

Dec. 15, 1936.

B. B. STERN

2,064,635

ROTARY TYPE PUMP

Filed Jan. 13, 1936

3 Sheets-Sheet 1

FIG. 1.

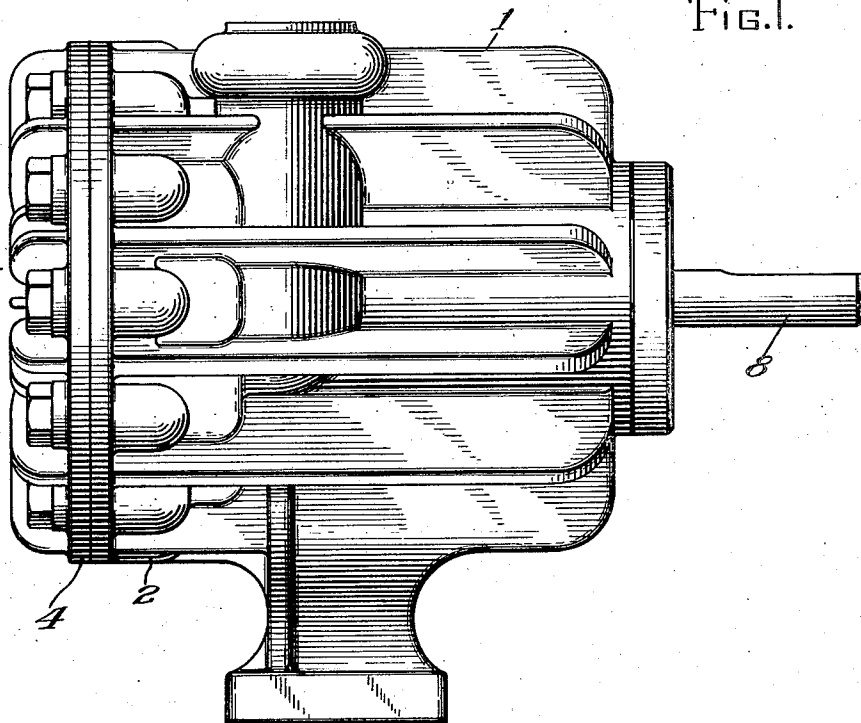
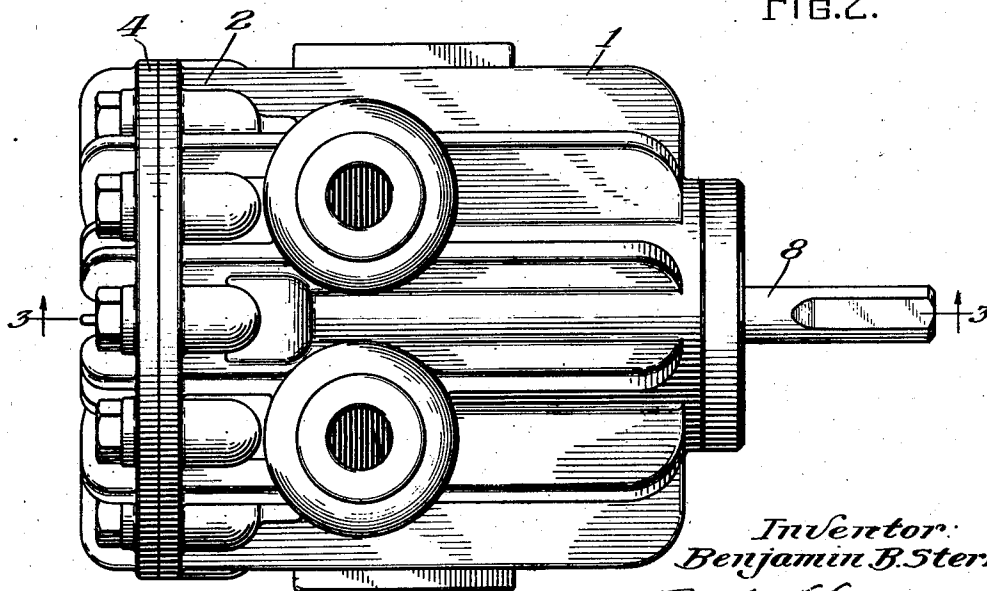


FIG. 2.



