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HYDRAULIC PUMP OR MOTOR

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3 Sheets-Sheet 1

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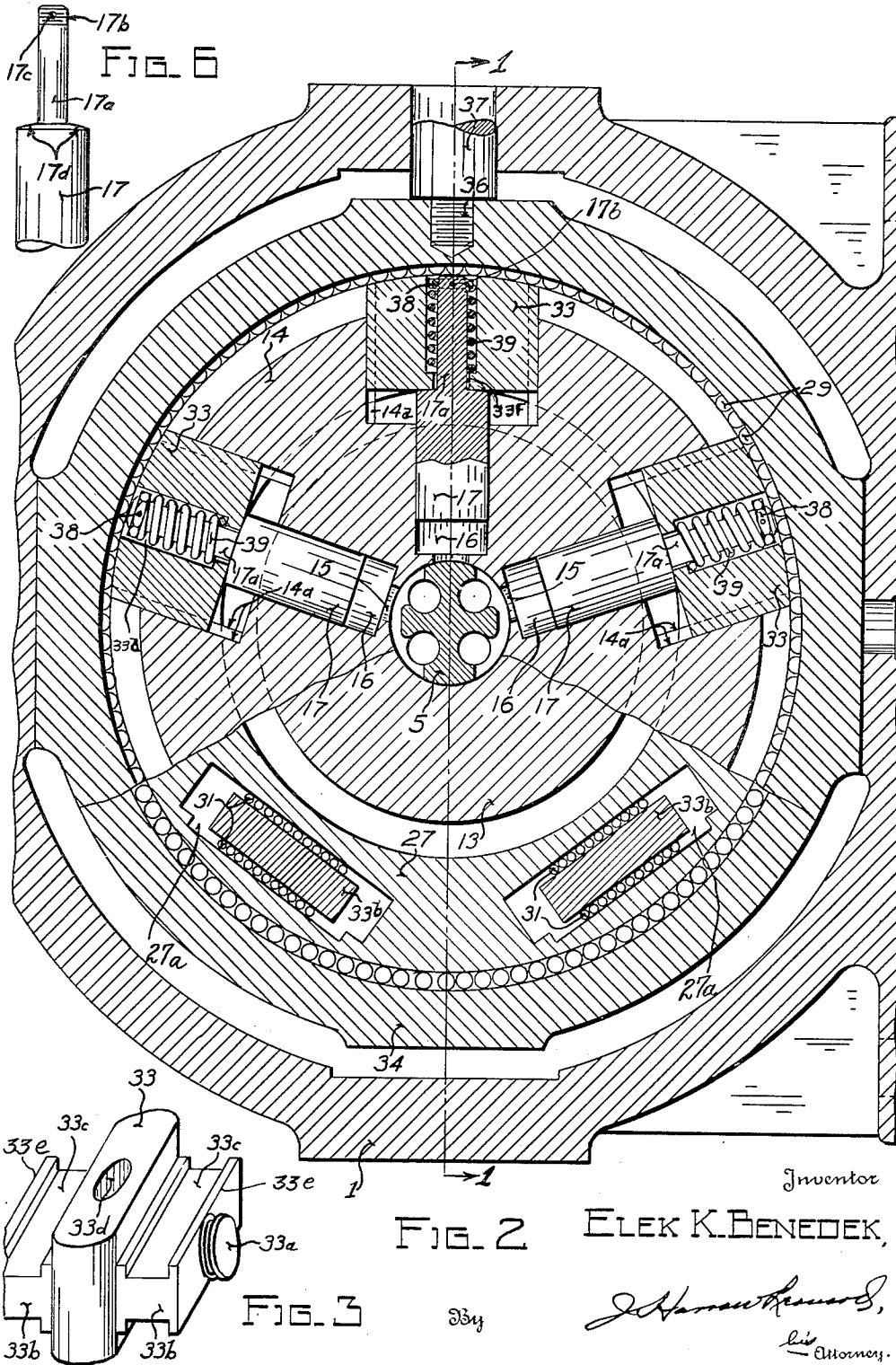
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HYDRAULIC PUMP OR MOTOR

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7 Claims. (Cl. 103-161)

This invention relates to rotary, radial piston pumps and motors.

