Dec. 30, 1952 H. E. RAYMOND 2,623,472

REVERSIBLE PUMP

Filed July 7, 1947 7 Sheets-Sheet 1

FIG. 1

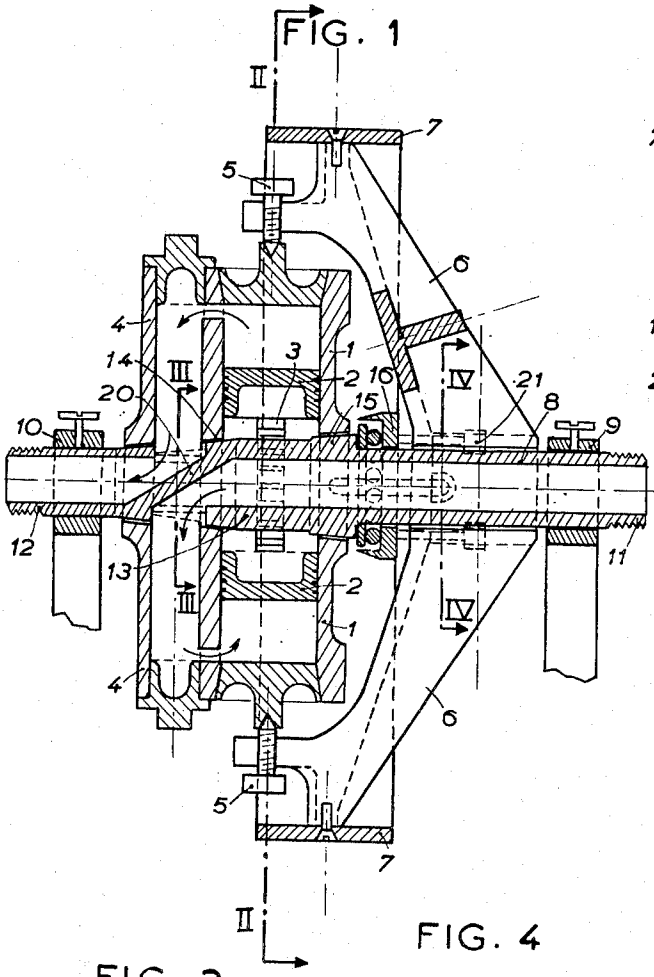


FIG. 2

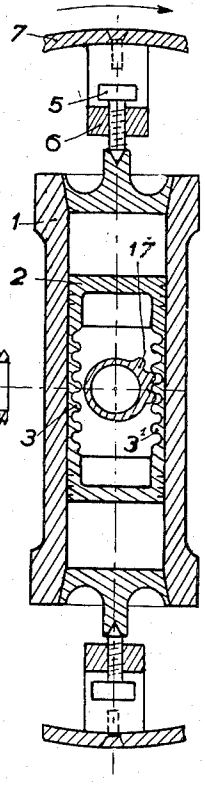


FIG. 3

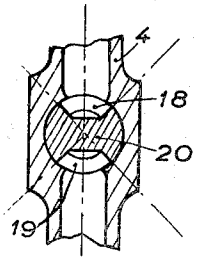
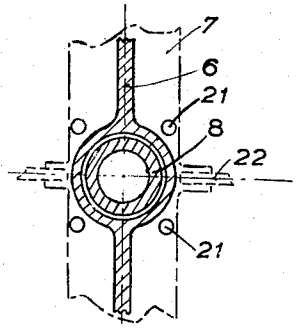


FIG. 4



INVENTOR

HENRI E. RAYMOND

By: Young, Emery & Thompson

Attys.

Dec. 30, 1952 H. E. RAYMOND 2,623,472

REVERSIBLE PUMP

Filed July 7, 1947 7 Sheets-Sheet 2

FIG. 5.

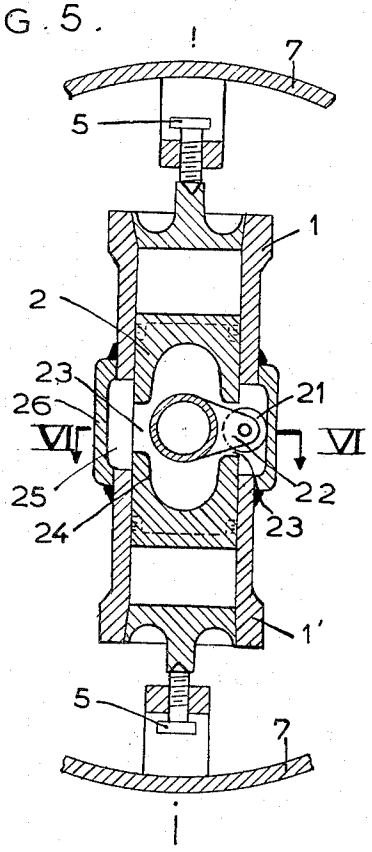
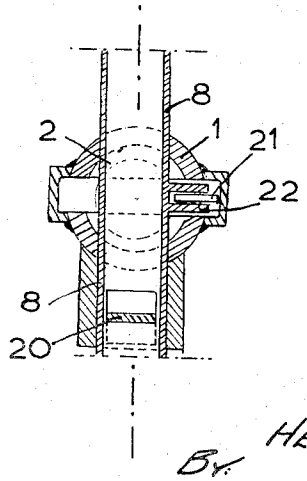


FIG. 6.



INVENTOR
HENRI E. RAYMOND
By
Young, Emery & Thompson
Attys.

