Nov. 8, 1938. R. J. F. MOORE 2,135,760

ROTARY ENGINE AND PUMP

Filed Sept. 14, 1935 2 Sheets-Sheet 1

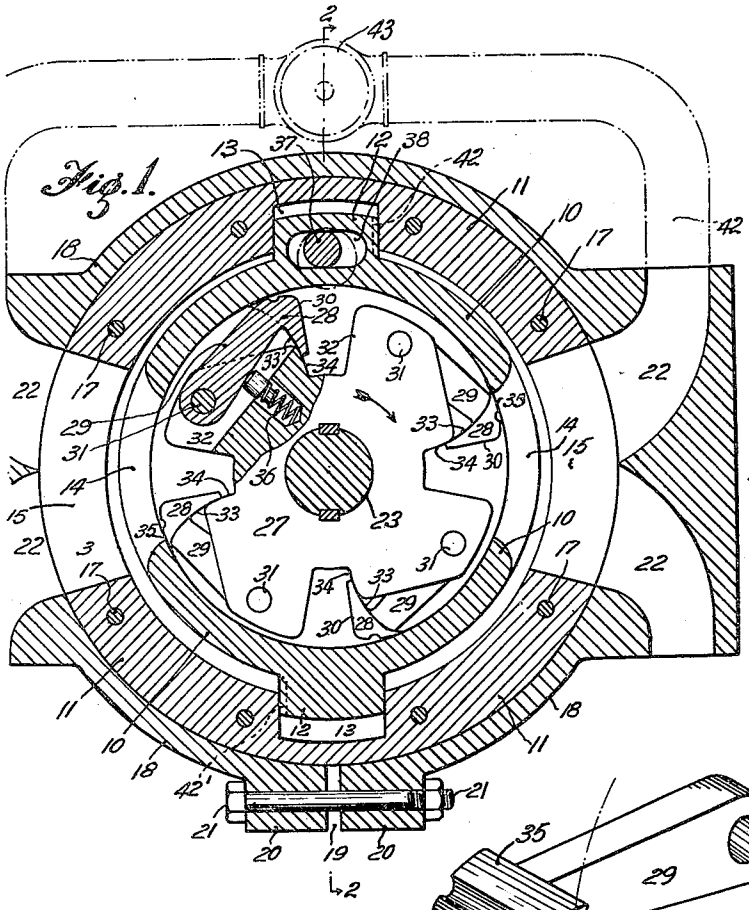


Fig. 1.

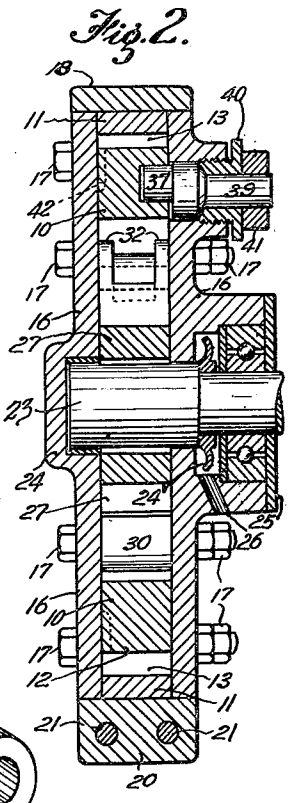


Fig. 2.

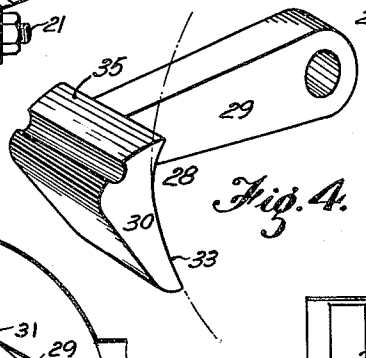


Fig. 4.

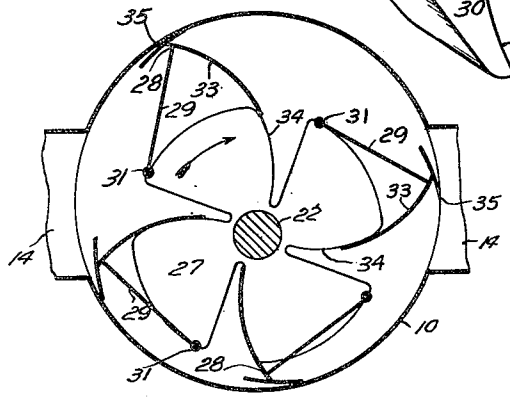


Fig. 3.

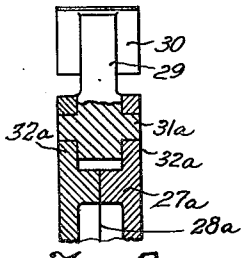


Fig. 5.

