

April 19, 1966

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3,246,574

ROTOR ASSEMBLY IN VANE MACHINE WITH PRESSURE BALANCE DEVICES

Original Filed Sept. 12, 1960

4 Sheets-Sheet 1

FIG. 1

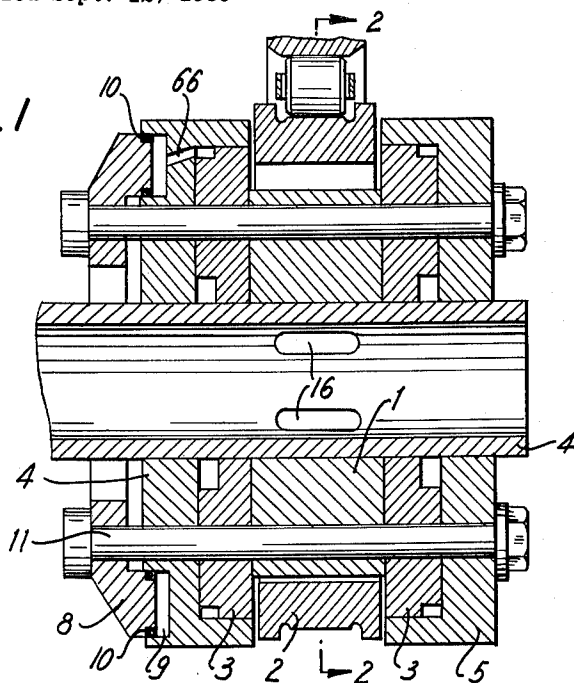
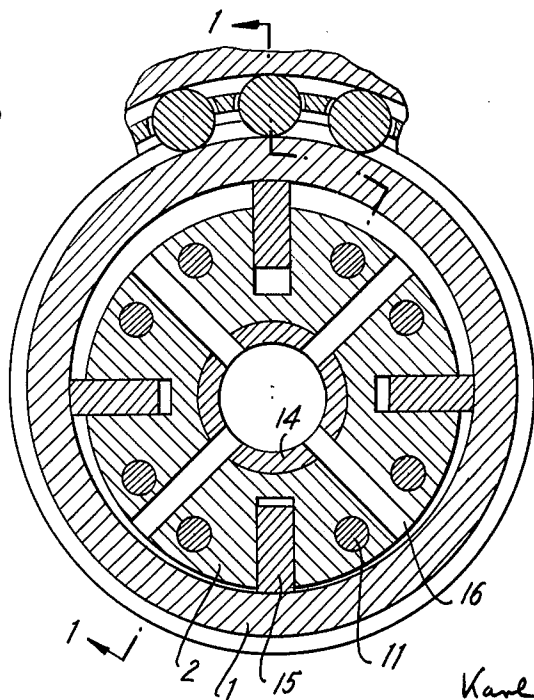


FIG. 2



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FIG. 3

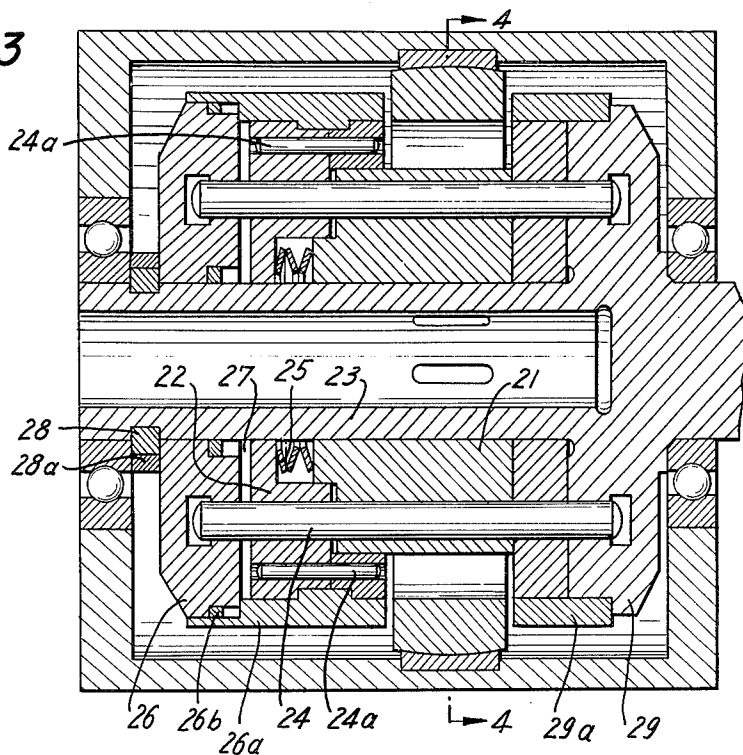
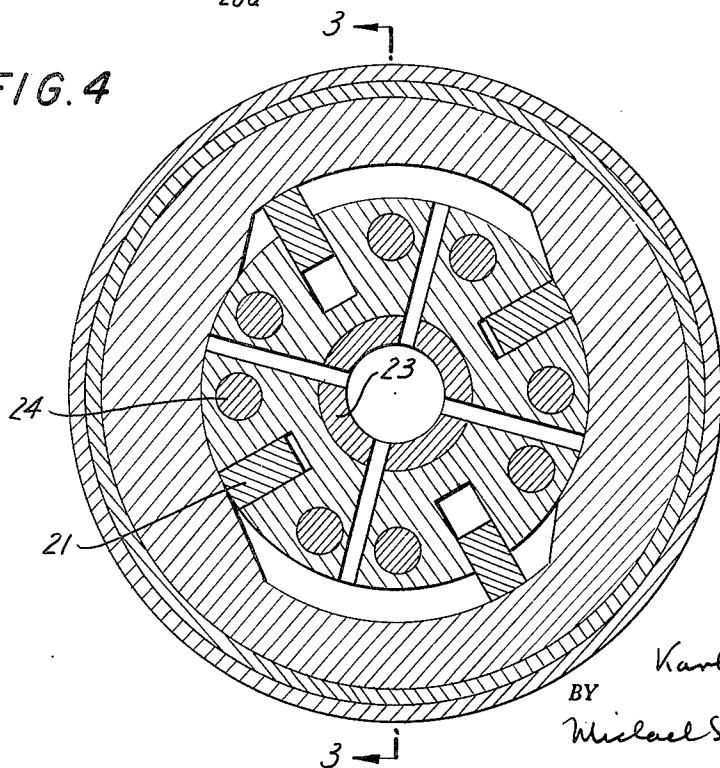