Dec. 30, 1952 H. E. RAYMOND 2,623,472

REVERSIBLE PUMP

Filed July 7, 1947 7 Sheets-Sheet 3

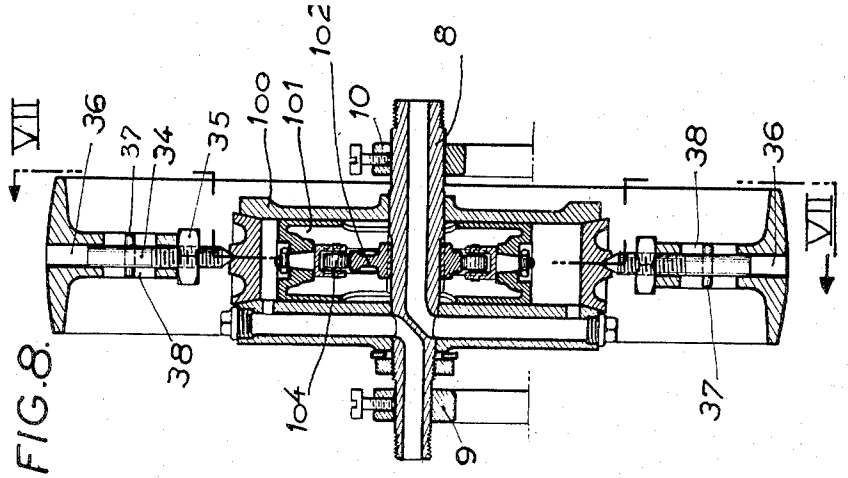


FIG. 8.

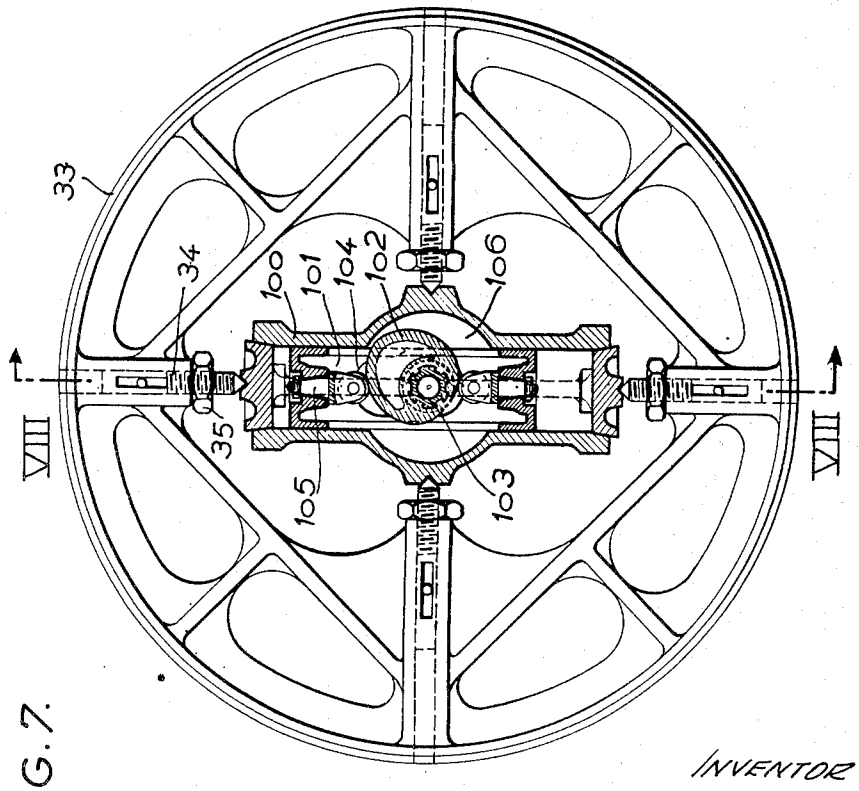


FIG. 7.

INVENTOR
HENRI E. RAYMOND
By Young, Emery & Thompson
Att'ys.

