April 14, 1925. 1,533,338

G. J. RAYNOR

FLUID OPERATED ROTARY DRIVING OR DRIVEN ELEMENT

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Fig. 1.

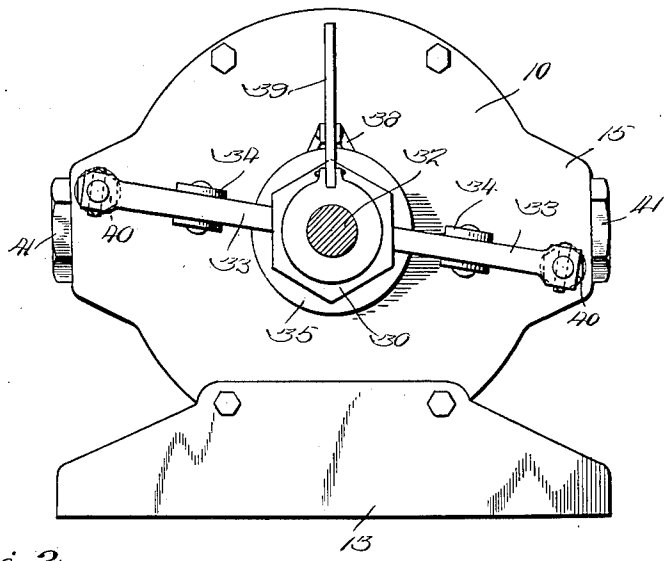


Fig. 2.

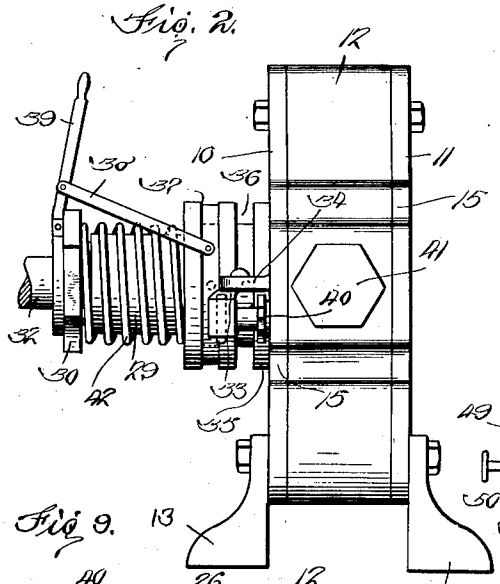


Fig. 6.

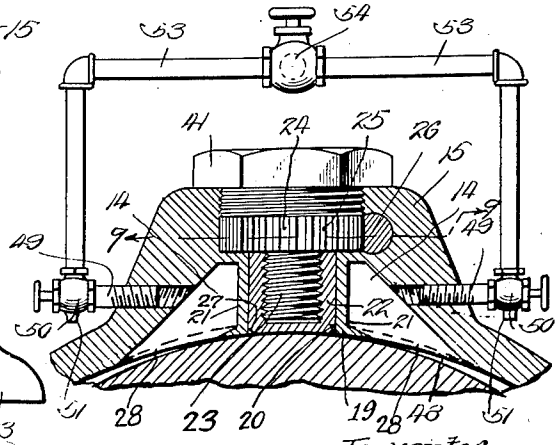
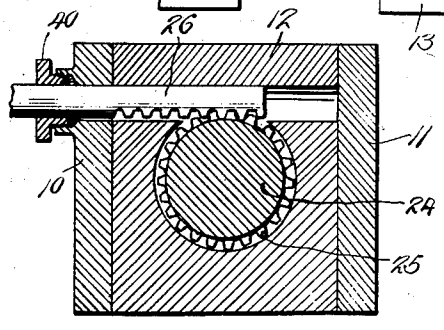


Fig. 9.



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Fig. 3.

