points. At their inner extremities and the diametrically opposite points the passages 48 and 49 lead to ports 48b and 49b respectively that open through the face of said rotor. In the rotary assembly of the pump the ports 48b and 49b co-operate respectively with the heads 35b and 35a of plunger 35.

OPERATION

The operation of the pump above structurally described is as follows: Fig. 3 shows the crank pin 37 of piston head 36 adjusted concentric to the axis of the rotor head, and in this adjustment, as is evident, when the rotor head is rotated there will be no movement whatever of the piston-acting plungers in the cylinder-acting seats of the rotor head and, of course, there will be no pumping of the fluid even in the one direction or the other. The pump is then neutral.

Figs. 4 and 5 show the crank or wrist pin 37 adjusted to a position below the axis of the rotor head. Fig. 4 shows the piston heads 34a and 34b aligned with the segmental sealing surface 27, while Fig. 5 shows the rotor head moved 90° further in a clockwise direction, so that the piston heads 34a and 34b will be aligned with said sealing surfaces 27. Fig. 6 shows the rotor turned 45° beyond the position shown in Fig. 5.

In tracing the action of the flow of the fluid through the pump under rotation of the rotor head in a clockwise direction in respect to Figs.

4, 5 and 6, attention will be directed particularly to Fig. 6. In the particular position shown in Fig. 6, two of valve-acting segments 32 are aligned with the sealing surfaces 27 and, in fact, in all rotary position there will be one or the other of the said valve-acting segments engaged to some extent with the said sealing surfaces 27.

When the rotor is in, or substantially in, the position shown in Fig. 6, thrusting movement of plunger 35 will be moving piston head 35a toward the axis of rotation and the piston head 35b away from the axis of rotation, so that the outer face of piston head 35 will be drawing in fluid from chamber 28 and piston head 35b will be discharging fluid into chamber 29; and at the same time plunger 34 will be moving piston 34a toward the axis of rotation and the piston 34b away from the axis of rotation so that the outer face of said piston head 34a will be drawing in fluid from chamber 28 while the outer surface of piston head 34b will be discharging fluid into chamber 29. Of course, each piston-acting plunger in turn performs the function indicated after passing the sealing surfaces 27. Attention is also here called to the fact that when the piston-acting plungers are in alignment with the sealing surfaces 27 and hence moving at minimum speed, the other piston-acting plunger is then being moved at a maximum speed, so that the pumping work produced by the plungers will be nearly inversely proportional and the total pumping action kept substantially constant, and the pump will be operated without noticeable vibration.

Auxiliary pumping action

In addition to the above pumping action a further simultaneous pumping action is produced as follows: In the position of the parts shown in Fig. 6 and under the conditions of rotation already described, a secondary pumping action is taking place, to wit; the inner surface of piston 35a will be discharging fluid through port 48b and channel 48 and will be delivering fluid to chamber 29 through port 48a; at the same time inner surface of piston head 35b will be drawing fluid from chamber 28 through port 49a, channel 49 through port 49b into space inward of said piston head 35b. Also at the instant above noted, the inner surface of piston head 34a will be forcing fluid through port 47a, channel 47 into chamber 29; and at the same time inner surface of piston head 34b will be drawing in liquid through channel 46 and ports 46a. Of course, the functions just described as to each of the plungers and its piston heads, will be alternated between the two plungers as they pass the sealing surfaces 27.

The just above described pump action produced by the inner face of the piston head is, of course, additional to that produced by the outer surface of said piston head, and very clearly increases the pumping capacity of a pump of given size or dimensions. Moreover, it aids in lubricating the parts of the pump and prevents water-locking between moving elements, and in fact it is thought that the additional power required to produce this parallel pumping action performed by the inner face of the piston heads is probably not greater than that which would be required to get rid of water that would tend to be choked or locked between moving parts of the plungers.

In the description of the operation so far given the rotor head has been assumed to be rotated in a clockwise direction in respect to Fig. 6 and similar views, and the chamber 28 has been the

intake chamber while the chamber 29 has been the outlet or discharge chamber. If, however, under the same direction of rotation of the rotor head, the shifter head be adjusted vertically so that the cross head will set the crank 37 of shifter head 36 at a point above the axis of rotation of the rotor head, then pumping action will be reversed, by causing the liquid to be drawn into chamber 29 and discharged into chamber 28. With this simple adjustment, the pump is made reversible in its action, without changing the direction of rotation of the rotor head; and moreover these adjustments, varying from neutral to maximum pumping action, in either direction of flow, can be produced to any degree while the pump is in operation.

