June 3, 1969

R. B. PETTIBONE

3,447,477

POWER TRANSMISSION

Filed June 22, 1967

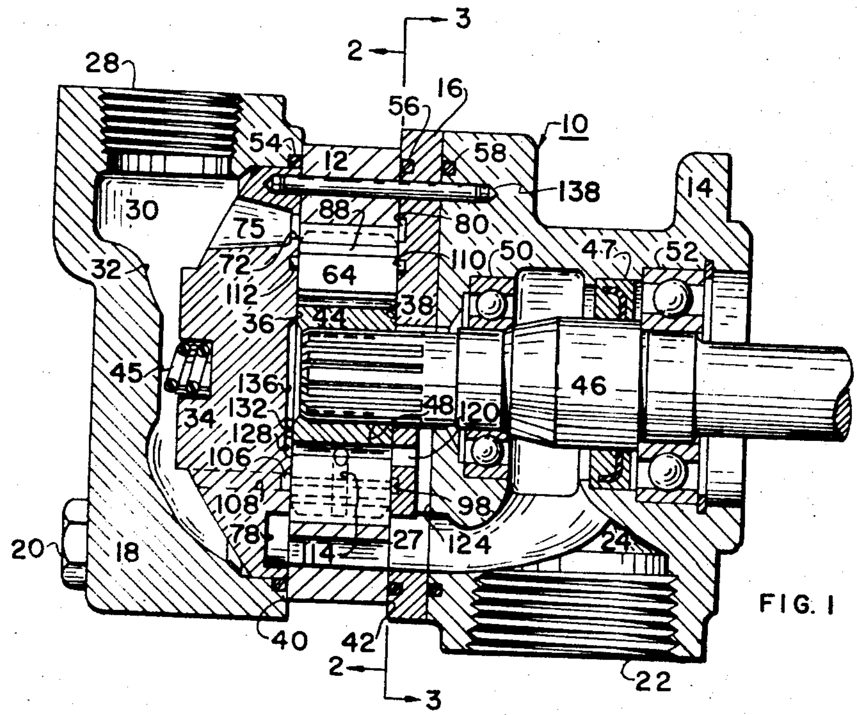


FIG. 1

FIG. 2

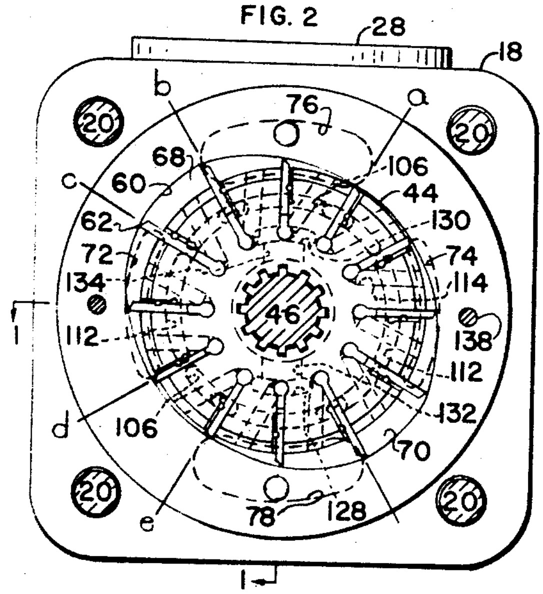
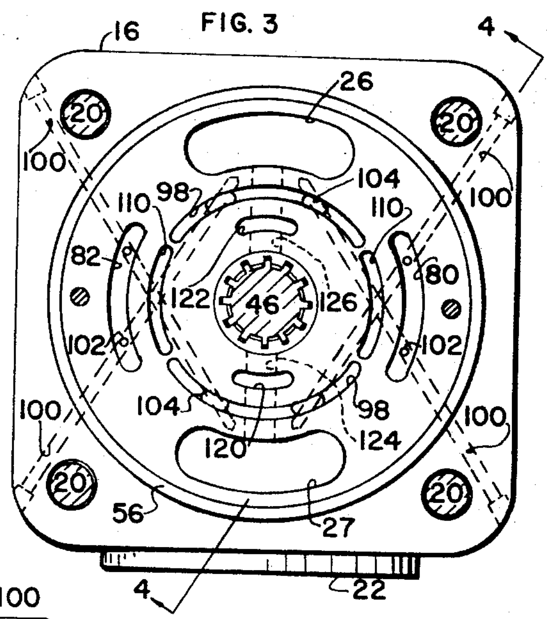