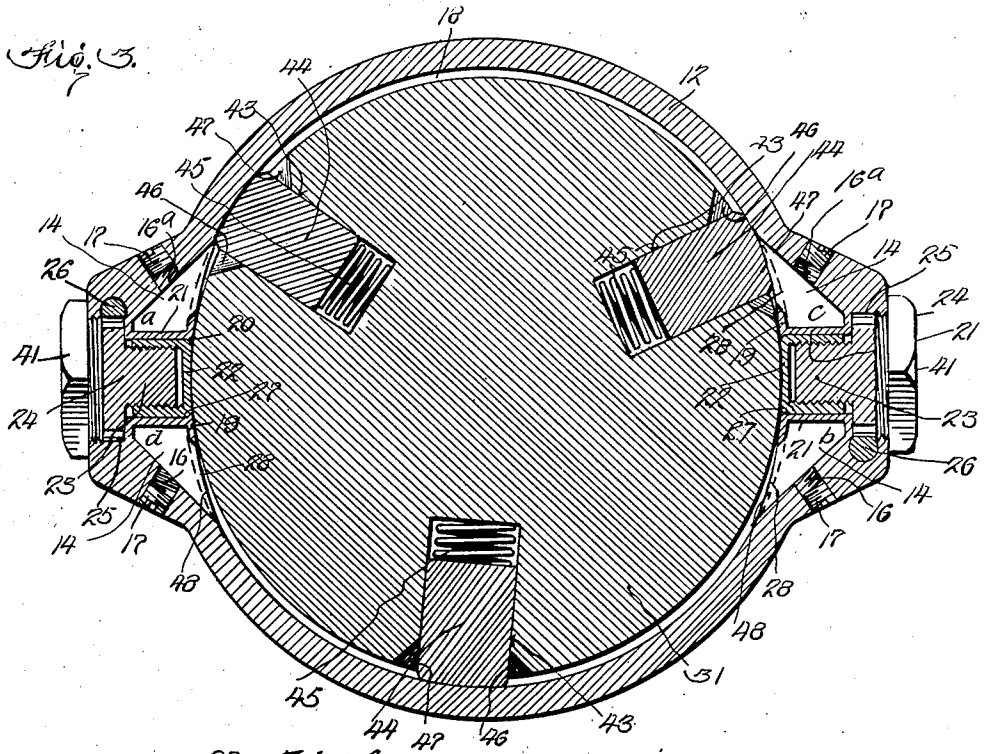
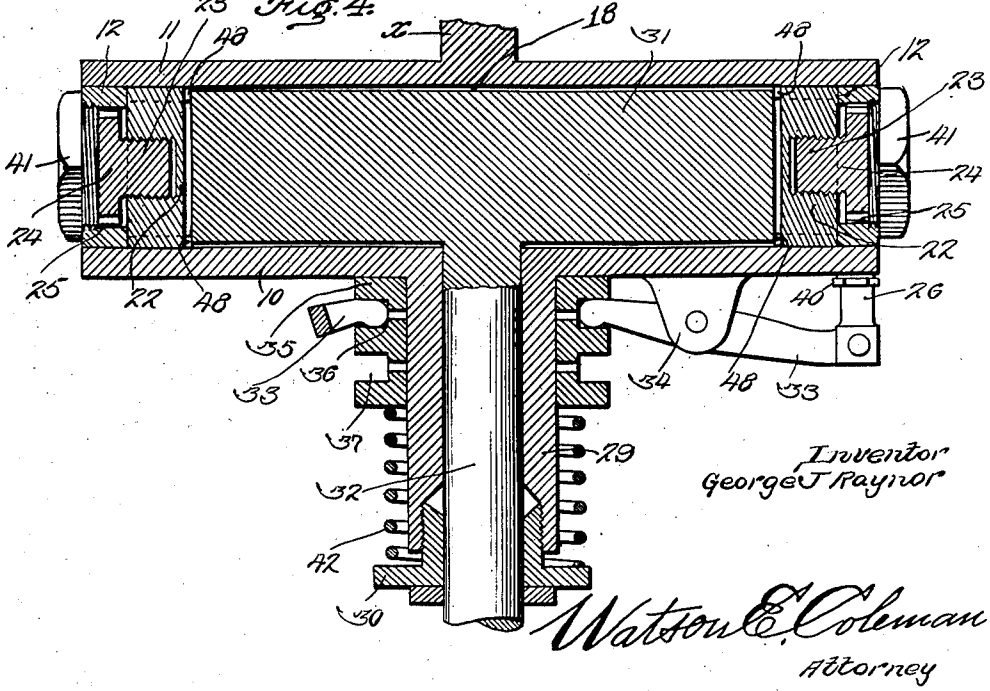