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ROTARY ENGINE AND PUMP

Filed Sept. 14, 1935 2 Sheets-Sheet 2

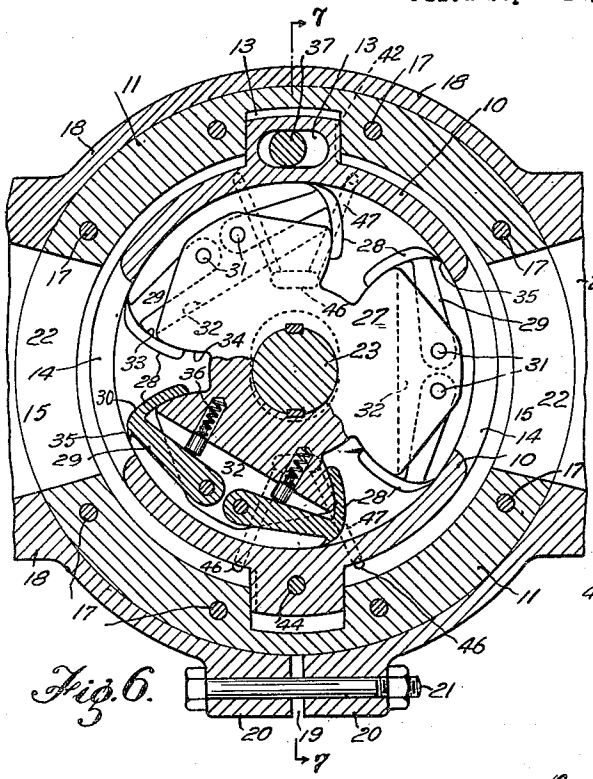


Fig. 6.

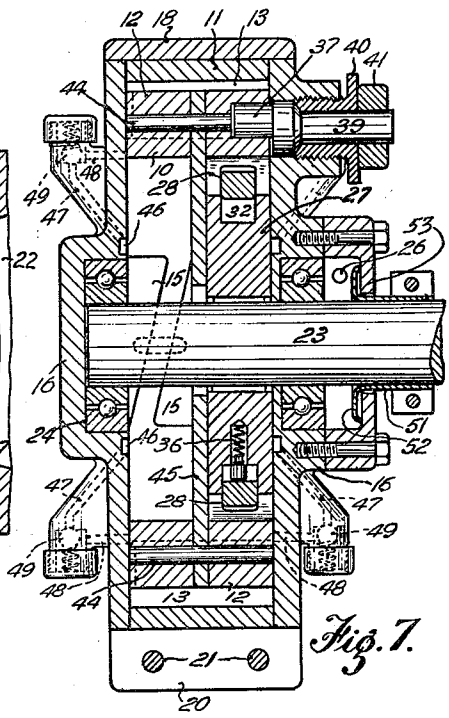


Fig. 7.

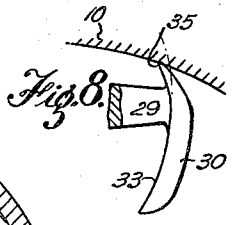


Fig. 8.

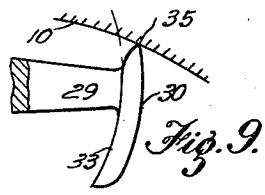


Fig. 9.

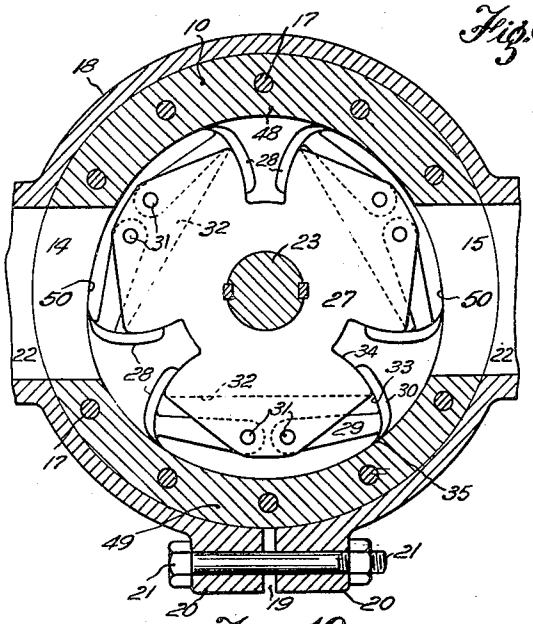


Fig. 10.

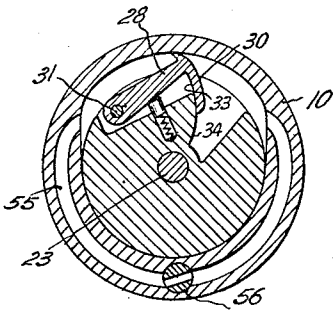


Fig. 11.

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UNITED STATES PATENT OFFICE

2,135,760

ROTARY ENGINE AND PUMP

Raymond John Francis Moore, Oakleigh, Australia

Application September 14, 1935, Serial No. 40,646
In Australia September 15, 1934

11 Claims. (Cl. 103—140)

This invention relates to improvements in and connected with rotary pumps, engines and the like, and refers especially to rotary pumps and engines adapted for use with liquids and gases, and to power transmission mechanisms embodying such engines and pumps.

Power transmission mechanisms in accordance with the invention may be employed for the propulsion of motor vehicles and for many other purposes.

One object of the present invention is to provide improvements in the construction and operation of rotary pumps and engines.

A further object is to provide simple and efficient power transmission mechanisms embodying rotary engines and/or pumps and by means of which forward and reverse movements at uniformly variable speeds, and freewheeling, clutch and braking effects may be readily obtained.

One broad feature of the invention resides in providing a rotary engine or pump having a cylinder, a rotor adapted to be disposed eccentrically within the cylinder, at least one blade member pivotally mounted on the rotor and adapted to make sealing contact with the periphery of the cylinder, a rotor sealing face on each of the blade members and disposed concentrically with the pivotal axis thereof, and a coacting sealing face on the rotor and disposed between said first mentioned rotor sealing face and the pivotal axis of the blade, said rotor sealing faces being arranged adjacent the free ends of the respective blade members.