Dec. 30, 1952 H. E. RAYMOND 2,623,472

REVERSIBLE PUMP

Filed July 7, 1947 7 Sheets-Sheet 4

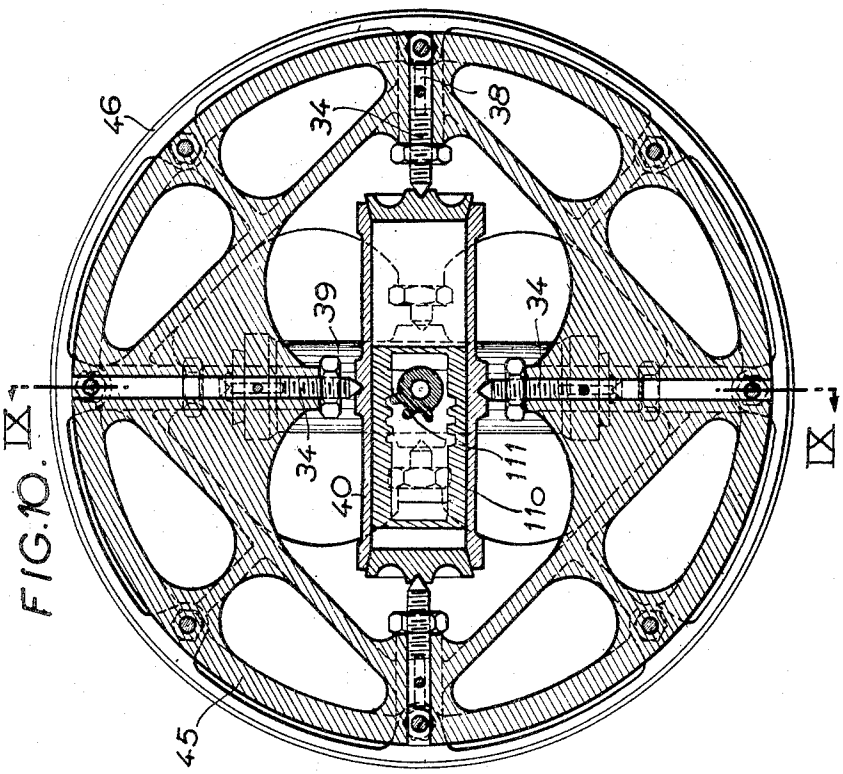


FIG. 10.

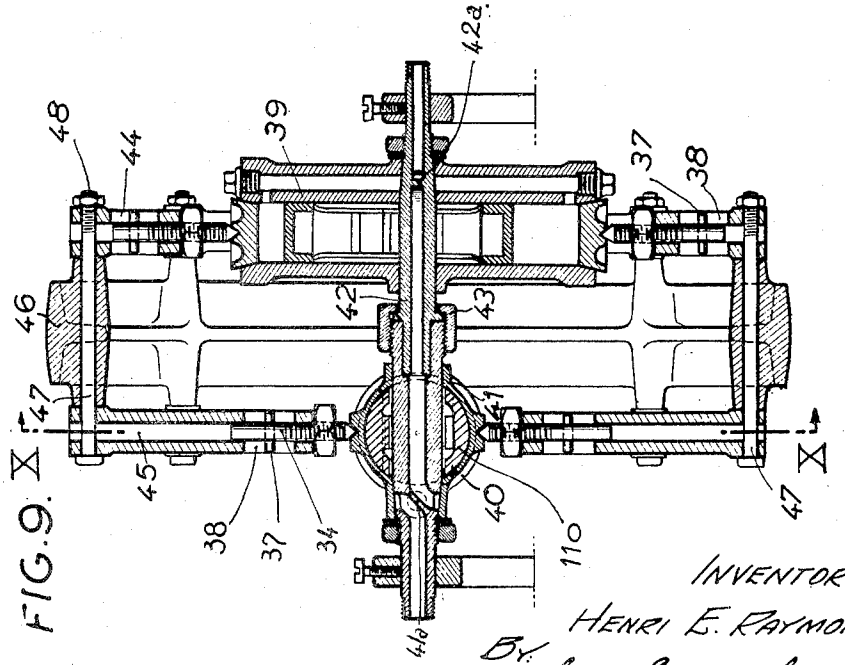


FIG. 9.

INVENTOR
HENRI E. RAYMOND
BY
Young, Emery & Thompson
ATTYS.

Dec. 30, 1952 H. E. RAYMOND 2,623,472

REVERSIBLE PUMP

Filed July 7, 1947 7 Sheets-Sheet 5

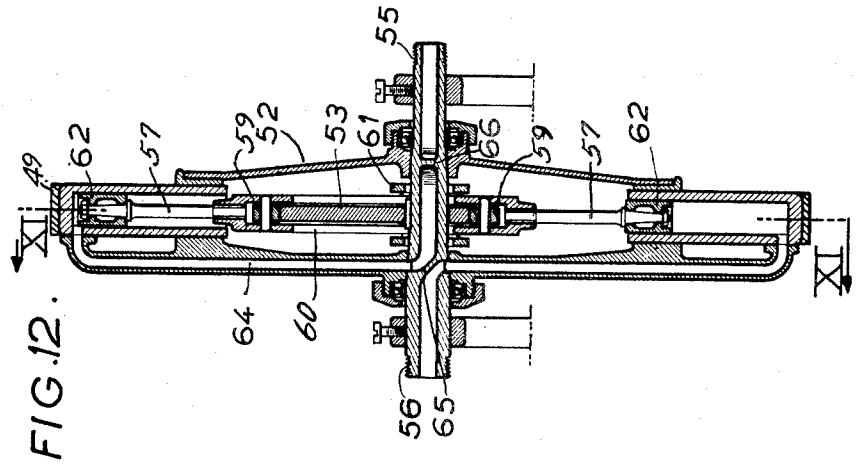


FIG. 12.