Fig. 4.



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Fig. 5.

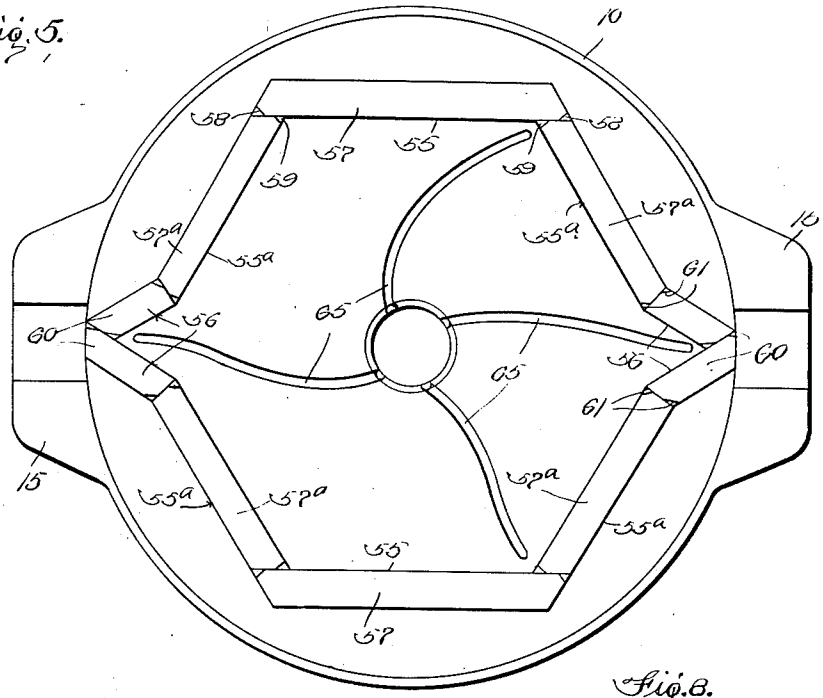


Fig. 8.

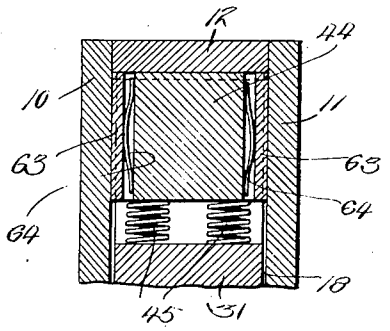


Fig. 7.

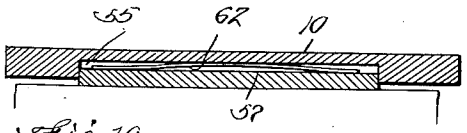
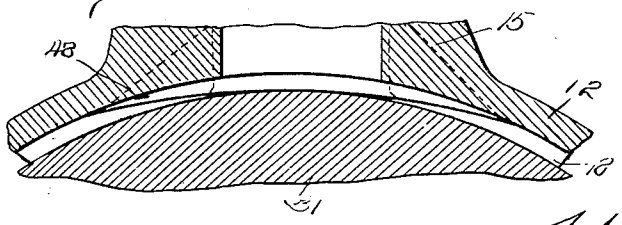


Fig. 10.



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Patented Apr. 14, 1925. 1,533,338

UNITED STATES PATENT OFFICE.