One of the principal general objects of the present invention is to provide an improved piston head which operates both to reciprocate the piston and to effect torque transmission between the cylinder barrel and the rotary reactance in a manner such that the piston is freed from torque transmission and all stresses except direct hydraulic load and radial reactance thrusts.

A more specific object is to provide a rotary pump or motor employing a radial flange in the zone of the cylinders with a combination radial crosshead, guided by the flange, and modified T-head structure, for transmitting the hydraulic load, whereby the piston is relieved by the T-head structure from eccentric application of the hydraulic load reactance and is relieved by the radial head from torque transmission between the barrel and reactance rotor.

Other specific objects are to provide a combination piston head for this purpose which is simple, compact, and rugged, and to mount the head in the rotary reactance anti-frictionally in a simplified and efficient manner.

Other objects are to provide a floating connection between the combined piston heads and the associated pistons, and to guide the combined head against lateral displacement and prevent lateral vibration thereof.

Other objects and advantages will become apparent from the following specification wherein reference is made to the drawings in which:

Fig. 1 is a vertical longitudinal sectional view through a pump or motor embodying the principles of the present invention and is taken on a plane indicated by the line 1-1 of Fig. 2;

Fig. 2 is a vertical cross sectional view taken on a plane indicated by the line 2-2 of Fig. 1, part of the roller elements of the reactance rotor being shown in elevation for clearness in illustration;

Fig. 3 is a perspective view of the combination piston head interponent for providing the operative load and torque connection between the reactance and barrel;

Fig. 4 is a top plan view of a modified form of interponent, and cooperating part of a barrel flange, illustrating the connection between the interponent and flange;

Fig. 5 is a perspective view of a retaining frame for constraining the elongated rollers of the interponent to capillary spacing from each other

and for constraining them to proper position with respect to the interponent;

Fig. 6 is a fragmentary elevation of a floating piston which may be used in connection with the interponent;

Fig. 7 is a fragmentary longitudinal sectional view of a pump or motor disclosing modified combined piston head and reactance rotor and is taken on a plane indicated by the line 7-7 of Fig. 8;

Figs. 8 and 9 are cross sectional views taken on planes indicated by lines 8-8 and 9-9 respectively of Fig. 7; and

Fig. 10 is a fragmentary side elevation of the combined head and piston of Fig. 7.

Referring to the drawings, the pump or motor structure is shown as enclosed in an annular housing 1, having, at one end, a radial flange wall 1a terminating inwardly in a coaxial hub portion 1b, the flange wall 1a and hub portion 1b forming one end closure of the housing. The opposite end of the housing is closed by a rigid end cover 2, having a radially extending wall 2a, generally symmetrical with respect to the wall 1a and hub portion 1b of the housing. The end cover 2 is secured to the housing 1 by a series of bolts 3 so that the end cover 2 may be adjusted axially of the housing by interposing suitable shims between the end of the casing 1 and the margin of the end cover 2.

Mounted by one end in the hub portion 1b is a rigid stationary valve pintle having a large shank portion 4 which is fixedly secured in the hub 1b. The pintle protrudes from the hub 1a into the casing in coaxial relation thereto, and is provided with a tapering valve portion 5. The valve portion 5 terminates short of the free end of the pintle in a suitable circumferential trough or race 6, formed on the pintle and extending entirely therearound for receiving cageless elongated rollers 7. The rollers 7 may be capillary cageless needle rollers or larger rollers, spaced, however, a capillary distance from each other circumferentially of the pintle. On the pintle between the valve portion 5 and the shank 4 is a cylindrical bearing surface portion or raceway on which are accommodated a plurality of cageless elongated rollers 8 corresponding to the rollers 7, for purposes later to be described.

In the valve portion 5 of the pintle are a pressure port 9 and a suction port 10. The pressure port 9 is in communication through the usual longitudinal ducts in the pintle with a main pressure port 11 formed in the shank 4, as better illustrated in Fig. 2. Correspondingly, the suc-

tion port 10 is in communication through suitable ducts in the pintle with a main suction port 12 which may be in communication with a suitable sump, (not shown). The fluid circuit is completed by connection of a fluid pressure generating machine or driven machine to the main port 11 in the customary manner.

