March 16, 1954 J. DEUBEL 2,672,099

ROTARY PUMPING APPARATUS

Filed Oct. 16, 1950

2 Sheets-Sheet 1

Fig 1

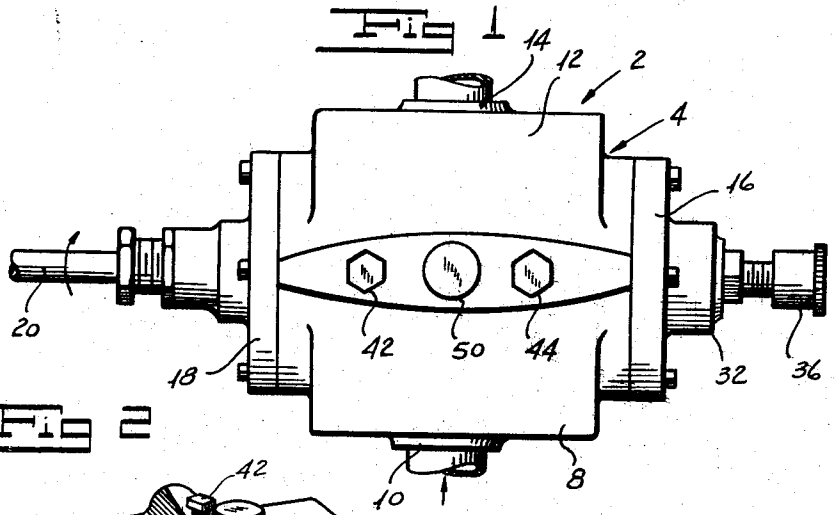
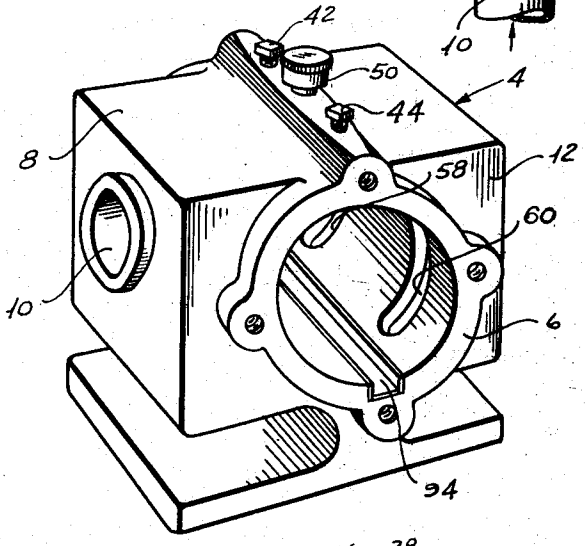