GEORGE J. RAYNOR, OF DETROIT, MICHIGAN.

FLUID-OPERATED ROTARY DRIVING OR DRIVEN ELEMENT.

Application filed May 25, 1921. Serial No. 472,462.

To all whom it may concern:

Be it known that I, GEORGE J. RAYNOR, a citizen of the United States, residing at Detroit, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Fluid-Operated Rotary Driving or Driven Elements, of which the following is a specification, reference being had to the accompanying drawings.

This invention relates to mechanism including a rotor and a stator, the rotor being driven by fluid or acting to drive fluid, in other words to devices such as rotary engines, rotary pumps or rotary hydraulic clutches, all of such devices operating on the same general principle, that is having a casing and a bladed rotor rotating therein.

The general object of my invention is to provide mechanism which is adapted to be used either as a rotary engine, a pump or a hydraulic clutch, and which is so constructed that it is adapted by very slight reorganization to be used for any one of the three purposes above described. A further object is to provide an improved valve so adjusted that it may act as an abutment when the mechanism is being used for a rotary engine or a combined rotary engine and pump or whereby it may be used as a controlling valve when the mechanism is being used as a hydraulic clutch.

And a further object is to provide a construction of this character which, when used as a rotary engine or pump, may be driven in opposite directions, that is reversed, without the necessity of complicated reversing gears.

Another object is to provide means whereby the space between the side wall of the rotor casing or stator and the rotor may be packed.

Other objects will appear in the course of the following description.

My invention is illustrated in the accompanying drawings, wherein:—

Figure 1 is a side elevation of my invention when used as a rotary engine or pump;

Figure 2 is an end elevation of the construction shown in Figure 1;

Figure 3 is a sectional view through the rotor and casing parallel to the side wall of the casing showing the mechanism when used as a clutch;

Figure 4 is a diametrical section through Figure 3 and through the valves, the valves being shown as partly open;

Figure 5 is an inside elevation of the rotor casing showing the packing strips;

Figure 6 is an enlarged sectional view through one of the heads of the rotor casing, showing the pipes whereby the mechanism is adapted for use as a rotary engine;

Figure 7 is a fragmentary longitudinal sectional view through a portion of the rotor casing showing one of the packing strips therein;

Figure 8 is a longitudinal sectional view through a portion of the rotor and one of its blades;

Figure 9 is a sectional view on the line 9—9 of Figure 6;

Figure 10 is a fragmentary sectional view through a portion of the rotor and one of the valve heads to show the rib 48.

Referring to these drawings, it will be seen that essentially my mechanism comprises the side walls 10 and 11 and the circumferential wall 12, the heads or side walls 10 and 11 being bolted to the circumferential wall 12. When the device is designed to be used as a rotary engine or as a pump, a base formed of two supporting members 13 is bolted or otherwise attached to the casing to support the same, as illustrated in Figure 1. When, however, the mechanism is designed to be used as a hydraulic clutch, this base is omitted, the casing being then attached to the shaft, as for instance a driven shaft, X (see Figure 4) while the rotor is attached to a driving shaft.

At opposite points in its diameter the circumferential wall 12 is formed to provide a pair of chambers 14 spaced from each other which, as illustrated, are triangular in form, the wall 12 being laterally enlarged at these diametrically opposite points to accommodate the chambers and accommodate the valves disposed in said chambers and the valve operating mechanism. It will be understood that the ends or heads 10 and 11 are also extended, as at 15, to form side walls for these chambers 14. Each chamber 14 is formed with a port, the port of one chamber being designated 16 and of the other 16^a and when this mechanism is designed to be used as a pump or as a rotary engine or as a combination pump and rotary engine, these ports 16 and 16^a are designed to be connected to suitable pipes whereby fluid may be supplied to the engine and pump and conducted therefrom. When the mechanism is designed to be used as a

hydraulic clutch, however, these ports 16 and 16ª are closed by plugs 17, as illustrated in Figure 3.