FIG. 4



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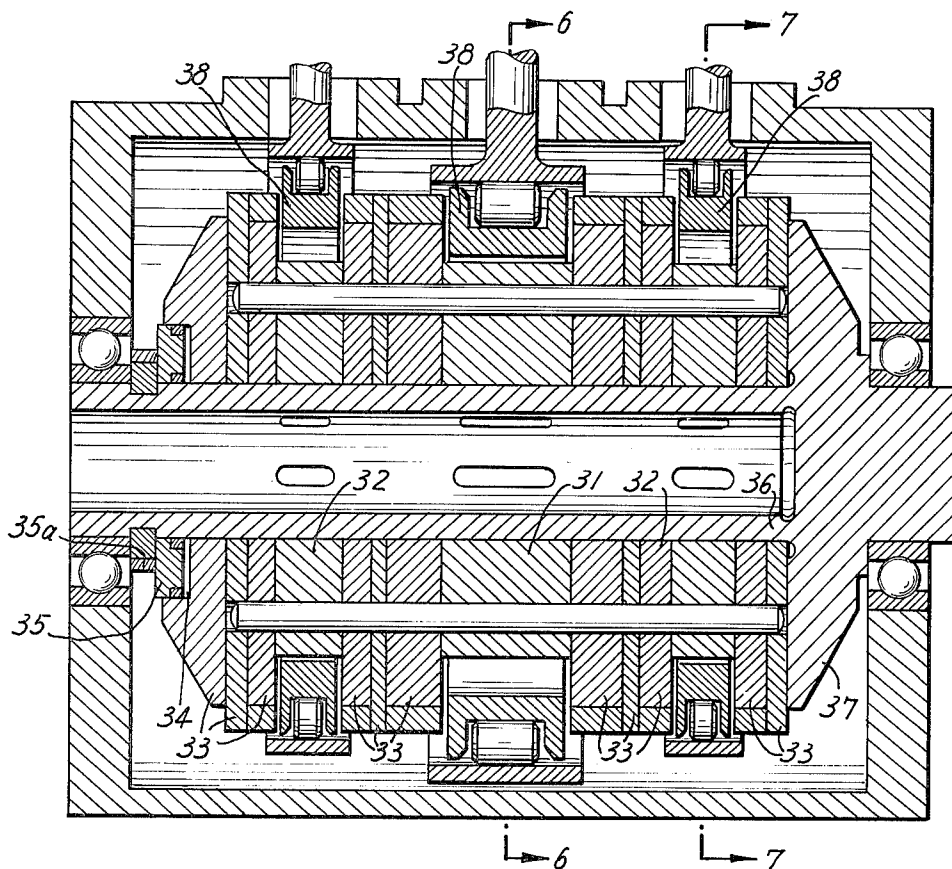
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FIG. 5



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FIG. 6

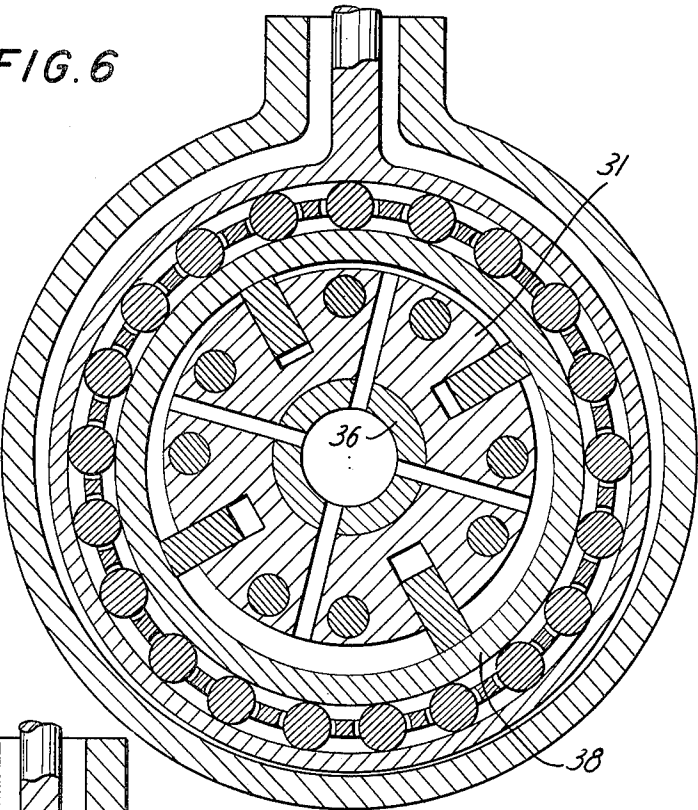
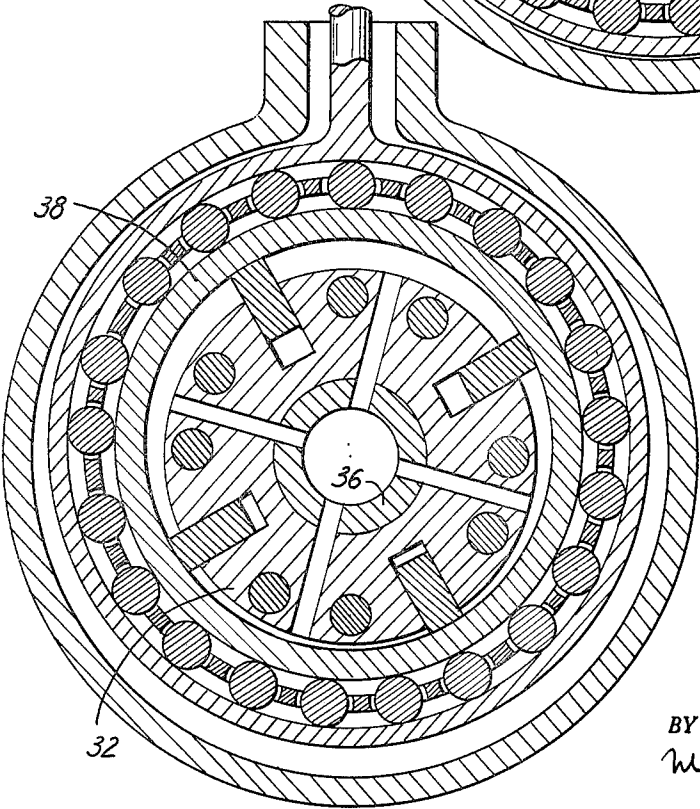


FIG. 7



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3,246,574

ROTOR ASSEMBLY IN VANE MACHINE WITH PRESSURE BALANCE DEVICES

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Continuation of application Ser. No. 55,265, Sept. 12, 1960. This application Feb. 11, 1965, Ser. No. 436,709
Claims priority, application Japan, Sept. 11, 1959, 34/29,238

28 Claims. (Cl. 91—121)

The present application is a continuation of my earlier application Serial No. 55,265, filed September 12, 1960, now abandoned, and entitled "Rotor Assembly in Vane Machine With Pressure Balance Devices."

