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2,967,489

POWER TRANSMISSION

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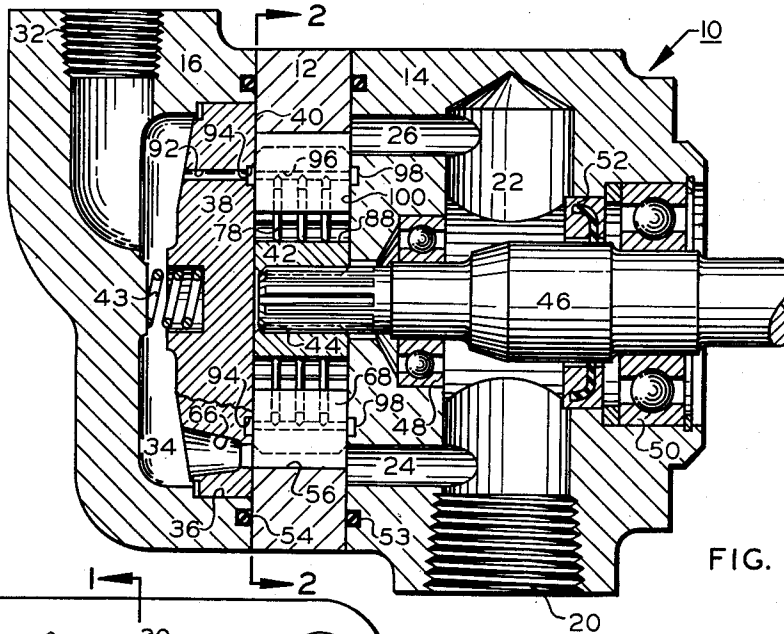


FIG. 1

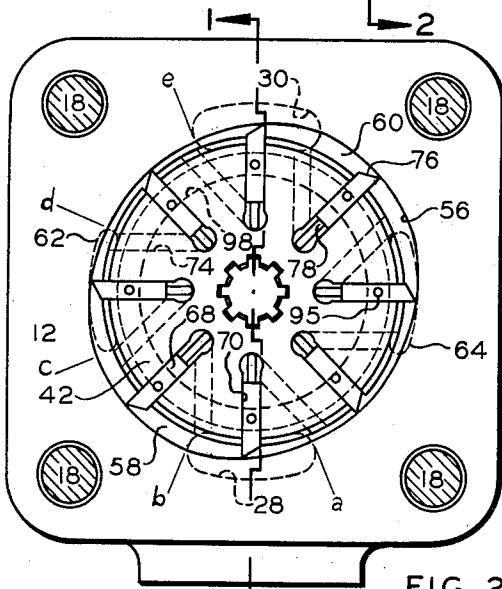


FIG. 2

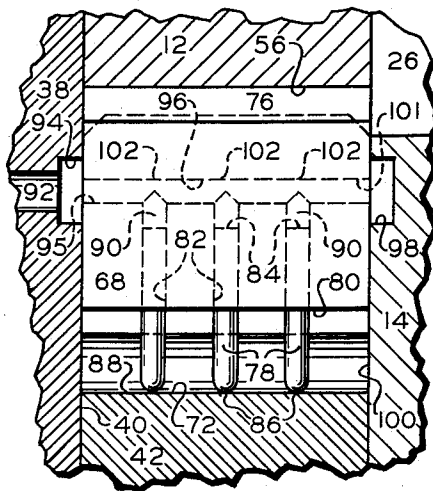


FIG. 4

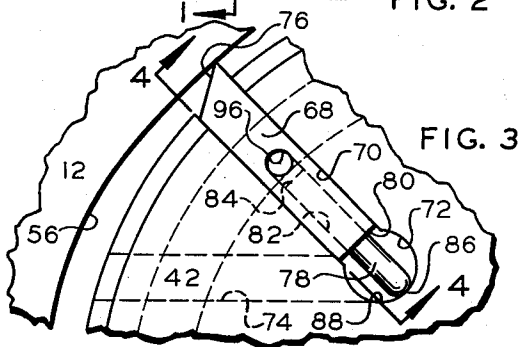


FIG. 3

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2,967,489

POWER TRANSMISSION

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16 Claims. (Cl. 103—136)

This invention relates to power transmissions, and is particularly applicable to those of the type comprising two or more fluid pressure energy translating devices, one of which may function as a pump and another as a fluid motor.

More particularly the invention relates to a fluid energy translating device of the sliding vane type capable of functioning as a pump or as a motor.