FIG. 3



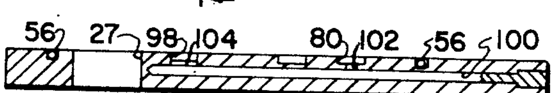


FIG. 4

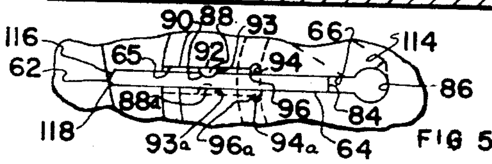


FIG 5

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BY

[signature]

ATTORNEYS

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3,447,477

POWER TRANSMISSION

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U.S. Cl. 103—136 11 Claims

ABSTRACT OF THE DISCLOSURE

A fluid energy translating device of the sliding vane type having a stator with high pressure and low pressure passages and a vane track with a rotor rotatably mounted within the track and encased between two cheek plates; the rotor having a plurality of radial stepped slots with a vane and pivotal thrust member assembly slidably mounted therein and which form separate expansible pressure chambers in each slot which, when filled with a pressure fluid, will provide an outward force for maintaining the vanes in contact with the vane track.

A pressure porting arrangement in each cheek plate which permits high pressure fluid to enter, from both sides of the rotor, the expansible pressure chambers in those slots associated with the vanes which are traversing the low pressure passages of the device; the same expansible chambers exhausting fluid into a blind port in each cheek plate forcing fluid to flow into the running clearance between the rotor and cheek plate faces when the vanes are traversing the high pressure passages of the device for creating a pressure in the same chambers greater than that existent in the high pressure passages resulting in a favorable unbalanced outward force for maintaining the vanes in contact with the vane track and for minimizing rotor-cheek plate contact by equalizing the pressure in the running clearance between the rotor and cheek plate faces.

BACKGROUND OF THE INVENTION

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 the other as a fluid motor. More particularly, this invention relates to an improvement in sliding vane type pumps and motors such as illustrated in the patent to Harry F. Vickers No. 1,989,900.

In units of this type, it has been a conventional practice to transmit high pressure to the full underside of the vanes so as to maintain the vanes in contact with the vane track. One of the limiting factors in the life of such units is the excessive wear rate between the vanes and the vane track under excessive operating conditions. This is due to the fact that the vanes traversing the suction ramp are completely unbalanced having only low pressure on their outer ends while the inner ends are continuously subjected to high pressure.

Although a certain amount of wear is permissible without destroying the efficiency of the pump, when certain limiting speeds and pressures are exceeded the wear rate is so great as to be economically unfeasible.

Because of this limitation, other constructions have been designed which connect the high pressure side of the device to the inner ends of the vanes only on the high pressure or discharge phase thereof, and which connect the low pressure side of the device to the inner ends of the vanes during the low pressure or suction phase. While this has proved to be a relatively effective device, practical considerations have resulted in a maximum operating speed. At higher speeds the vanes become improperly

balanced and not only is the volumetric efficiency of the device decreased, but likewise its pumping capacity. As the speed of the device increases, the centrifugal force urging the vanes against the track increases, but this advantage is overcome by an increased pressure differential tending to separate the vanes from the track. As the speed of the rotor increases the pressure differential required to cause the vanes to pump the fluid out increases and at certain higher speeds becomes so great that the vanes are unbalanced inwardly and move away from the track.