The present invention relates to a rotor in vane-machines or fluid handling machines, particularly compressors, liquid pumps, gas motors, steam engines, liquid motors and liquid operated gears, and the like and more particularly to such vane-machine rotor arrangements, capable of high pressure and being provided with axial vane extensions into slots of the rotor side-walls, where recesses or spaces containing fluid or gas under pressure are used to produce counter-balancing forces in order to decrease the resultant of forces acting on the rotor or on the rotor parts.

Rotary vane fluid handling machines of the type contemplated by the invention have been used heretofore in which pressures of fluids in spaces, especially in working cells were acting diametrically on the rotor. Various rotary vane machines are suitable disclosed, for example, in U.S. Patent 2,335,284 and others diametrically to the rotor. In such vane machines working-cells have been provided, which were separated from each other by vanes, rotor, case and side walls of the rotor. Each working chamber had a suction area and a delivery area, the latter was under higher pressure in operation. The suction areas were diametrically provided to the rotor and so were the delivery-areas of the working cells. Consequently the pressures acting against the rotor out of the fluid under pressure in the working cells were diametrically to the rotor and oppositional directed, so that they balanced each other and the resultant of the pressure actions on the rotor out of the working chambers became zero or negligibly small.

Even vane machines with plates on the sides of the rotor, pressed by pressure in direction to the rotor have been used heretofore, as shown for instance in German Patent 407,297, and others. The plates on the axial ends of the rotor were pressed by spring forces or by forces of liquid or gas under pressure, thereby compressing the clearance between the axial ends of the vanes and the rotor and the side-plate of the rotor.

While the aforementioned patents succeeded somewhat in the balancing of forces, acting out from spaces of fluids or gases under pressure during rotary vane-machinery operation, the constructions set forth do, especially in cases of high pressure, not afford in the same operation reduction of friction to the fullest extent possible. Friction remains between the rotating parts and the stationary case. They also do not afford free movement of the vanes in their rotor-slots during operation of vane-machinery with extremely high pressure. At high pressure the vanes stop by clearance decrease on their axial ends. Due to the increasingly widespread use of rotary vane machines, it has become increasingly important to provide rotary vane machine constructions in which all avoidable friction sources may be eliminated in order to improve the total efficiency of such machines to the highest extent possible in praxis, while also the clearances between the moving parts have to be kept in suitable measures up to ex-

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tremely high pressure and while the undisturbed travel of the vanes in the slots has to be secured.

It is an object of the present invention to overcome the foregoing drawbacks and to provide a rotor arrangement for rotary vane machines of the foregoing type, wherein the rotor is provided with recesses or spaces containing fluid or gas under pressure to counterbalance other forces, acting on the rotor, in order to control the clearances between moving parts and to eliminate leakage—or friction causing deformations of rotor parts. By means of controlling the clearances friction becomes eliminated.

It is another object of the invention to improve the undisturbed travel of the vane in the slots of the rotor and rotor side walls by supporting the vanes in the rotor side-wall slots and by providing the spaces containing the fluids or gases under pressure for counterbalancing effects on the rotating rotor parts, so that the axial ends of the vanes are free of clearance decreases.

Since the casing ring, as known from British Patent 744,446 surrounding the rotor and fitting between the side-walls of the rotor rotates together with the rotor, reducing the relative speed between casing ring and rotor side-wall parts, the above mentioned objects and other objects increase substantially the total efficiency and the power, force and pressure of these rotary vane machines. Other and further objects of the invention will become apparent from a study of the within specification and accompanying drawings, in which:

FIG. 1 is a longitudinal sectional view of a rotor of a rotary vane machine illustrating the constructional arrangement of the rotor balance device in accordance with the invention;

FIG. 2 is a sectional view, taken along the line II—II of FIG. 1;

FIG. 3 is a longitudinal sectional view, showing and illustrating constructional arrangements of another embodiment of the invention;

FIG. 4 is a sectional view, taken along the line IV—IV of FIG. 3;

FIG. 5 is a longitudinal sectional view showing and illustrating constructional arrangements of a further embodiment;

FIG. 6 is a sectional view, taken along the line VI—VI of FIG. 5; and

FIG. 7 is a sectional view, taken along the line VII—VII of FIG. 5.

In accordance with the present invention it has been found, that it is most suitable to overcome the foregoing drawbacks in the use of rotors, which are designed in accordance to the British Patent 744,446 which relates to my own invention. The said patent has provided the vanes with extensions into slots of the rotor-side-walls, consequently succeeding in the use of pressure in the working cells up to ten times higher, than in vane machinery without vanes support in rotor-side-wall slots. Since the vanes are not necessarily guided on their axial end surfaces in that case, the axial end portions of the vanes can be dimensioned, so that suitable large clearances can remain between the vane-axial ends of the enclosing rotor side cover, providing undisturbed and frictionless travel of the vanes in the slots.

Only this kind of vane-machine, which has the vanes supported in the side walls of the rotor and which have large dimensioned spaces on the axial end surfaces of the vanes providing undisturbed travel of the vanes in the slots, is suitable for creating the maximum possible total efficiency of the vane machines in practice. Every other kind of vane machine, not provided with said features, is not capable of undisturbed travel of the vanes in case of high pressure—and consequently is not capable of the highest efficiency because in cases of middle or low

pressure the friction loss in relation to the total power of the vane machine is relatively larger than in high pressure cases and consequently middle or low pressure vane machinery can not reach the same high total-efficiency as high pressure vane machinery.

Therefore it was only of limited success to compress plates or casing parts on the axial ends of the earlier vanes in order to eliminate leakage on the axial ends of the vanes, as shown in the former art. Also pressure fields, which acted against the axial slidable walls in direction to the rotor in order to decrease by pressure force the clearance between the end surfaces of the vanes and the side closing members of the rotor were limited in success to middle or low pressure in the vane machine working cells, because:

(1) The vanes were not supported in the rotor side wall slots and consequently, as known from British Patent 744,446 were not suitable for high pressure;

(2) In case of increase of pressure in the balancing chambers to very high pressure, compression of the rotor parts occurred which resulted in clearance decreases between the axial end surfaces of the vanes and the axial enclosing case- or rotor-member. Consequently the vane became blocked between its axial enclosing members.

