Feb. 5, 1946. W. R. TUCKER 2,394,120

PUMP WITH SPLIT CYLINDER

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FIG. 2.

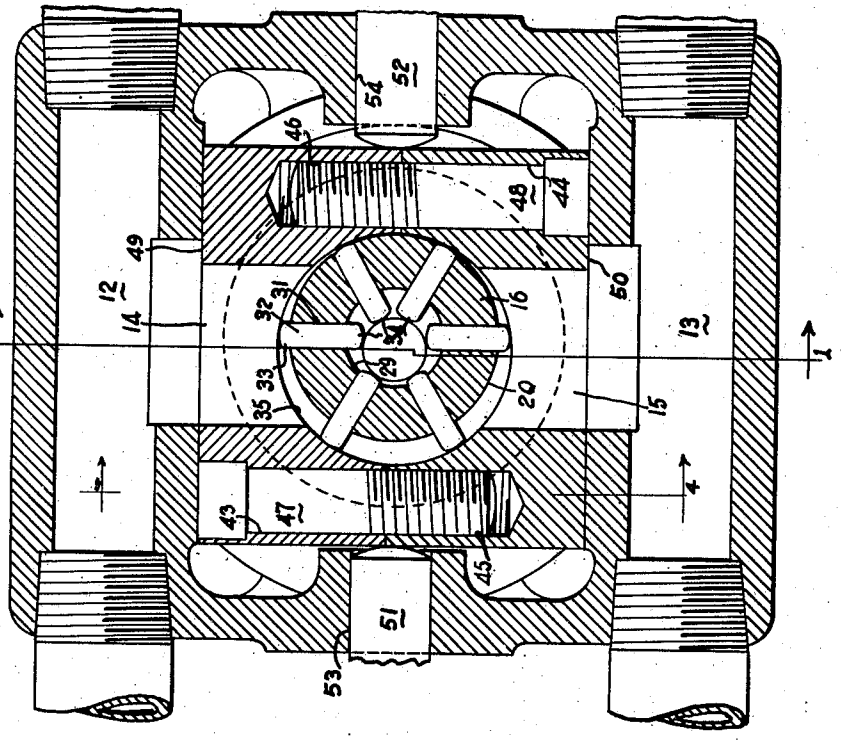
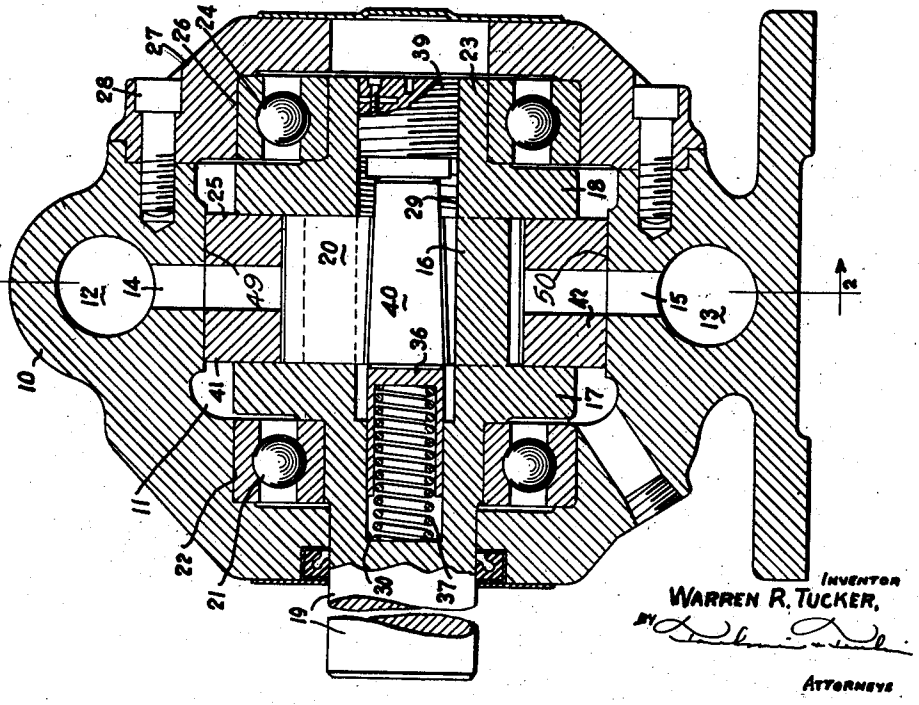


FIG. 1.