Fig 2



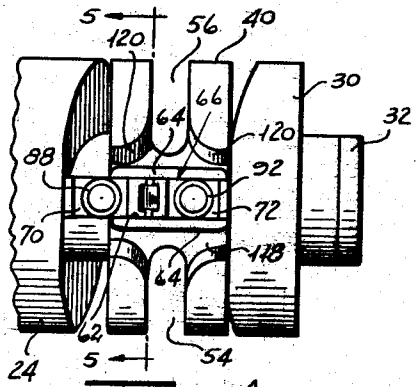




Fig 4

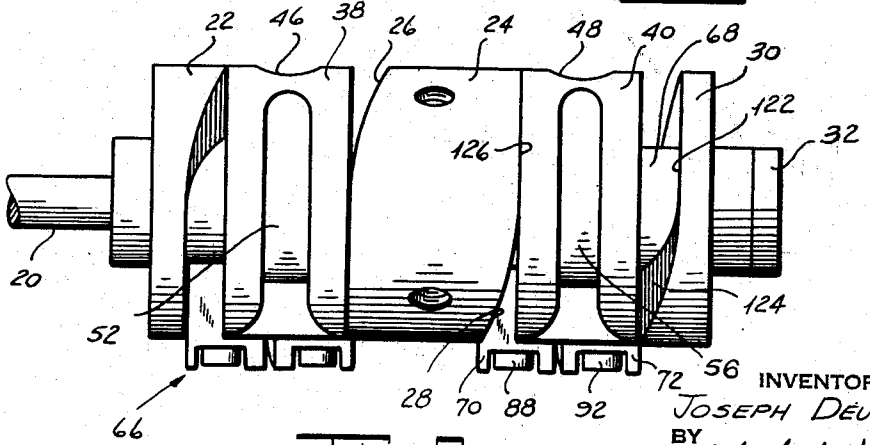



Fig 3

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ROTARY PUMPING APPARATUS

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Fig 5

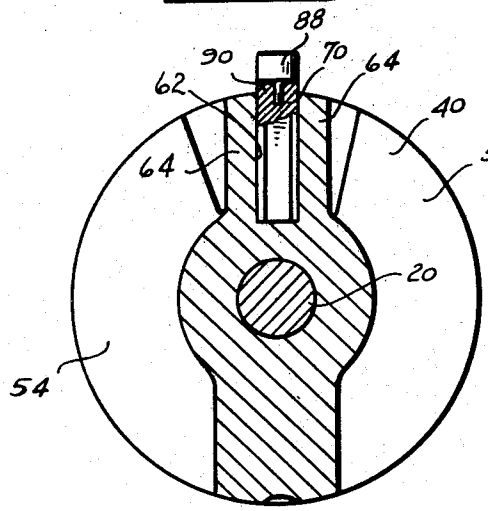



Fig 6

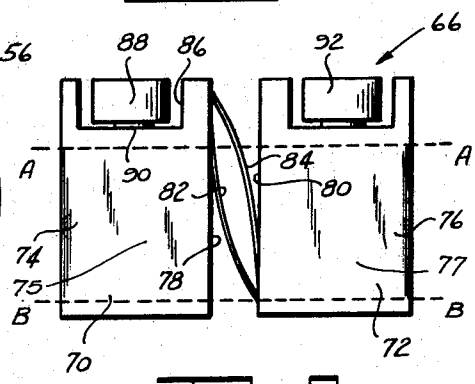
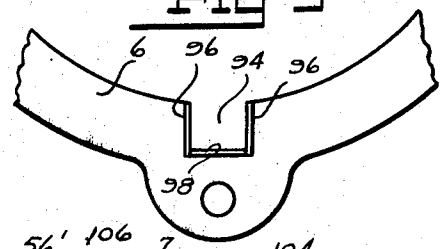