More particularly, each of said blade members may comprise an arm pivotally mounted on the rotor and a headpiece of substantially arcuate form at the outer end of said arm, said headpiece corresponding in width to the rotor and having portion of its curved inner face hereinafter termed the "rotor-sealing" face disposed concentric with the pivotal axis thereof and arranged in close proximity to the correspondingly curved side of a slot provided in the rotor and adapted to accommodate a portion of or the inner end of the headpiece.

The outer end of the headpiece is adapted to make sealing engagement with the periphery of the cylinder and for that purpose it may be formed with a sealing face corresponding in curvature to the cylinder and extending on both sides of an arc produced from said rotor-sealing face on the inner surface of said headpiece.

This construction, when employed in an engine, permits of said rotor being driven in one direction only and likewise, when employed in a pump, liquid will be delivered thereby only when said rotor is rotated in the opposite direction.

Alternatively, two sets of oppositely extending pivoted blade members may be mounted alternately on the rotor, and the cylinder-sealing face at the outer end of each headpiece—i. e. the face adapted to engage the periphery of the cylinder—may be disposed entirely inside or entirely outside an arc produced as aforesaid from the rotor-sealing face on the inner surface of said headpiece.

When this construction is employed in an engine, the rotor is capable of being driven in either direction by a fluid under pressure and likewise, when used in a pump, liquid may be delivered thereby irrespective of the direction of rotation of said rotor.

A further important feature of the invention resides in the provision of a rotary pump or engine having an open-ended cylinder, a rotor within the cylinder, members on the rotor adapted to make sealing contact with the periphery of the cylinder, an outer casing enclosing the cylinder, means for displacing the cylinder relatively to the rotor to vary the eccentricity thereof whereby the displacement capacity of the said engine or pump may be regulated and means whereby the cylinder is subjected externally to fluid pressures corresponding to the fluid pressures in the interior thereof.

More particularly the cylinder may be so arranged that its axis may be moved through a rectilinear path extending through the axis of the rotor it being understood that, when the cylinder is concentric with the rotor, no liquid will be delivered (in the case of a pump) even though the rotor is being rotated, whilst, when the cylinder axis is disposed on one side of the rotor axis, the direction in which liquid is delivered is opposite to the direction in which said liquid will be delivered when the cylinder axis is on the opposite side of the rotor axis, the direction of rotation of the rotor remaining unchanged.

Having set forth the object and nature of the invention, reference will be made to the accompanying sheets of explanatory drawings wherein:—

Figure 1 is a view in sectional elevation of a rotary engine or pump in accordance with the present invention.

Figure 2 is a view in sectional side elevation taken on the line 2—2 of Figure 1;

Figure 3 is a diagrammatic view similar to Figure 1 and illustrating the action of the engine or

pump. In this view certain features of the invention are greatly exaggerated.

Figure 4 is a perspective view of one of the blades shown in Figures 1 and 2.

Figure 5 is a view in sectional side elevation of portion of a rotor blade of modified construction.

Figure 6 is a view similar to Figure 1 and shows a reversible rotary pump or engine.

Figure 7 is a view in sectional side elevation taken on the line 7—7 of Figure 6.

Figure 8 is a detail view of portion of one of the blades shown in Figures 6 and 7 and is drawn to a larger scale.

Figure 9 is a view similar to Figure 8 and shows a blade of modified construction.

Figure 10 is a view similar to Figure 6 and shows a reversible engine or pump having a non-displaceable cylinder; and

Figure 11 is a view similar to Figure 1 and shows a shock absorber in accordance with the invention.

Referring to Figures 1 and 2 the reference numeral 10 designates a circular cylinder open at both ends and arranged within an annular holder 11.

The width of the cylinder 10 is equal to that of the annular holder and the inner diameter of the latter is substantially greater than the external diameter of said cylinder.

The cylinder is provided externally with a pair of diametrically opposed projecting guides 12 of approximately rectangular form which are adapted to be received in corresponding guide slots 13 formed transversely in the inner periphery of the annular holder. These guide slots 13 are of such depth as to permit of the cylinder being displaced in its own plane whereby the axis thereof may coincide with the axis of the annular holder or may be arranged on either side thereof.

Diametrically opposed ports 14 are provided in the periphery of the cylinder at right angles to the above-mentioned projecting guides 12 and corresponding ports 15 provided in the annular holder are disposed in alignment therewith.

The thickness of the cylinder wall is preferably increased somewhat in the neighborhood of the ports 14 in order to provide increased strength, and it will be noted that this increase in thickness does not necessitate an increase in the internal diameter of the annular holder 11 in view of the fact that, when the cylinder is displaced within the holder, the ports in said cylinder are moved in a direction substantially parallel to the adjacent portions of the inner periphery of said holder.

An end plate 16 corresponding in diameter to the outer diameter of the annular holder 11 is arranged at each end thereof and a liquid-tight seal is formed therebetween by means of a plurality of clamping bolts 17 passing through the said discs and the intermediately disposed holder.

An outer casing 18 encircles the said end discs and the annular holder, and this casing is provided with a radial slot 19 having lugs 20 at each side thereof to receive one or more clamping bolts 21 whereby the holder may be contracted to closely engage the outer peripheries of the said end discs and annular holder and form a fluid tight joint therebetween.

This outer casing is also provided with bifurcated fluid passages 22 the inner ends of which are disposed in alignment with the said ports 14 and 15, in the cylinder and annular holder respectively.

A driving spindle 23 passes axially through one of the end plates 16 and one end of said spindle is mounted in a closed bearing 24 in the opposite end plate.

In order to prevent the passage of liquid through the open bearing at the right hand side of the pump (Figure 2) a grooved ring 24' is preferably secured on the spindle within a recess provided in a boss on the adjacent end plate 16, said recess being closed at its outer end by a fixed annular disc 25 which has a neat fit on the spindle.