Such devices generally comprise a stator including a vane cam track within which is rotatably mounted a rotor carrying radially sliding vanes to form fluid inlet and fluid outlet working zones located between the periphery of the rotor and the vane track, either of which may be a low or a high pressure working zone dependent upon the pump or motor function of the device. In such devices the vanes as followers are adapted to follow the cam track and to provide proper sealing between inlet and outlet porting correlated with the fluid inlet and fluid outlet zones. Thus, it is essential for efficient operation that the vanes be completely extended outwardly and that the outer edges of the vanes be maintained in engagement with the track during the complete rotary cycle of the device.

During operation of such a device, the vanes are urged outwardly by centrifugal force and inwardly by mechanical cam action of the track. However, there are many conditions existing and forces created tending to prevent the vanes acting as free followers and also causing the vanes to collapse and retract from the vane track, such as both mechanical and viscous friction, bearing loads of the vanes against the track or between the vane and rotor, and differential pressures creating unfavorable resultant forces acting on the extreme inner and outer end areas of the vanes.

Several schemes have been utilized to alleviate and counteract these conditions and forces, the most common of which utilize the transmitting of pressure, either continuously or intermittently, to the extreme inner ends or undersides of the vanes. In the continuous pressure scheme, operating pressure is conducted to the undersides of the vanes during the complete rotary cycle and because the vanes are completely unbalanced during the low pressure phase of the cycle, an excessive wear rate between the vanes and cam track is incurred under extremely high pressure operating conditions.

In the intermittent pressure scheme, pressure is transmitted to the undersides of the vanes only during the high pressure phase of the rotary cycle in an attempt to completely balance the pressures on opposite ends of the vanes during the complete rotary cycle of the device. However, when the vanes are completely balanced by the intermittent pressure scheme recited, centrifugal force alone must be depended upon to move the vanes completely outward in engagement with the track and as a result, in many modern applications, the outward movement of the vanes is not complete or delayed, the vanes have a tendency to leave the track,

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and consequently the efficiency of the operation is impaired.

In summary, by following the prior art teachings, one could build a vane pump or motor having excellent wear characteristics (intermittent undervane pressure) or excellent efficiency (continuous undervane pressure) but these properties were, to a great extent, inversely related.

It is, therefore, an object of this invention to provide an improved, low cost, efficient and long wearing fluid pressure energy translating device of the sliding vane type.

More specifically it is an object of this invention to provide such a device having an improved vane biasing arrangement in which wear between the track and vanes is minimized and efficiency is increased.

It is another object of this invention to provide such a device having an improved vane pressure biasing arrangement which insures complete extension of the vanes and maintenance of the same in engagement with the vane track without an excessive wear rate and also prevents vane collapse from the track during the high pressure phase of the rotary cycle.

It is a further object of this invention to provide a fluid energy translating device incorporating radially sliding vanes associated with which are reaction members together with a pressure transmitting system for said vanes and reaction members for accomplishing the above recited results.

It is still another object of this invention to provide such a device having all of the advantages previously recited without increasing the over-all dimensions of devices currently in production and without appreciably increasing the cost of such units.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing wherein a preferred form of the present invention is clearly shown.

In the drawing:

Figure 1 is a longitudinal sectional view of a device embodying the present invention and taken on line 1—1 of Figure 2.

Figure 2 is a sectional view taken on line 2—2 of Figure 1.

Figure 3 is an enlarged partial sectional view of the vanes and porting arrangement associated therewith shown in Figure 2.

Figure 4 is a partial sectional view taken on line 4—4 of Figure 3.

Referring now to Figure 1, there is shown a rotary, sliding vane, device or pump, indicated generally by the numeral 10, the housing of which comprises a vane cam track section 12 sandwiched between a body member 14 and an end cover 16, all of which are secured to each other by bolts 18 extending through cover 16 and section 12 into threaded holes in body 14. The body section 14 is provided with an inlet supply connection port 20 having an inlet passage 22 leading therefrom which has two branches 24 and 26 respectively terminating in a pair of fluid inlet port openings 28 and 30 which are shown in hidden lines in Figure 2.