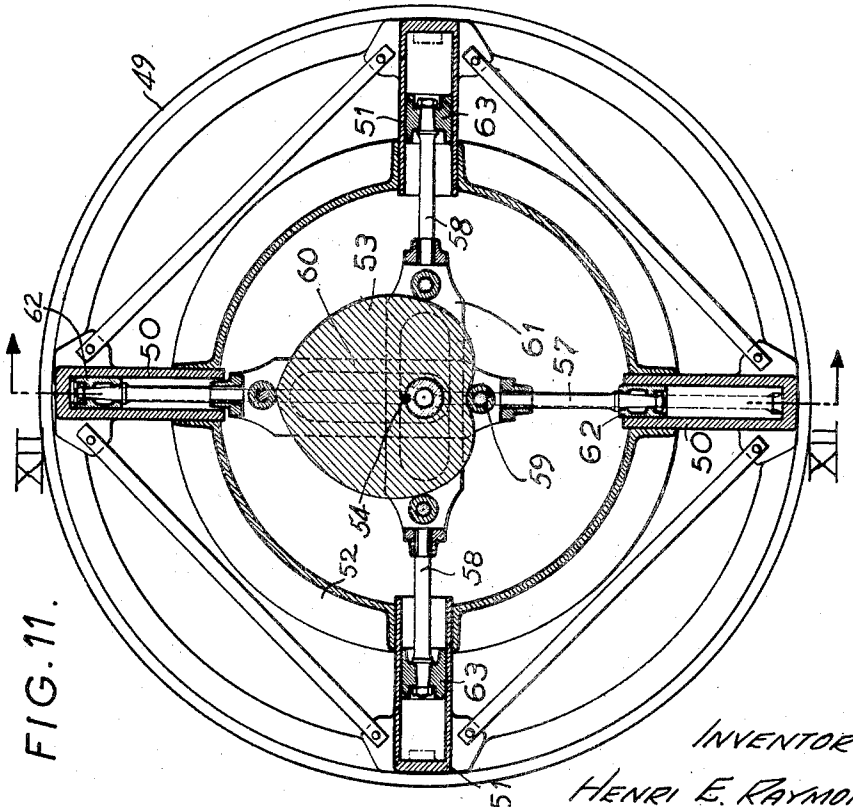


FIG. 11.

INVENTOR
HENRI E. RAYMOND
By Young, Emery & Thompson
Attys.

Dec. 30, 1952 H. E. RAYMOND 2,623,472

REVERSIBLE PUMP

Filed July 7, 1947 7 Sheets-Sheet 6

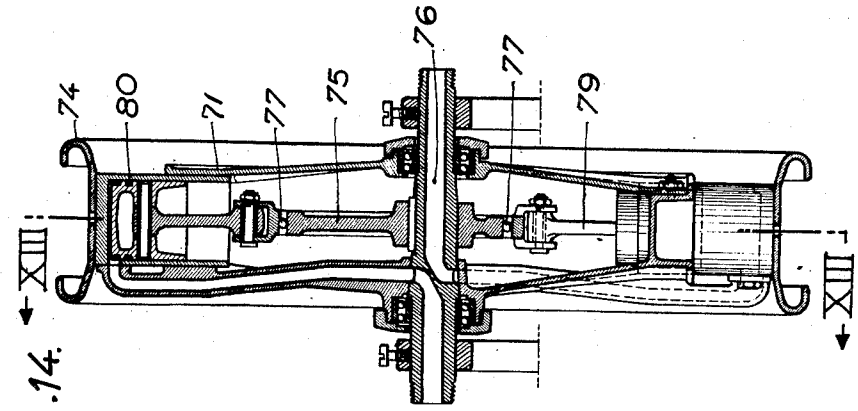


FIG. 14.

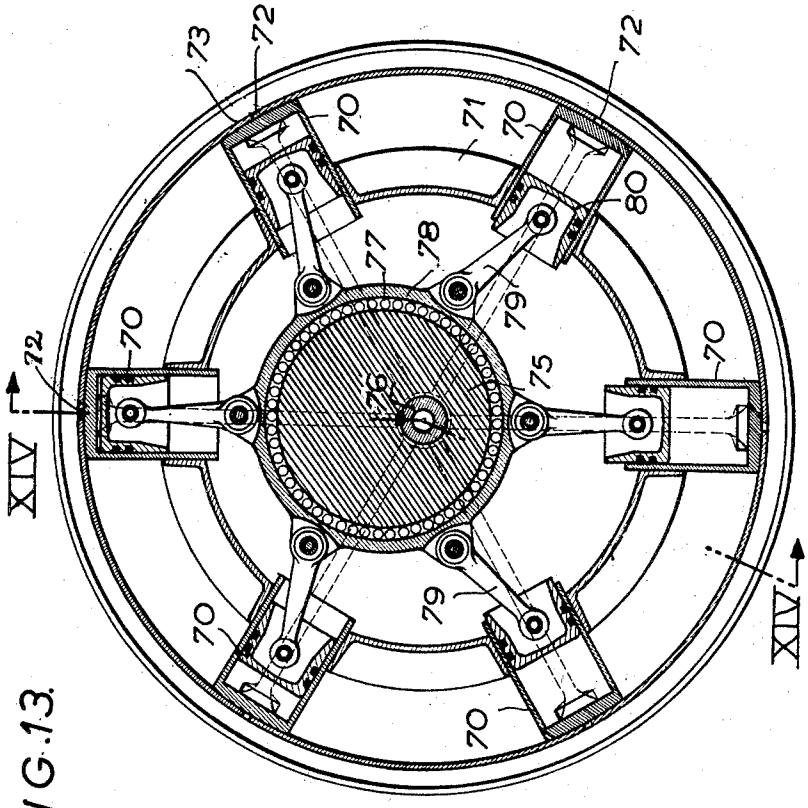


FIG. 13.

INVENTOR
HENRI E. RAYMOND
By: Young, Emery & Thompson
Attys.

Dec. 30, 1952 H. E. RAYMOND 2,623,472

REVERSIBLE PUMP

Filed July 7, 1947 7 Sheets-Sheet 7

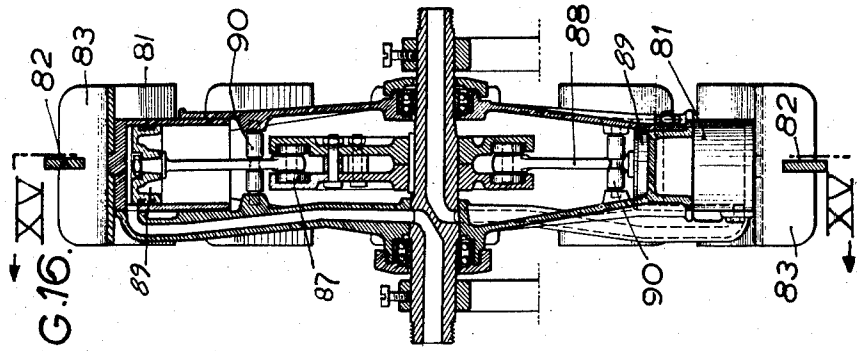


FIG. 16.