Any liquid thrown outwards from the ring 24 is discharged from the recess through a passage 26.

A rotor 27 is secured to the spindle within the cylinder 10 and the width of said rotor corresponds with the width of the cylinder and of the annular holder 11 whereby the opposite ends of said rotor are disposed in close proximity to the inner faces of the end plates. Preferably the rotor is so mounted on the spindle as to be capable of a slight rocking movement whereby it will automatically align itself with the said end plates. This rotor is disposed concentrically with the annular holder 11 as will be clear from the drawings and from the preceding description, and the diameter of said rotor is less than the diameter of the cylinder.

A plurality of blade members 28 are pivoted to the rotor and are regularly spaced thereon. These blades are adapted to make sealing contact at or adjacent to their outer ends with the inner periphery of the cylinder 10 and the radial length of the blades is greater than the difference between the diameter of the rotor and that of the cylinder whereby a line drawn from the pivotal axis of a blade to the sealing surface thereof will make an acute angle with the portion of the cylinder periphery which is engaged thereby.

Each of these blade members 28 may consist of a centrally disposed arm 29 having an integral headpiece 30 of approximately arcuate shape at its outer end (see Figure 4).

The inner end of each arm 29, the thickness of which is substantially less than that of the rotor 27, is mounted on a pivot pin 31 passing transversely between a spaced pair of lugs 32 on the periphery of the rotor.

Alternately, each of the pivoted blades may be mounted as shown in Figure 5 wherein the rotor 27*a* is split as indicated at 28*a* and each lug 32*a* is provided with an opening for receiving the stub shafts 31*a* which are formed integral with the inner end of the arm 29.

The width of the headpiece 30 corresponds with that of the rotor whereby the sides of said headpiece are disposed in sealing relationship with the inner surfaces of the corresponding end plates 16.

The rotor is formed with a plurality of transverse slots corresponding in number to the pivoted blades 28 and these slots are so arranged as to accommodate the inner ends of the headpieces of said blades.

The inner portion 33 of the curved inner surface of each headpiece 30 is concentric with the pivotal axis thereof and the corresponding side 34 of the rotor slot therefor is similarly curved and is disposed in such close proximity thereto as to prevent liquid passing from the slot below the blade into the pocket or space therebehind, or vice versa.

This curved inner surface 33 of the headpiece 30 of the pivoted blade is hereinafter referred to as the rotor-sealing surface.

The outer end of the headpiece 30 forms a sealing face 35 to closely engage the inner periphery of the cylinder 10 and this sealing face, hereinafter called the cylinder sealing face, corresponds in curvature to the cylinder and is concentric therewith when said cylinder 10 is concentric with the rotor 27.

Furthermore, this cylinder-sealing face 35 extends on both sides of an arc produced from the aforementioned rotor-sealing surface 33 on the headpiece as shown in Figures 3 and 4.

Compression springs 36 may be arranged between the arms 29 of the blade members 28 and the adjacent portions of the rotor in order that said blades will remain in engagement with the cylinder surface even when the pump is not being actuated.

These springs 36 are preferably arranged as shown to prevent their falling out in the event of breakage.

The cylinder 10 may be displaced in any approved manner as for example by means of a crank pin 37 engaging a transverse slot 38 in one face of one of the projecting guides 12 on the outer surface thereof. This crank pin is formed on the inner end of the spindle 39 projecting through a suitable sealing sleeve 40 in the corresponding end plate 16 of the pump and an arm 41 or other member is mounted on the outer end thereof to enable same to be actuated as desired.

It will be clear that, by rotating the crank pin 37 through an angle of 180°, the cylinder will be displaced whereby its axis moves from a position at one side of the rotor axis to a corresponding position on the opposite side thereof, and that, when the cylinder is disposed in its mid-position, it is concentric with the rotor.

From the foregoing description it will be understood that the fluid pressures inside and outside the displaceable cylinder 10 are practically balanced, and consequently that the effort necessary to move the cylinder is quite small. As a result, there is little tendency for the leakage of fluid past the sides of the displaceable cylinder.

Furthermore, the diametrically opposed projecting guides 12 on the exterior of the cylinder are each provided with suitable means to enable fluid from the spaces between the cylinder and the annular holder 11 to pass to and from the ends of the guide slots 13 for said projections. For this purpose a slot 42 may be formed in one side of each of the guides 12.

When the device is used as a pump, the rotor is rotated in the direction of the arrows in Figures 1 and 3, while, when it is used as a motor, it is rotated in the opposite direction.

When the cylinder 10 is disposed concentrically with the rotor 27, no liquid will be delivered by the pump even though the rotor is being actuated in the direction of said arrows, owing to the fact that, under these conditions, the closed pockets formed by adjacent blade members 28 do not vary in volume while passing around the cylinder. In other words, said blade members do not undergo angular movement when the cylinder is concentric with the rotor.

When, however, the cylinder is disposed eccentrically to the rotor as shown, the volume of each of said pockets varies progressively during rotation and liquid is accordingly drawn into the left-hand port 14 and is discharged through the port opposite thereto. When, on the other hand, the axis of the cylinder is disposed on the opposite side of the axis of the spindle, the direction of flow of liquid is reversed though the rotor continues to move in the original direction. Also, the degree of eccentricity determines the volume of liquid which is delivered during each complete revolution of the rotor. It will thus be seen that, although the rotor 27 revolves in one direction only, liquid may be pumped in either direction and at any velocity up to the maximum capacity of the pump merely by regulating the position of the displaceable cylinder 10 in relation to the rotor.