Rotatably mounted within the casing is a cylinder barrel 13 having an impeller shaft 13a with a suitable keyway 13b for securing the shaft to a driving or driven means. The barrel has a dead end axial bore in which the protruding portion of the pintle is accommodated. The barrel bore is provided with circumferential bearing surfaces in radial alignment with the sets of rollers 7 and 8 respectively for maintaining the pintle in accurate coaxial relation with the barrel bore at the valve portion.

The pintle fits the barrel bore with slight radial clearance in the valve portion and must be constrained to position with this clearance for efficiency in operation and proper slip characteristics. The rollers 7 and 8, therefore, are sufficiently strong and present a sufficiently large bearing area to the pintle and barrel bore wall to maintain the pintle with this clearance, even under hydrostatic load and, in fact, where necessary, to stress the pintle to proper coaxial relation in event of slight inaccuracy in mounting and assembly. Thus proper cooperation of the pintle and cylinders of the barrel is assured. The barrel is rotatably mounted in the casing entirely independently of the rollers 7 and 8, as will later be described. For this purpose the barrel is provided at the end adjacent the pintle hub with a reduced diameter hub portion 13c and at the opposite end with a correspondingly reduced diameter hub portion. These hub portions, in turn, form with the central portion, annular axially extending shoulders and contiguous radially extending shoulders 13d. Between the hub portions, the barrel has a radial flange 14 having radial guideways 14a. In the zone of the flange the barrel has a set of circumferentially spaced radial cylinders 16, each of which is arranged for valving cooperation with the ports 9 and 10 through suitable ports 15, consequent upon rotation of the barrel, the cylinders being substantially coextensive axially of the barrel with the flange 14. Mounted within the cylinders are radially reciprocable pistons 17, which are better illustrated in Fig. 6. Each piston 17 carries, at its outer end, a coaxial neck 17a, the outer end of which neck is threaded to receive a spring retaining nut, later to be described, and is provided with a hole 17c for receiving a cotter pin or other means for securing the nut in place. The outer end of the piston adjacent its juncture with the neck 17a, is rounded to present a somewhat spherical load transmitting shoulders 17d for engagement with the combined piston head interponent, later to be described.

Mounted on each of the annular shoulders of the barrel and abutting the shoulders 13d are the inner races 20 and 21 respectively of sets of combination radial load and axial thrust anti-friction ball bearings 18 and 19 respectively. The outer races 23 and 22 respectively of the ball bearings are mounted within the casing 1 and end cover 2, suitable radial shoulders 1c and 2b respectively being provided for resisting axial outward thrusts of the bearings.

The bearing race 21 may be held securely in place by a suitable lock nut 24 in threaded engagement with the barrel and an interposed lock

washer 25. The bearing mounting thus provided is sufficiently rigid to retain the barrel in proper position and withstand all thrusts created by torque transmission or radial driving force to and from the barrel through the shaft 13a.

The rotary reactance of the present pump or motor comprises a pair of coaxial rings 26 and 27 respectively, arranged alongside opposite end faces of the flange 14. The rings are preferably rectangular in cross section, the adjacent radial end faces thereof lying alongside the outer end faces of the flange 14 with operating clearance therebetween. The rings are antifrictionally mounted on sets of elongated free rollers 28 and 29 respectively which support the rings 26 and 27 in a reactance housing 34 in coaxial relation thereto. The reactance housing, in turn, is mounted in the casing 1 on suitable parallel sliding bearing surfaces so that it may be shifted to different positions while supported with its axis and the axis of the rings 26 and 27, parallel to the axis of the barrel.

Diametrically opposite control rods 37 extend through suitable bores in the casing and parallel to the bearing surfaces of the housing 34 for adjusting the housing from the outside of the casing, the rods 37 preferably being in screw threaded engagement with the housing, as indicated at 36.

