Feb. 4, 1936. W. J. CAREY 2,029,520

PUMP OR MOTOR

Filed July 13, 1934 2 Sheets-Sheet 1

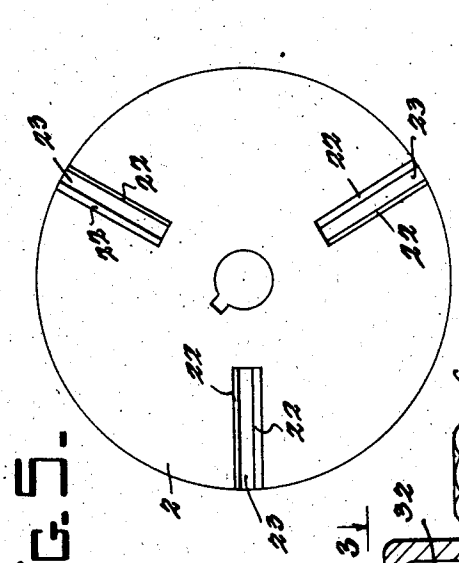


Fig. 5.

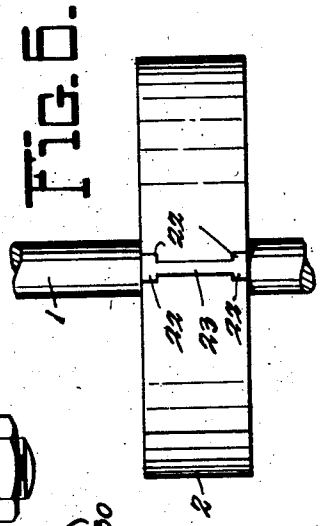


Fig. 6.

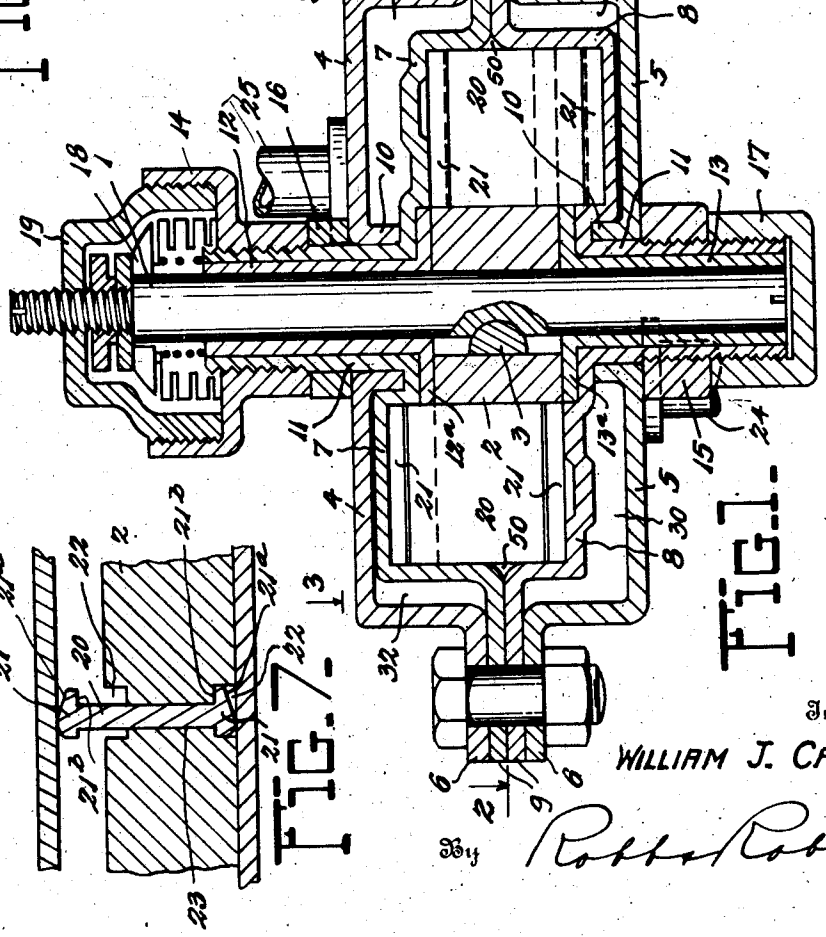


Fig. 1.