Suitable clearances between the said axial ends of the vanes and enclosing members were not manageable over great pressure differences, because decrease of clearance resulted in increase of friction and on the other hand increase of clearance resulted in increase of leakage. Both, increase of leakage as well as increase of friction naturally resulted in a decrease of the total efficiency, therefore reducing the application of the vane machine.

In case of diametrical pressure fields around the rotor, balancing the forces of fluid or gas under pressure radially to the rotor naturally stationary casings had to be applied. Consequently high relative speed occurred between the axial end sealing surfaces of the vanes and the axial enclosing casing member or wall. This high relative movement produces friction in the medium between the vane-axial end surface and the enclosing wall member, reducing the total power of the vane machine extremely, because the relative speeds between mechanical parts with small clearances are limited.

It is now found in accordance to this invention that no suitable success for increasing the total efficiency of modern vane machinery as required in practice could be obtained from improvements of balancing fields of the former art, which were limited to the smaller or about 2500 p.s.i. pressure, and which were of suitable high efficiency only to more or less or about 1000 p.s.i.

On the other hand, as the pressure increased many times over the former art of vane machinery by supporting of vanes in rotor-side-wall slots, as cited in British Patent 744,446 new disadvantages occurred by the high pressure acting in fluids or gases in the working chambers.

These disadvantages were:

(1) With increase of pressure in working cells axial elongations of the rotor or of the bolts, clamping rotor sidewalls or rotor, rotor sidewalls and rotor side casings together elongated under pressure in the working cells, consequently increasing the clearance between rotor-surrounding casing ring and rotor sidewalls, resulting in a larger leakage and in efficiency loss,

(2) With increase of pressure in working cells radial directed forces, acting on the rotor increased and deformed or dispositioned the rotor with respect to the rotor's axis.

In order to overcome these drawbacks and in order to develop a vane machine which might be suitable to improve the pressure capability of the vane machine so that power output and total efficiency might increase to such an extent, as might be required in vane machinery of the future, an axial balancing cover becomes provided on the axial side of the axial rotor, outside of the axial clos-

ing cover, rotating together with the rotor. The said balancing cover encloses a space containing fluid or gas under pressure between the axial balancing cover and the closing cover of the rotor. Said cover and the rotor,

or said cover, rotor parts and rotor shaft may be fastened together by bolts or pins or by bushings or other fastening means. The fluid or gas under pressure in the space between the axial balancing cover and the closing cover of rotor spaces acts in opposition to the said both covers. By this force the rotor parts are compressed with increasing pressure, eliminating the former axial elongation of the rotor parts totally. This compression of rotor parts is without any negative effect to the vanes, because clearances or spaces between the axial ends of the vanes and the axial enclosing rotor-closing-cover can be designed larger, than the compression rate is, without any defective influence to the vane or the vane machinery. The axial balancing cover becomes pressure loaded in direction away from the rotor by the fluids or gases under pressure in the said space between the said covers. Axially is the balancing cover fastened by rotor bolts, or by snap rings or divided rings and rings or nuts on the rotor bushing or by other fastening means. Rotor parts or balancing cover may be axially moveable to a small extent on the rotor bushing on the rotor bolts. Eventually the balance cover may be axially slideable on the rotor closing part. Sealing means can be provided for the sealing of the space containing fluids or gases under pressure between the balance cover and the closing cover of the rotor. Fluid or gas containing space between the said covers should be connected by conduits or other connection means to spaces containing fluid or gas under pressure within the rotor or the rotor adjacent members or parts of the vane machine. Suitable use of the forces of fluids or gases acting on the rotor- and balancing-parts as well as use of the resistance to deformation by rotor and bolts or busings(s) probably use of additional spring forces results in positive influence to the dimension of the clearance between the rotor enclosing casing ring (case) and the rotor side walls and rotor side wall members. This is of high effect, if the clearance is provided smaller in case of high pressure in order to decrease the leakage through said clearance and provided larger in cases of low pressure in order to decrease the friction between case and rotor side parts.

Also it is possible to eliminate the radial resultant of forces of fluids or gases acting on the rotor. In order to arrive at this face, three rotors or more may be provided on the same axis, one in the middle of the two others, the middle one of the same axial dimension as the sum of both others. The casing ring (cases) surrounding the middle one of the rotors has to become the oppositional eccentric position, but the same dimension, to the two other (outer) casing rings, which surround the other two rotors. All three rotors may be fastened together by bolts or rotor busings, or other connection means. As a consequence of this assembly the resultant of forces of fluids, or gases in working cells under pressure acting in radial direction to the rotor becomes eliminated to zero. Consequently the rotor floats between forces of fluids or gases under pressure. The load of the rotor bearings becomes negligible and the friction of rotor-bearings becomes small.

While in smaller units and in action of smaller pressure in fluids or gases, show in the former art it might look in the first impression, that the manufacturing of the new vane machine with its additional parts might become expensive. But actually the power of the vane machine designed in accordance to this invention increases per unit of weight. Therefore the manufacturing cost in relation to the derived power becomes smaller. Total efficiency increases and also the pressure acting in the working cells can be increased to a large extent.

It is of convenience to apply the invention embodiments to vane machines with vanes floating between fluids or

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gases under pressure, control means floating between fluids or gases under pressure and swimming casing rings, arranged so that they follow decentred movements of rotor parts. Then units of small power may be built as well as units of very large sizes of vane machines, i.e., those of several times 10,000 horsepower with a high total efficiency. In this manner, machines of the rotary vane type using the instant rotor-side-balance arrangement will operate at high total efficiency, will meet the durability and toughest requirements sought in industrial practice, and will operate safely over an extended useful life. In particular, those vane machines in cases of higher horsepower (some thousand horsepower) will operate over a wide range of evolution and pressure with a high total efficiency up to about 97%, if hydraulic fluid is acting in the working cells.

Referring to the drawings, rotor 1 is the rotor of the vane machine, marked as Pos. 1 in FIGURES 1 and 2 and is surrounded by a capsulering or annular casing means eccentrically adjustable and having annular end face means confronting corresponding annular faces of side wall means of the rotor which are provided on both axial ends of the rotor. Each rotor sidewall consists of two parts; one inner slot disk 3, and an outer seal casing 4 respectively 5, and is enclosed outwards radially and axially.