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FIG. 3.

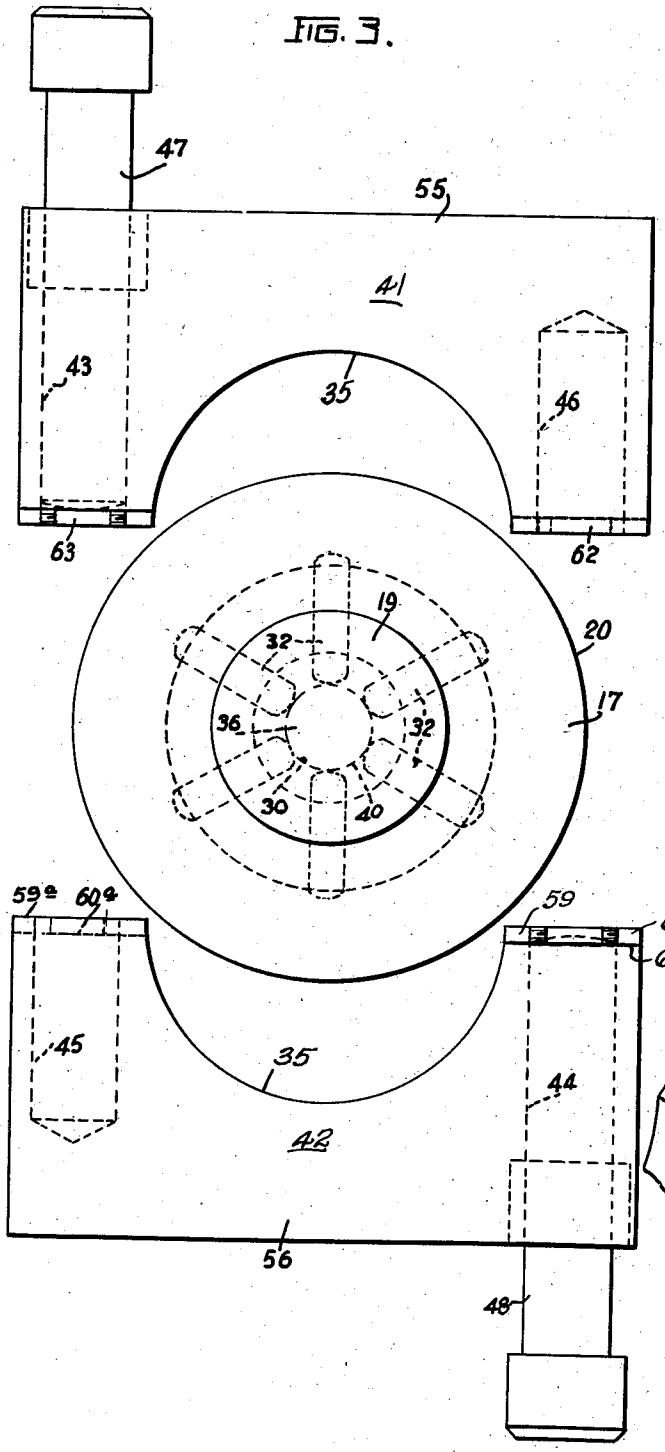


FIG. 4.