For mounting the rings and rollers 28 and 29, the housing 34 is provided with a pair of annular internal recesses, as illustrated in Fig. 1, having circumferential axially extending bottom walls which form the operating bearing surfaces or races for the sets of rollers 28 and 29. The end margins of the housing 34 extend radially inwardly and form retaining shoulders 35 which, in inner diameter, are larger than the outer diameter of the rings 26 and 27, so as to form within the housing 34 circumferentially closed troughs in which the rollers 28 and 29 are entirely counter-sunk for receiving slip fluid and maintaining the fluid under centrifugal pressure for lubrication of the rollers 28 and 29. The rollers 28 and 29 are spaced capillary distances from each other so that, while not true capillary rollers, they are maintained in spaced relation from each other by capillary oil films and the fluid pressure.

For connecting the pistons 17 and the rotary reactance, and for transmitting torque between the barrel and reactance, combination head interponents, as better illustrated in Fig. 3, are provided. Each interponent comprises a central elongated body or radial head portion 33, having torque transmitting ends which are cylindrical and extend parallel to the axis of the piston associated therewith. This body portion is mounted in an associated guideway 14a of the flange 14 so as to be reciprocable radially therein, the walls of the guideway 14a being cylindrical and substantially congruent to the leading and trailing ends of the interponent for transmitting torque and for preventing lateral displacement of the interponent. Extending laterally from the radial head portion 33 are tangential head portions 33b arranged one at each side of the radial head portion. The head portions 33b are provided each with inner and outer bearing surfaces 33c which are parallel to each other and extend tangentially of the path of rotation of the interponents. At the lateral limits of each of the surfaces 33c, 70 tangentially extending shoulders 33e are provided so as to form troughs for accommodating elongated free rollers such, for example, as capillary cageless needle rollers, in a manner later to be described. On the outermost lateral faces of 75

each of the head portions 33b are lugs 33a respectively, each of which lugs is provided with a circumferential groove adjacent the outer face of the associated T-head portion. The body portion is also provided with a bore 33d which is arranged centrally thereof and parallel to the axis of the associated piston and terminates inwardly in a coaxial bore 33f of less diameter.

Referring next to Figs. 1 and 2, the rings 27 are correspondingly provided with tangential grooves 27a which extend endwise of the rings entirely therethrough and have parallel inner and outer tangential reactance or track surfaces. The interponent is mounted within the guideways 14a of the barrel flange with the head portions 33b accommodated in the grooves 27a of the reactance rings respectively, the grooves being longer than the heads to permit relative tangential oscillation therealong. Cageless elongated rollers 31 are disposed on the surfaces 33c of the interponent, with their axes extending parallel to the barrel axis, and engage the trackways of the grooves 27a. The head portions 33b are substantially coextensive with the reactance rings parallel to the barrel axis so that when received in the grooves 27a, the outer faces of the head portions 33b lie substantially in the plane of the outer end faces of the rings 26 and 27 respectively with the lugs 33a extending outwardly therebeyond. Suitable snap washers 32 are disposed in the grooves of the lugs 33a and engage the outer end faces of the rings 26 and 27, thus constraining the rings from axial separation. The rollers 31 are thereby accommodated in troughs which entirely enclose them except at the ends of the troughs. Consequently, since the rings 26 and 27 may float axially relative to the housing 34 and are constrained against inward separation by the flange 14 and outward separation by the washers 32, the rings are self-aligning axially of the barrel and align properly with the interponents.

For connecting the pistons to the interponents, the necks 17a of the pistons are inserted in the aligned bores 33d and 33f of the associated interponents until the spherical load transmitting bearing surface 17d of the piston is firmly in engagement with the radially inwardly exposed face of the interponent. A suitable compressed coil spring 39 is received in the bore 33d, one end abutting the shoulder formed by the juncture of the smaller bore 33f with the bore 33d. The opposite end of the spring abuts a nut 38 which is screwed onto the end portion 17b of the neck of the piston and locked in place by a suitable lock pin engaging the hole 17c. The spring has sufficient compression to retain the piston firmly against the cooperating face of the interponent. The bore 33f, however, is of slightly greater diameter than the neck of the piston so that the piston is free to adjust itself within certain limits and thus become self-adjusting with respect to the interponent so as to be subjected to axially directed load only. In this manner a floating engagement between the interponent and piston is provided.