Each of said rotor blades 28 is maintained in sealing engagement with the inner periphery of the cylinder 10 by the pressure of the fluid medium, this result being obtained as clearly shown in Figure 3 by reason of the variation in the point of contact between the cylinder sealing surface 35 of each blade and the cylinder periphery during the rotation of the rotor.

In this connection, it may be explained, when a blade is disposed in a position adjacent to the greatest radial distance between the rotor and the cylinder wall, the cylinder-sealing face of said blade bears against the cylinder at or adjacent to its forward end, i. e. the end remote from the pivotal axis thereof and beyond an arc produced from the rotor sealing face 33 of the blade.

On the other hand, when a blade is disposed at the opposite side of the cylinder to that above-mentioned, the inner end of the sealing face 35 engages the cylinder periphery, i. e. the end of the sealing face adjacent to the said pivotal axis and within an arc produced from said rotor face 35.

If, now, the direction of rotation of the rotor is reversed, no liquid will be pumped as the fluid pressure will cause the blades to move inwards out of engagement with the periphery of the cylinder. This action will be clear from an inspection of Figure 3.

Alternatively, if the device is used as an engine and the cylinder 10 is disposed as shown in Figures 1 and 3, fluid under pressure is delivered to the right-hand passages 22 and the rotor is actuated in the opposite direction to the arrows in Figures 1 and 3. If the cylinder 10 is moved whereby its axis lies on the opposite side of the spindle axis, the fluid under pressure is supplied to the left-hand passages 22 and the rotor moves in the same direction as before, i. e. in a direction opposite to that of the arrows in Figures 1 and 3.

If the device is to be used as a fluid clutch, the upper inlet and discharge ports 22 may be connected by a passage 42 shown in broken lines at the top of Figure 1, the passage being provided with a valve 43 to control the flow of liquid therethrough and lower ports 22 are closed. It will be clear hereafter that the construction shown in Figures 6 and 7 may be similarly used as a fluid clutch.

Assume now that the rotor is connected to a driving spindle which rotates in the direction of the arrow and that the casing 18 is connected to a driven spindle. When the valve 43 is fully open, no motion will be imparted to the driven spindle as the liquid will be merely circulated through the by-pass and the pump. When, on the other hand, the valve 43 is closed, no liquid can pass through the by-pass and the driven spindle will be rotated at the same speed as the driving spindle. If, further, the valve is arranged

at an intermediate position, the driven member will be rotated but at a lower speed than the driving spindle depending on the "slip" occasioned by the flow of liquid through the by-pass.

As no liquid is pumped when the direction of movement of the rotor is reversed, it will be clear that a ratchet effect may be obtained by oscillating the rotor.

In the modification of the invention shown in Figures 6 and 7, a somewhat modified form of blade 28 is employed and two direct coupled pumps are provided to minimize pulsations in the delivery of liquid and to more accurately balance the pressures on the cylinder, these pumps being connected to common inlet and discharge passages.

For this purpose a partition plate 45 is arranged between a pair of displaceable cylinders 10 constructed and arranged in the manner above set forth.

The two cylinders 10, together with the partition plate 45, are connected by dowell pins 44 and are mounted within an annular holder 11 which is fitted with end plates 16 and arranged within a contractible outer casing 18 substantially in the manner above set forth.

The rotors 27 in the cylinders 10 are so disposed on the spindle 23 that there is a phase displacement between the pivoted blades 28 of the different pumps, e. g. in the case of the two pumps shown the blades in one pump are disposed one half of the blade pitch in advance of the blades in the other pump.

If desired, more than two pumps may be arranged in this way.

On referring to Figure 7 it will be noted that the rotor and associated parts have been omitted from the left-hand cylinder in order to show that the ports 15 are disposed obliquely whereby uniform wear of the blade surfaces will be obtained.

Each rotor 27 is provided with two sets of oppositely extending pivoted blades 28 which are arranged alternately whereby each adjacent pair thereof constitutes a unit.

The blades are formed with arms and with substantially arcuate headpieces in the manner previously described and the inner ends of each adjacent pair of headpieces are adapted to be received into a common slot formed transversely in the outer surface of the rotor.

Each side of each of said slots is curved to conform to the pivotal axis of the corresponding blade or headpiece and the adjacent inner surface of said arcuate headpiece is disposed in close proximity thereto to prevent the passage of liquid below the headpiece into the space or pocket therebehind as in the case of the pump previously described.

These pivoted blades 28 are similar to the blades shown in Figures 1 to 4 except that the cylinder sealing surface 35 at the outer end of the headpiece 30 thereof is disposed completely inside an arc produced from the rotor sealing surface on the curved inner face of said headpiece (see also Figure 8).

In other words, the distance between the cylinder sealing surface 35 and the pivotal axis of the blade is less than the radius of the rotor sealing surface 33.

With this construction it is desirable to provide means to relieve the pressure within the transverse slots 34 in the rotor when said slots are successively disposed at the minimum distance from the cylinder surface and for this purpose a diametrically opposed pair of ports 46 is provided in the inner surface of each of the end plates.

A pair of passages 47 connect each of these ports 46 with ports 48 also provided in the inner faces of the end plates 16 and so disposed as to be covered by the respective cylinder 10 when the latter is in its central, i. e. its concentric position.

When, however, said cylinder is moved in either direction from its central position, the ports at the outer end of the corresponding passages are uncovered to permit of the escape of liquid from the rotor slots successively registering with the port 46 at the inner end thereof (see lower portion of Figure 6).