Still other types of devices have been designed to provide a proper unbalanced condition to meet the requirements of a very high speed and pressure operation. This is accomplished by having an intermediate pressure chamber associated with a relatively smaller pressure effective surface on each vane in addition to the chambers associated with the inner ends of the vanes, and by providing a pressure transmitting porting arrangement to both chambers such as illustrated in the patents to Duncan B. Gardiner Nos. 2,967,488 and 2,919,651.

Another of the limiting factors in the service life of such units is the development of localized wear points between the vanes and the walls of the slots in which they are carried. This is due in part to the severe bending moment produced on the vanes by a pressure differential there-across when the vanes are in an extended position. The conventional construction utilized in the past has provided a vane of substantially uniform thickness to engage the sides of the vane receiving slot and extending therefrom to engage the vane track. In pumps utilizing the conventional construction, there has been noted excessive wear of the vane track, the rotor, and the individual vanes. This surface disturbance interrupts the smooth contour of the track to cause noisy and inefficient operation. Further, unless the conventional vanes are carefully fitted to the vane slots, internal leakage in such units may exceed acceptable limits.

Because of this limitation, other constructions have been designed to minimize the heretofore noted wear, such as illustrated in the patent to me No. 2,821,143. This design, while advantageous, does not support all frontal tangential forces imposed upon the vane, thus permitting contact stress between the vane and rotor segment at the lower end of the vane, resulting in deterioration of the vane and slots during very high pressure and speed operation.

Another of the limiting factors in the service life of such units is the premature deterioration of the face of the rotor and cheek plate when operated at extremely high speeds and pressures. As illustrated in the herebefore mentioned Gardiner patents, pressurized fluid is transmitted from the pressure plate through the rotor intermediate chambers to ports on the opposite side of the rotor whereupon fluid flows into the space between the rotor and wear plate and thus providing a fluid film for preventing rotor and wear plate contact. At extremely high speed and pressure operation, there is a notable pressure drop across the rotor causing the rotor to shift toward and to come into contact with the wear plate resulting in noise and undue wear.

SUMMARY

This invention comprises a rotary fluid energy translating device of the sliding vane type having in combination a plurality of stepped slots and vanes with a thrust member mounted for pivotal movement between each vane and slot with means forming separate pressure chambers in each slot, one of which is associated with a pressure responsive surface on the thrust member, the other associated with a pressure responsive surface on the vane, and means forming a pressure transmitting porting arrangement to both chambers, the said surfaces being effective under pressure to urge the vanes into engagement with the track.

It is an object of the invention to provide a fluid energy translating device of the sliding vane type having an improved vane biasing arrangement.

It is another object of this invention to provide a fluid energy translating device having an improved vane structure and vane biasing arrangement which reduces wear between the vanes and the guiding slots.

It is still another object of this invention to provide a fluid energy translating device having dual pressure chambers associated with each vane and an improved pressure transmitting arrangement associated therewith which assures proper rotor balance at high pressure and high speed operation and which reduces noise and wear between the rotor and cheek plates.

It is a further object of this invention to provide a fluid energy translating device of the sliding vane type having means for providing a controlled, safe, and efficient differential therein for urging the vane in contact with the vane track.

It is also an object of the invention to provide a fluid energy translating device of the sliding vane type which is of low cost, efficient, quiet, and long wearing.

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

In the drawing:

FIG. 1 is a longitudinal sectional view of a fluid energy translating device embodying a preferred form of the present invention and taken on line **1—1** of FIG. 2.

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

FIG. 3 is a sectional view **3—3** of FIG. 1.

FIG. 4 is a partial sectional view taken on the line **4—4** of FIG. 3.

FIG. 5 is an enlarged partial sectional view of the vanes as illustrated in FIG. 2.