An outlet connection port 32 is provided in the end cover 16 which is directly connected to a pressure delivery chamber 34 formed in an enlarged bore 36 of the end cover 16 where a pressure plate 38 is floatably mounted in the bore 36. The pressure plate 38 is urged rightwardly by outlet pressure in the chamber 34 so that the outer portion of a plane side surface thereof and indicated by the numeral 40, is maintained in engagement against an opposing mating surface of the cam ring 12 and so that the remainder of said surface 40 is main-

tained in fluid sealing engagement with the immediately adjoining surface of a rotor 42 and vanes carried thereby within the cam section 12. Spring 43 initially biases the pressure plate 38 toward the rotor until pressure builds up in the pressure chamber.

The rotor 42 is rotatably mounted within the cam section 12 on the splined end 44 of a shaft 46 which is rotatably mounted within bearings 48 and 50 mounted within the body section 14. The shaft 46 is provided with a seal 52 while O-ring seals 53 and 54 prevent leakage at the juncture of the cam ring section 12 with the body 14 and end cover 16.

The contour of the inner surface of the cam section 12 forms a vane track substantially elliptical in shape indicated by the numeral 56 which together with the periphery of the rotor and the adjoining enclosing surfaces of the body and pressure plate define two opposed working chambers indicated by the numerals 58 and 60, each of which, for the purposes of convenience, may be divided into fluid inlet and fluid outlet zones and which forms a sliding vane device of the double throw type. The fluid inlet zones comprise those portions of the working chambers 58 and 60 respectively registering with the fluid inlet port openings 28 and 30 of the inlet passages 24 and 26. The fluid delivery zones comprise those portions of the working chambers 58 and 60 registering respectively with opposed arcuately shaped fluid delivery port openings 62 and 64 (shown in dot dash lines in Figure 2, to illustrate positional relation only) which are recessed in the surface 40 of the pressure plate 38 and which are directly connected to the pressure chamber 34 by means of duplicate passages 66 leading therefrom, one of which is shown in Figure 1.

The pumping device so far described is of the well known structure disclosed in the patent to Gardiner, No. 2,544,988. It has been the practice in devices of this type to provide the rotor with a plurality of radial slots, each of which has a vane slidably mounted therein, the outer ends of which are adapted to engage the elliptically shaped vane track. In devices of this type, pressure is continuously transmitted from the high pressure outlet side of the device to the enlarged chambers at the inner ends of the vanes to completely extend the vanes and to insure track engagement by the vanes.

The vane track of the present device is similar to that in the Gardiner device as including an inlet zone ramp extending from "a" to "b," a true arc portion extending from "b" to "c," a delivery zone ramp extending from "c" to "d" and another true arc portion extending from "d" to "e." The track is symmetrical about each of its major and minor axes, thus each of the ramp and true arc portions from "a" to "e" are duplicated in the remaining opposed portion of the track. As the ends of the vanes 68 carried by the rotor traverse the inlet ramps, the vanes move radially outward with respect to the rotor, and while the vane ends traverse the delivery ramps, the vanes move radially inward. In the true arc portions, the vanes partake of no radial movement.

In the present device the radial slots in the rotor are indicated by the numeral 70 and the enlarged innermost portions of the slots forming pressure chambers by the numeral 72. The spacing between each pair of vanes is adapted to span the distance between each pair of ports so as to provide proper sealing between the inlet and outlet porting connected to the working chambers of the device.

At this point the present invention device departs from the continuous outlet pressure scheme of devices of the Gardiner type by the provision of a plurality of angular passages 74, one for each slot, which lead from the periphery of the rotor to the inner enlarged chambers of the vane slots. The passages 74 are adapted to transmit to the chambers 72 and thus to the inner surfaces of the vanes, the cyclically changing pressure which is exerted on the outer edges 76 of the vanes as they traverse the

inlet and outlet ramps of the vane track. The present invention device also departs at this point from conventional vane pressure balancing schemes by the provision of a plurality of reaction members for each vane indicated by the numeral 78 which together with a correlated porting arrangement provides a controlled vane pressure unbalance on the suction stroke of the device insuring complete extension of the vanes and also maintenance of the outer edges of the vanes in contact with the vane track through the complete rotary cycle of the device.

Referring now to the several figures, the rotor is provided with eight of the radial slots 70 within which are slidably mounted the vanes 68 which are flat sided and substantially rectangular in shape to conform to the slot configuration. The inner ends of the vanes exposed to pressure within the vane slot pressure chambers are indicated by the numeral 80. A plurality of holes 82 are drilled from the flat inner end surface 80 of each vane to form cylinders which extend into the vane slightly over one half the length thereof, and which in the present device are three in number for each vane. Each of the drilled holes or cylinders 82 has slidably mounted therein one of the reaction members 78, which comprise round pins which are flat surfaced at their outer upper ends 84 and rounded at their lower inner ends 86. The length of the reaction members 78 relative to the vanes is such that a portion of each reaction member may extend from the inner end of its associated vane with a rounded inner end surface 86 thereof bottoming against an inner wall or surface 88 of the enlarged vane slot chamber 72, forming an expansible reaction member pressure chamber 90 within each drilled hole 82 of each vane immediately adjacent the outer flat end surface 84 of each reaction member.