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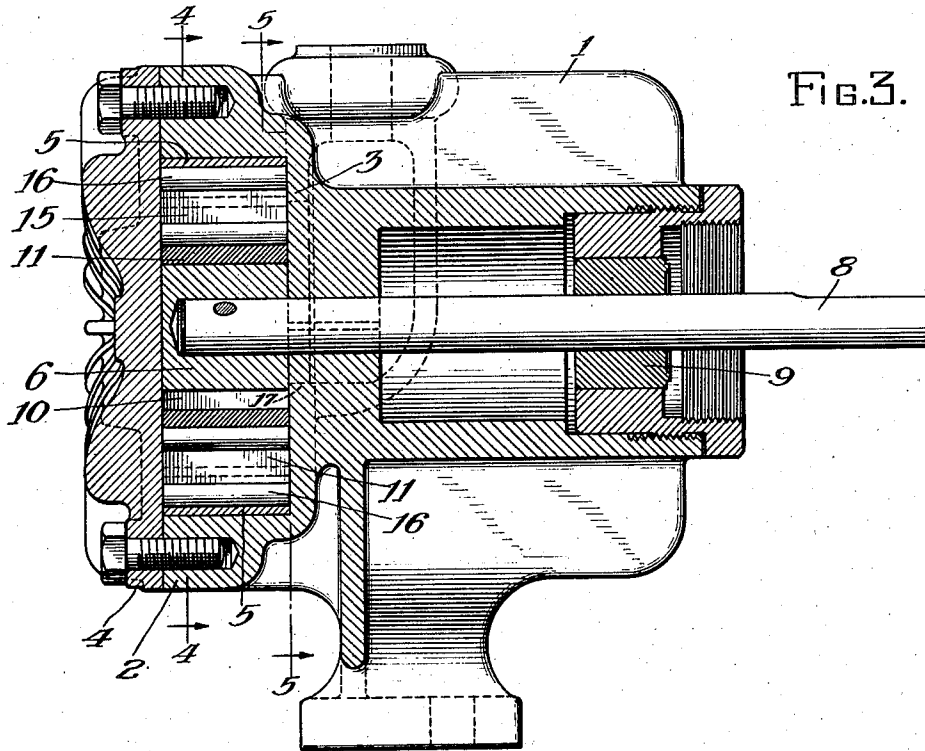


Fig.3.

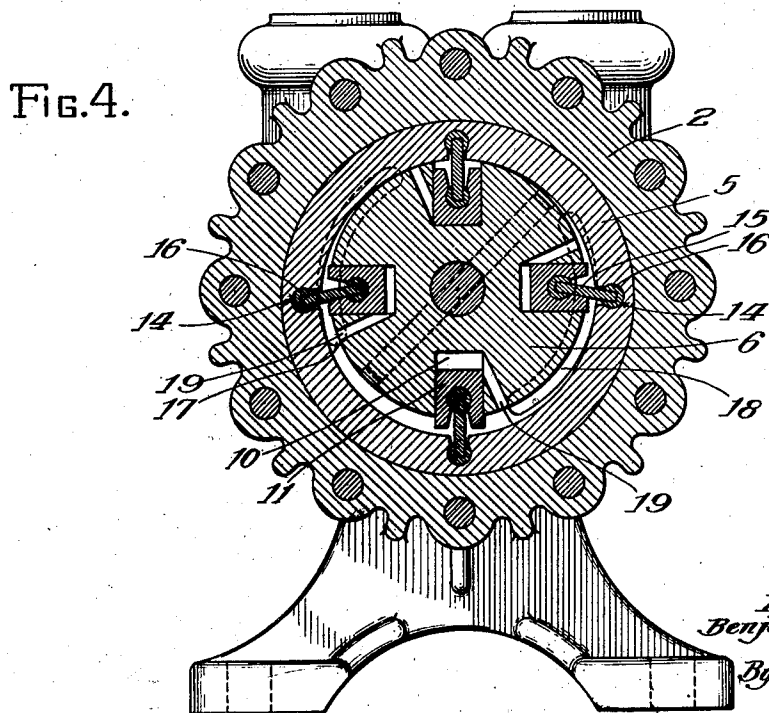


Fig.4.

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FIG. 5.