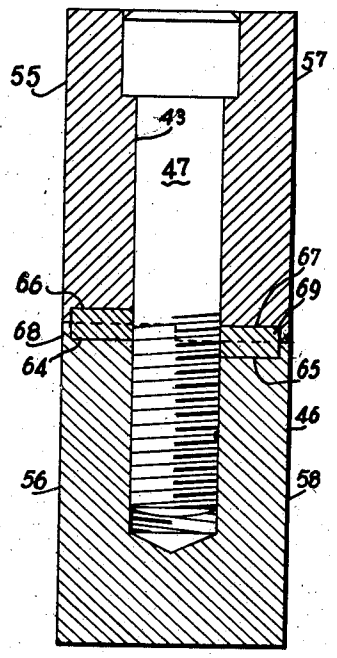
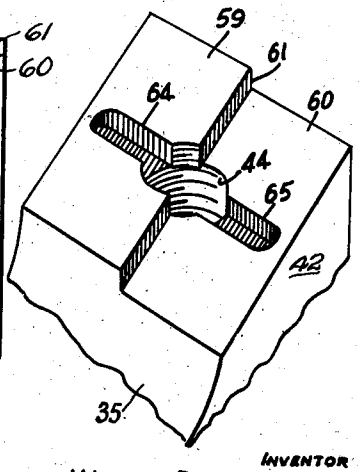


FIG. 5.



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PUMP WITH SPLIT CYLINDER

Warren R. Tucker, Dayton, Ohio, assignor to The Hydraulic Development Corp. Inc., Wilmington, Del., a corporation of Delaware

Application November 14, 1941, Serial No. 419,058

7 Claims. (Cl. 103—136)

This invention relates to a fluid pump and particularly to a pump of the rotary type for circulating a liquid.

An object of the invention is to provide a rotary pump having a solid rotor and a split cylinder.

Another object of the invention is to provide a rotary pump wherein a more rugged construction is used for retaining the cylinder and rotor in cooperative working relationship.

Another object of the invention is to provide a rotary pump having a minimum number of fastening means for holding the cylinder and rotor in assembled relationship.

Another object of the invention is to provide a rotary pump wherein the end walls of the rotor are integral with the body of the rotor, the cylinder associated therewith being split parallel to the axis thereof to permit assembly upon the rotor.

It is another object of the invention to provide a rotary pump of the vane type wherein the body of the rotor and the end walls for the same are a unitary structure and the cylinder thereof is divided to permit assembly upon the rotor.

Another object of the invention is to provide a variable delivery pump constructed in accordance with the foregoing objects.

Another object of the invention is to provide a reversible and variable delivery pump constructed in accordance with the foregoing objects.

Another object of the invention is to provide a pump housing and pump structure for location within the housing which is more compact and more rugged.

It is another object of the invention to provide a rotary pump having a cylinder divided along the axis thereof.

Another object of the invention is to provide a rotary pump having the cylinder divided along the axis thereof wherein means is provided for aligning the cylinder halves.

Another object of the invention is to provide a rotary pump having a cylinder divided along the axis thereof with means for aligning the cylinder halves both longitudinally of the axis and transversely of the axis of the cylinder.

Further objects and advantages will become apparent from the drawings and the following description.

In the drawings:

Figure 1 is a longitudinal cross-sectional view of a rotary or vane pump built in accordance with the teachings of this invention and is taken along line 1—1 of Figure 2.

Figure 2 is a transverse cross-sectional view of the pump taken along line 2—2 of Figure 1.

Figure 3 is an end elevational view of the cylinder and rotor of the pump of Figures 1 and 2 shown in their relative positions prior to assembly.

Figure 4 is a cross-sectional view of the means for securing together the parts of the cylinder, taken along line 4—4 of Figure 2.

Figure 5 is a perspective elevational view of the structure for aligning halves with respect to one another longitudinally and transversely of the axis of the cylinder.