Each of the passages 47 is provided with a non-return valve 49 to prevent the passage of liquid into the rotor slots 32 and it will thus be clear that any liquid discharged from a rotor slot into a port 46 passes outwardly through that one of the corresponding passages 47 which communicates with the induction side of the pump. Although, for the purposes of illustration, these passages 47 are shown as extending through projections on the end plates 16, they are preferably provided in the end plates themselves.

When this arrangement is used as a pump, the rotor may be moved in either direction and the direction of flow of the liquid for a given direction of rotation is determined solely by the position of the displaceable cylinders 10 in relation to the axis of the spindle.

Likewise, the device may be used as a motor by supplying fluid under pressure to either side of the cylinders, the direction of rotation of the rotor being then determined by whether the cylinder axis is above or below the axis of the spindle.

It is important to note that this result is due to the use of opposed pairs of pivoted blades 28 having their cylinder sealing surfaces disposed entirely on one side of an arc produced from the corresponding rotor sealing faces.

By way of illustration, let it be assumed that the device is being used as a pump and that the rotor is turned clockwise in Figure 6. It will then be clear that the trailing blades are effective at the upper arcs of the cylinders in that figure while the opposite blades of each pair (viz those having their headpieces in advance of their pivots) are effective at the lower arcs of the cylinders. In other words, one blade of each opposed pair will be maintained in contact with the cylinder wall by the fluid pressure aided by the spring 36.

In lieu of employing pivoted blades 28 having their cylinder sealing surfaces 35 disposed within an arc produced from the rotor sealing surface 33, said faces 35 may be disposed outside said arc as shown in Figure 9.

Figure 7 also illustrates a preferred manner of preventing leakage of fluid through the bearing of the spindle 23.

For this purpose a sleeve 51 formed integrally with the resilient metal disc 52 is clamped to the spindle 23 and the outer peripheral edge of said disc is turned outwards and arranged to bear against the inner surface of an annular cover plate 53 which is secured in a fluid-tight manner to the adjacent end plate 16 of the pump.

It will be clear that any liquid under pressure which passes through the bearing of the spindle into the chamber enclosing the resilient disc will cause the latter to be firmly pressed against the annular cover and so prevent the escape of the

liquid except through an opening 26 provided for the purpose.

It is not always necessary or desirable to use displaceable cylinders as shown in the figures previously described. For example, when the invention is used for the transmission gear of a motor vehicle, a pump as shown in Figures 6 and 7 may have it rotor spindle connected to the power shaft of the engine and a rotary motor of the same general type may be rigidly connected to one or more road wheels.

By providing a displaceable cylinder in the pump, the speed ratio may be varied from a predetermined value in one direction to the same value in the opposite direction, and it is not necessary to provide displaceable cylinders in the rotary motors.

Referring now to Figure 10, the inner surface of each of the non-displaceable cylinders 10, instead of being circular, preferably comprises a segment 48 of relatively small radius disposed concentric with the rotor axis, a concentric segment 49 disposed opposite to said first mentioned segment and of increased radius, and an opposed pair of eccentric curved surfaces 50 connecting the adjacent ends of the segments 48 and 49 by means of smooth curves.

Inlet and discharge ports 14 are provided in said eccentric segmental surfaces 50 of the cylinder and correspond in width thereto. It will accordingly be understood that pivoted blades 28 fitted to the rotor do not undergo angular movement when passing between the ports, as such movement takes place only when said blades are passing across the ports.

By means of this construction, wear and friction are reduced to a minimum because angular movement of the blades can take place only when the fluid pressures on opposite sides thereof are balanced.

Although, in order to illustrate the invention, the pumps and engines have been described herein as forming part of the power transmission mechanism, it will be clear that such engines and pumps may be employed for any purpose and that same are adapted to operation both with liquids and gases.

In the case of a shock absorber (see Figure 11), I may arrange the rotor to make sealing contact at one point with the internal periphery of the cylinder, said rotor being fitted with a single pivoted blade member 28 of the type shown in Figure 1, Figure 8 or Figure 9. A by-pass 55 is provided in the cylinder and is fitted with an adjustable valve 56.

In use, the rotor may move freely in one direction, owing to the blade member 28 being pressed inwards towards the rotor while its return movement will be retarded to an extent depending on the valve opening in the by-pass.

I claim:

1. A rotary engine or pump having a substantially cylindrical chamber, the inner peripheral surface of which constitutes a smooth continuous curve, said cylindrical chamber having spaced inlet and discharge ports communicating therewith, a rotor arranged eccentrically within the chamber and having its entire peripheral surface disposed out of sealing contact with the inner periphery of said cylindrical chamber, a plurality of transversely arranged blade members pivotally supported on the rotor adjacent its periphery, a headpiece at the free end of each blade member, each said headpiece extending approximately radially of the rotor and being receivable in a coacting pocket in the periphery thereof, the inner face of each headpiece, with respect to the pivotal axis thereof, being disposed in constant sealing relationship with a coacting face on the rotor, said coacting face forming one side of the pocket for said headpiece, the entire outer face of each headpiece with respect to the pivotal axis thereof being disposed out of sealing relationship with the rotor at all times, the outer end of each headpiece, with respect to the rotor axis, being disposed in constant sealing engagement with the curved wall of the chamber, at least one blade member being disposed at all times in contact with the cylinder at each side of a line connecting the said inlet and discharge ports.