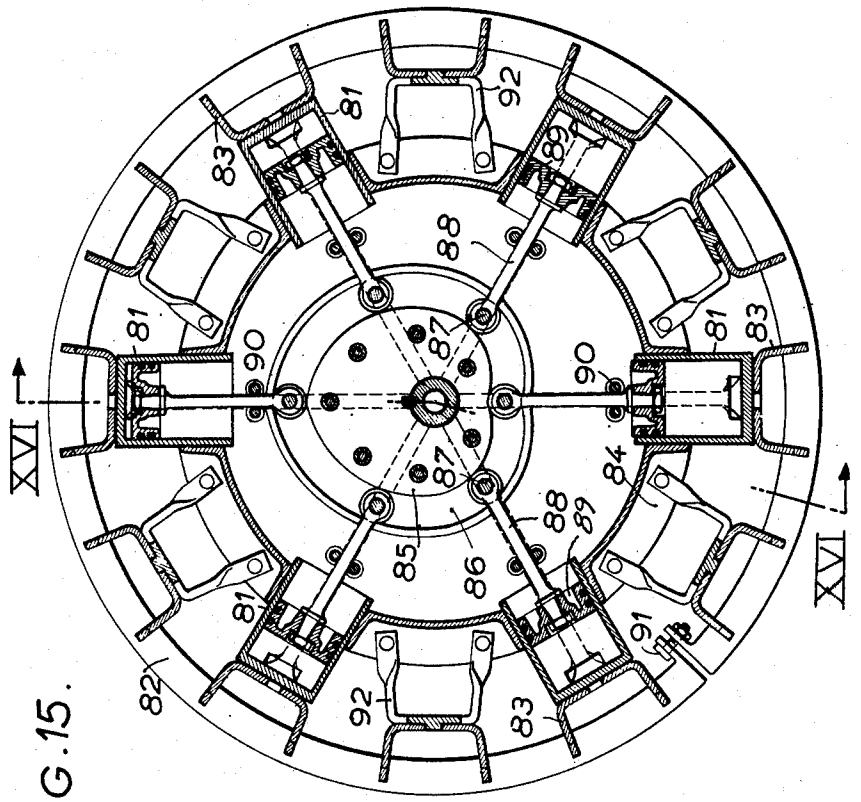


FIG. 15.

INVENTOR
HENRI E. RAYMOND
By Young, Emery & Thompson
Attys.

Patented Dec. 30, 1952 2,623,472

UNITED STATES PATENT OFFICE

2,623,472

REVERSIBLE PUMP

Henri Edgard Raymond, Guissalles par Vindelle, France

Application July 7, 1947, Serial No. 759,426
In France July 11, 1946

4 Claims. (Cl. 103—161)

1

My present invention has for its object to provide pumps of the type including rotary cylinders adapted for reversible operation.

The pumps according to the invention are mounted within a drive wheel rotated about a fixed hollow shaft, and are characterised in that they comprise in combination cylinders rigid with said wheel, pistons in said cylinders, a control mechanism for said pistons secured on said fixed shaft, lateral conduits on each cylinder, intake and delivery being effected at both ends of said fixed shaft, a partition in said fixed shaft separating the intake from the delivery side thereof and cooperating with ports formed in said fixed shaft, before which ports the outlets of said lateral cylinder conduits are adapted to ride as the device is rotated.

In one specific embodiment, my apparatus comprises a double piston reciprocable in a double cylinder forming the body of the pump either through a partial pinion and rack member, or through a roller mounted on a connecting rod. The above assembly is secured on a rotatable element adapted to form both a fly-wheel and a drive sheave.

The pump thus formed does not include any seal joint or any special valve means, this making for a simplified construction and facilitating mounting and dismantling operations. The pump is of a reversible character, that is, by reversing the direction of rotation of the fly-wheel the suction and delivery functions are reversed. It is therefore adapted also to operate as a prime mover operated by pressure fluid, by reversing either the feed supply or the direction of rotation of the device.

In another embodiment, the rotor comprises two pump barrels displaced 90° from each other around the axis of rotation thereof and having different diameters, the delivery of one pump barrel being made to supply the intake of the other one, both pump barrels being rotated in unison about a fixed axis.

In this way, two stage expansion or compression may be realized.

According to another embodiment, cylinders in a number greater than or equal to three are mounted in radial formation upon a casing or sump containing lubricating oil and accommodating the piston drive mechanism.

The above arrangement provides for continuity in the action of the group and a more efficient balancing of the reactions around the axis of rotation.

The wheel supporting the pump cylinders may

2

serve the part both of a drive wheel and a fly wheel. It may also constitute a vehicle wheel, more particularly for a tractor, or a bladed or vaned wheel.

The characteristic features, objects and advantages of the invention will appear from the ensuing disclosure relating to various embodiments of the invention, in reference with the accompanying drawings wherein:

Fig. 1 is a longitudinal sectional view of the pump;

Fig. 2 is a transverse cross section on line II—II of Fig. 1.