Fig. 7.

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PUMP OR MOTOR

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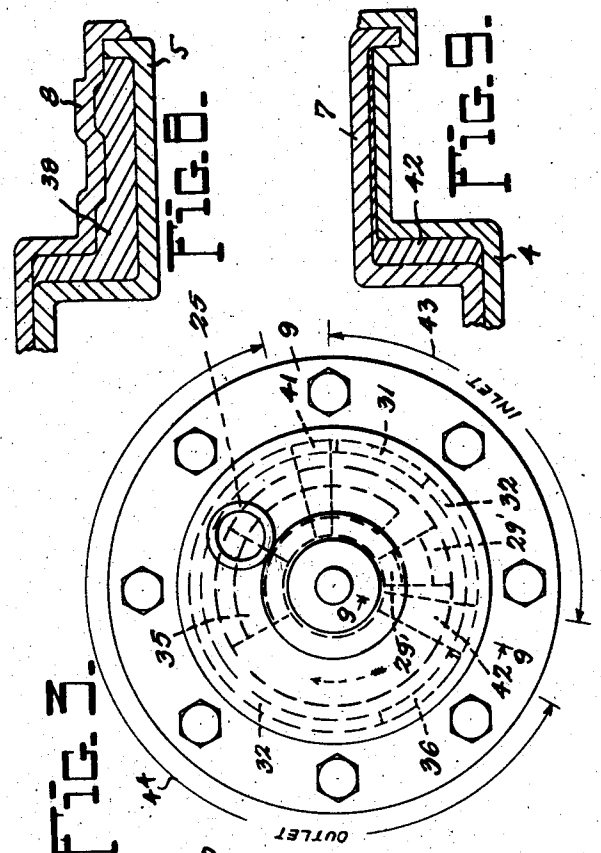


Fig. 3.

Fig. 2.

Fig. 5.

Fig. 6.

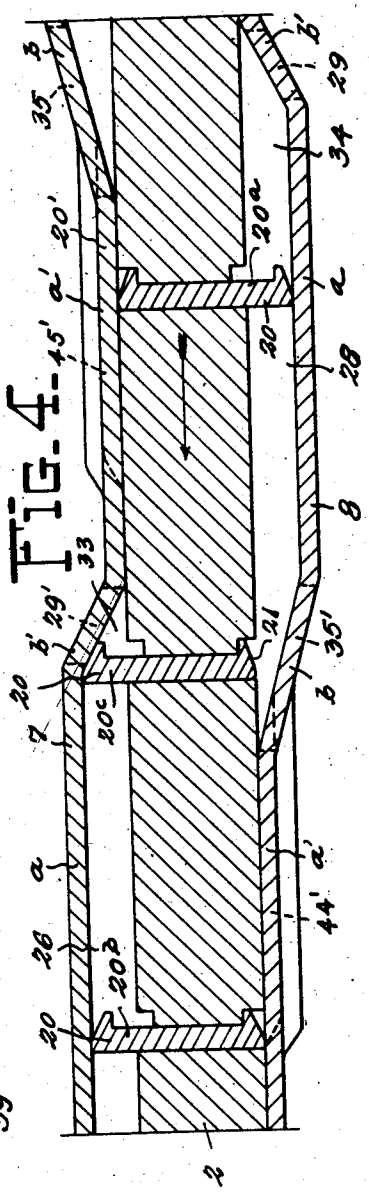


Fig. 4.

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2,029,520

PUMP OR MOTOR

William J. Carey, Cleveland Heights, Ohio

Application July 13, 1934, Serial No. 735,029

14 Claims. (Cl. 103—139)

The present invention involves novel improvements in that type of fluid pumps comprising primarily a casing, a rotor in the casing, and axially sliding blades or vanes supported on the rotor and shifting constantly during the revolution of the said rotor.

An especial object of improvement of the invention lies in the provision of a new type of blade or vane in conjunction with special construction of the pumping chamber in which the rotor and the blades operate, such that I am enabled to avail of the pressure generated on the fluid being pumped as a means for acting upon the blades or vanes to maintain the latter in close contact with the walls of the pumping chamber, thereby not depending solely upon the engaging action of said walls, with the mechanical friction generated thereby, as a means for compelling the proper movement of the blades and for holding these blades in fluid tight contact with the said walls.