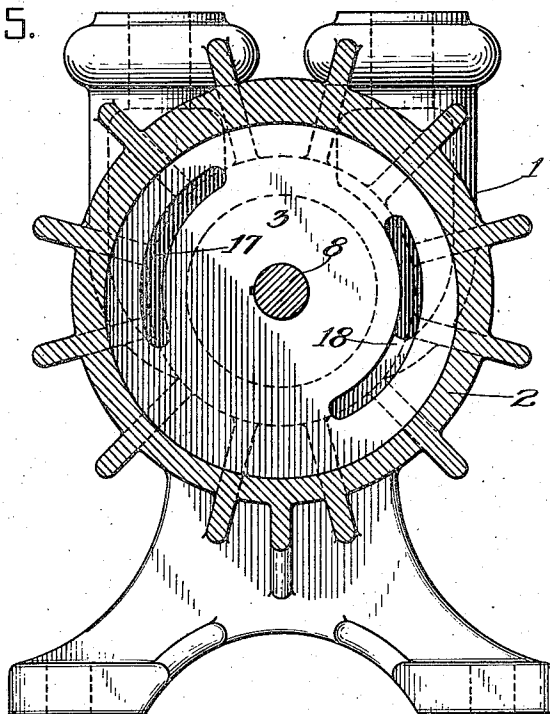


FIG. 6.

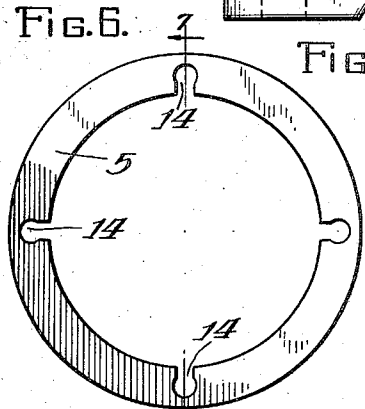


FIG. 7.

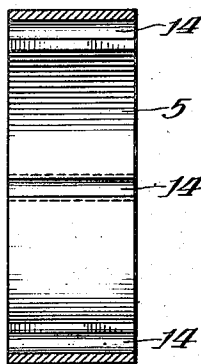


FIG. 10.

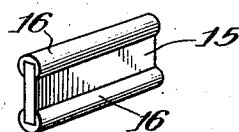


FIG. 11.

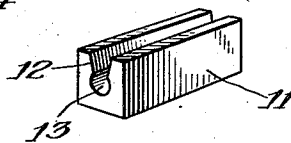


FIG. 8.

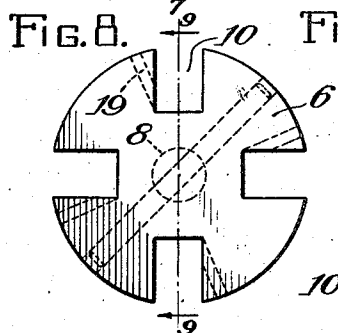
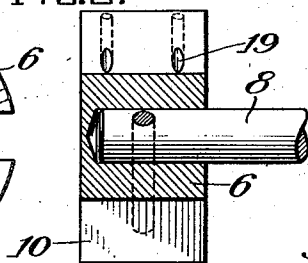


FIG. 9.



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## UNITED STATES PATENT OFFICE

2,064,635

## ROTARY TYPE PUMP

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Application January 13, 1936, Serial No. 58,788

4 Claims. (Cl. 103—121)

In the old types of pumps embodying a stationary cylinder having therein an eccentrically mounted rotor provided with peripheral, movable vanes, the vanes engage directly with the surrounding cylinder wall. Because the vanes must be movable upon the rotor, they can be held against the cylinder wall only through the action of gravity, centrifugal force, or springs. This definitely limits the pressures at which such pumps can operate to comparatively low values, because the forces that hold the vanes against the cylinder wall cannot be made great enough to resist high pressures within the cylinder. By reason of the fact that the vanes are dragged over the cylinder wall while pressed against the same, wear takes place rapidly. Even if the vanes are made of softer metal than the cylinder, to permit the vanes to be rapidly brought to a good bearing against the cylinder wall and the greater part of the wear to take place in the vanes, there is inevitably a definite amount of grooving or scoring of the cylinder which makes it difficult to secure good bearings between the cylinder and vanes that are inserted to take the place of worn vanes. Consequently, these pumps require a lot of attention in order to keep them in reasonably good working order, and even then, during the greater part of the life of a pump the bearings between the vanes and the cylinder wall are so imperfect as to permit objectionable leakage of fluids past the vanes. Furthermore, if it be attempted to pump viscous materials, these will enter between the vanes and the surrounding cylinder wall and will cause leakage or slippage past the vanes, due to the fact that the holding forces for the vanes are not great enough to force the vanes through the viscous material intervening between them and the surrounding cylinder wall.