The high pressure delivery side of the device is connected to all of the reaction member pressure chambers during both the intake and delivery phases of the rotary cycle of the device. For this purpose, a plurality of drilled holes forming passages 92 are constructed in the pressure plate, one of which is shown in Figures 1 and 4, which connect the pressure chamber 34 to a circular pressure groove 94 recessed in the pressure plate on the rotor side thereof. The pressure plate groove 94 is adapted to register with openings 95 of drilled passages 96, one in each vane, extending completely through each vane widthwise from side to side thereof and each of which intersects the upper ends of the reaction member pressure chamber of its associated vane. A mirror image 98 of the pressure plate circular groove 94 may be recessed in a plane surface 100 of the body member 14 adjacent the rotor so as to register with openings 101 of the vane passageways 96 on the opposite side of the rotor.

Pressure transmitted from the outlet side of the device to the reaction member pressure chambers 90 and acting on the end surfaces 84 of the reaction members 78 is adapted to maintain the same with their opposite rounded ends bottomed against the innermost surfaces 88 of the vane slot pressure chambers 72. The resultant force on each reaction member tending to bottom the same is equal to the magnitude of the outlet pressure in the reaction member pressure chamber 90 times the area of the surface 84 of the reaction member. As it is axiomatic that the fluid pressure transmitted to said chambers is transmitted equally in all directions and thus, as to the resultant forces imposed on the reaction members there must be equal resultant forces created in opposition to the same, there is thereby created a total resultant force on each vane acting in an opposite direction to that imposed on the reaction members, which is equal to the total force acting on the end surface areas of the three reaction members. This resultant opposition force on each vane is imposed on three spaced projected surface areas of the vane passageways 92 immediately opposite each reaction member pressure sur-

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face and which for the purposes of convenience are indicated in Figure 4 by the numeral 102.

In operation, with a prime mover, not shown, connected to the shaft 46 for turning the rotor 42 clockwise as viewed in Figure 2 and the inlet port 20 connected to a source of fluid supply, fluid is conducted to the inlet port openings 28 and 30 adjacent the inlet ramp portion of the vane track by means of passage 22 and branch passages 24 and 26. As the vanes traverse the inlet ramps of the vane track, fluid is withdrawn through the inlet port openings 28 and 30 into the intervane spaces and carried to the outlet ports 62 and 64 from whence it is discharged through the outlet port 32 by the medium of the pressure plate outlet passages 66, and the pressure chamber 34 which is directly connected to the outlet port 32.

As the outer ends of the vanes pass through the inlet zones of the working chambers of the device, the pressure existent in said zones which is imposed on the outer edges 76 of the vanes will also be transmitted to the inner surfaces 80 of the vanes by the medium of the angular vane slot passages 74 extending from the periphery of the rotor to the chambers 72. Thus the vanes on the inlet phase of the device are substantially balanced only as to pressures existing at their extreme inner and outer end surfaces. However, a controlled unbalance for aiding centrifugal force in completely extending the vanes and maintaining the vanes in engagement with the track is provided by connecting the pressure chamber on the outlet side of the device to the reaction member pressure chambers 90 through the medium of pressure plate passages 92 and groove 94 and the vane passages 96 and openings 95 thereof. Outlet pressure transmitted to the vane passages 96 is transmitted to the reaction member pressure chambers 90 of each vane and acting on the reaction member surfaces 84 urge the reaction members to a bottoming position with their innermost ends 86 in engagement with the inner surfaces 88 of the vane slot pressure chambers 72. The resultant force on vanes 68 projects the vanes outward to aid centrifugal force in completely extending the vanes. This force on the vanes is upwardly as viewed in Figure 4, and is equal to outlet pressure times the total end surface areas 84 of the three reaction members 78. It can be clearly seen that this resultant outward force on the vanes not only aids centrifugal force in rapidly completely extending the same but produces a continuous, controlled force in favor of maintaining the outer edges 76 of the vane 68 in contact with the vane track 56. The area of the pins is preselected in order that the total resultant force be of an order such as to prevent an excessive relative wear rate of the vanes and cam track but be of a magnitude high enough to insure rapid complete extension of the vanes without delay and to insure maintenance of the outer edges of the vanes in engagement with the vane track.