The rotor 1 is constructed firm to a bushing 14, that is rotative set outside of an engaged pintle. The in-leading and off-leading of the medium into and from the vanecells ensue through the engaged pintle, arranged in-leading and off-leading channels in the pintle upon the channel 16, which are provided in the rotor 1 and bush 14.

According to this invention, a pressure counteracting chamber 9 is arranged axial outside of the cooperating side walls of the rotor, which is formed here by a ring-groove made in a seal-casing the axially outer member 4, and enclosed axial outwards by a seal-disk or cover means 8. The pressure medium of the machine is introduced in this chamber, so that this chamber serves as pressure counteracting compartment. The elastic packing is marked as position 10.

The rotor 1, side walls of rotor consisted of slit-casing 3 and seal casing 4 respectively 5, and seal disk or cover 8 are jointed with bolts 11. Bolts 11 connect rotor means 1, side walls means 3, 4, 5 and cover means 8 for rotation, and limit outward axial movement of cover means 8 in a position in which the side wall means have limited freedom of axial movement so that the volume of the pressure compartment 9 may change. By the arrangement of pressure counteracting compartment or chamber 9, the pressure force (acting axially on the side walls of the rotor and trying to expand the space between the capsule ring and side walls of rotor) works contrary to the pressure force from the pressure counteracting chamber 9, so that the expansion of space between casing ring and side walls of rotor does not more ensure, if the pressure counteracting chamber is of suitable proportions. As may be specially seen from FIGURES 3 and 4, spring, especially the disk springs 25 are inserted between the rotor 21 and side walls of rotor 22, which are axially movable for a limited distance along on the bush 23 and bolts 24a and 24, and exert axial pressure on the movable side wall 22 against the rotor. Besides a pressure counteracting chamber 27, into which a pressure medium should be introduced, is arranged between this side wall 22 and a fastening disk 26. Rings 26a, 26b, and 29a are fastening rotor side wall parts.

The rotor, side walls of rotor and fastening disk are held together between a spring ring or radially divided safety-stopping 28 with hold-ring 28a and a flange part 29 of the bush 23. They are movable and axially guided by bolts 24 but they are fastened for rotation together. They are connected with the flange part 29 of the bush

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by bolts 24. The dimension of the pressure counteracting chamber 27 and strength of the disk spring 25 are acting in opposition to each other, so that at less acting pressure by fluid or gas in counteracting chamber 27 the clearance between annular casing and the side walls of the rotor is larger under the force of the disk spring and therefore friction is reduced. While at higher acting pressure the clearance is reduced under the force of higher medium pressure out from pressure counteracting chamber 27 on side wall of rotor 22 and therefore leakage is reduced. As shown in FIG. 4, the inner surface of the annular casing is non-circular.

In this way it is possible that the machine works at many different acting pressures occasionally with best possible efficiency. As shown in FIGURES 5, 6 and 7, the rotor assembly is divided into 3 individual rotors, one middle rotor 31 and two side rotors separated axially by isolating walls 33.

A ring groove 34 is made in one side wall of the rotor, which acts as a pressure counteracting chamber and is closed axially outwards by an outer seal disk 35. All rotor parts 31, 32 all side walls of rotor 33 and the seal disk 35 are axially movable along on the bush 36 between the snap-ring or a radial enclosed divided safety-stop ring 35a, and a flange part 37 of the bush 36, but connected for rotation. The function of the pressure counteracting chamber 34 is the same as at the function of the corresponding chamber or compartment illustrated in FIGURES 1, 2, 3 and 4. Besides in connection with the above mentioned subdivision of the rotor, there is an arrangement as shown in FIGURES 5, 6 and 7.

Both side rotor parts 32 act radially opposite to the middle rotor part 31. The working cells are axially displaced as the rotors are. Entrance and exit of fluid or gas are oppositional in the middle rotor to those in both outer rotors. The side rotor parts 32 are made just half as wide as the middle rotor part 31.

By this arrangement, the resultants of the force of fluid in the working cells which are acting radially on the rotor are directed in opposition to each other, and, since they are of equal strength, the total resultant of the said force equals zero. Thus the radial pressure load at the rotor parts becomes negligible, so that the rotor runs under nearly no load, which results in reduction of deformation, leakage, and friction. The purpose of the annular casing means 38 is in principle the same as illustrated in FIGURES 1 and 2. Through channels and windows on the pintle, all 3 rotors are supplied with fluid or gas. It will be obvious to those skilled in the art while the application and drawings have been set forth herein to illustrate the invention, various changes and modifications may be made without departing from the spirit and scope of the invention, which is to be limited only by the appended claims.

What is claimed is:

1. A rotary fluid handling machine comprising, in combination, at least one annular casing means having an internal space and having annular end face means at the opposite axial ends thereof; said annular end face means having an inner edge; at least one rotor means received in said space and having an axis of rotation, said rotor means formed with a plurality of substantially radially inwardly extending slot means; at least two side wall means each having an outer annular face, respectively confronting and being located closely adjacent to one of said annular end face means and covering at least an annular region of the same along said inner edge thereof; vane means reciprocally received in said slot means so as to divide said space into a plurality of fluid receiving working chambers, said vane means slidably engageable with said casing means; means for admitting a working fluid to said working chamber; cover means outwardly adjacent to at least one of said side wall means and defining with said one side wall means at least one pres-

sure compartment; means for connecting said rotor means, said side wall means and said cover means so that said rotor means, said side wall means and said cover means rotate in unison and for limiting axial movement of said cover means so that said side wall means have limited freedom of axial movement with respect to said cover means and said casing means; and means for admitting a pressure fluid to said pressure compartment so that the pressure fluid may counteract the fluid pressures developing in said working chambers and that the pressure fluid may maintain said side wall means in close proximity of said annular region of the end face means of said casing means.

2. A fluid handling machine as set forth in claim 1, wherein the means for admitting pressure fluid to said pressure compartment comprises a channel provided in said one side wall means.