Fig 9



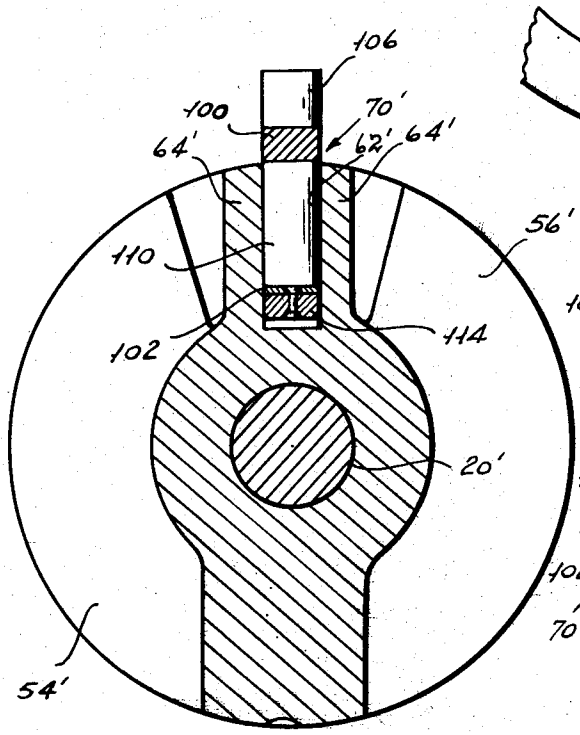




Fig 7

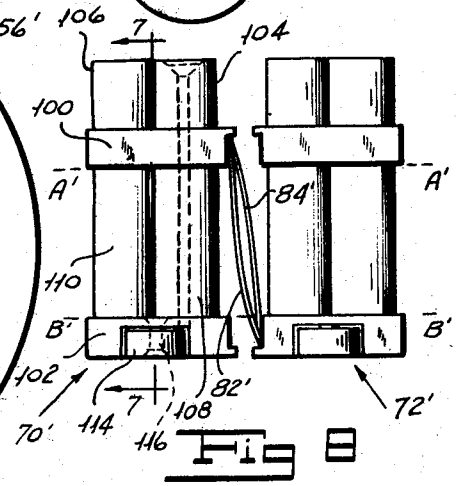



Fig 8

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Patented Mar. 16, 1954 2,672,099

# UNITED STATES PATENT OFFICE

2,672,099

## ROTARY PUMPING APPARATUS

Joseph Deubel, Garfield, N. J.

Application October 16, 1950, Serial No. 190,403

12 Claims. (Cl. 103—123)

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This invention relates to pumping apparatus of the rotary type, such apparatus being especially suitable for displacing and delivering liquids and gases under pressure. The apparatus of the invention, however, is not limited to being used as a pump since, by supplying fluid under pressure to it, it may be operated as a motor rather than as a motor-driven pump.

The apparatus of the invention relates to that type of rotary fluid displacing apparatus wherein there is employed in a casing a hub member, said hub member having on opposite sides of the axis thereof fluid receiving chambers, such chambers being separated by a displaceable abutment means which reciprocates longitudinally of the hub member in the casing. Reciprocation of such abutment member and displacement of fluid in the housing from the inlet chamber in the hub member to the outlet chamber therein are effected by at least one face cam member positioned to confront the hub member on one end of the latter, the cam member being rotated by the driving motor for the pump.

The invention has among its objects the provision of an improved sealing means between the outer end of the reciprocable abutment means in the hub member and the casing or housing of the pump.

Yet another object of the invention resides in the provision of improved abutment means in the hub member, such abutment means being characterized by the ease with which it is reciprocated and the markedly reduced wearing effect which it produces upon the housing of the pump and upon the ways in the hub member in such pump.

The invention further provides a novel arrangement of multiple fluid displacing units in a single casing, such arrangement yielding a pump of high capacity, small over-all dimensions, and substantially pulsation-free delivery.

The above and further objects of the invention will be more readily apparent upon consideration of the following described preferred embodiments of the apparatus of the invention, such embodiments being shown in the accompanying drawings, in which:

Fig. 1 is a view in plan of the assembled pump of a preferred embodiment of the invention;

Fig. 2 is a view in perspective of the housing of the pump with the hub members, cams, and motor driven shaft, as well as the end plates, removed therefrom;

Fig. 3 is a view in side elevation of the hub members, cams, and motor driven shaft, such

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members as a unit being designed to fit within the housing shown in Fig. 2;

Fig. 4 is a view in bottom plan of the right hand end of the assembly shown in Fig. 3;

Fig. 5 is a view in vertical section through such assembly, the section being taken along the line 5—5 in Fig. 4;

Fig. 6 is a view in side elevation of the abutment members making up the abutment means shown in Figs. 3, 4, and 5;

Fig. 7 is a view in transverse section through the inner assembly of the pump, that is, through the motor driven shaft and a hub member thereof, the section being taken in the same manner as that in Fig. 5, the figure showing a second embodiment of the assembly;

Fig. 8 is a view in side elevation of such second embodiment of the abutment members making up the abutment means employed in the apparatus of Fig. 7; and

Fig. 9 is an enlarged view in end elevation of the bottom portion of the main housing of the pump at the bore therethrough, the figure showing particularly the disposition of the wear plates in the longitudinal groove in the housing, such groove receiving the outer edge of the reciprocable abutment means.