The chambers 14 are separated from the rotor chamber 18 of the mechanism by a circumferentially extending web 19 and this web is formed to provide a transversely extending opening 20 which is defined by two transversely extending walls 21. Operating between these walls is a gate valve 22 or abutment, and this element 22 may be used either as a gate valve or as an abutment. This element 22 may be projected through the aperture 20 into contact with the rotor or shifted out of contact with the rotor by means of a screw 23 having a head 24, this screw 23 having screw-threaded engagement with the body of the gate valve and the head 24 having teeth 25, the teeth of each head being adapted to be engaged by a rack bar 26 having teeth meshing with the gear teeth on the head and operated by means which will be later described so as to cause the rotation of the screw 23 and the retraction or projection of the corresponding abutment or valve. The under face of this valve 22 is bevelled at opposite corners, as at 27.

It will be seen that the transversely extending walls 21 define on each side of the mechanism the triangular chambers 14 into which chambers the ports 16 and 16ª open, each of these chambers opening by a port 28 to the interior of the rotor casing. The rotor casing is provided with the outwardly projecting hub 29 constituting a bearing and provided with a stuffing box 30 at one end, and disposed within the rotor casing is a rotor 31 having a shaft 32 which extends out through the hub 29 and through the stuffing box 30. When this mechanism is used as a clutch, the rotor casing, as before remarked, is attached to one shaft to rotate therewith, while the rotor 31 is attached to the other shaft to rotate therewith. When the mechanism is used as a motor or engine, however, the shaft 32 delivers power. When the mechanism is used as a combined pump and rotary engine, the shaft 32 simply constitutes the axial bearing or support for the rotor 31.

The extremities of the racks 26 are operatively connected to pivoted arms or levers 33 pivoted upon lugs 34 projecting from one of the heads or end walls of the rotor and these levers 33 are engaged by a longitudinally slidable member 35 mounted upon the hub 29. This member 35 is in the form of a shipper ring having an annular groove 36 in which the inner ends of the levers 33 engage. The member 35 is also annularly grooved, as at 37, and operatively engaging at diametrically opposite points with this groove 37 is a forked link 38, the outer end of which is pivoted to a lever 39 mounted upon any suitable support on the shaft 32 but not rotating therewith. It will be obvious, therefore, that by shifting the lever 39, the levers 33 will be shifted and these in turn will shift the racks 26 and rotate the screws 23 to adjust the valves or abutments. The rack bars 26 extend through the stuffing boxes 40 mounted in the wall of the rotor casing. Plugs 41, as illustrated most clearly in Figure 6, fit in screw-threaded openings in the member 12 and abut against the heads 24 of the screws 23.

It is to be understood that when the mechanism is designed to operate as a rotary engine or as a pump, the rack bars 26 need not be used, nor the attendant mechanism, and the screws 23 are then adjusted from time to time to hold the members 22 against the rotor, as will be hereafter stated. A spring 42 around the hub 29 bears against the end of the ring 35 so as to yieldingly hold this ring in its innermost position and yieldingly hold the rack bars 26 in their outward position.

The rotor 31 is formed at a plurality of points with the radially extending recesses 43 which extend transversely of the rotor and disposed in these recesses are the piston blades 44 which are outwardly urged by means of coiled springs 45 disposed in the bottoms of the recesses. On each side of a blade the face of the rotor is cut away to form the pockets 46 and 47 which are approximately triangular in form. The springs 45 will act to urge the blades 44 outwardly against the inner face of the circumferential wall of the casing. At opposite points in its diameter the inner face of the rotor casing is flattened as to its curvature, as most clearly shown in Figure 10, and the openings through the bottoms of the chambers 14 are defined by the longitudinally extending walls 48, as shown most clearly in Figures 4 and 10. The piston blades are wider than the distance between these lateral walls 48 so that as a piston blade approaches a valve chamber it will commence to engage the inner faces of the walls and be forced inward. Then as it passes the valve or abutment member 22, it will gradually move outward.