As the rotor continues to turn and the vanes pass through the true arc sections of the vane track, they will partake of no radial movement.

As the vanes traverse the outlet ramps of the vane track and the outer portions thereof pass through the outlet working zones of the device, they are retracted by the cam contour of the vane track. During this operating phase of the device, the resultant inward and outward pressure forces on the vanes are substantially balanced. The same pressure existent in the outlet working zones of the device and imposed on the outer edges 76 of the vanes 68 is transmitted to the innermost areas 80 of the vanes through the medium of the angular vane slot passages 74. The area of each vane taken up by the reaction members is cancelled by the spaced areas 102 in the vane passages 92 and to which pressure is conducted from the discharge side of the device as previously recited. As the resultant forces on the extreme inner and outer ends of the reaction members are the

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same, the vanes are thus substantially balanced during the discharge phase of the device.

It will thus be seen that the present invention has provided a rotary fluid energy translating device of the sliding vane type in which controlled forces are created for aiding centrifugal force in extending the vanes and for maintaining the outer edges of the vanes in engagement with the vane track. This is accomplished by means of reaction members for each vane correlated with porting for continuously connecting the high pressure side of the device to reaction member pressure chambers within each vane and within which are exposed pressure responsive surface areas of the reaction members opposed to which are intermediate areas of the vane. For every resultant force urging the reaction members to a bottoming position within the vane slot, there is created a resultant reaction force on the vane in the opposite direction which aids in extending the same and maintains the vane in engagement with the vane track.

The deficiencies of conventional continuous pressure systems, wherein the vanes are completely unbalanced on the inlet side of the device, and the deficiencies of conventional intermittent pressure systems, wherein the vanes are completely balanced during the complete rotary cycle of the device and centrifugal force alone is depended upon to completely extend the vanes on the inlet side of the device, are overcome by the invention. The number and size of the reaction members may be predetermined to create a resultant force on the vanes for counteracting resisting forces which is low enough to prevent an excessive wear rate and yet high enough to aid centrifugal force in overcoming the resistant forces to rapidly completely extend the vanes.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. In a rotary fluid energy translating device of the sliding vane type including high and low pressure operating passages, one of which is an inlet passage and the other an outlet passage, and a vane track: a rotor having a plurality of radial slots and rotatable within the track; a vane slidable in each slot having a track engaging outer radial end surface and an inner radial end surface effective under pressure for urging the vane toward the track; a cylinder in each vane having an end wall forming an intermediate vane surface also effective under pressure to urge the vane toward the track; a reaction member, including an outer radial end surface, telescopically disposed within the cylinder for movement relative thereto, said outer end surface being in opposing relation to the intermediate vane surface; and passage means connecting the high pressure operating passage to the cylinders imposing a force on the outer surfaces of the reaction members, whereby a resultant reaction force is imposed on the intermediate vane surfaces for aiding centrifugal force in extending the vanes and for maintaining the vanes in engagement with the track.

2. In a rotary fluid energy translating device of the sliding vane type including high and low pressure operating passages, one of which is an inlet passage and the other an outlet passage, and a vane track: a rotor having a plurality of radial slots and rotatable within the track; a vane slidable in each slot having a track engaging outer radial end surface and an inner radial end surface effective under pressure for urging the vane toward the track; a cylinder in each vane having an end wall forming an intermediate vane surface also effective under pressure to urge the vane toward the track; a reaction member, including an outer radial end surface, telescopically disposed within the cylinder for movement relative thereto, said outer end surface being in opposing relation to the intermediate vane surface and forming an expansible chamber within said cylinder between said surfaces; and

passage means connecting the high pressure operating passage to the expansible chambers of the cylinders imposing a force on the outer surfaces of the reaction members, whereby a resultant reaction force is imposed on the intermediate vane surfaces for aiding centrifugal force in extending the vanes and for maintaining the vanes in engagement with the track.