Another feature of the invention resides in the provision of peculiar formations of the rotor at the points of mounting of the blades or vanes thereon, whereby cushion recesses or grooves are provided so that as the blades shift from one lateral extreme of their movement to the other, knocking impingement of the ends of blades caused to engage the casing walls will be avoided by entrapping the fluid in the recesses and cushioning the movement of the blades thereby. As a result of this feature of my invention, a reduction of wear on the walls of the pumping chamber is effected.

A further objective in carrying out my invention has been to produce a new type of composite casing with an enclosed pumping chamber for the pumping blades or vanes; in other words, my casing is made with an inner casing member and an outer casing member, said members built up each from two sections and being formed from pressed metal such as steel, or the like, the various sections properly secured together, after assembly of the blades on the rotor and locating these parts in the inner casing constituting the pumping chamber.

In reference to the phase of my invention, utilizing the pressure of the pumped fluid to act upon the vanes or blades, it is notable that I avail of a pumping chamber which embodies parallel walls or sides, and intermediate these parallel walls or sides are helical portions or inclines, as commonly known in the art.

However, in my invention, I provide a peculiar distancing between the sides of the pumping chamber at the diagonal or helical wall portions, a distancing which is greater than the operative axial length of the blades or vanes, whereby I obtain in large degree the pressure effect upon the latter which is desirable for the purposes of my invention. As a detail feature of this construction, it is noted that the inclinations of the said helical portions at the inlet and outlet sides or walls are different, thus providing for the spacing action which has been above referred to, giving rise to the pressure effects desired, all as will be more fully pointed out hereinafter in conjunction with the appended drawings, in which:—

Figure 1 is a general vertical sectional view of a pump embodying the essential features of the invention.

Figure 2 is a plan view looking down upon the bottom portion of the main casing or housing in the direction of the arrows 2—2 in Figure 1.

Figure 3 is a top plan view of the pump looking downwardly thereon, and illustrating only the parts of the top casing or housing member, dotted lines showing certain portions of the upper section of the pumping chamber, the rotor and parts below the upper section of the pumping chamber omitted.

Figure 4 is a development of the pumping chamber or inner casing and rotor with the vanes or blades thereon in a diagrammatic layout for understanding of the cycle of suction and pumping actions of the parts.

Figure 5 is a plan view of the rotor alone.

Figure 6 is a view in elevation of the drive shaft, rotor, and one of the blade grooves in the rotor clearly shown.

Figure 7 is a fragmentary sectional view showing the mounting of one of the blades upon the rotor in the pumping chamber.

Figure 8 is a fragmentary sectional view on the line 8—8 of Figure 2.

Figure 9 is a fragmentary sectional view on the line 9—9 of Figure 3.

Referring now to the drawings and describing the invention specifically, it is notable that my pump comprises any suitable and desired form of driving shaft 1 upon which is mounted the rotor 2, see Figure 1, said rotor being locked on the shaft by a key 3 against rotation relatively to the shaft.

The pump comprises a casing made up of upper and lower sections 4 and 5, provided with external or peripheral flanges 6. Nested or enclosed within the outer casing of the pump is an inner casing comprising sections 7 and 8, these sections constituting what will be termed hereinafter the pumping chamber of my device. The sections