Referring now to FIGURES 1, 2, and 3, there is shown a rotary fluid pump indicated by the numeral **10**, the housing of which comprises a cam ring section **12** sandwiched between a body section **14** having a wear plate **16** and an end cover **18**, all of which are suitably connected to each other by bolts **20**. The body section **14** is provided with an inlet supply connection port **22** having an inlet passage **24** leading therefrom which is branched and terminates in a pair of fluid openings, one of which is shown in FIG. 1, registering with duplicate opposed fluid openings **26** and **27** extending through the wear plate **16** and which are shown in FIG. 3.

An outlet connection port **28** is located in the end cover **18** which leads directly from a pressure delivery chamber **30** formed in an enlarged bore **32** of the end cover **18** where a pressure plate **34** is floatably mounted in the bore **32**. The pressure plate **34** and wear plate **16** are each formed with a flat surface indicated, respectively by the numerals **36** and **38** which abut opposing flat faces **40** and **42** of the cam ring **12** and provide fluid sealing engagement for the immediately adjacent faces of rotor **44** mounted within the cam ring **12**. The pressure plate is adapted to be urged against a portion of the flat face **40** of the cam ring **12** and in fluid sealing engagement with the rotor by pressure in the pressure chamber **30**. A spring **45** initially biases the pressure plate toward the rotor until pressure builds up in the pressure chamber.

The rotor **44** is driven by a shaft **46** provided with a seal **47**, and extends from the body for connection to a prime mover, not shown. The shaft is spline connected to the rotor at **48** and is rotatably mounted in bearing **50** and **52**, in the body **14**. O-ring seals **54** and **56** prevent leakage at the juncture of the end cover **18** and the wear plate **16** with the cam ring **12** while an O-ring seal **58** prevents leakage at the juncture of the body **14** and the wear plate **16**.

The inner surface of the cam ring **12** forms a cam track substantially elliptical in shape, indicated by the number **60**, against which the outer tips **62** of vanes **64**, the latter of which are slidably mounted in slots **66** of the rotor **44**, are adapted to be maintained in contact. The cam track contour and the outer periphery of the rotor define two opposed working chambers, indicated by the numerals **68** and **70**, each of which, for the purposes of convenience, may be divided into a fluid inlet zone, and a fluid delivery zone. The fluid inlet zones are those portions of the working chambers **68** and **70** registering with the opposed fluid inlet openings **26** and **27** in the wear plate **16**. The fluid delivery zones are those portions of the working chambers **68** and **70** registering respectively with opposed arculate fluid delivery ports **72** and **74** in the pressure plate **34**, shown as dotted lines in FIG. 2 which are connected to the pressure chamber **30** by means of duplicate passage **75** leading therefrom, one of which is shown in FIG. 1.

The fluid inlet ports **26** and **27**, which extend completely through the wear plate **16**, are also duplicated respectively by mirror image ports **76** and **78** in the face **36** of the pressure plate; and fluid delivery ports **72** and **74** in the pressure plate **34** are also duplicated respectively by mirror image pressure ports **80** and **82** in the face **38** of the wear plate **16** to produce filling and balance on opposite sides of the rotor.

The vane track **60** includes 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 both its major and minor axes, thus each of the ramps and true arc portions from *a* to *e* are duplicated in the lower portion of the track. As the ends of the vanes 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.

The inner ends of the vane slots **66** are enlarged to form with the inner ends **84** of the vane **64**, enclosed undervane pressure chambers **86** which undergo cyclic contraction and expansion during rotation of the rotor.

A slipper **88** which, as later explained, performs the function of a thrust member is essentially a half round rod equal in length to the van width and is mounted in the vane **64** in a mating half round groove **90** which performs the function of a socket in the vane **64** for providing pivotal movement relative thereto. Each slipper has a flat outer end surface **92** and a pressure responsive intermediate surface **93**, the flat outer end surface being extended out from the vane for slidable abutment with a side wall **65** in each slot **66**. The wall **65** of each vane slot **66** is formed with a stepped portion indicated by the numeral **94** which together with the intermediate slipper surface **93**, forms in each slot an enclosed intermediate expansible pressure chamber **96**. The intermediate chamber **96** opens exteriorly to each side face of the rotor while undergoing cyclic expansion and contraction as the rotor revolves.