2. A rotary engine or pump having a substantially cylindrical chamber, the inner peripheral surface of which constitutes a smooth continuous curve, said cylindrical chamber having spaced inlet and discharge ports communicating therewith, a rotor arranged eccentrically within the chamber, a plurality of blade members pivotally supported on the rotor adjacent its periphery, a headpiece at the free end of each blade member and extending substantially radially of the rotor, transverse sealing faces on the rotor, the inner face of each headpiece with respect to the pivotal axis thereof being disposed in constant sealing relationship with one of said transverse sealing faces on the rotor and the entire outer face of each headpiece, with respect to said pivotal axis thereof, being out of sealing relationship with the rotor at all times, the outer end of each headpiece with respect to the rotor axis, providing a surface for maintaining constant sealing engagement with the inner periphery of the cylindrical chamber, characterized in that an arc struck from the pivotal axis of the headpiece and produced from the corresponding transverse sealing face on the rotor passes through said sealing surface at the outer end of the headpiece, at least one blade member being disposed at all times in contact with the cylinder at each side of a line connecting the said inlet and discharge ports.

3. A rotary engine or pump having a substantially cylindrical chamber the inner peripheral surface of which constitutes a smooth continuous curve, said cylindrical chamber having spaced inlet and discharge ports communicating therewith, a rotor arranged eccentrically within the chamber and having its entire peripheral surface disposed out of sealing relationship with the inner periphery of the cylindrical chamber, a plurality of similarly arranged blade members pivotally supported on the rotor adjacent its periphery, a headpiece at the free end of each blade member, each headpiece extending approximately radially of the rotor and being receivable in a corresponding peripheral pocket in the rotor, the inner face of each headpiece with respect to the pivotal axis thereof being disposed in constant sealing relationship with a coacting sealing face on the rotor, said coacting sealing face forming a portion of the boundary of the corresponding peripheral pocket in the rotor, the entire outer face of each headpiece with respect to the pivotal axis thereof being disposed out of sealing relationship with the rotor at all times and the outer end of each headpiece, with respect to the rotor axis, having a cylinder sealing face to maintain sealing engagement with the peripheral surface of the cylindrical chamber, said cylinder sealing face extending on opposite sides of an arc struck from the pivotal axis of the headpiece and produced from the rotor sealing surface provided

by said inner face of the headpiece, at least one blade member being disposed at all times in contact with the cylinder at each side of a line connecting the said inlet and discharge ports.

4. A rotary engine or pump according to claim 3 wherein the cylindrical chamber is circular in cross section and wherein the cylinder sealing face at the outer end of each headpiece is curved to conform to the curvature of the cylindrical chamber.

5. A rotary engine or pump having a substantially cylindrical chamber the inner peripheral surface of which constitutes a smooth continuous curve, said cylindrical chamber having spaced inlet and discharge ports communicating therewith, a rotor arranged eccentrically within the chamber and having its peripheral surface disposed entirely out of sealing relationship with the peripheral surface of the chamber, a plurality of blade members pivotally supported on the rotor adjacent its periphery, said blade members being arranged in oppositely inclined pairs, a headpiece at the free end of each blade member and extending approximately radially of the rotor, a plurality of transverse sealing faces on the rotor, the inner face of each headpiece, with respect to the pivotal axis thereof, being disposed in constant sealing engagement with the corresponding transverse sealing face on the rotor, the entire outer face of each headpiece, with respect to the pivotal axis thereof being disposed out of sealing relationship with the rotor at all times, the outer end of each headpiece, with respect to the rotor axis, forming a cylinder sealing surface which is maintained in constant engagement with the inner periphery of the cylindrical chamber characterized in that said cylinder sealing surface is disposed at one side of an arc struck from the pivotal axis of the headpiece and produced from the rotor sealing surface at said inner face thereof, at least one blade member being disposed at all times in contact with the cylinder at each side of a line connecting the said inlet and discharge ports.

6. A rotary engine or pump having a substantially cylindrical chamber, the inner peripheral surface of which constitutes a smooth continuous curve, said cylindrical chamber having inlet and discharge ports communicating therewith, a rotor arranged eccentrically within the chamber and having its peripheral surface disposed entirely out of sealing relationship with the peripheral surface of the chamber, a plurality of blade members pivotally supported on the rotor adjacent its periphery, said blade members being arranged in oppositely inclined pairs, a headpiece at the free end of each blade member and extending approximately radially of the rotor, a plurality of transverse sealing faces on the rotor, the inner face of each headpiece, with respect to the pivotal axis thereof being disposed in constant sealing engagement with the corresponding transverse sealing face on the rotor, the entire outer face of each headpiece, with respect to the pivotal axis thereof, being disposed out of sealing relationship with the rotor at all times, the outer end of each headpiece, with respect to the rotor axis, forming a cylinder sealing surface which is maintained in constant engagement with the inner periphery of the cylindrical chamber, characterized in that said cylinder sealing surface is inside an arc struck from the pivotal axis of the headpiece and produced from the rotor sealing surface at said inner face thereof, at least one blade member being disposed at all times in contact with the cylinder at each side of a line connecting the said inlet and discharge ports.

7. A rotary engine or pump having a substantially cylindrical chamber the inner peripheral surface of which constitutes a smooth continuous curve, said cylindrical chamber having spaced inlet and discharge ports communicating therewith, a rotor arranged eccentrically within the chamber and having its peripheral surface disposed entirely out of sealing relationship with the peripheral surface of the chamber, a plurality of blade members pivotally supported on the rotor in adjacent oppositely inclined pairs, a headpiece at the free end of each blade member and extending approximately radially of the rotor, a plurality of transverse sealing faces on the rotor, the inner face of each headpiece with respect to the pivotal axis thereof, being disposed in constant sealing engagement with the corresponding transverse sealing face on the rotor, the entire outer face of each headpiece, with respect to the pivotal axis thereof, being disposed out of sealing relationship with the rotor at all times, the outer end of each headpiece, with respect to the rotor axis, forming a cylinder sealing surface which is maintained in constant engagement with the inner periphery of the cylindrical chamber, characterized in that said cylinder sealing surface is outside an arc struck from the pivotal axis of the headpiece and produced from the rotor sealing surface at said inner face thereof, at least one blade member being disposed at all times in contact with the cylinder at each side of a line connecting the said inlet and discharge ports.