Fig. 3 is a fragmentary section on line III—III of Fig. 1.

Fig. 4 is another fragmentary section on line IV—IV of Fig. 1.

Fig. 5 is a transverse cross section of a modification.

Fig. 6 is a cross section on line VI—VI of Fig. 5.

Fig. 7 shows another embodiment in longitudinal cross section on line VII—VII of Fig. 8.

Fig. 8 is a transverse cross section on line VIII—VIII of Fig. 7.

Fig. 9 shows another modified embodiment in longitudinal section on line IX—IX of Fig. 10.

Fig. 10 is a transverse cross section on line X—X of Fig. 9.

Fig. 11 illustrates another modified construction in longitudinal section on line XI—XI of Fig. 12.

Fig. 12 is a section on line XII—XII of Fig. 11.

Fig. 13 shows another embodiment in longitudinal section on line XIII—XIII of Fig. 14.

Fig. 14 is a transverse cross section on line XIV—XIV of Fig. 13.

Fig. 15 shows another embodiment in longitudinal section on line XV—XV of Fig. 16.

Fig. 16 is a transverse cross section on line XVI—XVI of Fig. 15.

Now referring to the embodiment shown in Figs. 1 to 4, the pump essentially comprises a cylinder 1 in which is reciprocable a double piston 2. Within said piston there is provided a double rack member 3—3'. Upon the cylinder there is mounted a lateral conduit 4 communicating with the cylinder 1 at both ends thereof.

Both ends of cylinder 1 are blocked by means of screws 5 on the ends of arms 6 of T-shaped cross section; said arms 6 are connected with a circular element 7. The part 7 forms a drive sheave for the pump. The assembly 6—7 forms a drive fly-wheel.

The pump 1—2 and fly wheel 6—7 are mount-

ed on the tubular fixed shaft 8 mounted in two supports 9 and 10. Said tubular shaft is adapted to provide an intake for the pump through its right end 11 (Fig. 1) which is provided with a threaded portion to receive a suitable union. It also serves for delivery through its left hand end 12 also provided with a threaded portion adapted to receive a suitable union.

The shaft 8 is formed towards its center point, where it extends through the cylinder 1, with a conical portion 13 and in particular two conical bearing surfaces 14 and 15. A ball thrust bearing 16 is provided for the positioning of the rotary cylinder on the bearings 14 and 15. Upon the portion 13 there is provided a partial gear 17.

The shaft 8 is formed opposite to the conduit 4 with two facing ports 18 and 19 respectively at its top and bottom (Fig. 3). Between both ports 18 and 19 there is arranged within the tubular shaft 8 an obliquely extending partition or septum 20. As a result of the provision of this septum, the aperture 19 and consequently the conduit 4 as it passes in front of said aperture is placed in communication with the suction end 11 of the pump. Similarly the aperture 18 communicates with the delivery end and connects the latter with the conduit 4 as said conduit passes in front of the aperture 18.

The fly-wheel or sheave 7 may be supported, apart from the opposite arms 6, by means of auxiliary arms such as 22 provided in any suitable number (Fig. 4). The ball thrust bearing 16 may be blocked in position by means of set screws 21 engaging the flange of the T-shaped arms 6.

The pump assembly is driven in rotation through the fly wheel sheave 7 in the direction of the arrow (Fig. 2). In this rotation about the fixed shaft 8, the rack teeth 3' mesh with the teeth 17 fixed on the shaft 8. The piston 2 travels in one direction within the cylinder. As the second set of teeth 3 engages the partial gear 17, the piston is moved in the opposite direction. In this way, successive suction and delivery phases are created at both ends of the cylinder 1. Since said cylinder ends communicate with the conduits 4, as the latter come into registry with the ports 18 and 19 of the shaft 8, intake and delivery are produced as diagrammatically indicated by the arrows (Fig. 1). This result is obtained without the use of any special means such as valves and simply as a result of the provision of the septum 20 separating the intake from the delivery end in the fixed tubular shaft.

The septum 20, as shown in Fig. 3 is so conformed that communication of the conduits 4 with both parts of the hollow shaft 8 is effective until the pistons have reached the end of their stroke, at which time communication is cut off between the intake and the delivery ends.

By reversing the direction of rotation, the relative positions of the intake and delivery are reversed. A similar result could be obtained by maintaining the pump barrel stationary and rotating the shaft 8.

A modified embodiment is illustrated in Figs. 5 and 6. In this modification there are also provided the pump barrel 1 with the double piston 2 mounted on the fixed tubular shaft 8, wherein the suction and delivery sections are separated by the oblique septum 20. Rather than being driven through the rack members 3, 3' and the partial gear 17, the piston 2 is herein driven through a roller 21 mounted on the connecting rod 22 rigid with the shaft 8 and consequently fixed.

Within the piston 2 grooves 23—24 are formed wherein the roller 21 rides; as the assembly 1—2 driven from the fly-wheel or sheave 6—7 is rotated about its axis (or vice versa), the fixed roller 21 causes reciprocation of the piston 2. The latter cooperating with the side conduit 4 and the tubular shaft 8 successively produces at both sides of the piston 2 suction and discharge, as indicated previously, it being possible moreover to reverse said effects by reversing the direction of rotation.

In order to increase the total stroke of the piston it is simply necessary to increase the spacing of the axis of roller 21 from the axis of the shaft 8. For that purpose, there may be provided centrally of the cylinder 1 a recess 25 of suitable depth accommodating passage for said roller 21. In this arrangement, the cylinder 1 is supplemented with an element 26 secured in any suitable manner such as by screwing or welding.