Where the mechanism is designed to be used as a rotary engine, one of the chambers 14, as chamber *a*, will act as an inlet for motive fluid, the next successive chamber *c* will act as an outlet or exhaust passage, the next successive chamber *b* as an inlet, and the next successive chamber *d* again as an outlet. Preferably and in order to permit the engine to be reversed under these circumstances, each pair of chambers 14 is provided with the pipes 49, (see Figure 6) each of these pipes 49 being connected to a valve casing 50, this valve casing being provided with exhaust openings 51

and being connected by pipes 53 to a valve casing 54, in turn connected to a source of fluid under pressure. The valve casing 54 is provided with a controlling valve whereby motive fluid may be entirely cut off from the engine or reduced, and the valves within the valve casings 50 provide means whereby the inlet of motive fluid to one of the chambers 14 may be permitted and the inlet of motive fluid to the other chamber 14 cut off and this chamber 14 connected to the exhaust opening 51. Any suitable valves, as for instance globe valves, may be used for this purpose.

Where the mechanism is designed to be used as a combined pump and rotary engine, motive fluid may be admitted through the pipes to one of the chambers 14 and act upon the piston blade through half of the rotation of the rotor and be discharged at the opposite chamber 14, while water may be admitted through another chamber 14 and discharged out of the fourth chamber 14. Thus in Figure 3 the chamber *a* may be the chamber into which motive fluid is admitted, the chamber *c* the chamber from which the motive fluid is expelled or exhausted, the chamber *b* the chamber into which water is allowed to enter or is drawn by the pumping action of the blade, and the chamber *d* the chamber from which the water is eventually expelled. Under these circumstances, as before remarked, the device will act as a combined pump and rotary engine.

Where the mechanism is to be used as a clutch, however, the pipes 49 to 53 and the valves associated therewith are not used and the port openings 16 and 16ª into the chambers 14 are closed by the plugs 17. When the mechanism is designed to be used as a rotary engine or as a pump, the members 22 are forced inward until they come in contact with the face of the rotor. The corners of the piston blades are bevelled and as the corners of the members 22 are also bevelled, as at 27, it is obvious that when the piston blades intersect the members 22, the piston blades will be momentarily depressed against the action of the springs 45 to permit the piston blades to pass the abutments constituted by the members 22. This is true where the mechanism is used as a rotary engine or as a pump. When, however, the mechanism is used as a clutch, the members 22 constitute valves and the position of these valves relative to the periphery of the rotor is to be controlled and regulated so as to cause the space between the rotor and the inner face of the valve 22 to be larger or smaller as may be desired. Under these circumstances the path of the fluid, when the valves 22 are open, is beneath the flanges 19 as the rotor rotates, or in other words as the rotor rotates, assuming that the valves are wide open, the oil which fills the space between the rotor and the outer casing simply acts as a film which only very slightly impedes the motion of the rotor, if it impedes it at all, and of course does not transmit any motion to the rotor casing. When, however, the valves 22 are turned inward nearly to the position shown in Figure 3, these valves will obstruct the movement of the oil and, therefore, there will be some motion transmitted from the rotor to the outer casing or other element of the clutch so that the two elements will more or less rotate together. There will be, however, slippage of the rotor with relation to the outer casing so that the outer casing will not rotate as fast as the rotor. If the valve is moved inward to the position shown in Figure 3, there will be no chance for the oil to pass and the rotor and the outer casing will move together. For instance, when the annulus 35 is fully over against the side wall 10 of the rotor and urged thereto by the spring 42, the valves 22 will be fully raised and a maximum space will be permitted for the passage of fluid. When, however, the lever 39 is shifted to shift the ring 35 against the action of the spring 42, the screws 23 will be turned so as to cause the valves to approach nearer and nearer to the periphery of the rotor and thus reduce the fluid passage between the valves and the rotor. Where the device is to be used as a clutch, the whole space between the periphery of the rotor and the rotor casing is to be filled with oil. Now if the valves 22 be drawn outward to their fullest extent away from the face of the rotor, it is obvious that the rotor will move practically freely and independently of the rotor casing but if, on the other hand, the screws 23 be turned so as to carry the valves 22 into close contact with the rotor casing, then it is obvious that the oil cannot circulate and as a consequence the rotor and the rotor casing will rotate together. By shifting the valves 22 a greater or less distance from the face of the rotor, slippage will occur between the rotor and the rotor casing so that a differential drive will be secured.