During operation of the pump or motor, the head portions 33b necessarily oscillate to and fro from their normal position in the grooves 27a for compensating for the tangential components of eccentricity of the barrel and reactance rings. Such action might be apt to displace the rollers 31 forwardly or rearwardly along the head portions. For preventing such displacement, suitable frames, such as illustrated in Fig. 5, may be provided for use on the head portions. These

frames comprise longitudinal side frame members 40a which may lie along the ends of the sets of rollers 31, and end frame members 40b which are positioned at the ends of the set of rollers. Suitable upright corner posts connect the side and end frame members which cooperate with the radially inward set of rollers 31. The frames have been omitted from the assembly views for clearness in illustration.

The arrangement of the needles in the frame is such that, when no oil is provided, there is a minimum total clearance at each end of the frame (for example, at 40b) of one-fourth of the maximum piston stroke which is equal to one-half of the maximum eccentricity of the pump. In addition to this clearance for eccentricity there should be allowed an amount of clearance equal to the diameter of from one to three needles. When the dry needles, in this relation, are flooded with oil and the piston is in dead center position, the needle assembly closely approaches both ends of the frame without touching or hitting it. The spacing is reduced upon reciprocation to the extent of capillary oil films which act as shock absorbers between the individual needles as the set changes its direction of reciprocation. Thus rollers can roll freely but are prevented by the frame from being displaced endwise of the sets. Actual physical spacing of the needle rollers depends somewhat upon the material of the rollers, their finish, as well as the viscosity of the oil. The nature of the needles and their spacing so that they may act as capillary needle rollers is more fully described in my United States Letters Patent No. 2,074,202, issued on March 16, 1937.

The above described spacing of the needles is for a fixed frame 40 because, in the case of the fixed frame, clearance must be allowed both for capillary spacing and for eccentricity. In case the frame 40 is made to reciprocate relative to the T-head portions then only the clearance of from one to three needles need be allowed for providing the capillary interspaces between the needles. In the latter instance, the frame can reciprocate with the needles of the set.

A modified interponent is illustrated in Fig. 4, the parts thereof, corresponding to the parts of the interponent of Fig. 3, being designated by corresponding primed numerals. The only difference between this interponent and the interponent of Fig. 3 is that the cylindrical surfaces of the former are replaced by suitable undercut end portions operating in complementary channels in the flange 14, so as to form dovetail connections between the interponent and the flange 14 of the barrel for constraining the interponent from movement relative to and axially of the barrel.

While the combined radial crosshead and T-head structure has been referred to as an "interponent", the term is not to be construed as an element used only with a relatively floating piston. The piston may be floatingly carried thereby as described, or rigidly secured thereto, or formed integral therewith, as hereinafter disclosed.

In operation, the interponent provides the combined advantages of the T-head type of piston and the radial crosshead and rolling pin type. It makes possible also the concurrent employment of the torque transmitting cylinder barrel flange heretofore used only in connection with the crosshead and roller type of pistons. The advantages of the interponent may be better understood by the following brief description of the operation thereof.

Due to the T-head portions 33b operating in the tangential ways of the reactance, the hydraulic load reactance is necessarily transmitted to the pistons radially and at their axis, as in the case of the conventional T-head structure. In the more conventional T-head, however, torque transmission, as distinguished from load transmission, between the barrel and rotary reactance must be through the medium of the pistons, as more fully set forth in my copending application, Serial No. 13,294, filed March 27, 1935. Thus, while the ordinary T-head relieves the piston from tangential load components and from eccentrically or angularly disposed load reactance by applying the load radially and along the axis of the piston, it subjects the piston to torque transmitting stresses, tending to rock and bind the piston in the cylinder. On the other hand, in the rolling pin and radial crosshead type of piston, the piston is relieved from torque transmission by the radial head, but is subjected to a necessarily occurring tangential component of load reactance resulting from the manner in which the crosspins and reactance coact. Consequently, due to this component, the load transmission is not directed axially of the piston, and the piston is subjected to load transmission and reactance forces tending to rock and bind it in the cylinder.