Although the preferred form of the invention is shown with a single slipper vane combination in each slot, two slippers may be utilized with each vane in each slot to achieve the desired unbalanced outward force therein. Such a construction is illustrated by the dotted lines in FIG. 5 wherein a slipper **88*a*** is pivotally mounted at one end in the vane **64** and at its other end is slidably abutting a wall of slot **66** in which an expansible chamber **96*a*** is formed between an intermediate pressure responsive surface **93*a*** and a step **94*a***. The dual slipper vane construction will function in the same manner as the single slipper vane construction as described herein.

In the form of device illustrated, a flow path is formed connecting the high pressure side of the device to the expanding intermediate chambers. The flow path is formed by providing diametrically opposed ports **98** in the face **38** of the wear plate which are adjacent to the inlet ramps and true arc portions and are connected to the pressure ports **80** and **82** by drilled passages **100** and **102** and **104** (as shown in FIGURES 3 and 4). The ports **98** are also duplicated by pressure ports **106** in the face **36** of the pressure plate **34** and are connected to the pressure chamber **30** by drilled passages **108**. The pressure chamber **30** thus forms with the pressure plate outlet or delivery ports **72** and **74** and passages **75** a continuous outlet passage leading to the outlet port and also form with the diametrically opposed ports **98** and **106** a flow path for connecting the high pressure side of the device to the expanding intermediate chambers. There is also provided diametrically opposed blind ports **110** in the wear plate face **38** and diametrically opposed blind ports **112** in the pressure plate face **36**; the ports being adjacent the outlet ramps, the purpose of which is explained hereafter.

The vanes traversing the inlet ramp *a–b* and it duplicate inlet ramp are extending causing an expansion of their associated intermediate chambers **96**. The intermediate chambers of the extending vanes are in communication with the diametrically opposed ports **98** and **106** during the vane extending phase and high pressure fluid will flow from ports **98** and **106** to fill these chambers. Simultaneously, the vanes, which are traversing the outlet ramp *c–d* and its duplicate outlet ramp, are retracting, causing a contraction of their associated intermediate chambers **96**, and the same chambers will displace pressure fluid into the diametrically opposed blind ports **110** and **112**.

During the discharge phase of the device, the blind ports, from which fluid can flow only into the running clearance formed between the rotor side faces and the face surfaces of the opposed cheek plates **16** and **34**, are adapted to create a pressure in the intermediate chambers which is greater than the pressure existent in the fluid outlet zone through which the outer ends of the vanes pass.

As explained hereafter, the pressure in the fluid delivery zones and the associated inner vane chambers are equal, therefore, the higher pressure produced in the intermediate chambers will result in a favorable unbalanced outward force for maintaining the vanes in contact with the vane track during the discharge phase. The effective area of the exposed intermediate surface **93** of the slipper **88** is preselected to create a resultant force sufficient to maintain the tip of the vanes in contact with the vane track during all phases in a cycle of the device, but low enough top revent excessive ring wear during the suction phase.

As hereinbefore mentioned, the excess fluid, which is exhausted from the intermediate chamber into the blind ports during the discharge phase, will flow into the running clearance between the adjacent faces of the pressure plate, rotor, and wear plate for providing a film of fluid on both sides of the rotor. With fluid being fed into the chambers at both faces of the rotor, the aforesaid unfavorable condition of a pressure differential across the rotor is eliminated, thus permitting the rotor to center itself between the pressure plate and the wear plate.