7 and 8, like the sections 4 and 5, of the outer casing, are equipped with peripheral flanges 9 that are received between the flanges 6 and thus I am enabled to clamp tightly together the various flanges 6 and 9 with an assemblage of the outer casing members 4 and 5 and the pumping chamber or sections 7 and 8, as illustrated in Figure 1, the outer casing enclosing the inner casing that constitutes the pumping chamber. I contemplate making the sections 4, 5, 7 and 8 by pressing these sections out of steel or any suitable metal, dependent somewhat upon the purpose for which my pump may be employed, and with the foregoing in view, the sections 4 and 5 are provided with axis flanges 10 which are pressed into engagement with tubular extensions 11 at the axis portion of the sections 7 and 8 of the pumping chamber, the said tubular extensions 11 being of sleeve-like formation and fitting snugly against the tubular bearing members 12 and 13 supported on the shaft 1. Said tubular members 12 and 13 are respectively equipped with flanges 12*a* and 13*a*, which are seated at opposite sides of and engage with the rotor 2 adjacent to its axis. The casing parts 4 and 5 are maintained in engagement with the outer sides of the top section 7, and the bottom section 8 of the pumping chamber, by means of clamping heads 14 and 15, screw threaded on the upper and lower portions of the tubular extensions of the sections of the pumping chamber or inner casing. The upper clamping head 14 engages a clamping collar 16 intermediate it and the top section 4 of the outer casing. A cover or clamping member 17 also screws upon the threaded lower portion of the tubular extension 13 and closes the lower end of the pump and also encloses the lower end portion of the shaft 1. A suitable packing gland 18 is mounted above the clamping head 14 for cooperation with the upper end portion of the shaft 1 and is held in place by a cap member 19.

The rotor 2 carries blades or vanes 20 of novel construction, said blades being formed to freely slide axially of the rotor and shaft 1, and equipped at their opposite ends with heads 21, the outer surfaces of which are inclined as at 21*a* and the inner surfaces of which define sharp angles as at 21*b* and project laterally from the body of the vanes for a special purpose. The heads 21 are adapted to move into recesses 22 formed in opposite sides of the rotor and located at the opposite extremes of the grooves 23 of said rotor in which the bodies of the blades are slidably supported. The bottoms of the recesses 22 form limiting stops for the heads 21 of the blades 20 to prevent actual contact of the ends of the latter with the wall portions to eliminate friction between these parts. The formation of the heads 21*a* and the recesses 22 is particularly designed in order to entrap the pressure fluid as the heads enter the recesses, whereby to obtain a cushioning effect derived from the entrapped pressure fluid, this cushioning effect being intended to reduce the impingement or impact of the blades, as actuated by the pressure fluid in a manner to be later pointed out herein.

The formation of the pumping chamber or inner casing, comprising the parts 7 and 8 is peculiar as the sections 7 and 8 are pressed in a special manner in order to provide upper and lower walls having portions parallel with one another designated at *a* and *a'* in the development view of Figure 4 and other portions inclined in reference to the plane of the rotor as designated *b* and *b'* in Figure 4, the sections or members 7 and 8 being formed identically of the same shape, but when assembled into the pump construction being disposed relatively to each other in a circumferential manner, as seen in Figures 2 and 3, so that the inclined portions *b* and *b'* are opposite one another, and the portions *a* and *a'* are opposite one another. It is notable that the portion *a'* is shorter in length than the portion *a*, and the inclined portion *b'* is shorter in length than the inclined portion *b*. Likewise, it is of importance to note that the inclined portions *b'* have steeper angularity than the inclined portions *b* for reasons to be developed hereinafter.

The lower member 5 of the outer casing is provided with an inlet pipe or conduit 24, shown in full and dotted lines in Figure 1, and in dotted lines in Figure 2, whilst the upper member 4 of the outer casing is likewise provided with an outlet conduit or pipe 25, for outlet of the liquid or fluid under the pumping action of the pump.

The pumping chamber mentioned heretofore is divided into pumping compartments 26 and 28, which are located above and below the rotor as indicated in Figure 4. The pumping compartment 26 is divided into suction and compression zones by means of the blades or vanes 20. The inlet conduit or pipe 24 supplies the fluid directly into the suction zone of the pumping compartment 28 through the inlet port 29 and into the space 30 between the lower member 8 of the pumping chamber and the lower member 5 of the outer casing. The fluid will also travel around in the space 30 previously referred to to an opening 31 passing through the flanges 9 of the members 7 and 8 so as to enter the space 32 between the upper members 4 and 7 at their peripheral portions. The fluid will now travel further around in this peripheral space until it reaches the inlet ports 29' in the upper member 7 so that said fluid may also enter the suction zone of the pumping compartment 26, this suction zone being indicated at 33, at the same time as the fluid enters into the suction zone 34 near the port 29. Thus, the inlet conduit 24 supplies both of the suction zones 33 and 34 of the compartments 26 and 28 respectively, at the same time, these compartments being above and below the rotor 2.