In order to prevent the escape of fluid around the pistons the side faces of the casing are formed with grooves 55 and 55ª, there being a series of these grooves extending tangentially to a circle described upon the rotor axis but in angular relation to each other. At diametrical points where the pistons move into engagement with the abutments or valves there are also formed angularly related grooves 56 extending at an acute angle to each other, as illustrated most clearly in Figure 5. Disposed in the grooves 55 are compression strips 57. These strips 57 extend over the ends of compres-

sion strips 57ª disposed in the grooves 55ª. The angular extremities of the compression strips 57 are bevelled, as at 58, and the outer corner of that strip 57ª which abuts against the strip 57 is also bevelled, as at 59, these bevelled faces preventing the blades from striking the corners of the strips upon a movement in either direction. The junctions of the strips 57ª and the strips 60 in the grooves 56 are also bevelled, as at 61, for the same purpose. These strips 57, 57ª and 60 are urged outward by springs 62. The pistons are also formed on their side walls with compression strips 63 urged laterally outward by springs 64. Oil grooves 65 are formed in the side faces of the rotor whereby oil may be carried from the bearings of the central shaft to the compression strips.

As before stated, the rotor is formed on each side of the blade with the cavities 46 and 47. These are for the purpose of preventing the rotor ever being on a dead center. Thus, for instance, assuming that the rotor is travelling in a clockwise direction and then as the rotor blade passes the left hand top chamber 14, the motive fluid will pass from said chamber into the cavity 46 and, bearing against the front wall of this cavity, act to urge the rotor forward. It will likewise be seen that with the arrangement of the three blades, one is always being acted on by the motive fluid when the other is passing an abutment or valve so that there is no possible chance for the rotor to stop with its blades so disposed as to be incapable of being acted on by motive fluid and propelled.

It will be seen that I have provided a mechanism which may be used as a rotary engine by the application thereto of the pipes 53 and 49 and the valves 50 and 54 by rigidly supporting the rotor casing, or may be used as a combined engine and pump by admitting steam or other motive fluid, for instance, to the chamber *a* and exhausting it from the chamber *c*, while admitting water into the chamber *b* and forcing this water out through the chamber *d*, and that by detaching the pipes 49 from engagement with the chambers 14 and closing the inlet ducts to these chambers by plugs and attaching a driving shaft to the casing and a driven shaft to the rotor or vice versa, I have provided a rotary clutch. Under these last circumstances the clutching movement is controlled by the action of the valves 22 which, when forced entirely in, prevent the free circulation of the water, oil or other liquid used in a hydraulic clutch, or which, when shifted a slight degree from the face of the rotor, permit the rotor and casing to travel at slightly different speeds, and which, when shifted fully outward, permit the rotor to travel at one speed and the casing to remain motionless.

While I have illustrated a form of my invention which I believe to be particularly effective for the purpose described, I do not wish to be limited thereto, as it is obvious that many changes might be made in the details of construction and arrangement of parts without departing from the spirit of the invention.

I claim:—

1. A mechanism of the character described including a rotor casing formed with a chamber in its wall, a rotor disposed within the casing having resiliently projected, radial blades, a member disposed in said chamber and movable toward or from the periphery of the rotor, the member being interiorly screw-threaded, the wall of said casing having an outwardly opening recess registering with said chamber, a pinion having a screw-threaded shank engaging the member and the pinion being disposed in the recess in the wall of the chamber, a plug adapted for the application of a wrench and disposed to close the outer end of said recess, a rack extending through the wall of the casing and meshing with the pinion, the rack being longitudinally shiftable, and manually operable means exterior to the rotor for shifting said rack.