For the purpose of equalizing the pressure in the inner and outer ends of the vanes, the rotor is provided with a plurality of angular drilled passages **114**, one for each vane slot, which lead from the periphery of the rotor, between the vanes to the enlarged chambers **86** at the inner end of each vane slot. The outer end of each vane is constructed with a trailing taper **116** and a relatively small leading taper **118** to form the tip **62** which as aforementioned is adapted to contact the vane track. The outer surface of the vanes comprising the tappers **116** and **118** are exposed to the pressures in the expanding and contracting intervane spaces and by means of the angular

passages **114**, the cyclically changing intervane pressure is conducted to the inner chambers **86**.

In order to facilitate filling of the undervane chambers **86** during the suction stroke and during high speed operation, the wear plate **16** is also provided with auxiliary inlet ports **120** and **122** which are connected to the inlet passage of the body device, and the spacing between the shaft and rotor by slots **124** and **126**. Duplicate auxiliary inlet ports **128** and **130** are provided in the face of the pressure plate adjacent the rotor, and are connected respectively by means of slots **132** and **134** to a recess **136** in the pressure plate. Inlet fluid is therefore conducted from the auxiliary inlet porting in the wear plate side of the device through the medium of the spacing between the shaft and rotor splining to the recess **136**, and by means of slots **132** and **134**, to the duplicate auxiliary ports **128** and **130** of the pressure plate. Dowel pins **138** are utilized to provide proper alignment of the porting located in the wear and pressure slots with the working chambers of the device.

The system pressure imposed on the slipper **88** forces it into contact with the vane to take up any excess or free clearance, permitting a relaxation of the vane and rotor slot machining tolerances. The relative pivotal motion of the slipper **88** and vane **64** provides a mechanical seal which not only reduces the leakage between the intermediate chambers and the working chambers, but it eliminates the need for close vane-slipper-step slot dimensions.

The relative pivotal motion of the slipper and vane also permits the slipper to act as a self-aligning bearing pad for compensating for vane tilt thus reducing rotor vane contact stress resulting from the aforementioned bending forces imposed on the vane.

Devices embodying the invention operate at much higher pressure and speeds than conventional devices of the type herebefore mentioned, yet minimizes excessive wear rate while providing utmost efficiency and long life.

While the form of the embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adapted, 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 low and high pressure operating passages, one of which is an inlet passage and the other an outlet passage, and a vane track;

a rotor having means forming a plurality of stepped slots and rotatable within the track;

a plurality of vanes slidably mounted within said slots, the outer ends of which are adapted to engage the track;

a plurality of thrust members mounted between said slots and said vanes for pivotal movement relative thereto, each vane and each thrust member having a surface thereon effective under pressure to urge the vanes toward the track;

means forming separate pressure chambers in each slot, one of which is associated with the thrust member surface, the other associated with the vane surface;

and passage means connecting the high pressure operating passage of the device to at least one of said separate pressure chambers for aiding centrifugal force in maintaining the outer ends of the vanes in engagement with the vane track.

2. In a rotary fluid energy translating device of the sliding vane type including low and high pressure operating passages, one of which is an inlet passage and the other an outlet passage, and a vane track having a low pressure and high pressure ramps;

a rotor having means forming a plurality of stepped slots and rotatable within the track;

a plurality of vanes slidably mounted within said slots, one end of each vane being adapted to abut the track and the intervane spaces undergoing alternate phases of expansion and contraction as the vanes traverse the vane track ramps during a cycle of the device;

a plurality of thrust members mounted between said slots and said vanes for pivotal movement relative thereto, each vane and each thrust member having a surface effective under pressure to urge the vanes toward the track;

means forming separate pressure chambers in each slot, one of which is associated with the thrust member surface, the other associated with the vane surface;

means for porting the cyclically changing intervane pressure to one of said chambers in timed relation with the expansion and contraction phases of the intervane spaces;

and passage means connecting the high pressure passage to the other of said chambers during the intervane expansion and contraction phases of the device.

3. A combination as in claim **2** including a restricted flow path in said passage means connecting the high pressure passage to the said other chambers during the intervane contraction phases of the device for creating a pressure in said other chambers during said contraction phase which is greater than is existent in the high pressure passage.