The apparatus of the invention represents an improvement over that shown and claimed in Patent No. 2,142,867, dated January 3, 1939, issued to Joseph Deubel et al. The apparatus of the present invention among other features provides an improved seal between the outer edge of the reciprocable abutment means and the housing of the pump, and also presents improved abutment means which, as above explained, minimize wear on the ways in the hub members in the pump and on the casing of the pump, and produces a much more perfect seal between the abutment means, the hub member, and the pump casing than was possible with the prior apparatus.

In addition, the pump of the present invention in a preferred embodiment thereof provides a much more pulsation-free delivery of fluid therefrom, because of the novel arrangement of a plurality of units in a single housing.

In Fig. 1 the pump, there shown in plan, is designated generally by the reference character 2, such pump including the pump housing 4, which is conveniently made in the form of an integral casting. Housing 4 has a central cylindrical portion 6, portion 6 being provided on opposite sides thereof with chambered portions 8 and 12, chamber 8 being the inlet chamber when the motor driven shaft 20 is rotated in the direction indi-

cated in Fig. 1, and chamber 12 being the outlet chamber. Inlet chamber 8 is provided with the inlet aperture 10, into which a supply pipe is screwed, and outlet chamber 12 is provided with a similar aperture 14, through which fluid under pressure may be delivered to an outlet pipe. The housing of the pump is completed, when the inner parts of the pump are assembled therein, by the rear end plate 16 and the front end plate 18, the motor driven shaft 20 being supported in bearings in such end plates.

The assembly which fits within the bore in the cylindrical portion 6 of the housing 4 is shown in Fig. 3. Mounted on the motor driven shaft 20, reading in a direction from left to right, are the first cam 22 which is keyed on the shaft for rotation therewith, the first hub member 38, in which the shaft 20 is freely rotatable, the second, double-faced, cam 24, the second hub member 40 likewise having shaft 20 freely rotatable therein, and the last, single-faced, cam 30. At the right of such assembly, beyond the end of the small hub portion on cam 30, is the ball bearing race member 32 which supports the rear end of the shaft for rotation in hub 34 of rear end plate 16. The rear ball bearing 32 is lubricated by means of the grease cup 36, shown in Fig. 1.

When the assembly shown in Fig. 3 is mounted in the pump housing, the depressions 46 and 48 of hub members 38 and 40, respectively, are disposed beneath the inner ends of the set screws 42 and 44 at the top of the housing 4. When such set screws are tightened to cause their ends to enter the depressions of the hub members, the hub members are fixedly mounted in the housing. The periphery of the central, double-faced, cam 24 is lubricated by the grease cup 50 on top of the housing. As is shown in Fig. 3, the hub members 38 and 40, respectively, are provided with inlet chambers 52 and 56, such chambers being in the form of transverse grooves in the hubs such grooves being dead-ended at a point short of the top of the hub member. Each such hub member has a similar outlet chamber disposed on the opposite side thereof, the outlet chamber for hub member 40 being shown in Fig. 4 at 54. When the assembly of Fig. 3 is operatively mounted in casing 4, the outlet and inlet chambers in the hub members 38 and 40 are positioned in communication with corresponding ports through the side walls of portion 6 of the casing, two such ports in turn communicating with the chamber 10 and two with chamber 12. In Fig. 2 the two ports 58 and 60 communicating with chamber 12 are shown. It will be obvious that port 60 cooperates with chamber 54 of hub member 40.