3. A rotary fluid handling machine comprising, in combination, annular casing means having an internal space and having annular end face means at the opposite axial ends thereof, said annular end face means having an inner edge; rotor means received in said space and having an axis of rotation, said rotor means formed with a plurality of substantially radially inwardly extending slot means; at least two side wall means each having an outer annular face respectively confronting and being located closely adjacent to one of said annular end face means and covering at least an annular region of the same along said inner edge thereof; vane means reciprocally received in said slot means so as to divide said space into a plurality of fluid receiving working chambers, said vane means slidably engageable with said casing means; means for admitting a working fluid to said working chambers; cover means outwardly adjacent to one of said side wall means, one of said two last mentioned means having a cylinder space and the other of said two last mentioned means having a piston shaped portion extending into said cylinder space and defining therein a pressure compartment; means for connecting said rotor means, said side wall means and said cover means so that said rotor means, said side wall means and said cover means rotate in unison and for limiting axial movement of said cover means so that said side wall means have limited freedom of axial movement with respect to said cover means and said casing means; and means for admitting a pressure fluid to said pressure compartment so that the pressure fluid may counteract the pressures developing in said working chambers and that the pressure fluid may maintain said side wall means in close proximity of the end face means of said casing means.

4. A rotary fluid handling machine comprising, in combination, at least one annular casing means having an internal space and having annular end face means at the opposite axial ends thereof, said annular end face means having an inner edge; at least one rotor means received in said space and having an axis of rotation, said rotor means formed with a plurality of substantially radially inwardly extending slot means; at least two side wall means each having an outer annular face respectively confronting and being located closely adjacent to one of said annular end face means and covering at least an annular region of the same along said inner edge thereof; vane means reciprocally received in said slot means so as to divide said space into a plurality of fluid receiving working chambers, said vane means slidably engageable with said casing means; means for admitting a working fluid to said working chambers; cover means outwardly adjacent to at least one of said side wall means and defining with said one side wall means at least one pressure compartment; means comprising a plurality of bolts extending in parallelism with the axis of said rotor means for connecting said rotor means, said side wall means and said cover means so that said rotor means, said side wall means and said pressure balancing means

rotate in unison and for limiting axial movement of said cover means so that said side wall means have limited freedom of axial movement with respect to said cover means and said casing means; and means for admitting a pressure fluid to said pressure compartment so that the pressure fluid may counteract the fluid pressures developing in said working chambers and that the pressure fluid may maintain said side wall means in close proximity of the end face means of said casing means.

5. A rotary fluid handling machine comprising, in combination, at least one annular casing means having an internal space and having annular end face means at the opposite axial ends thereof, said annular end face means having an inner edge; at least one rotor means received in said space and having an axis of rotation, said rotor means formed with a plurality of substantially radially inwardly extending slot means; at least two side wall means each having an outer annular face respectively confronting and being located closely adjacent to one of said annular end face means and covering at least an annular region of the same along said inner edge thereof; vane means reciprocally received in said slot means so as to divide said space into a plurality of fluid receiving working chambers, said vane means slidably engageable with said casing means; means for admitting a working fluid to said working chambers; cover means outwardly adjacent to at least one of said side wall means and defining with said one side wall means at least one pressure compartment; means for connecting said rotor means, said side wall means and said cover means so that said rotor means, said side wall means and said cover means rotate in unison and for limiting axial movement of said cover means so that said side wall means have limited freedom of axial movement with respect to said cover means and said casing means; resilient means disposed between said rotor means and at least one of said side wall means for biasing said one side wall means axially of and away from said rotor means; and means for admitting a pressure fluid to said pressure compartment so that the pressure fluid may counteract the fluid pressures developing in said working chambers and the force of said resilient means so that the pressure fluid may maintain said side wall means in close proximity of the end face means of said casing means and with said rotor means.

6. A rotary fluid handling machine comprising, in combination, at least one annular casing means having an internal space and having annular end face means at the opposite axial ends thereof, said annular end face means having an inner edge; at least one rotor means received in said space and having an axis of rotation, said rotor means formed with a plurality of substantially radially inwardly extending slot means; at least two side wall means each having an outer annular part closely adjacent to one of said annular end face means and covering at least an annular region of the same along said inner edge thereof; said side wall means each having an inner part adjacent said rotor and having second slot means communicating and being in registry with said first named slot means; vane means reciprocally received in the slot means of said rotor means and of said inner part of said side wall means so as to divide said space into a plurality of fluid receiving working chambers, said vane means slidably engageable with said casing means, said side wall means including parts located axially outward and closing said second slot means; means for admitting a working fluid to said working chambers; cover means outwardly adjacent to at least one of said side wall means and defining with said one side wall means at least one pressure compartment; means for connecting said rotor means, said side wall means and said cover means so that said rotor means, said side wall means and said cover means rotate in unison and for limiting said axial movement of said cover means so that said side wall means have limited freedom of axial movement with respect to said pressure balancing means and said casing means; and means for

admitting a pressure fluid to said pressure compartment so that the pressure fluid may counteract the fluid pressures developing in said working chambers and that the pressure fluid may maintain said side wall means in close proximity of the end face means of said casing means.

7. A fluid handling machine as set forth in claim 6, comprising three annular casing means and three rotor means including a median rotor means and a pair of outer rotor means, the axial length of said median rotor means at least approximating the combined axial length of said outer rotor means.

8. A fluid handling machine as set forth in claim 7, wherein each casing means has an inner circular surface surrounding said space and having a center spaced from said axis so that said rotor means are eccentrically received in the internal space of the respective casing means, and further comprising means for changing the eccentricity of said casing means with respect to said rotor means.

9. A fluid handling machine as set forth in claim 7, wherein each casing means has an inner circular surface surrounding said space and having a center spaced from said axis so that said rotor means are eccentrically received in the internal space of the respective casing means, further comprising means for turning the casing means of said median rotor means in a first angular direction so as to change the eccentricity of said last mentioned casing means with respect to the median rotor means, and means for turning the other two casing means in the opposite angular direction so as to change the eccentricity of said other two casing means with respect to the corresponding outer rotor means.

10. A rotary fluid handling machine, comprising, in combination, annular casing means having an internal space and annular end face means at the opposite axial ends thereof, said annular end face means having an inner edge; and internal surface means bounding said space; rotor means received in said space means and having an axis of rotation, at least a portion of said internal surface means being more distant from the axis of said rotor means than the remainder of said internal surface means, said rotor means having substantially radially inwardly extending slot means; a pair of side wall means each having an outer annular face respectively confronting and being located adjacent to one of said annular end face means and covering at least an annular region of the same along said inner edge thereof; vane means reciprocally received in said slot means so as to divide said space into a plurality of fluid receiving working chambers, said vane means slidably engageable with the internal surface means of said casing means; fluid admitting and evacuating means communicating with said working chambers; cover means outwardly adjacent to and defining at least one pressure compartment with one of said side wall means; means for connecting said rotor means, said side wall means, and said cover means so that said rotor means, said side wall means and said cover means rotate in unison and for limiting axial movement of said cover means so that at least said one side wall means has limited freedom of axial movement with respect to said pressure balancing means and said casing means; and means for admitting pressure fluid to said compartment so that the fluid pressure in said compartment may counteract the axial component of fluid pressure in said working chambers to maintain said side wall means in close proximity of the end face means of said casing means.