2. A mechanism of the character described, including a rotor casing formed with a chamber in its wall, a rotor disposed within the casing and having resiliently projected, radial blades, a member disposed in said chamber and movable toward or from the periphery of the rotor, a pinion having a screw-threaded shank engaging the member and adapted to shift it upon a rotation of the pinion, a rack engaging the pinion, a lever pivoted upon the rotor casing and having one end thereof engaging the rack to shift it, an annular member concentric to the rotor axis and engaging one end of the lever, and means for shifting said annular member in one direction or the other.

3. A mechanism of the character described including a rotor casing, a rotor therein formed with radial recesses, radial blades disposed in the recesses and resiliently urged outward against the circumferential wall of the rotor casing, the rotor casing at opposite points in its diameter being formed with pairs of chambers, each chamber having a port communicating with the interior of the rotor casing, a member disposed between each pair of chambers and shiftable toward or from the periphery of the rotor, the member having bevelled corners and the rotor blades being formed with bevelled corners whereby the blades and members may pass each other, and manually operable means for shifting said members toward or from the periphery of the rotor, the chambers being each provided with ducts whereby said chambers may receive or discharge

motive fluid, said ducts being adapted to be entirely closed.

4. A mechanism of the character described including a rotor casing, a rotor therein formed with radial recesses, radial blades disposed in the recesses and resiliently urged outward against the circumferential wall of the rotor casing, the casing at opposite points in its diameter being relatively flattened and being formed in this flattened portion with a pair of chambers, each chamber having a port communicating with the interior of the rotor casing, a member disposed between each pair of chambers and shiftable toward or from the periphery of the rotor, and manually operable means for shifting said members toward or from the periphery of the rotor, the chambers being each provided with ducts whereby said chambers may receive and discharge motive fluid and said ducts being adapted to be entirely closed.

5. In a mechanism of the character described, a rotor casing, a rotor therein having radial grooves extending transversely across the rotor, blades disposed in the rotor and having compression strips resiliently urged outward against the face of the casing, the opposite end faces of the rotor casing being grooved tangentially to a circle concentric to the axis of rotation of the rotor, and compression strips disposed in said grooves and resiliently urged toward the rotor.

6. In a mechanism of the character described, a rotor casing, a rotor therein having radial grooves extending transversely across the rotor, blades disposed in the rotor and having compression strips resiliently urged outward against the face of the casing, the opposite end faces of the rotor casing being grooved tangentially to a circle concentric to the axis of rotation of the rotor, and compression strips disposed in said grooves and resiliently urged toward the rotor, said compression strips at their corners being bevelled to permit the passage of the rotor and prevent the rotor striking against the extremities of the compression strips.

7. In a mechanism of the character described, a rotor casing, a rotor therein having radial grooves extending transversely across the rotor, blades disposed in the rotor and having compression strips resiliently urged outward against the face of the casing, the opposite end faces of the rotor casing being grooved tangentially to a circle concentric to the axis of rotation of the rotor, compression strips disposed in said grooves and resiliently urged toward the rotor, said compression strips at their corners being bevelled to permit the passage of the rotor and prevent the rotor striking against the extremities of the compression strips, and means whereby lubricant may be delivered to the spaces behind said strips.

8. A hydraulic clutch including a rotor casing, a rotor operating therein and having radial blades, the periphery of the rotor being spaced from the inner face of the casing and the blades being bevelled at their forward and rear edges, a valve disposed in the rotor casing and shiftable outward of the periphery thereof or toward and into contact with the periphery of the rotor, said valve having bevelled corners, manually operable means for adjusting said valve including a screw engaging the valve and having a pinion, a rack engaging the pinion, and manually operable means for shifting the rack.

In testimony whereof I hereunto affix my signature.

GEORGE J. RAYNOR.