3. In a rotary fluid energy translating device of the sliding vane type including high and low pressure operating passages, one of which is an inlet passage and the other an outlet passage, and a vane track: a rotor having a plurality of radial slots and rotatable within the track; a vane slidable in each slot having a track engaging outer radial end surface exposed to cyclically changing pressure and an inner radial end surface effective under pressure for urging the vane toward the track; a cylinder in each vane having an end wall forming an intermediate vane surface also effective under pressure to urge the vane toward the track; a reaction member, including an outer radial end surface, telescopically disposed within the cylinder for movement relative thereto, said outer end surface being in opposing relation to the intermediate vane surface; passage means connecting the cyclically changing pressure imposed on the outer end surfaces of the vanes to the inner end surfaces of the vanes; and passage means connecting the high pressure operating passage to the cylinders imposing a force on the outer surfaces of the reaction members, whereby a resultant reaction force is imposed on the intermediate vane surfaces for aiding centrifugal force in extending the vanes and for maintaining the vanes in engagement with the track.

4. In a rotary fluid energy translating device of the sliding vane type including high and low pressure operating passages, one of which is an inlet passage and the other an outlet passage, and a vane track: a rotor having a plurality of radial slots and rotatable within the track; a vane slidable in each slot having a track engaging outer radial end surface exposed to cyclically changing pressure and an inner radial end surface effective under pressure for urging the vane toward the track; a cylinder in each vane having an end wall forming an intermediate vane surface also effective under pressure to urge the vane toward the track; a reaction member, including an outer radial end surface, telescopically disposed within the cylinder for movement relative thereto, said outer end surface being in opposing relation to the intermediate vane surface and forming an expansible chamber within said cylinder between said surfaces; passage means connecting the cyclically changing pressure imposed on the outer end surfaces of the vanes to the inner end surfaces of the vanes; and passage means connecting the high pressure operating passage to the expansible chambers of the cylinders imposing a force on the outer surfaces of the reaction members, whereby a resultant reaction force is imposed on the intermediate vane surfaces for aiding centrifugal force in extending the vanes and for maintaining the vanes in engagement with the track.

5. In a sliding vane fluid energy translating device including high and low pressure operating passages, one of which is an inlet passage and the other an outlet passage, and a vane track: a rotor rotatable within the track having a plurality of radial slots opening at one end thereof at the periphery of the rotor and having a pressure chamber at their opposite end; a vane slidable in each slot having a track engaging outer radial end surface exposed to cyclically changing pressure of the device and an inner radial end surface effective under pressure within the vane slot pressure chamber to urge the vane toward the track; a cylinder formed in each vane having an end wall forming an intermediate vane surface effective under pressure to also urge the vane toward the track; a reaction member, including an outer radial end surface, telescopically disposed within the cylinder for movement relative thereto, said outer surface being in opposing relation to the intermediate vane surface and forming an expansible chamber in the cylinder between the opposed surfaces;

passage means conducting the cyclically changing pressure imposed on the outer end surfaces of the vanes to one of the said chambers; and passage means connecting the high pressure passage to the other of said chambers.

6. In a sliding vane fluid energy translating device including high and low pressure operating passages, one of which is an inlet passage and the other an outlet passage, and a vane track: a rotor rotatable within the track having a plurality of radial slots opening at one end thereof at the periphery of the rotor and having a pressure chamber at their opposite end; a vane slidable in each slot having a track engaging outer radial end surface exposed to cyclically changing pressure of the device and an inner radial end surface effective under pressure within the vane slot pressure chamber to urge the vane toward the track; a cylinder formed in each vane having an end wall forming an intermediate vane surface effective under pressure to also urge the vane toward the track; a reaction member, including an outer radial end surface, telescopically disposed within the cylinder for movement relative thereto, said outer surface being in opposing relation to the intermediate vane surface and forming an expansible chamber in the cylinder between the opposed surfaces; passage means conducting the cyclically changing pressure imposed on the outer end surfaces of the vanes to the vane slot pressure chambers; and passage means connecting the high pressure passage to the vane cylinder pressure chambers.

7. In a sliding vane fluid energy translating device including high and low pressure operating passages, one of which is an inlet passage and the other an outlet passage, and a vane track: a rotor rotatable within the track having a plurality of radial slots opening at one end thereof at the periphery of the rotor and having a pressure chamber at their opposite end; a vane slidable in each slot having a track engaging outer radial end surface exposed to cyclically changing pressure of the device and an inner radial end surface effective under pressure within the vane slot pressure chamber to urge the vane toward the track; a cylinder formed in each vane having an end wall forming an intermediate vane surface effective under pressure to also urge the vane toward the track; a reaction member, including an outer radial end surface, telescopically disposed within the cylinder for movement relative thereto, said outer surface being in opposing relation to the intermediate vane surface and forming an expansible chamber in the cylinder between the opposed surfaces, said reaction member having an inner radial end surface extending into said vane slot pressure chamber; means forming an abutment in said vane slot pressure chamber for the inner end surface of the reaction member; passage means conducting the cyclically changing pressure imposed on the outer end surfaces of the vanes to the vane slot pressure chambers; and passage means connecting the high pressure passage to the vane cylinder pressure chambers.