The pump of this invention is of the rotary type for moving a body of liquid and for placing the same under pressure. The conventional rotary pump consists of a rotor driven by a suitable power shaft and rotated within a suitable cylinder bore. End plates are secured to the rotor or the cylinder to provide a pumping chamber between the rotor and the cylinder. Liquid is drawn into the pump by rotation of the rotor and is discharged under pressure from the opposite side of the pump.

When rotary pumps are used to develop high liquid pressures there is considerable tendency for the fastening means securing the end plates to the rotor or cylinder to stretch and permit leakage of high pressure liquid. Therefore, it becomes important to produce a rotor and cylinder structure which will have a minimum number of bolts securing the assembly.

In this invention the rotor of the pump and the end plates normally associated with the rotor are produced as a one-piece unit. The cylinder associated with the rotor is divided along the axis of the cylinder to provide two halves which can be bolted together when in position adjacent the rotor to produce a pump assembly. The structure of this invention thereby uses only two bolts to assemble the rotor and cylinder in their operating relationship.

The rotary pump of this invention will be described with particular reference to a vane type rotary pump. However, it is to be understood that the structure disclosed in this invention is not limited to a vane type rotary pump but can be used in connection with other forms of the rotary pumps.

In this invention the pump consists of a casing 10 having a chamber 11 which receives the rotary pump unit. Liquid flow passages 12 and 13 are positioned adjacent the chamber 11 at opposite sides thereof and can be used either as inlet or outlet passages according to the direction of ro-

tation of the pump or the position of the cylinder with respect to the rotor. The liquid flow passages 12 and 13 are connected to the chamber 11 by means of the passages 14 and 15 respectively.

The pump unit located within the chamber 11 consists of a rotor 20 and a cylinder 25.

The rotor 20 is a one-piece unit and consists of a cylindrical body portion 16 having annular flanged portions 17 and 18 which form end plates associated with the body portion 16. The end plate 17 is integral with a shaft 19 which forms the drive shaft of the rotor 20. The shaft 19 is bearinged within the casing 11 by means of the ball bearing 21 which is suitably positioned within a recess 22 in the chamber 11.

The end plate 18 has a cylindrical extending portion 23 forming a shaft for supporting the end plate 18. The shaft 23 is supported by means of a ball bearing 24 suitably carried within a recess 26 provided in a cover or end plate 27. The end plate 27 is secured to the casing 10 by means of the bolts 28.

The rotor 20 has an axial bore 29 and an axial bore 30 of somewhat less diameter than the bore 29. The rotor 20 is also provided with a plurality of slots 31 which may extend radially from the axis of the rotor 20. These slots are of the same length as the distance between the end plates 17 and 18 and extend completely through the body portion 16 of the rotor 20.

Vanes 32 are carried in the slots 31 and are of substantially the same size as the slots 31 to provide a sliding relationship therebetween. The outer ends 33 of the vanes 32 engage the cylinder bore 35 of the cylinder 25, while the inner ends 34 of the vanes 32 engage a frusto-conical shaped member 40. The inner ends of the vanes 34 are provided with an angular surface along the length of the vanes 32 to match the angular shaped surface of the frusto-conical shaped member 40. Since the inner ends 34 of the vanes 32 engage the member 40 the outer ends 33 of the vanes 32 will be maintained in engagement with the cylinder bore 35 at all times.

The frusto-conical shaped member 40 is located within the axial bore 29 provided in the rotor 20 and is urged in a rightward direction, as viewed in Figure 1 by means of a piston plunger 36 slidably positioned within the axial bore 30. A compression spring 37 urges the piston plunger 36 against the lefthand end of the member 40 so that the angular walls of the member 40 will urge the vanes 32 outwardly as heretofore disclosed.

The righthand end of the axial bore 29 in the rotor 20 is threaded to receive a threaded plug 39, the inner end of which is in engagement with the righthand end of the member 40, whereby the member 40 is positioned with respect to the vanes 32 to retain the same in their proper relationship within the cylinder bore 35.