The object of the present invention is to improve the construction of pumps of the aforesaid type in a manner to overcome the aforesaid objections.

Or, viewed in one of its aspects, the present invention may be said to have for its object to produce a simple and novel rotary pump of the aforesaid type in which the seal between the rotor unit and the surrounding cylinder wall does not depend upon centrifugal force, gravity or springs, in which there is no scraping action of vanes or the like over a cylinder wall, in which the working pressures may be high, in which the bearings are all of such a character that if the sealing against leakage or slippage past the vanes is initially effective, it will re-

main so for a long time, and in which repairs, when needed, may easily be made and insure efficient operation thereafter.

In carrying out my invention I provide the stationary cylinder with an internal sleeve or lining fitting within the same so as to be rotatable therein. This sleeve or lining, which may be termed an auxiliary cylinder, is of the same length as the main cylinder, so that the bearing surface between the two has a very large area; thereby reducing wear to a minimum and insuring a seal against slippage or leakage of fluids between the engaged surfaces of the main and auxiliary cylinder. The rotor may consist of any usual or suitable cylindrical member mounted for rotation about a fixed axis within the cylinder. The vanes are hinged to the sleeve or auxiliary cylinder and are connected to the body of the rotor in such a manner that they may move down into slots in the latter or be drawn partly out of such slots to accommodate themselves to the variation in the radial width of the gap between the body of the rotor and the surrounding auxiliary cylinder in the different angular positions of the rotor. The connection between the body of the rotor and the vanes may consist of blocks or slides slidably fitted in the slots and having hinge connections with the vanes.

The various features of novelty whereby my invention is characterized will hereinafter be pointed out with particularity in the claims; but, for a full understanding of my invention and of its objects and advantages, reference may be had to the following detailed description taken in connection with the accompanying drawings, wherein:

Figure 1 is a side view of a pump embodying the present invention; Fig. 2 is a top plan view of the pump; Fig. 3 is a central vertical section of the pump, namely a section on line 3—3 of Fig. 2; Fig. 4 is a section on line 4—4 of Fig. 3; Fig. 5 is a section on line 5—5 of Fig. 3; Fig. 6 is an end view of the cylinder lining or auxiliary cylinder, detached from the pump; Fig. 7 is a section on line 7—7 of Fig. 6; Fig. 8 is an end view of the cylindrical body of the rotor, removed from the pump; Fig. 9 is a section on line 9—9 of Fig. 8; Fig. 10 is a perspective view of one of the vanes and Fig. 11 is a perspective view of one of the blocks or slides to which the inner ends of the vanes are hinged.

Referring to the drawings, 1 represents a casting which may be said to constitute the stationary body of the pump. At one end of the

member 1 is the pump cylinder 2 which is permanently closed at its inner end by an integral wall 3 and has at its outer end a detachable closure or cover 4. The inner faces of the members 3 and 4 are parallel with each other. Accurately fitted within the cylinder is a thick sleeve 5, the ends of which bear against the end walls of the cylinder. Consequently, while the member 5, or auxiliary cylinder, is rotatable within the stationary cylinder, there is an effective seal between the end and peripheral surfaces of the latter and the end and cylindrical walls of the main cylinder. Within the compound cylinder thus produced there is located a cylindrical rotor member 6 of smaller diameter than the interior of the auxiliary cylinder and eccentrically mounted so that at one side, which in the arrangement shown is the top, it fits against the inner surface of the auxiliary cylinder. In other words, there is between the members 5 and 6 the usual space 7 that is crescent shaped in a plane at right angles to the cylinder axis. The rotor member 6 is fixed in any suitable manner to the end of a shaft 8 that extends out through the end wall 3 of the cylinder and through a suitable bearing 9 at some distance from said wall. The shaft 8 is parallel to the axis of the cylinder but is displaced therefrom a distance equal to the difference between the internal diameter of the auxiliary cylinder and the external diameter of the cylindrical rotor member.