8. A rotary engine or pump having a cylinder, the inner peripheral surface of which constitutes a smooth continuous curve, said cylinder having spaced inlet and discharge ports communicating therewith, end members for the cylinder, a rotor mounted eccentrically within the cylinder and having its ends arranged in sealing relationship with said end members for the cylinder, a plurality of blade members pivotally mounted on the rotor, a headpiece at the outer end of each of said blade members, each headpiece having its sides arranged in sealing relationship with said end members for the cylinder, a sealing surface on each of said headpieces in constant sealing engagement with the periphery of the cylinder, the inner face of each of said headpieces with respect to the pivotal axis thereof, being concentric with said pivotal axis and constituting a concave sealing surface, and sealing surfaces on the rotor arranged to coact with said concave sealing surface, the entire outer faces of said headpieces with respect to the pivotal axes thereof, being disposed out of sealing contact with said rotor at all times, at least one blade member being disposed at all times in contact with the cylinder at each side of the centerline connecting the inlet and discharge ports, and the cylinder sealing surface on the headpiece of each blade member extending on opposite sides of an arc produced from the concave sealing surface of said headpiece.

9. A rotary engine or pump having a cylinder, the inner peripheral surface of which constitutes a smooth continuous curve, said cylinder having spaced inlet and discharge ports communicating therewith, end members for the cylinder, a rotor mounted eccentrically within the cylinder and having its ends arranged in sealing relationship with said end members for the cylinder, a plurality of blade members pivotally mounted on the rotor, a headpiece at the outer end of each

of said blade members, each headpiece having its sides arranged in sealing relationship with said end members for the cylinder, a sealing surface on each of said headpieces in constant sealing engagement with the periphery of the cylinder, the inner face of each of said headpieces with respect to the pivotal axis thereof, being concentric with said pivotal axis and constituting a concave sealing surface, and sealing surfaces on the rotor arranged to coact with said concave sealing surface, the entire outer faces of said headpieces with respect to the pivotal axes thereof, being disposed out of sealing contact with said rotor at all times, at least one blade member being disposed at all times in contact with the cylinder at each side of the centerline connecting the inlet and discharge ports, and the cylinder sealing surface on the headpiece of each blade member lying inside an arc produced from the concave sealing surface on said headpiece.

10. A rotary engine or pump having a cylinder, the inner peripheral surface of which constitutes a smooth continuous curve, said cylinder having spaced inlet and discharge ports communicating therewith, end members for the cylinder, a rotor mounted eccentrically within the cylinder and having its ends arranged in sealing relationship with said end members for the cylinder, a plurality of blade members pivotally mounted on the rotor, a headpiece at the outer end of each of said blade members, each headpiece having its sides arranged in sealing relationship with said end members for the cylinder, a sealing surface on each of said headpieces in constant sealing engagement with the periphery of the cylinder, the inner face of each of said headpieces with respect to the pivotal axis thereof, being concentric with said pivotal axis and constituting a concave sealing surface, and sealing surfaces on the rotor arranged to coact with said concave sealing surface, the entire outer faces of said headpieces with respect to the pivotal axes thereof, being disposed out of sealing contact with said rotor at all times, at least one blade member being disposed at all times in contact with the cylinder at each side of the centerline connecting the inlet and discharge ports, and the blade members being arranged in oppositely directed pairs and the cylinder sealing faces on the headpieces thereof being disposed inside arcs produced from the concave sealing surface on said blade members.

11. A rotary engine or pump having a cylinder, the inner peripheral surface of which constitutes a smooth continuous curve, said cylinder having spaced inlet and discharge ports communicating therewith, end members for the cylinder, a rotor mounted eccentrically within the cylinder and having its ends arranged in sealing relationship with said end members for the cylinder, a plurality of blade members pivotally mounted on the rotor, a headpiece at the outer end of each of said blade members, each headpiece having its sides arranged in sealing relationship with said end members for the cylinder, a sealing surface on each of said headpieces in constant sealing engagement with the periphery of the cylinder, the inner face of each of said headpieces with respect to the pivotal axis thereof, being concentric with said pivotal axis and constituting a concave sealing surface, and sealing surfaces on the rotor arranged to coact with said concave sealing surface, the entire outer faces of said headpieces with respect to the pivotal axes thereof, being disposed out of sealing contact with said rotor at all times, at least one blade member being disposed at all times in contact with the cylinder at each side of the centerline connecting the inlet and discharge ports, the blade members being arranged in oppositely directed pairs and said cylinder sealing surfaces disposed at one side of an arc produced from the respective rotor sealing faces thereof, an outer casing, means for displacing the cylinder in its own plane within said casing, one of said members closing the end of the cylinder having a port therein, a passage connecting said port with a further port in said end member, said further port being closed by the cylinder wall when said cylinder is in the neutral position and being opened to the space surrounding said cylinder when the latter is displaced, whereby its axis is on the opposite side of the axis of the spindle from said ports, said first mentioned port being arranged to successively register with the spaces between adjacent blade members when said spaces are disposed on the opposite side of the spindle axis to the axis of the cylinder.

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