As heretofore described, the rotor 20 of the pump of this invention is made in one piece consisting of the body 16, the end plates 17 and 18 and the extending shaft portions 19 and 23. To assemble the cylinder 25 upon the rotor 20 the cylinder is made in two half segments 41 and 42. The cylinder segments 41 and 42 have bolt holes 43 and 44 extending therethrough to receive bolts 47 and 48 respectively to engage tapped holes 45 and 46 respectively in the opposite segment. The bolts 47 and 48 can be as large in diameter as desired, since they extend through the cylinder body and can be positioned in a manner that they do not interfere with any of the operating mechanism.

Since the rotor 20 is a one-piece element and the cylinder 25 is a two-part element the only fastening means required for assembling the cylinder and the rotor in working relationship are the two bolts 47 and 48. Therefore, the ruggedness of the rotor and the cylinder is greatly increased and the tendency toward separation of the working parts of the rotor and cylinder is eliminated since the bolts 47 and 48 can be made sufficiently large to absorb any pressure which can be developed by the pump.

The cylinder 25 is slidably positioned within the chamber 11 between the parallel walls 49 and 50, the cylinder 25 having cooperating parallel walls for engagement therewith. Actuating members 51 and 52 extend through the wall of the chamber 11 through the openings 53 and 54 into engagement with opposite sides of the cylinder 25. The actuating members 51 and 52 may be connected to suitable mechanisms for shifting the position of the cylinder 25 with respect to the rotor 20 to vary the eccentricity between the rotor and the cylinder and thereby vary the capacity of the pump, or if the eccentricity is reversed from that shown in Figure 2 the delivery from the pump will be reversed. The controls for actuating the members 51 and 52 can be either manual or automatic controls and are well known in the art of variable delivery fluid pumps and further discussion thereof is not deemed necessary.

Since the cylinder 25 is constructed in two half segments 41 and 42 it becomes necessary to align the half segments both longitudinally and transversely with respect to the axis of the cylinder bore 35. Such an alignment is required to permit the vanes to pass over the dividing line between the cylinder segments 41 and 42 and also to locate cooperating exterior faces 55, 56 and 57, 58 of the cylinder segments in the same plane so that the end plates 17 and 18 will seal against the parallel exterior faces 55, 56 and 57, 58 of the cylinder segments 41 and 42.

Each of the cylinder segments has its parting face provided with a shoulder and a key slot which cooperates with a shoulder and a key slot in the cooperating parting face of the opposite cylinder segment. In Figure 5 there is shown one of the parting faces of the cylinder segments 41 and 42 and particularly the parting face of the righthand side of the lower cylinder segment 42, as viewed in Figure 3.

The parting face of the lower cylinder segment 42, as shown in Figure 5, consists of a plane area 59 and a plane area 60 which are joined by a vertical shoulder 61. The bolt hole 44 extends through the parting face at right angles thereto. The vertical shoulder 61 is positioned approximately midway across the parting face of the segment 42 with respect to the longitudinal axis of the cylinder 25 and radially from the axis of the cylinder 25.

As shown in Figure 3, the high plane area of the righthand side of the lower segment 42 is positioned toward the rear thereof, while the low plane area 60 is positioned toward the front of the figure. The position of the plane areas 59*a* and 60*a* on the lefthand side of the lower segment 42, as viewed in Figure 3, are reversed from the plane areas 59 and 60 on the righthand side of the lower segment 42. The upper cylinder segment 41 has the parting faces 62 and 63 con-

structed in the same manner as the parting face shown in Figure 5 and the location of the plane areas of the parting faces 62 and 63 are arranged to cooperate with the parting faces of the lower cylinder segment in a manner that the vertical shoulders between the plane areas are in engagement with each other to position the cylinder segment 41 with respect to the cylinder segment 42 longitudinally of the axis of the cylinder bore 35. The shoulders 61 between the plane areas of the parting faces thereby locate the exterior faces 55, 56 and 57, 58 of the cylinder segments 41 and 42 in parallel planes.