The rotor member 6 and the auxiliary cylinder 5 are connected together by the vane elements of the pump which also constitute the driving connection between the rotor and the auxiliary cylinder. Since the rotor member 6 and the auxiliary cylinder revolve about parallel axes spaced apart from each other, they must move more or less relatively to each other as they revolve, and therefore the connections between the same and the vanes must be such that the vanes will serve their intended purpose and yet leave the members 5 and 6 free to adjust themselves relatively to each other as they revolve. This can conveniently be brought about by a vane construction which combines radial sliding movements with swinging movements. In the arrangement shown, the rotor member 6 has in the periphery comparatively wide, deep, radial slots 10 extending through the length thereof. In these slots are fitted blocks 11 which may move into the slots until they lie entirely below the periphery of the member 6 or be moved outwardly so as to project somewhat beyond the member 6. Each of the blocks 11 has in the outer edge a groove extending throughout the length thereof, which groove comprises an outer section 12 that is widest at the top and narrows gradually toward the lower end, together with an inner section 13 which is in the form of a cylindrical bore of a diameter larger than the width of the narrowest portion of the section 12. In other words, the groove, as viewed from one end of the block, has somewhat the appearance of a keyhole slot. In the auxiliary cylinder there are internal, longitudinal grooves 14 corresponding in angular spacing and in number to the slots in the rotor member 6; these grooves being similar to the grooves in the blocks. The vanes are thick, flat metal plates 15 each having thickened marginal portions 16 along its long edges; such thickened portions being cylinders of the same diameter as the cylindrical portions of the grooves in the blocks 11 and the auxiliary cylinder 5.

It will be seen that the movable parts may all

be inserted through the open end of the main cylinder after the outer cover has been taken off. The order in which the different pieces are assembled is of no importance, but it is evident that if desired, the auxiliary cylinder and the rotor may first be slipped into the stationary cylinder, the blocks may then be inserted endwise into the slots in the rotor member 6; and, after the members 5 and 6 have been placed in the proper angular positions relatively to each other, the vanes may be inserted endwise, each with a cylindrical edge portion fitted in the cylindrical part of a groove in the auxiliary cylinder and the other cylindrical edge portion fitted into the cylindrical section of the corresponding block in the rotor. Then, upon again attaching the cover or outer cylinder head, the assembly is complete. Also, since the member 6, the blocks, and the vanes are all of the same length, namely as long as the distance between the inner faces of the end walls and the stationary cylinder, seals are produced between the ends of all of these movable parts and the end walls of the cylinders. The principal wear takes place at the ends of the rotatable parts, and the compensation for this may readily be made by initially making the lengths of the movable parts slightly greater than the distance between the cylinder heads as they appear in the drawings, gaskets being placed between the movable cover or head and the adjacent end of the stationary cylinder. Then, as wear takes place, thinner gaskets may be substituted until finally the detachable head rests directly against the end of the stationary cylinder.

It will be seen that the vanes are positively connected to the auxiliary cylinder and only have a slight rocking movement relatively thereto. Consequently, all scraping action such as occurs when more or less radial vanes are dragged over the inner surface of a stationary cylinder is eliminated. Furthermore, because the wear in the hinge connections of the vanes with the auxiliary cylinder and the sliding blocks is slight, it is only necessary that the hinge joints be made with sufficient accuracy to be effectively sealed initially, in order to insure that there will be no leakage or slippage past these joints after long and continued operation of the pump.

In the arrangement shown, there are four vanes spaced 90° apart. In the stationary end wall of the cylinder are provided two ports 17 and 18 disposed on opposite sides of the point or zone of contact between the member 6 and the surrounding auxiliary cylinder. Either of these two ports may constitute the inlet and the other the outlet because, with the parts constructed as shown, the rotor may be driven in either direction and the operation will be the same in either case.

The ports 17 and 18 open into the interior of the cylinder for a considerable angular distance beginning with the tips of the horns of the crescent shaped space between the rotor member 6 and the auxiliary cylinder. The ports may be of uniform widths throughout their lengths, because where they are wider than the radial width of the crescent shaped space 7, the ends of the members 5 and 6 form closures therefor. Assuming that the shaft 8 is turning in the clockwise direction, as viewed in Fig. 4, air or other fluent material will be drawn into the cylinder through the port 18 by reason of the suction that is being produced by the right-hand vane and the vane that points directly