The compression zone of the pumping compartment 26 which is to the left of the middle abutment 20' is seen in the development of Figure 4 and is connected at the proper time of the pumping cycle with the outlet port 35 and fluid will be discharged therefrom into the space 32 between the parts 4 and 7, and will travel around in this space until it reaches the passage 36 connecting the space 32 with the space 30 formed by the lower members 5 and 8. The space 30 is also in communication with the outlet port 35' in the member 8 this being illustrated in Figure 2, which permits the discharge of fluid from the compression zone of the pumping compartment 28. The space 32 between the members 4 and 7 is in communication with the outlet conduit or pipe 25 so that the fluid discharged into the space 30 and 32 may pass out from the outer housing through said conduit 25.

It will be seen from the foregoing in view of the fact that the spaces 32 and 30 are located between and around the members 4 and 7 and the members 5 and 8, that to divide the spaces 30 and 32 into proper inlet and outlet passages or zones it is necessary to partition the spaces in some way. For this purpose, packing members or gaskets 37 and 38 are arranged between the mem-

bers 4 and 7 as illustrated in Figure 2 to divide the space 32 into the outlet segment 39 and the inlet segment 40, as diagrammatically illustrated by the arrow lines in Figure 2.

In a like manner, the packing members 41 and 42 partition the space 32 between and around the members 5 and 8 so as to form the inlet zone or segment 43 and outlet zone 44 according to the arrow lines shown in Figure 3. The packing members partition the respective spaces in a horizontal as well as in a vertical direction, as is clearly shown in Figures 8 and 9. It should be noted that the packing members are placed in such a manner as not to interfere with the openings or passages in the flanges 9, so as not to interfere with the flow of the fluid from the inlet conduit to both inlet ports and above and below the rotor and also not to interfere with the outlet flow of the fluid from the outlet ports above and below the rotor to the outlet conduit 25. The outlet ports are arranged in the annular center zones of the pumping compartments, as seen in Figures 2 and 3, and the inlet ports are located in annular zones of the said pumping compartments laterally disposed from the center annular zone of the pumping compartment. It will, therefore, be seen that the zones of the blades or vanes 20 which register with the inlet ports will not register with the outlet ports so that an even wear of the entire blade surfaces which engage the upper and lower members 7 and 8 will be obtained.

By reference to Figure 4, the pumping cycle will now be described. The rotor 2 rotates in a direction indicated by the arrow, and the blade 20*a* which has just passed the inlet port 29 is sucking in fluid at the said inlet port into the suction zone 34. Upon further continuation of rotation of the rotor the blade 20*b* will pass the inlet port 29 and cut off the communication of the suction zone 34 with said inlet port 29. The fluid which is now between these two blades 20*a* and 20*b* will be moved within the pumping compartment 28 toward the outlet port 35' and as soon as communication between the said suction zone 34 and the outlet port 35' is established, the fluid will be discharged through the latter. It has to be noted, of course, that the suction zone 34 becomes a compression zone at the time the communication of said zone with the inlet port 29 is cut off. The discharge action just referred to is shown in the diagram of Figure 4, taking place in this diagram between the blades 20*a* and 20*c*. Figure 4 illustrates how the said fluid by reason of the extent of axial movement of the blade 20*c* is acting upon the lower head 21 of said blade in the direction of its axial movement to create a pressure thereon, shifting said blade out of contact with the lower member 8 and into fluid tight contact at its upper portion with the member 7 of the pumping chamber. As soon as this contact with the upper portion 8 of is established and upon further movement of the rotor and blade 20*c*, suction will be created in the zone 33 by the blade 20*c*, in a like manner, as has been described in reference to blade 20*a* creating suction in the zone 34. Therefore, the same cycle as described previously in regard to the lower pumping chamber 28, will take place in the upper pumping chamber 26.

The fluid in the suction zone 33 will be ultimately discharged to the outlet 35 in the same manner as the discharge has taken place at the outlet 35', and the blade 20*c* will at such time be acted upon by the pressure created in the upper pumping compartment to shift the same blade downwardly in contact again with the lower member 8, after the same manner as the blade 20*a* was previously described as being shifted upwardly into fluid tight contact with upper member 7 of the pumping chamber.