11. A fluid handling machine as set forth in claim 10, further comprising means for biasing said one side wall means in the axial direction of and away from said rotor means so that said one side wall means is urged toward said pressure balancing means.

12. A fluid handling machine as set forth in claim 11,

wherein said biasing means comprises at least one dished spring.

13. In a rotary fluid handling machine, in combination, annular casing means having an internal space and annular end face means at the opposite axial ends thereof, said annular end face means having an inner edge, and internal surface means bounding said space; rotor means received in said space means and having an axis of rotation, at least a portion of said internal surface means being more distant from the axis of said rotor means than the remainder of said internal surface means, said rotor means having substantially radially inwardly extending slot means; a pair of side wall means disposed at the opposite axial ends of said rotor means, at least one of said side wall means having an inner part provided with slots in registry with said slot means, each of said side wall means having annular end face means closely adjacent to the respective annular end face means of said annular casing means and covering at least an annular region of the same along said inner edge thereof; vane means reciprocally received in said slot means and having portions slidably received in said slots of said side wall means, so that said vane means divide said space into a plurality of fluid receiving working chambers, said side wall means including an outer part covering said slots, said vane means slidably engageable with the internal surface means of said casing means; fluid admitting and evacuating means communicating with said working chambers; and cover means for biasing at least one of said side wall means toward the respective end face means of said casing means so as to counteract the axial component of fluid pressure in said working chambers with a force which increases in response to increasing fluid pressure in said working chambers.

14. A combination as set forth in claim 13, further comprising means for connecting said rotor means with said side wall means and with said cover means for turning movement so that the side wall means and the cover means participate in the angular movements of said rotor means.

15. A combination as set forth in claim 13, further comprising means for subjecting said one side wall means to substantially constant axial pressure counter to the bias of said pressure balancing means.

16. A combination as set forth in claim 13, wherein the internal surface means of said casing means comprise two diametrically opposed portions whose distance from the axis of said rotor means exceeds the distance between said last mentioned axis and the remainder of said internal surface means.

17. A combination as set forth in claim 13, further comprising stationary supporting means, first bearing means received in said supporting means and rotatably mounted in said rotor means, and second bearing means received in said supporting means and rotatably mounting said casing means, said second bearing means eccentric with respect to said first bearing means.

18. A rotary fluid handling machine comprising, in combination, annular casing means having an internal space, first and second annular end face means disposed at the opposite axial ends of said casing means, said annular end face means having an inner edge, and internal surface means bounding said internal space; rotor means received in said space and having an axis of rotation, at least a portion of said internal surface means being more distant from the axis of said rotor means than the remainder of said internal surface means, said rotor means having substantially radial slot means; first side wall means adjacent to said rotor means and having a portion closely adjacent to said first annular end face means and covering at least an annular region of the same along said inner edge thereof; second side wall means adjacent to the rotor means opposite said first side wall means and having a portion closely adjacent to said second annular end face means and covering at least an

annular region of the same along said inner edge thereof; said second side wall means comprising a first member located nearer to and a second member more distant from said rotor means, said first member having radial slots registering with said slot means; vane means reciprocally received in said slot means and in said slots so as to divide said space means a plurality of fluid receiving working chambers, said vane means slidably engageable with said internal surface means; fluid admitting and evacuating means communicating with said working chambers; pressure balancing means outwardly adjacent to and defining at least one pressure compartment with said second member of said second side wall means; means for connecting said first and second side wall means, said rotor means and said pressure balancing means so that said rotor means, said first and second side wall means and said pressure balancing means rotate in unison and that said first side wall means and at least the first member of said second side wall means have limited freedom of axial movement with respect to said pressure balancing means and said casing means, said connecting means comprising at least one bolt parallel with the axis of said rotor means and extending through said pressure balancing means, through said side wall means and through said rotor means, and means provided on said bolt for limiting axial movements of said pressure balancing means away from said second member and vice versa; and means for admitting pressure fluid to said compartment so that the fluid pressure in said compartment may counteract the axial component of fluid pressure in said working chambers to maintain said side wall means in close proximity to the respective end face means.

19. A rotary fluid handling machine comprising, in combination, annular casing means having an internal space and annular end face means at the opposite axial ends thereof, said annular end face means having an inner edge, and internal surface means bounding said space; rotor means received in said space means and having an axis of rotation, at least a portion of said internal surface means being more distant from the axis of said rotor means than the remainder of said internal surface means, said rotor means having substantially radially inwardly extending slot means; a pair of side wall means each having an annular portion adjacent to one of said annular end face means and covering at least an annular region of the same along said inner edge thereof; vane means reciprocally received in said slot means so as to divide said space into a plurality of fluid receiving working chambers, said vane means slidably engageable with the internal surface means of said casing means; fluid admitting and evacuating means communicating with said working chambers; cover means outwardly adjacent to and defining at least one pressure compartment with one of said side wall means, said pressure compartment constituting a cylinder chamber and one of said two last mentioned means comprising piston means extendable into said cylinder chamber; means for connecting said rotor means, said side wall means, and said cover means so that said rotor means, said side wall means and said cover means rotate in unison and that at least said one side wall means has limited freedom of axial movement with respect to said cover means and said casing means whereby said piston means increases the pressure of fluid contained in said cylinder chamber when said one side wall means tends to move toward said cover means in response to the axial component of fluid pressure prevailing in said working chambers; and means for admitting pressure fluid to said compartment so that the fluid pressure in said compartment may counteract the axial component of fluid pressure in said working chambers to maintain said side wall means in close proximity of the end face means of said casing means.