4. In a rotary fluid energy translating device of the sliding vane type including low and high pressure operating passages, one of which is an inlet passage and the other an outlet passage, and a vane track having a low and high pressure ramp;

a rotor having means forming a plurality of stepped slots and rotatable within the track;

a plurality of vanes slidably mounted within said slots wherein an outer end of each vane is adapted to abut the track and the intervane spaces undergoing alternate phases of expansion and contraction as the vanes traverse the vane track ramps during a cycle of the device;

a plurality of thrust members mounted between said slots and said vanes for pivotal movement relative thereto, wherein each vane and each thrust member respectively have a vane end surface and a thrust member surface and each vane and each thrust member respectively form an end pressure chamber and an intermediate pressure chamber in each slot, the said surfaces being effective under pressure in said chambers to urge the outer ends of the vanes in engagement with the track;

means for porting the cyclically changing intervane pressure to the end chambers in timed relation with the expansion and contraction phases of the intervane spaces;

and passage means for connecting the high pressure passage to the intermediate chambers.

5. A combination as in claim **4** including said plurality of slots with means forming a step in each wall therein;

and said thrust members being mounted on opposite sides of each vane between the vane and slot wall for pivotal movement relative thereto.

6. In a rotary fluid energy translating device of the sliding vane type including low and high pressure operating passages, one of which is an inlet and the other an outlet passage, and a vane track having inlet pressure and outlet pressure ramps;

a rotor having means forming a plurality of stepped slots and rotatable within the track;

means forming two cheek plates, said rotor being disposed between said cheek plates, there being a running clearance between said cheek plates and rotor;

a plurality of vanes slidably mounted within said slots, one end of each vane being adapted to abut the track and the intervane spaces undergoing alternate phases of expansion and contraction as the vanes traverse the vane track ramps during a cycle of the device;

a plurality of thrust members mounted between said slots and said vanes for pivotal movement relative thereto, each vane and each thrust member having a surface effective under pressure to urge the vanes towards the track;

means forming separate pressure chambers in each slot, one of which is associated with the thrust member surface, the other associated with the vane surface;

passage means for connecting the cyclically changing intervane pressure to only one of said separate pressure chambers in each slot in timed relation with the expansion and contraction phases of the intervane spaces;

means connecting the high pressure operating passages simultaneously through both cheek plates on opposite sides of said rotor to the other of said pressure chambers in each slot as the vanes traverse the low pressure ramp; and

means forming blind ports in each of said cheek plates on opposite sides of the rotor, said ports registering with said other pressure chambers as the vanes traverse the outlet pressure ramp, the only outlet from the blind ports being the said running clearance on opposite sides of the rotor, and creating a pressure in said other chamber greater than is existent in the high pressure passage for providing a favorable unbalanced outward force for maintaining the vanes in contact with the vane track and also for equalizing the pressure on opposite sides of the rotor in said running clearance.

7. In a rotary fluid energy translating device of the sliding vane type including low and high pressure operating passages, one of which is an inlet passage and the other an outlet passage, and a vane track having inlet and outlet pressure ramps;

a rotor having means forming a plurality of slots and rotatable within the track;

means forming two cheek plates, said rotor being disposed between said cheek plates, there being a running clearance between said check plates and rotor;

a plurality of vanes slidably mounted within said slots, one end of each vane being adapted to abut the track and the intervane spaces undergoing alternate phases of expansion and contraction as the vane traverse the vane track ramps during a cycle of the device;

means forming separate surfaces associated with each vane, said surfaces being effective under pressure to urge the vanes towards the track;

means forming separate pressure chambers in each slot one of which is associated with one of said surfaces, the other associated with the other of said surfaces;

means for connecting the cyclically changing pressure to one of said separate chambers in each slot in timed relation with the expansion and contraction phases of the intervane spaces;

means connecting the high pressure operating passages simultaneously through both cheek plates on opposite sides of said rotor to the other of said pressure chambers in each slot as the vanes traverse the low pressure ramps;

and means forming blind ports in each of said cheek plates on opposite sides of the rotor, said ports registering with said other pressure chambers as the vanes traverse the outlet pressure ramps, the only outlet from the blind ports being the said running clearance on opposite sides of the rotor and creating a pressure in said other chamber greater than is existent in the high pressure passage for providing a favorable unbalanced outward force for maintaining the vanes in contact with the vane track and also for equalizing the pressure on opposite sides of the rotor in said running clearance.