With the present interponent, however, the torque transmitted by the T-head portions is transmitted first to the radial crosshead portion 33 of the interponent. Since the radial crosshead portion is snugly received in the guideways of the barrel flange and guided thereby, torque transmission, which would otherwise tend to rock the piston in the cylinder, is resisted by cooperation of the radial crosshead portion and the flange of the barrel. The piston, therefore, whether connected to the interponent as a floating structure or formed integral therewith, is entirely relieved from all torque transmission by the radial crosshead portion, and relieved from all load reactance forces except direct radial load reactance applied axially of the piston.

With the combination piston head or interponent above described, the piston is thus relieved from all forces tending to bind it in the cylinder, lateral rocking forces being withstood by the radial head portion. In this manner, the most desirable features of the T-heads and radial crossheads are combined and the undesirable effects of both are eliminated.

Referring next to Figs. 7 to 10 inclusive, there is illustrated an integral piston and interponent and an improved rotary reactance for cooperation therewith. In this structure, the cylinder barrel 50 cooperates with a valve pintle 51. The barrel has a plurality of radial cylinders 52 each having a suitable cylinder port 53 for cooperation with the valve ports of the pintle in the conventional manner. In the zone of the cylinders 52 the barrel is provided with a radial flange 54, portions thereof being removed to permit passage of tie bolts between the rotary reactance members, as will later be described. The flange 54 is provided with a series of radial guideways 55, one guideway being provided for each cylinder 52.

Mounted within the cylinders are radial pistons 56, each piston having an interponent 57 integral therewith.

Referring to Fig. 10, the interponent 57 of each piston comprises a radial crosshead portion 57a, and laterally extending tangential T-head

portions 57b, these parts corresponding respectively to the portions 33 and 33b of the interponent illustrated in Fig. 3 and heretofore described. The torque transmitting end walls of the radial head portion 57a may be flat or cylindrical and parallel to the piston axis and the corresponding walls of the guideways 55 may likewise be flat or cylindrical to correspond thereto and snugly engage the radial crosshead portion 57a for transmitting torque therethrough between the barrel and reactance while relieving the piston from torque transmitting forces.

For actuating the pistons through the medium of the T-head portions 57b, a pair of coaxial rotary reactance rings 60 are provided, the rings 60 being rotatably mounted in a suitable reactance housing 61, as will hereinafter be described. For ease in construction and for rigidity with minimum weight and size, the rings are preferably of U or channel-shaped cross section as illustrated in Fig. 7, having inner U-arm walls 60a and outer walls 60b. The rings are disposed at opposite sides of the radial crosshead portion 57a of the interponent 57 and open theretoward so as to receive the crosshead portions 57b in the channel ways between the walls 60a and 60b. The radially inward walls 60a are chordal and engage the radial inward tangential surfaces of the T-head portions 57b for guiding the same and operating the pistons on the suction stroke and for cooperating in transmitting torque between the reactance and the interponent. The outer surfaces for engagement with the radially outward faces of the T-head portions 57b are provided by segmental blocks 62, of which the chordal faces 62a are exposed inwardly for engagement with the T-head portions 57b. The blocks 62 have cylindrical outer faces 62b which are coaxial with and of the same radius as the outer channel wall 60b of the associated ring 60. The rings 60 are secured together by suitable tie bolts 64 which are accommodated between the cut out portions of the flange 54, and positioned one between adjacent ends of the blocks 62. In this manner the blocks 60 are retained in the associated rings but are free to shift circumferentially thereof within certain limits determined by the bolts 64. The use of such blocks permits proper alignment of their chordal reactance surfaces with the T-head portions 57b and also provides for the maintenance of wedge-shaped oil films between the cooperating reactance surfaces of the T-head portions 57b and the rotary reactance, as more fully described in my copending application, Serial No. 589,746, filed January 29, 1932.