In view of the fact that three blades are preferably utilized in the pump construction described here, it will be noted that suction and expulsion of the fluid will take place in the upper and lower pumping compartments at the same time with the result of a double acting effect of a double acting pump. In the development view of Figure 4, the lower member 8 and the upper member 7 are provided with grooves 44' and 45' respectively, these grooves extending from the outlet ports 35' and 35 a sufficient distance in the direction of rotation of the rotor to maintain the blade at one end operating adjacent to said grooves under continuous endwise or axial pressure to thus maintain the opposite head 21 of such blade in fluid tight engagement with the surface of the wall of the pumping chamber with which it is cooperating. The axial movement of the blades 20 is, of course, obtainable through the peculiar spacing of the inclined portions *b* and *b'*, previously referred to, these parts being spaced a greater distance than the axial length of each blade as evident from Figure 4 of the drawings.

Whereas, in prior pumps or motors of the class of this invention, reliance for shifting the axial blades or vanes is had upon the mechanical contact between the walls of the pumping chamber and the ends of the blades, in my invention this mechanical engagement or contact is in part done away with to the end of eliminating much of the mechanical friction involved therein and to the end of utilizing the pressure force of the fluid itself as not only the shifting means for the blades, but as the means for maintaining these blades at their proper ends in fluid tight engagement with the cooperating wall of the pumping chamber whilst the blades are performing their pumping operations.

By reason of the fact that the members 7 and 8 of the pumping chamber are made from pressed metal, it will be evident that these members are rounded at the points from which the flanges 9 extend and provide at this point an outwardly converging annular chamber 50, which will receive and contain a certain amount of the pressure fluid or liquid and provide a cushion means for counteracting the friction produced between the blades and the outermost portions of the members 7 and 8 incident to the centrifugal force communicated to the blades during the rotation of the rotor 2 which is operated usually at high speed.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States, is:—

1. In a pump or motor of the class described, in combination, a rotor, a pumping chamber in which said rotor operates, blades mounted in the rotor and axially movable with respect to the latter to engage at one end with a wall of said pumping chamber, while the opposite end is free from the opposite wall of said chamber at a predetermined point in the travel of the blades with the rotor, whereby the pressure fluid acting upon the blades during the movement of the rotor is adapted to shift the blades to maintain one end thereof in fluid tight contact with a wall of the chamber.

2. In a pump or motor, in combination, a ro-

tor, driving means therefor, pumping blades shiftable axially of the rotor, and a pumping chamber in which the rotor and blades are mounted forming a guide for the latter provided with opposing portions of different inclination spaced apart a greater distance than the axial length of the blades, whereby the pressure of fluid in the chamber may act on one end of the blades to shift the blades axially to force the opposite end thereof into fluid tight contact with a wall of the pumping chamber.

3. In a pump or motor of the class described, in combination, a rotor, a pumping chamber in which said rotor operates, blades mounted in the rotor and axially movable with respect to the latter to engage at one end with a wall of said pumping chamber, while the opposite end is free from the opposite wall of said chamber at a predetermined point in the travel of the blade with the rotor, whereby the pressure of fluid acted upon by the blades during the movement of the rotor is adapted to shift the blades in axial directions to maintain one end thereof in fluid tight contact with a wall of the chamber, the said blades being formed with heads at their opposite ends and the rotor being formed with recesses to receive said heads and to entrap the pressure fluid as the heads enter the recesses, whereby to provide a cushion effect between the said fluid and the heads as the heads enter the recesses.

4. In a pump or motor of the class described, in combination, a rotor, driving means for rotation of said rotor, pumping blades shiftable on the rotor in axial directions with respect to the latter and a pumping chamber enclosing said rotor with its blades and comprising pumping compartments and fluid supply means connected with said pumping compartments, the said blades being formed dimensionally so that the fluid in the pumping compartments when under pressure may actuate said blades to force the same in axial directions into fluid tight connection with a wall of the pumping compartments during the rotation of the rotor, said pumping chamber being provided with means for maintaining the blades under fluid pressure substantially 360° of rotation of said rotor.