8. As a new article of manufacture slidable in a rotor slot having parallel side walls with a step formed therein, a vane and thrust member assembly comprising:

a flat vane, substantially rectangular in cross section, constructed with a groove forming a socket located in a flat surface of the vane betwen an outer end surface and an inner end surface;

a thrust member having a flat outer end surface and a half round inner end surface, the inner end surface being disposed within the vane socket for pivotal movement relative thereto, the flat outer end surface being extended beyond the flat vane surface and adapted to engage a side wall of the slot and provide a surface effective under pressure for aiding centrifugal force is extending the vane.

9. As a new article of manufacture for use within a vane track of a fluid energy translating device:

a rotor having a plurality of substantially radial slots with parallel side walls extending from the periphery of the rotor with a step formed in a wall in each slot, each slot having an enlarged pressure chamber formed at the inner end thereof;

a flat, substantially rectangular vane slidable in each slot, each vane having a track engaging outer end surface and an inner end surface said inner end surface being located at the pressure chamber end of the slot;

a substantially half round groove located in the flat surface of the vane between the outer end surface and the inner end surface;

a thrust member having a substantially flat outer end surface, a pressure responsive intermediate surface, and a half round inner end surface the inner end surface being disposed within each vane groove for pivotal movement relative thereto, the flat outer end surface of each member being extended beyond the flat vane surfaces for slidable abutment with a side wall of each slot to form an intermediate expansible chamber between each stepped portion of each slot and each thrust member intermediate surface, the said intermediate chambers each opening exteriorly to at least one side of the rotor;

and a separate passage for each vane slot extending from the periphery of the rotor to the inner pressure chambers of the vane slots.

10. As a new article of manufacture slidable in a rotor slot having parallel side walls with a step formed in each wall, a vane and thrust member assembly comprising:

a flat vane, substantially rectangular in cross section having means forming a socket located in each flat surface on opposite sides of the vane between an outer end surface and the inner end surface;

a thrust member having a flat outer end surface and a half round inner end surface, the inner end surface being pivotally disposed within each vane socket for pivotal movement relative thereto, and the flat outer end surface being extended beyond the flat vane surface, and adapted to engage a side wall of the slot and provide a surface effective under pressure for aiding centrifugal force in extending the vane.

11. As a new article of manufacture for use within a vane track of a fluid energy translating device:

a rotor having a plurality of substantially radial slots with parallel walls extending from the periphery of the rotor with a step formed in each wall of each slot and having enlarged pressure chambers formed at the inner ends of each slot;

a flat substantially rectangular vane slidable in each slot, each vane having a track engaging outer end surface and an inner end surface, said inner end surface being located at the pressure chamber end of the slot;

a substantially half round groove located in each flat surface on opposite sides of the vane between the outer end surface and the inner end surface;

a thrust member having a substantially flat outer end surface, a pressure responsive intermediate surface and a half round inner end surface, the inner end surface being disposed within each vane groove for pivotal movement relative thereto, the flat outer end surface of each member being extended beyond the flat vane surface for slidable abutment with the side walls of each slot to form an intermediate expansible chamber between each stepped portion of each slot, and each thrust member intermediate surface, the said intermediate chambers each opening exteriorly to at least one side of the rotor;

and a separate passage for each vane slot extending from the periphery of the rotor to the inner pressure chambers of the vane slots.

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U.S. Cl. X.R.

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