To locate the transverse position of the segments with respect to one another and thereby establish a perfect cylinder bore a recess 64 is provided in the plane area 59 and a recess 65 is provided in the plane area 60, as shown in Figure 5. The recesses 64 and 65 are located at right angles to the shoulder 61 and are in parallel alignment with the axis of the cylinder bore 35. The parting face of the upper cylinder segment 41 cooperating with the parting face of the lower cylinder segment is provided with corresponding recesses therein, as shown in Figure 4, these recesses being indicated by the numerals 66 and 67. A key 68 is placed within the cooperating recesses 64 and 66 and a corresponding key 69 is placed in the cooperating recesses 65 and 67. The keys 68 and 69 provide means to align the cylinder bore of the upper segment 41 with a cylinder bore of the lower segment 42 in a transverse relationship with respect to the axis of the cylinder bores.

With the cylinder segments 41 and 42 arranged in their proper aligned relationship the bolts 47 and 48 can be tightened to retain the alignment and assemble the divided cylinder 25 upon the one-piece rotor 20.

It may thus be seen that the applicant has provided a pump structure wherein there is required the use of only two bolts to maintain the assembly in proper working relationship and which bolts can be of the size necessary to withstand the maximum force tending to separate the cylinder segments. While other bolts 28 hold the cover plate 27 to the casing 10, yet these bolts do not absorb any strain developed by the pressure within the pump and are thus relatively unimportant from the standpoint of assembly of the pumping unit itself.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a rotary pump comprising a one-piece rotor including a cylindrical body portion and parallel end plates, a multiple-part cylinder for said body portion, said cylinder being divided substantially parallel with the axis thereof to permit assembly upon said rotor body portion between said end plates, said cylinder parts having cooperating engaging paired faces disposed substantially parallel to the axis of the cylinder, each of said engaging pair of faces comprising two plane areas offset laterally to the axis of the cylinder and connected by a shoulder, disposed angularly to the axis of the cylinder the engaging faces of each pair being complementary to align said cylinder parts longitudinally along the axis of the cylinder when said shoulders are in contact.

2. In a rotary pump, a rotor including a cylindrical body portion and parallel end plates, a multi-part cylinder divided parallel with the axis thereof to permit assembly upon said rotor body, said cylinder parts having cooperating engaging paired faces disposed parallel to the axis of the cylinder, each of said faces comprising plane areas offset laterally of the cylinder axis and joined by a shoulder disposed substantially normal to the axis of the cylinder, the engaging faces of each pair being complementary to align said cylinder parts in the direction of the axis of the cylinder and position the cooperating end face walls of the cylinder parts in planar relationship for engaging said end plates on said rotor when said complementary shoulders are in contact, there being mating key slots in each cooperating face, substantially normal to said shoulders to jointly form a key-retaining slot for receiving a key to align said cylinder parts in a direction normal to the axis of said cylinder.

3. A rotary pump comprising a one-piece rotor including a cylindrical body portion and parallel end plates, a multiple-part cylinder divided parallel with the axis thereof to permit assembly upon said rotor body and between said end plates and in rotary and sealing engagement with the end plates, said cylinder parts having cooperating engaging paired faces disposed parallel to the axis of the cylinder, one of each of said paired faces comprising plane areas offset laterally of the cylinder axis and connected by a shoulder disposed angularly to the axis of the cylinder and extending completely across said face for cooperative engagement with a cooperating shoulder on the cooperating engaging face, the meeting faces of each pair being complementary to thereby align said cylinder parts in a direction longitudinally of the cylinder axis and position the cooperating end face walls of the cylinder parts in planar relationship for rotary engaging relationship with said end plates on said rotor, these being mating key slots in each of said cooperating faces, each slot being disposed angularly to said shoulders and extending across said shoulders, and a key fitting the slot conjointly formed by each mating pair of slots to align said cylinder parts in a direction normal to the axis thereof.