down. By the time that the shaft has made somewhat less than a quarter turn, the right-hand vane will have passed the lower end of the port 18 and the lowermost vane will have just about reached the lower end of the port 17. Thus, there is a body of fluent material trapped between a pair of vanes. As the shaft continues to rotate, the section of the annular space within which this fluent material is confined narrows, causing the fluent material to be placed under pressure. Since the fluent material has nowhere else to go, it flows out through the port 17. By the time that the shaft has completed almost half a revolution, the space within which the body of fluent material under consideration was originally confined will be reduced to the vanishing point, so that all of the fluent material will have been forced out through the port 17. Of course, if there be back pressure in the port 17, there may be back flow through this port until an equalization of pressure results. But, no matter how great this back pressure is, it cannot drive the trapped fluent material back beyond the vane which is driving it ahead, because this vane is positively interlocked with the surrounding cylinder. Also, during the time of great pressure on the fluent material which is being forced out of the pump, the vane in advance of this confined or trapped body of fluent material prevents any leakage in the forward or clockwise direction between the rotor and the cylinder. Consequently, the pump may operate effectively against high back pressure or, in other words, it may operate as a high pressure compressor. It is also evident that if highly viscous materials are being pumped, they will be handled just as effectively as air or other materials, because there is nothing that they can do to disturb the proper functioning of the vanes as is the case where such materials can get between the vanes and the cylinder and hold the vanes out of engagement with the latter. Although it is common to have contact between cylindrical rotors and the surrounding cylinder wall, this has heretofore been a rubbing contact which soon results in sufficient wear to break the seal. In my construction, the relative movements between the members 5 and 6 are radial rather than circumferential, and therefore there is no rubbing action that will affect the tightness of the seal between these two members in the zone where they happen to be in engagement with each other. Here, again, a good initial seal will remain so.

Attention may be called also to the fact that the openings or passages 19 leading from the periphery of the rotor 6 into the inner or lower end of each of the slots 10 serve as vents to permit accumulations of material that may occur in the slots to be forced out of the slots by the blocks as the latter travel inwardly in the slots.

While I have illustrated and described with particularity only a single preferred form of my invention, I do not desire to be limited to the exact structural details thus illustrated and described; but intend to cover all forms and arrangements which come within the definitions of my invention constituting the appended claims. I also wish to have it understood that whereas I have illustrated my invention as applied to a

pump and described it in detail as such, the same principles are applicable to machines in which the fluent material furnishes the driving power, so that the machine is a motor rather than a pump or compressor, and that where I use the word pump I intend also to include motors.

I claim:

1. In a rotary pump of the type comprising a stationary cylinder having inlet and outlet ports spaced apart angularly of the cylinder, and a rotor mounted eccentrically in the said cylinder and having peripheral vanes: an auxiliary cylinder in the form of a sleeve fitting and rotatable in the stationary cylinder and contacting with the periphery of the rotor at a point between said ports, the rotor having peripheral radial slots, slides in said slots, and vanes each hinged at its inner end to one of said slides and at its outer end to the auxiliary cylinder.

2. In a rotary pump of the type comprising a stationary cylinder having inlet and outlet ports, and a rotor mounted eccentrically in the cylinder and having thereon movable peripheral vanes: an auxiliary cylinder in the form of a sleeve fitting and rotatable in the said stationary cylinder and contacting with the periphery of the rotor at a point between said ports, radially movable elements on the rotor, and hinge connections between the outer ends of the vanes and the auxiliary cylinder and between the vanes and said radially movable elements.

3. In a rotary pump of the type containing a rotor mounted eccentrically in a stationary cylinder and having thereon relatively movable peripheral vanes: an auxiliary cylinder in the form of a sleeve fitting and rotatable in the said stationary cylinder, blocks mounted on the rotor for radial sliding movements, each block having in the outer side longitudinal grooves, whose bottoms are cylindrical bores of more than 180° angular extent, the auxiliary cylinder having on the inner side grooves similar to the aforesaid grooves, and vanes between said blocks and the auxiliary cylinder and each having thickened cylindrical edge portions, one edge fitted into the groove in the corresponding block and one edge into one of the grooves in the auxiliary cylinder.

4. In a rotary type pump, a stationary cylinder having end walls one of which is detachable, a cylindrical, sleeve fitting and rotatable within said cylinder, a cylindrical rotor member smaller in diameter than the internal diameter of the sleeve positioned eccentrically within the latter, said rotor member having peripheral slots extending lengthwise thereof, blocks arranged and radially slidable in said slots, each block having a longitudinal groove terminating at the bottom in an enlarged cylindrical bore, said sleeve having in the inner face grooves similar to those in the blocks, vanes having thickened cylindrical edge portions, one of said edge portions of each vane fitting in the cylindrical bore of one of the blocks and the other in the cylindrical bore portion of one of the grooves in said sleeve; the sleeve, rotor member, blocks and vanes being all of the same length as the cylinder whereby they are caused to bear against the end walls of the cylinder and any one or all of them may be slid out of the cylinder upon removing the detachable wall.

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