It may be here restated that in all of the pumping actions, the more rapid the flow produced the less the pressure produced, and the slower the flow produced the greater the resulting pressure delivered; and these variations in pressure, from maximum to minimum, or conversely, may be produced by infinitesimally varying adjustments.

The number of the plungers in the seats of the rotor are, of course, produced by setting the plungers to rotate on an axis that is eccentric to the axis of rotation of the rotor head; and it would be true to state that the seats move radially in respect to the plungers, but the better statement is thought to be that the plungers move in their seats toward and from the axis of the rotor.

As to the by-passage or supplemental channels 48 and 49 in the rotor and the passages 46 and 47 in the plunger 34, it may be stated that they are thus located because of the difficulty in forming both classes of passages in any single element.

It is important to note that in this improved pump there may be some leakage between the movably engageable parts without any serious result. That is, a small amount of leakage would not be a waster of the energy delivered to the pump, but at most would simply require that the pump be given a little large size to offset the leakage. In fact, some leakage is desirable to give better lubrication to the parts. Of course, the auxiliary pumping action described very much more than offsets any possible result from leakage.

In this preferred pump two plungers and four piston-acting elements are employed, and that is considered by far the best arrangement. Nevertheless, the number of plungers and piston-acting elements may be varied either by increase or decrease in the number illustrated. The principles involved in this pump may be operative even with a single plunger with two piston-acting ends, for example; and such a pump might meet the requirement of certain low priced pump, even though it would not give a constant flow, such as produced by the improved pump illustrated.

What I claim is:

1. In a device of the rotary pump type, a casing having intake and outlet chambers separated by intervening segmental sealing surfaces, a rotary head in said casing having diametrically intersecting cylinder-acting plunger seats and intervening valve-acting segments, which latter cooperate with the sealing surfaces of said casing, transversely lapping piston-acting plungers working in said intersecting seats, said plungers having reduced intermediate portions and full width head portions, an elongated shifter head

mounted for endwise sliding movements only in the reduced intermediate portion of one of said plungers with its ends having lateral sliding engagement only with the spaced heads of the other plunger, and means having pivotal engagement with the intermediate portion of said shifter head and operative to shift the axis of rotation of said shifter head in respect to the axis of said rotor head.

2. In a device of the rotary pump type, a casing having intake and outlet chambers separated by intervening segmental sealing surfaces, a rotary head in said casing having diametrically intersecting cylinder-acting plunger seats and intervening valve-acting segments, which latter cooperate with said sealing surfaces, transversely interlapping piston-acting plungers working in said intersecting seats, a shifter head operating to reciprocate said plungers under rotation of said head, said plungers each at opposite ends having heads with outer and inner plunger-acting surfaces, said rotary assembly having ports, one of which leads from the outer end portion to the inner portion of one of said plunger seats, and the other of which leads from the outer end portion to the inner portion of the other of said plunger seats, and which ports register with the inner working surfaces of said plungers at all

times, and which ports lead to the pumping chamber in which the diametrically opposed outer plunger working surface moves, whereby each plunger has a dual pumping action.

3. In a device of the rotary pump type, a casing having intake and outlet chambers separated by intervening segmental sealing surfaces, a rotary head in said casing having diametrically intersecting cylinder-acting plunger seats and intervening valve-acting segments, which latter cooperate with said sealing surfaces, transversely interlapping piston-acting plungers working in said intersecting seats, a shifter head operating to reciprocate said plungers under rotation of said head, said plungers each at opposite ends having heads with outer and inner plunger-acting surfaces, said rotary head having a port that leads from the outer to the intermediate portion of one of said plunger seats and the plunger in the other plunger seat having a port that leads from the outer to the intermediate portion of the plunger seat in which said last noted port-equipped plunger is mounted and which ports register with the inner working surfaces of said plungers at all times, and which ports lead to the pumping chamber in which the diametrically opposed outer plunger working surface moves.

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