For anti-frictionally supporting the rings 60 in the reactance housing 61, an internal circumferential recess 61a is formed in the housing 61, the end walls 61b of the recess being substantially the same in inner diameter as the outer diameter of the ring 60 so that slight operating clearance only is provided between the radially inner faces of the shoulders provided by the walls 61b and the outer surface of the rings 60. Disposed in the raceway or recess 61a, is a single set of elongated rollers 65, the rollers and raceway being coextensive axially of the barrel and rings with the T-head portion 57b of the interponent, so that the radial load is transmitted directly to the rollers. The rollers are provided respectively with reduced diameter portions 65a intermediate their ends for accommodating a suitable spacer ring 66.

In the above examples, the T-head portion has

been shown as having tangential flat reactance surfaces for cooperation with corresponding flat surfaces of the reactance. It should be noted, however, that so-called T-head portions having curvilinear reactance surfaces and a reactance having a complementary curved way are within the scope of the invention and appended claims, "tangential" being used in the broader sense of meaning forwardly and rearwardly from the piston axis.

Having thus described my invention, I claim:

1. In a rotary, radial piston pump or motor, a rotatable barrel having a radial cylinder, valve means for the cylinder, a piston reciprocable in the cylinder, a head on the piston and having laterally extending T-head portions, said T-head portions having parallel inner and outer tangentially extending reactance engaging surfaces, rotary reactance rings eccentric to the barrel and arranged one at each side of the piston, and having grooves providing tangentially extending parallel ways operatively engaging said inner and outer reactance engaging surfaces respectively to reciprocate the piston, and mounting the said T-head portions and reactance rotor for relative tangential oscillation, said T-head portions having lugs extending beyond the rings axially of the barrel, and means on the lugs engaging the rings for constraining the rings from axial separation.

2. In a rotary, radial piston pump or motor, a rotatable barrel having a radial cylinder, valve means for the cylinder, a radial flange on the barrel in the zone of the cylinder, a guideway in the flange having guide surfaces parallel to the cylinder axis and positioned in advance of and to the rear of the cylinder respectively, a piston reciprocable in the cylinder, a rotary reactance eccentric to the barrel and disposed closely alongside the flange, said reactance having tangentially extending parallel inner and outer ways, a T-head interponent on the piston having a body portion reciprocable radially in the guideway and substantially coextensive axially of the barrel with said flange, and having a tangentially extending T-head portion on one face disposed laterally beyond the flange and accommodated between said ways for oscillation therealong, said reactance having a passage extending therethrough parallel to its axis and aligned with the interponent, means mounting the reactance for axially floating movement, said T-head portion having a lug received through said passage and extending beyond the outer end face of the reactance, and means connected to said lug and engageable with the said outer face of the reactance to constrain said reactance from movement axially of the barrel away from the piston.

3. In a rotary, radial piston pump or motor, a rotatable barrel having a rigid cylindrical portion and a radial cylinder therein, valve means for the cylinder, a radial flange on the rigid barrel portion in the zone of the cylinder and extending radially outwardly from the cylindrical portion, a radial guideway in the flange and aligned radially of the barrel with the cylinder, a piston reciprocable in the cylinder, a head on the piston having a body portion rigid fore and aft and reciprocable radially in the flange guideway and having laterally extending rigid T-head portions, said T-head portions being rigid with respect to the body portion and having parallel inner and outer tangentially extending reactance engaging surfaces, shoulders on each T-head portion along-

side the outer tangential margins thereof, whereby tangentially extending troughs are provided, elongated cageless needle rollers in said troughs and extending parallel to the axis of the barrel, said troughs being less in depth than the diameter of the rollers, a rotary reactance eccentric to the barrel and having portions disposed alongside the T-head portions respectively, tangential grooves in the reactance respective to and accommodating the T-head portions for relative tangential oscillation and accommodating said shoulders, and providing tangential ways in operative engagement with the rollers, whereby the rollers are constrained from axial displacement, and means for maintaining said reactance and T-head portions in substantially fixed position axially of the barrel with respect to each other and to the barrel.