5. In a pump or motor of the class described, in combination, a rotor, driving means therefor, blades mounted to shift axially of the rotor and carried thereby, a pumping chamber enclosing said rotor and blades and formed with inclines on opposite walls thereof and spaced apart a greater distance than the axial length of the blades, thereby creating suction and compression zones adjacent to said inclines, the said arrangement of the blades and inclines being such that the pressure of fluid in the pumping chamber when acted upon by the blades may be exerted against one end of the blades to force the opposite end into fluid tight engagement with a wall of the pumping chamber, the walls of the pumping chamber being provided with an inlet port in one of said inclined portions and an outlet port in another of said inclined portions and said walls being provided with passages for conveying fluid under pressure forward of the outlet port in the direction of rotation of the rotor to act upon the blades in their travel to force said blades in fluid tight engagement with the wall of the pressure chamber.

6. In a pump or motor of the class described, in combination, a rotor, a driving shaft therefor, blades movably mounted on the rotor and shiftable relatively thereto incident to the rotation of the rotor, a pumping chamber enclosing said rotor and blades, comprising opposing sections mounted in face on engagement with each other, a casing enclosing the said pumping chamber and comprising complemental sections facing one another and engaging with the opposite sides of the sections of the pumping chamber, the said casing being disposed with a fluid space intermediate same and the pumping chamber, fluid inlet means connected with the said space and fluid outlet means connected with said space, and instrumentalities for dividing the said space into inlet and outlet zones, and inlet and outlet ports intermediate the pressure chamber and the said inlet and outlet zones respectively, the said instrumentalities consisting of packings interposed and clamped between the sections of the casing and the sections of the pumping chamber in horizontal and vertical directions.

7. In a pump or motor of the class described, in combination, a rotor, a driving shaft therefor, pumping blades carried by the rotor and shiftable thereon during pumping cycles of operation of the pump or motor, a pumping chamber comprising opposite sections having engaged meeting faces and off-standing peripheral flanges, securing means for said flanges to hold the sections of the pumping chamber together, the inner peripheral portion of the said pumping chamber at the outer radial edges of the said blades being provided with an annular fluid receiving space to provide a fluid trap for trapping fluid to act as a cushion for the blades incident to the radial displacement of the blades on the rotor by centrifugal force generated during the rotation of the rotor.

8. In a pump or motor of the class described, in combination, a shaft, a rotor mounted thereon, a series of axially shifted pumping blades carried by the rotor, a pumping chamber comprising a body enclosing the rotor and blades and equipped with inclines permitting axial displacement of the blades relatively to the rotor, the outermost portion of said pumping chamber being engageable by the outer radial edges of the blades and being provided with an annular fluid trapping space for holding the fluid operated on by the rotor and blades, whereby such entrapped fluid may act as a cushion at the outer radial edges of the blades to cushion the engagement of the blades with the outermost portion of the pumping chamber incident to the centrifugal movement of the blades relatively to the rotor.

9. In a pump or motor of the class described, in combination, a driving shaft, a rotor mounted thereon, axially shiftable blades carried by the rotor for movement relatively thereto, a pumping chamber housing the rotor and its blades and having opposite walls thereof opposite the axially directed ends of the blades formed to provide upper and lower pumping compartments separated by the blades into compression and suction zones, the said walls of the pumping chamber at the said opposite ends of the blades being formed with inclines of different angles of inclination opposing each other and spaced apart a greater distance than the axial length of the blades, whereby pressure of the fluid in the pumping chamber may act in the compression zone upon one end of each blade to shift the same axially to bring its opposite end into fluid tight engagement with a wall of the pumping chamber.

10. In a pump or motor of the class described, in combination, a rotor, a plurality of axially movable blades mounted upon the rotor, an in-

ner pumping chamber enclosing the rotor and the said blades, an outer casing enclosing said inner pumping chamber and forming a space between said pumping chamber and the said casing, the said space being divided into upper and lower spaces by connection of the pumping chamber with the said casing at the outermost portions of the pumping chamber and casing, the said connection being provided with passages connecting the two spaces, a plurality of packing members in the said spaces for dividing each of the same into inlet and outlet zones below and above the pumping chamber and maintaining communication between the upper and lower inlet zones and the upper and lower outlet zones by means of said passages, the pumping chamber being provided with inlet ports in its upper and lower portion leading to the inlet zones between the pumping chamber and the outer casing, said pumping chamber being also provided with outlet ports leading to the outlet zones between the pumping chamber and the outer casing, conduit means connecting the inlet zones between the pumping chamber and the outer casing with a source of fluid supply, and outlet conduit means connecting the outlet zones between the pumping chamber and the outer casing for outflow of the fluid from the said outlet zones.