With the arrangement described, it will be seen that the pump operates without the use of valves and does not require the employment of any sealed joint, whereby its construction, and the mounting and dismantling of the pump are simplified.

According to an embodiment illustrated in Figs. 7 and 8 a pump barrel 100 similar to the one shown in Figs. 1 or 5 is mounted on a shaft 8 and is held within a rotary element 33 forming both a fly wheel and a drive sheave, by means of four adjustable set screws 34 and nuts 35. Said screws are housed in the tubular portions 36 formed in the armature of the fly wheel 33 and arranged in the transverse and longitudinal axes of the pump. Said screws are maintained through the medium of a projection 37 engaging a recess 38 formed in the screw so as to prevent the screw from rotating while causing it to slide in the tubular portion of the fly wheel.

Such mounting while simplifying the construction of the fly wheel makes it possible to reduce the length of the shaft 8 which as before is rested on the supports 9 and 10 arranged at both sides of the fly wheel.

The double piston 101 is driven in this embodiment by a heart shaped cam member 102 fixed on grooves 103 provided on the tubular shaft 8. With this cam are engaged rollers 104 supported by links 105 disposed within the piston. Bosses 106 are provided on both sides of the cylinder in order to permit the movements around the cam.

The preceding description was concerned with a pump having a single pump barrel. It will be obvious that the arrangement of the invention may be applied to pumps having multiple cylinders. That is, it is possible to use two twin parallel pump barrels for instance mounted on a common shaft with a common intake and delivery pipe.

According to an embodiment diagrammatically illustrated in Figs. 9 and 10 the rotor comprises two pump barrels 39 and 40 of different diameters and displaced 90° from each other. Each barrel is mounted on a respective shaft element 41 and 42, both said elements being rigidly interconnected by means of a threaded ring 43.

Each of said elements is provided with a septum (41*a* and 42*a*) similar to the septum 20 shown in Figs. 1 and 3 and both elements cooperate in such a way that the delivery end of one pump supplies the suction end of the other.

Each pump barrel is maintained fixed by means of four adjustable set screws 34 identical with those shown in Fig. 7. Said screws are housed within two disks: a disk 44 for the pump barrel 39 and a disk 45 for the pump barrel 40; the screws are slidable in said disks by means of a projection 37 accommodated in a recess 38 formed in each disk. Said disks are arranged and supported on both sides of a driving fly wheel 46 by means of rods 47 threaded at one end thereof, to receive a nut 48 the purpose of which is to maintain a rigid and adjustable spacing between the disks 44 and 45.

The drive mechanism of the double pistons as 110 is similar within each pump barrel to that described in reference to Figures 1 to 4, with the sole difference that the partial gear 111 on shaft 42 comprises only three teeth instead of five.

According to another embodiment, shown in Figs. 11 and 12, the pump comprises within a wheel or drum 49 four cylinders, namely two oppositely disposed cylinders 50 and two cylinders 51 also oppositely disposed, of larger diameter, mounted in radial relationship on a casing 52 containing lubricating oil and housing the piston driving mechanism which comprises a heart-shaped cam 53 made rigid through a key 54 with the fixed tubular shaft extending from the suction inlet 55 to the delivery outlet 56 (the functions of said inlet and said outlet may be reversed). Connecting links 57, 58 engaging through follower rollers such as 59, the cam 53, respectively actuate the pistons 62 and 63 and the opposite links are interconnected through fork members 60, 61 slidable on the shaft 55—56.

The side conduits of the cylinder 50 are tightly interconnected with the extensions 64 on the external face of the casing 52 and communicate at a desired instant with the distributing ports formed in the hollow shaft and separated by an oblique septum 65.

Similar conduits not visible in the drawings extend from the cylinder 51 to terminate at similar distributing ports separated by an oblique septum 66.

The pair of cylinders 50 operate in series with the pairs of cylinders 51, the pair of cylinders 50 of small capacity being made for example to produce a first expansion step and the pair of larger capacity cylinders 51 providing for a second expansion step, or vice versa in compression.

It is clear that both groups of cylinders respectively providing for both compression or expansion stages, rather than comprising two cylinders, could be made each to include, in the radial disposition shown, any desired number of pairs of cylinders. The cylinders operating the first stage will generally be of a different diameter from the cylinders operating the second stage, and the opposite pairs of the first mentioned cylinders will be provided in alternate relationship with the opposite pairs of the second mentioned cylinders along the periphery of the rotor. The side conduit of the cylinders of the first set will ride in front of the related distributing ports associated with a first oblique septum such as the septum 65 of Fig. 12, and the side conduits of the cylinders in the second set will ride in front of a second oblique septum such as 66 in Fig. 12.

The radial arrangement makes it possible to multiply, as well known in the art, the number of cylinders without any particular difficulty being encountered. There has therefore been shown in Figs. 13 and 14 a modification of the pump according to the invention which comprises six radially disposed cylinders but which in this case operate in only one compression or expansion stage.

Six identical cylinders 70 are associated with the casing 71 and are made rigid with the wheel rim 73 by means of projections 72. Said rim is in the example shown provided with a mounting 74 adapted to receive a penumatic tyre.

The control mechanism comprises an eccenter plate 75 splined on the shaft 76 carrying balls 77 on which is rotatable an annulus 78 around which are pivoted the connecting rods 79 leading to the pistons 80 in the cylinders 70.