20. A rotary fluid handling machine comprising, in combination, annular casing means having an internal

space, annular end face means at the opposite axial ends thereof, said annular end face means having an inner edge; and internal surface means bounding said space; rotor means received in said space means and having an axis of rotation, at least a portion of said internal surface means being more distant from the axis of said rotor means than the remainder of said internal surface means, said rotor means having substantially radially inwardly extending slot means; a pair of side wall means each having an annular portion adjacent to one of said annular end face means and covering at least an annular region of the same along said inner edge thereof; vane means reciprocally received in said slot means so as to divide said space into a plurality of fluid receiving working chambers, said vane means slidably engageable with the internal surface means of said casing means; fluid admitting and evacuating means communicating with said working chambers; cover means outwardly adjacent to and defining at least one pressure compartment with one of said side wall means; means for connecting said rotor means, said side wall means and said cover means so that said rotor means, said side wall means and said cover means rotate in unison and that at least said one side wall means has limited freedom of axial movement with respect to said cover means and said casing means, said connecting means comprising bolt means slidably extending through said rotor means, through said side wall means and through said cover means, said bolt means parallel with the axis of said rotor means and having abutment means respectively adjacent to the outer sides of said cover means and the other of said side wall means to limit the axial movements of said two last-mentioned means away from each other; and means for admitting pressure fluid to said compartment so that the fluid pressure in said compartment may counteract the axial component of fluid pressure in said working chambers to maintain said side wall means in close proximity of the end face means of said casing means.

21. A rotary fluid handling machine, comprising, in combination, annular casing means having an internal space annular end face means at the opposite axial ends thereof, said annular end face means having an inner edge, and internal surface means bounding said space; rotor means received in said space means and having an axis of rotation, at least a portion of said internal surface means being more distant from the axis of said rotor means than the remainder of said internal surface means, said rotor means having substantially radially inwardly extending slot means; a pair of side wall means each having an annular portion adjacent to one of said annular end face means and covering at least an annular region of the same along an inner edge thereof; vane means reciprocally received in said slot means so as to divide said space means into a plurality of fluid receiving working chambers, said vane means slidably engageable with the internal surface means of said casing means; fluid admitting and evacuating means communicating with said working chambers; cover means outwardly adjacent to and defining at least one pressure compartment with one of said side wall means; means for connecting said rotor means, said side wall means and said cover means so that said rotor means, said side wall means and said cover means rotate in unison and for limiting axial movement of said cover means so that at least said one side wall means has limited freedom of axial movement with respect to said pressure balancing means and said casing means, said connecting means comprising shaft means coaxially extending through said rotor means and having a first portion axially projecting from the other of said side wall means and a second portion axially projecting from said cover means, and means secured to one of said shaft portions and axially movably coupling said side wall means with rotor means and said pressure balancing means; and means for admitting pressure fluid to said compartment so that the fluid pressure

in said compartment may counteract the axial component of fluid pressure in said working chambers to maintain said side wall means in close proximity of the end face means of said casing means.

22. A fluid handling machine as set forth in claim 21, wherein said coupling means comprises at least one bolt parallel with the axis of said rotor means.

23. A fluid handling machine as set forth in claim 21, wherein at least one of said side wall means comprises a first member secured to said coupling means and a second member, and further comprising additional coupling means connecting said second member to said first member so that said members are axially movable with respect to each other.

24. A fluid handling machine as set forth in claim 21, wherein one of said shaft portions consists of an annular flange integral with said shaft means and the other of said shaft portions comprises an annular member received in a peripheral recess provided in said shaft means.

25. A fluid handling machine as set forth in claim 24, wherein said annular member is a split ring of resilient material.

26. A fluid handling machine as set forth in claim 24, wherein said annular member is a multi-section ring.

27. A rotary fluid handling machine comprising, in combination, annular casing means having an inner surface defining an internal space, said annular casing means having annular end faces at the opposite axial ends thereof, said annular end faces respectively having an inner edge; rotor means located in said space and having an axis of rotation, at least a portion of said inner surface being more distant from said axis than the remainder of said inner surface, said rotor means having substantially radially extending slot means; vane means reciprocally received in said slot means so as to divide said space into a plurality of fluid receiving working chambers, said vane means moving along said inner surface; fluid admitting and discharging means communicating with said working chambers; a pair of side wall means located on opposite axial ends of said rotor means and of said annular casing means, at least one of said side wall means including an inner member located directly adjacent said rotor means, and an outer member located on the side of said inner member remote from said rotor means, said inner and outer members being mounted for relative movement in axial direction, and defining with each other a first pressure compartment, and said inner and outer members having peripheral annular portions located opposite one of said annular end faces of said casing means and covering at least an annular region of the region of the same along the inner edge thereof and adapted to slide on the same in sealing abutment; pressure balancing means located on the side of said outer member remote from said inner member and defining with the same a second pressure compartment; means for connecting said rotor means, said side wall means and said pressure balancing means so that said rotor means, said side wall means and said pressure balancing means may rotate in unison and that at least said inner and outer members of said one side wall means have limited freedom of axial movement with respect to said pressure balancing means and said casing means;

and means for admitting fluid to said compartments so that the pressure in said second compartment urges said annular portion of said outer member into sealing engagement with said one end face of said casing means, and the pressures in said first and second compartments urge said inner member into sealing engagement with said one end face of said casing means.

28. A rotary fluid handling machine comprising, in combination, annular casing means having an inner surface defining an internal space, said annular casing means having annular end faces at the opposite axial ends thereof, said annular end faces respectively having an inner edge; rotor means located in said space and having an axis of rotation at least a portion of said inner surface being more distant from said axis than the remainder of said inner surface, said rotor means having substantially radially extending slot means; vane means reciprocally received in said slot means so as to divide said space into a plurality of fluid receiving working chambers, said vane means moving along said inner surface, and having end portions axially projecting from said slot means; fluid admitting and discharging means communicating with said working chambers; a pair of side wall means located on opposite axial ends of said rotor means and of said annular casing means, each of said side wall means including an inner member located directly adjacent said rotor means, and an outer member located on the side of said inner member remote from said rotor means, said inner member having radially extending slots registering with said slot means of said rotor means and receiving said end portions of said vane means for guiding the same, and said outer member covering said slots in said inner member, one pair of said inner and outer members being mounted for relative movement in axial direction, and defining with each other a first pressure compartment, and said inner and outer members having peripheral annular portions located opposite one of said annular end faces of said casing means, respectively, and covering at least an annular region of the respective annular end face along said inner edge thereof and being adapted to slide on the same in sealing abutment; pressure balancing means located on the side of one of said outer members remote from said inner member and defining with the same a second pressure compartment; means for connecting said rotor means, said side wall means and said pressure balancing means so that said rotor means, said side wall means and said pressure balancing means may rotate in unison and that at least said inner and outer members of said side wall means have limited freedom of axial movement with respect to said pressure balancing means and said casing means; and means for admitting fluid to said compartments so that the pressure in said second compartment urges said annular portion of said outer member into sealing engagement with said end faces of said casing means, and the pressures in said first and second compartments urge said inner members into sealing engagement with said end faces of said casing means.

No references cited.

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