4. In a rotary, radial piston pump or motor, a rotatable barrel having a rigid cylindrical portion, a radial cylinder therein, valve means for the cylinder, a radial flange on the rigid cylindrical portion of the barrel in the zone of the cylinder and extending radially of the barrel outwardly from the said cylindrical portion, a radial guideway in the flange and aligned radially of the barrel with the cylinder, a piston reciprocable in the cylinder, a head on the piston comprising a crosshead portion accommodated for reciprocation radially in the flange guideway and rigid fore and aft and laterally extending rigid T-head portions rigid with the crosshead portion, said T-head portions having parallel inner and outer tangentially extending reactance engaging surfaces, shoulders on the T-head portions alongside the outer margins thereof, whereby tangentially extending troughs are provided, elongated cageless rollers in said troughs and extending parallel to the axis of the barrel, said troughs being less in depth than the diameter of the rollers, a rotary reactance eccentric to the barrel and having a portion disposed alongside the crosshead portion of the piston head, tangential grooves in the reactance accommodating said T-head portions respectively and shoulders, and having ways in operative engagement with the rollers, whereby the rollers are constrained from axial displacement, means for maintaining said reactance and head in substantially fixed position axially of the barrel with respect to each other and to the barrel, and means for constraining said rollers to a capillary spaced relation with respect to each other.

5. In a rotary, radial piston pump or motor, a rotatable barrel having a radial cylinder, valve means for the cylinder, a radial flange on the barrel in the zone of the cylinder, a radial guideway in the flange, a piston reciprocable in the cylinder, a radial head on the piston reciprocable radially in the flange guideway and having laterally extending T-head portions, said T-head portions having parallel inner and outer tangentially extending reactance engaging surfaces, shoulders on the T-head portions alongside the outer margins thereof, whereby tangentially extending troughs are provided, elongated cageless rollers in said troughs and extending parallel to the axis of the barrel, said troughs being less in depth than the diameter of the rollers, rotary reactance means eccentric to the barrel and having portions disposed alongside the radial head, tangential grooves in the reactance accommodating said T-head portions and shoulders, and having ways in operative engagement with the rollers, whereby the rollers are constrained from

axial displacement, means for maintaining said reactance in substantially fixed position axially of the barrel, and frames carried on said T-head portions respectively for retaining said rollers between the ends of the associated T-head portions, and constraining the rollers to a capillary spaced relation with respect to each other.

6. In a rotary, radial piston pump or motor, a rotatable barrel having a rigid cylindrical portion and radial cylinders therein, valve means for the cylinder, a radial flange on the barrel in the zone of the cylinders and extending outwardly from said cylindrical portion, radial guideways in the flange, each guideway having guide surfaces parallel to the cylinder axis, pistons reciprocable in the cylinders respectively, combination heads on the pistons respectively and each comprising a radial head portion reciprocable radially in the associated flange guideway and guided and constrained from lateral displacement thereby, laterally extending rigid T-head portions in fixed position on said radial head portions respectively, said lateral T-head portions having parallel inner and outer tangential reactance engaging surfaces substantially coextensive tangentially of the path of rotation with the lateral faces of the associated head portions, rotary reactance means eccentric to the barrel and including coaxial rings extending alongside the flange and radial head portions, and having complementary ways

operatively engaging said inner and outer reactance engaging surfaces respectively for reciprocating the pistons and for transmitting torque through the medium of the radial head portions between the barrel flange and reactance means, and mounting the said lateral head portions in the reactance rotor for relative oscillation thereof tangentially, and means for anti-frictionally supporting the rings for rotation and positioned in alignment radially of the axis of rotation with said T-head portions respectively radially outwardly therefrom for direct load reactance.

7. In a rotary radial piston pump or motor, a rotatable barrel having radial cylinders, valve means for the cylinders, pistons reciprocable in the cylinders, heads on the pistons, said barrel having radial guideways accommodating the heads respectively, the heads and associated guideways having coacting surfaces configured to constrain the heads to fixed position laterally with respect to the barrel, axially floating rotary reactance means operatively associated with the heads for reciprocating the pistons, and means secured to the heads in fixed position laterally thereof and connected to the reactance means and constraining the reactance means from lateral movement relative to the heads.

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