8. A sliding vane fluid energy translating device comprising: a housing having inlet and outlet passages, one of which is a high pressure passage and the other a low pressure passage, and a vane track; a rotor rotatably mounted within the track and forming fluid inlet and fluid outlet zones respectively connected to the inlet and outlet passages; a plurality of radially sliding vanes in the rotor, each vane having a track engaging outer radial end surface exposed to cyclically changing pressure of the device for sweeping fluid from the inlet to the outlet zone, and an inner radial end surface effective under pressure for urging the vane toward the track; a cylinder in each vane having an end wall forming an intermediate vane surface; a reaction member, including an outer radial end surface, telescopically disposed within the cylinder for relative movement thereto, and having an inner radial end surface extending from the cylinder beyond the inner end surface of the vane, said reaction member outer surface and vane intermediate surface being in opposing relation to form an expansible cham-

ber within the cylinder between the said opposed surfaces; means forming an abutment in the rotor for the inner end surface of each reaction member; passage means connecting the cyclically changing pressure imposed on the outer end surfaces of the vanes to the inner end surfaces of the vanes; and passage means connecting the high pressure passage to the expansible chambers for imposing a force on said reaction members toward said abutments, whereby a resultant reaction force is imposed on the intermediate vane surfaces for extending said vanes and maintaining the same in engagement with the vane track.

9. In a fluid energy translating device including high and low pressure operating passages, one of which is an inlet passage and the other an outlet passage, and a vane track: a rotor rotatably mounted within the track carrying a plurality of radially sliding vanes adapted to be extended and retracted as the rotor turns, each vane having a track engaging outer radial end surface exposed to cyclically changing pressure; a plurality of cylinders within each vane, each cylinder having an end wall surface effective under pressure for urging the vane toward the track; a reaction member telescopically mounted in each cylinder having an outer radial end surface in opposing relation to the cylinder end wall surface and forming an expansible chamber within each cylinder; and passage means connecting the high pressure passage to the expansible chambers for imposing a radially inward acting force on the reaction member outer surfaces, whereby a resultant reaction force is imposed on the cylinder end wall surfaces for urging the vanes toward, and maintaining the outer surfaces in engagement, with the vane track.

10. In a rotary fluid energy translating device of the sliding vane type including high and low pressure operating passages, one of which is an inlet passage and the other an outlet passage, and a vane track: a rotor having a plurality of radial slots and rotatable within the track; a vane slidable in each slot having a track engaging outer radial end surface exposed to cyclically changing pressure and an inner radial end surface effective under pressure to urge the vane toward the track; means forming a plurality of cylinders within each vane, each cylinder having an end wall surface effective under pressure to also urge the vane toward the track; a reaction member, including an outer radial end surface, telescopically mounted within each cylinder for telescopic movement relative thereto, said end wall surfaces and reaction member outer surfaces being in opposing relation to form an expansible chamber within each cylinder between said opposed surfaces; passage means connecting the cyclically changing pressure imposed on the outer surfaces of the vanes to the inner end surfaces of the vanes; and passage means connecting the high pressure passage to the expansible chambers for imposing a radially inward acting force on said reaction members, whereby a resultant reaction force is imposed on the cylinder wall surfaces for extending the vanes toward, and maintaining said vanes in engagement with, the track.

11. In a rotary fluid energy translating device of the sliding vane type including high and low pressure operating passages, one of which is an inlet passage and the other an outlet passage, and a vane track: a rotor having a plurality of radial slots and rotatable within the track; a vane slidable in each slot having a track engaging outer radial end surface exposed to cyclically changing pressure and an inner radial end surface effective under pressure to urge the vane toward the track; means forming a plurality of cylinders within each vane, each cylinder having an end wall surface effective under pressure to also urge the vane toward the track; a reaction member, including an outer radial end surface, telescopically mounted within each cylinder for telescopic movement relative thereto, said end wall surfaces and reaction member outer surfaces being in opposing relation to form an expansible cham-

ber within each cylinder between said opposed surfaces, each reaction member having an inner radial end surface extending from the cylinder beyond the inner end surface of the vane; means forming abutments in the rotor for the reaction member inner surfaces; passage means connecting the cyclically changing pressure imposed on the outer surfaces of the vanes to the inner end surfaces of the vanes; and passage means connecting the high pressure passage to the expansible chambers for imposing a force on the reaction members urging the same toward said abutments, whereby a resultant reaction force is imposed on the cylinder end wall surfaces for urging the vanes toward, and maintaining the vane outer end surfaces in engagement with, the vane track.