Another modification as shown in Figs. 15 and 16 comprises a group of cylinders 81 mounted in radial formation and secured at their top end to a rim 82 by means of staples 83, the lower ends of the cylinders being secured on a casing 84 housing the drive mechanism which includes a cam 85 formed of two juxtaposed heart shaped disks and formed in their internal face with cam-ways or grooves 86 in which ride rollers 87 carrying the connecting rods 88 secured to the pistons 89. Rollers 90 are mounted on the casing at the base of the cylinders with the purpose of guiding the connecting rods in their reciprocation.

The rim 82 may be subdivided into two parts interconnected by means of connecting bolts 91. Between each pair of adjacent cylinders, a mounting 92 provided with staples is secured on the casing to impart greater rigidity to the assembly.

The radial arrangement of the cylinders has the advantage of ensuring continuity in operation and improved balance, both said advantages being enhanced as the number of cylinders is increased. In the case of single stage expansion (or suction) three pistons may suffice to ensure continuity in operation; in the case of expansion (or suction) in two stages the minimum number of the cylinders will obviously be equal to four.

In a great number of applications of the apparatus, the radial arrangement of the cylinders comprising the engine unit appears to be ideal for the construction of a drive wheel. This is so because it may then be mounted either in a rim with or without the provision of pneumatic tyres as shown in Figs. 13 and 14, or in a gear adapted to control pinions or racks or further the cylinder base may be provided with staples, for instance in the case of tractors as shown in Figs. 15 and 16 or further with vanes as required in navigation or propeller blades for use in aircraft.

My invention shows substantial advantages for driving any vehicle or structure movable in a fluid and wherein the operating torque is irregular: such as a vehicle, driving on a road including ups and downs, boats sailing in navigation channels having an irregular course, and the like, or else for vehicles the driving schedule of which includes a great many stops and starts: such as subways, taxis, elevators and the like.

It will of course be understood that the above-described and illustrated embodiments and the applications specifically listed have been merely given by way of example since my apparatus is adapted to a number of other uses such in particular as servo-motors for hydraulic control, wind engines and the like, without exceeding the scope of the invention.

I claim:

1. In a pump of the character described, a tubular fixed shaft, a wheel driven in rotation about said shaft, a reversible rotary pump mounted in said wheel, said pump comprising in combination two sets of cylinders, both sets including an equal number of cylinders disposed in radial formation in said wheel and rigid therewith, the cylinders of a first one of said sets being arranged to alternate with those of the other set along the periphery of said wheel, a drive mechanism for said pistons including cam means secured on said shaft and adapted to actuate said pistons on the radially inner faces thereof, a casing surrounding said drive mechanism, a side conduit on each cylinder having its radially outer end opening in an aperture formed in the radially outer end of a related cylinder, the side conduits of the said first set of cylinders extending on a face of said casing and the side conduits of said second set of cylinders being arranged on the other side face of said casing, an oblique septum in said fixed shaft cooperating with a first pair of diametrically opposed apertures in front of which apertures the side conduits of said first set of cylinders are adapted to ride, a second oblique septum cooperating with a second pair of diametrically opposed apertures offset 90° from the first said pair in front of which apertures the side conduits of said second set of cylinders are adapted to ride, intake and delivery being respectively effected at respective ends of said fixed shaft, both groups of cylinders being serially operated in two successive stages.

2. A reversible rotary pump comprising a shaft, a rotor block rotatable on said shaft, at least one pair of diametrically opposed cylinders rigid with said rotor block, pistons in said cylinders, means for rigidly interconnecting each pair of opposed pistons, a drive mechanism for said pistons including a cam fixed on said shaft, intake and discharge means for said cylinders, said interconnecting means between each pair of opposed pistons comprising a yoke with two branches passing laterally along each side of said cam means, said branches being slotted in order to permit the sliding with respect to said shaft during the rotation of said rotor, and two rolling cam follower means journalled at both ends of said yoke.

3. A reversible rotary pump comprising a shaft, a rotor block rotatable on said shaft, at least two pairs of diametrically opposed cylinders rigid with said rotor block, pistons in said cylinders, means for rigidly interconnecting each pair of diametrically opposed pistons, a drive mechanism for said pistons including a cam fixed on said shaft, intake and discharge means for said cylinders, said interconnecting means between each pair of opposed pistons comprising a yoke with two branches, the branches of the yoke interconnecting the pistons of a first pair of cylinders being adjacent respectively to the side faces of said cam, the branches of the yoke interconnecting the pistons of a second pair of cylinders passing out of the path of travel of the branches of the first said yoke.

4. In a reversible pump of the kind described, a drive mechanism comprising a tubular shaft, cam means rigid with said shaft and a plurality of mutually imbricated yokes around said cam means, each yoke having two branches, the branches of said yokes being slotted for sliding on said shaft, a first one of said yokes having its branches sliding along and adjacent the side faces of said cam means, a second yoke, sliding out of the path of travel of the first yoke and adjacent the branches of said first yoke, and rolling cam follower means journalled within and at both ends of each said yoke.

HENRI EDGARD RAYMOND.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,023,685	Ruwell	Apr. 16, 1912
1,193,283	Maw	Aug. 1, 1916
1,370,290	Crofton	Mar. 1, 1921
1,466,230	Johnson	Aug. 28, 1923
1,641,509	Stewart	Sept. 6, 1927
2,208,563	Benedek	July 23, 1940
2,336,996	McDonough	Dec. 14, 1943

FOREIGN PATENTS

Number	Country	Date
4,734	Great Britain	1878
9,628	Great Britain	1901