11. In a pump or motor of the class described, in combination, a rotor, driving means therefor, blades mounted to shift axially of the rotor and carried thereby, a pumping chamber enclosing said rotor and blades and divided by the latter into suction and compression compartments diagonally disposed to each other for equalizing reaction upon the rotor during the pumping operation, the pumping chamber comprising inclines on opposite walls thereof and spaced apart a greater distance than the axial length of the blades, thereby creating suction and compression zones adjacent to said inclines, the said arrangement of the blades and inclines being such that the pressure of fluid in the pumping chamber when acted upon by the blades may be exerted against one end of the blades to force the opposite end into fluid tight engagement with a wall of the pumping chamber, the walls of the pumping chamber being provided with an inlet port in one of said inclined portions and an outlet port in another of said inclined portions and said walls being provided with passages for conveying fluid under pressure forward of the outlet port in the direction of rotation of the rotor to act upon the blades in their travel to force said blades in to fluid tight engagement with the wall of the pressure chamber.

12. In a pump or motor of the class described, in combination, a rotor, driving means therefor, blades mounted to shift axially of the rotor and carried thereby, a pumping chamber enclosing said rotor and blades and formed with inclines on opposite walls thereof, some of said inclines being on an angle different from the angle of inclination of the other inclines and spaced apart a greater distance with respect to each other than the axial length of the blades, thereby creating suction and compression zones adjacent to said inclines, the said arrangement of the blades and inclines being such that the pressure of fluid in the pumping chamber when acted upon by the blades may be exerted against one end of the blades to force the opposite end into fluid tight engagement with a wall of the pumping chamber, the walls of the pumping chamber being provided with an inlet port in one of said inclined portions and an outlet port in another of said inclined portions and said walls being provided with passages for conveying fluid under pressure forward of the outlet port in the direction of rotation of the rotor to act upon the blades in their travel to force said blades into fluid tight engagement with the wall of the pressure chamber.

13. In a pump or motor of the class described, comprising, in combination, an outer casing having a plurality of casing members provided with inlet and outlet conduits, an inner casing provided with inlet and outlet passages nested within the outer casing and comprising a plurality of casing members, the inner casing being spaced from the said outer casing forming fluid spaces therebetween, gaskets between the inner and outer casing dividing the fluid spaces into inlet and outer compartments, a rotor within the inner casing, blades mounted in the rotor, and axially movable to engage at one end with a wall of the inner casing, while the opposite end is free from the opposite wall of said inner casing at a predetermined point in the travel of the blades with the rotor, whereby the pressure fluid acting upon the blades during the movement of the rotor is adapted to shift the blades to maintain one end thereof in fluid tight contact with a wall of the inner casing.

14. In a pump or motor of the class described, in combination, a rotor, a pumping chamber in which said rotor operates, blades mounted in the rotor and axially movable with respect to the latter to form with one end a fluid tight seal with a wall of said pumping chamber, while the opposite end is free from the opposite wall of said chamber at a predetermined point in the travel of the blade with the rotor, whereby the pressure of fluid acted upon by the blades during the movement of the rotor is adapted to shift the blades to maintain one end thereof in fluid tight contact with a wall of the chamber, the said blades being formed with heads at their opposite ends and the rotor being provided with abutment portions to contact said heads and to hold said blades in spaced relation with respect to said wall of the chamber to provide a fluid tight seal without actually contacting said wall.

WILLIAM J. CAREY.

CERTIFICATE OF CORRECTION.

Patent No. 2,029,520. February 4, 1936.

WILLIAM J. CAREY.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 5, second column, line 31, claim 13, for "outer" read outlet; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 3rd day March, A. D. 1936.

Leslie Frazer

(Seal)

Acting Commissioner of Patents.