4. A rotary pump comprising a rotor including a cylindrical body and parallel end plates, a multi-part cylinder divided parallel with the axis thereof to permit assembly upon said rotor body between and in sliding and sealing engagement with the end plates, said cylinder parts having meeting pairs of faces disposed parallel and substantially coplanar with the axis of the cylinder, one of each of said paired faces comprising areas offset laterally of the cylinder axis and joined by a shoulder disposed angularly to the axis of the cylinder extending across its face, the meeting faces of each pair being complementary, to align said cylinder parts axially of the cylinder when complementary shoulders are in contact to thereby position the cooperating end face walls of the cylinder parts in planar relationship for rotation in contact with said end plates, there being mating key slots in each of said cooperating faces, respectively, each slot being disposed angularly across said shoulders, a key fitting the slot conjointly formed by each pair of mating slots and aligning said cylinder parts normal to the axis thereof to position the same to form a true cylindrical cavity for said rotor body, and bolt means extending through apertures intercepting the corresponding shoulders and key slots to secure said cylinder parts together.

5. A variable delivery fluid pump including, a casing having parallel walls forming guiding surfaces for a cylinder movable therein, a one-piece

rotor including a cylindrical body portion and parallel end plates extending radially therefrom and supporting shaft portions bearinged in said casing, a multiple-part cylinder divided along the axis thereof positioned in cooperating relationship with said rotor and in engaging relationship with said end plates to provide a compression chamber, bolt means for holding said cylinder parts in assembled relationship, and parallel surfaces on said cylinder disposed parallel to the axis thereof and parallel with the dividing plane between the cylinder parts for engaging said parallel surfaces in said casing in sliding relationship therewith whereby to permit movement of said cylinder normal to the axis of said rotor for changing the eccentric relation therebetween and thereby changing the discharge capacity of said pump.

6. A variable delivery fluid pump including, a casing having parallel walls forming guiding surfaces for a cylinder movable therein, a rotor including a cylindrical body portion, parallel end plates extending normal to the axis thereof and supporting shaft portions journaled in said casing, a multiple-part cylinder divided along the axis thereof positioned in cooperating relationship with said rotor and in engaging relationship with said end plates to provide a compression chamber, bolt means for holding said cylinder parts in assembled relationship, parallel surfaces on said cylinder disposed parallel to the axis thereof and parallel with the dividing plane between the cylinder parts for engaging said parallel surfaces in said casing in sliding relationship therewith whereby to permit movement of said cylinder normal to the axis of said rotor for changing the eccentric relation therebetween and thereby changing the discharge capacity of said pump, said cylinder parts having cooperating engaging paired faces disposed parallel to the axis of the cylinder, each face of said paired faces comprising parallel flats offset laterally of said cylinder axis and joined by a shoulder disposed substantially normal to the axis of the cylinder, the faces of each pair being complementary to thereby align said cylinder parts along the axis of the cylinder and position the cooperating end face walls of the cylinder parts in coplanar relationship, there being matching key slots in each of said paired faces, each slot being disposed substantially normal to the corresponding shoulder, and a key fitting the slot formed conjointly by each matching pair of slots to thereby align said cylinder parts laterally of the axis thereof so that said parts conjointly form a true cylinder.

7. In a rotary pump, a rotor including a cylindrical body having parallel end plates normal to its axis of rotation, a plurality of parts adapted to conjointly form a cylindrical chamber for said body, said parts having paired meeting faces parallel to the axis of said chamber, each face comprising substantially parallel plane areas offset laterally of the cylinder axis said areas being connected by a shoulder transverse to said axis, the meeting faces of each pair being complementary, the parts being properly assembled along the axis of said cylinder when the shoulders of the respective pairs of faces are in contact.

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