12. In fluid energy translating device including high and low pressure operating passages, one of which is an inlet passage and the other an outlet passage, and a vane track: a rotor rotatably mounted within the track carrying a plurality of radially sliding vanes adapted to be extended and retracted as the rotor turns, each vane having a track engaging outer radial end surface exposed to cyclically changing pressure and an inner radial end surface effective under pressure to urge the vane toward the track; a plurality of cylinders within each vane, each cylinder having an end wall surface effective under pressure for urging the vane toward the track; a pin member telescopically mounted in each cylinder having an outer radial end surface in opposing relation to the cylinder end wall surface and forming an expansible chamber within each cylinder between the opposing surfaces; passage means connecting cyclically changing pressure to the inner end surfaces of the vanes; and passage means connecting the high pressure passage to the expansible chambers for imposing a radially inward acting force on the pin member outer surfaces, whereby a resultant reaction force is imposed on the cylinder end wall surfaces for urging the vanes toward, and maintaining the outer surfaces in engagement with, the vane track.

13. As a new article of manufacture for use in a rotor of a fluid energy translating device rotatably mounted within a vane track comprising: a flat vane substantially rectangular in cross section having a track engaging outer radial end surface, a cylinder formed in each vane; a reaction member, including an outer radial end surface, telescopically disposed within the cylinder for telescopic movement relative thereto, said cylinder having an end wall within the vane in opposing relation to the reaction member outer surface to form an expansible chamber within the cylinder between the cylinder end wall and outer surface of the reaction member; and passage means connected to the chamber opening exteriorly to at least one side of said vane.

14. As a new article of manufacture for use in a rotor of a fluid energy translating device rotatably mounted within a vane track comprising: a flat vane substantially rectangular in cross section having a track engaging outer radial end surface, a plurality of cylinders formed in each vane; a reaction member including an outer radial end surface telescopically disposed for relative movement within each cylinder, each cylinder having an end wall within the vane in opposing relation to each reaction member outer surface to form an expansible chamber within the cylinder between the cylinder end wall and outer surface of the reaction member; and passage means leading from said chamber opening exteriorly on at least one side of said vane.

15. As a new article of manufacture, a rotary assembly adapted to be rotatably mounted within the vane track of a fluid energy translating device, comprising: a rotor having a plurality of radial slots extending from the periphery of the rotor and terminating in an enlarged pressure chamber at their inner radial ends, a flat sided rectangular vane slidably mounted in each slot having a track engaging outer radial end surface and an inner radial end surface in communication with the pressure

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chamber; a separate passage for each vane slot leading from the periphery of the rotor to the chambers; a reaction member, including an outer radial end surface, telescopically mounted within each vane, said arrangement providing an intermediate vane surface in opposing relation to the reaction member outer surface and forming an expandible chamber within the vane between the intermediate vane surface and the reaction member outer surface, said reaction member having an inner radial end surface adapted to bottom within the vane slot pressure chamber, and passage means leading from said chamber opening exteriorly on at least one side of said vane.

16. As a new article of manufacture, a rotary assembly adapted to be rotatably mounted within the vane track of a fluid energy translating device, comprising: a rotor having a plurality of radial slots extending from the periphery of the rotor and terminating in an enlarged pressure chamber at their inner radial ends, a flat sided rectangular vane slidably mounted in each slot having a track engaging outer radial end surface and an inner radial end surface in communication with the pressure chamber; a separate passage for each vane slot leading from the periphery of the rotor to the chambers; a plurality of cylinders formed in each vane; a reaction member, including

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an outer radial end surface, telescopically disposed in each cylinder for movement relative thereto, each cylinder having an end wall in opposing relation to each reaction member outer surface and the arrangement providing an expandible chamber in each cylinder between the opposing surfaces, each reaction member having an inner radial end surface adapted to bottom within the vane slot pressure chamber; and passage means having an opening on at least one side of said vane leading to said chamber.

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