Also, as shown in Fig. 4, each of the hub members is provided at a point equally spaced from the bottom ends of the inlet and outlet chambers with a pair of parallel confronting longitudinally disposed and substantially radially extending flange members 64 which provide between their inner faces a longitudinally extending way, such way receiving the reciprocable abutment means. Such abutment means is designed, in a manner which will be more readily understood hereinafter, to separate the ends of the inlet and outlet chambers in the hub members from each other and to form a seal with the housing of the pump while being reciprocated longitudinally thereof by the face cams of each unit. As can be seen in Figs. 3 and 4, the inlet chamber 56 and the outlet chamber 54 in hub member 40 connect by means of curved ducts 120 and 118, respectively, with the chambers formed between the end faces of the hub member and the respective face cams 24 and 30. The two cam faces of each pair of face cams make up a unit; thus, cam 22 at the left in Fig. 3 and the face cam 26 of the member 24 form one unit, and the face cam 28 and the end cam 30 form another unit. The cams are generally of the same configuration as are those shown in Patent No. 2,142,867, and the combination of such cams, hub members, and abutment means of each unit functions in the same general manner as that disclosed in said patent.

Each of the face cams comprises a flat lobe or raised zone, a flat lower zone of greater angular extent than the lobe, and pitched zones connecting the lobe and the lower zone. In Fig. 3 a lower zone 122 and a pitched zone 124 are shown on cam 30. A lobe 126 is shown on cam 28. The lobe portion of each face is of a width somewhat greater than the distance between the outer edges of ports 118 and 120, so that when the lobe passes over this portion of the end wall of the hub member both parts will be momentarily completely sealed from chambers 54 and 56 in the hub member 40. The pitched zones of the face cams are of uniform pitch, such pitched zones and the lower zone of each cam forming with the confronting end wall of the hub member a fluid-receiving and displacing subchamber. The face cams in each unit are disposed substantially 180 degrees from each other, the axial distance between corresponding points on the confronting cams of each unit being substantially a constant. In order to increase the output volume of the pump as a whole, and also further to reduce pulsations in the delivered fluid, in the illustrated preferred embodiment there are employed, as explained, the two units employing hub members 38 and 40, respectively, mounted on the one motor driven shaft 20. The corresponding cams in the second unit are displaced angularly from the cams of the first unit 90 degrees, so that fluid delivered from the pump as a whole is substantially free from noticeable pulsations therein.

The pump functions generally as follows. The abutment means, at their corresponding outer ends protruding beyond the ways in the hub members, are adapted to engage with the faces of the two cams of each unit as they are rotated, the abutment means thus being reciprocated back and forth parallel to the axis of rotation of the drive shaft. The abutment means seals chamber 54 in the hub member, with its port connection, from the other such chamber 56, with its port connection, the sub-chamber provided between a cam element and the confronting end of the hub member at one side of the abutment means increasing in volume as the lobe of the cam retreats from the abutment means.

Assume that the inlet sub-chamber above referred to is that at the upper left in Fig. 4. The other sub-chamber on the same side of the axial plane through the pump rotor and through the central radial plane of the reciprocable abutment, as, for example, the right-hand subchamber in the upper portion of Fig. 4, formed between the face of the other cam and the other end of the hub member, behaves in the same manner, that is, it likewise draws fluid into the housing when its cam lobe retreats from the abutment. As a result, fluid is constantly drawn into the inlet port, at one instant by the first such sub-chamber, a short time later by the first and second sub-chambers, and shortly thereafter

by the second sub-chamber alone. Such cycle is continually repeated.

At the other side of the axial plane through the pump rotor and through the central radial plane of the reciprocable abutment, as in the lower portion of Fig. 4, the two sub-chambers function to compress the fluid delivered to them by the two intake sub-chambers and to deliver it to the outlet port. Thus, each of the first and second of such outlet sub-chambers compresses fluid and delivers it to the outlet port when its cam lobe approaches the abutment and thus the sub-chamber is of decreasing volume. The lobes of the two cams forming such first and second outlet sub-chambers are offset 180°, however, so that the delivery of fluid under pressure is effected, in each cycle, first by the first outlet sub-chamber only, an instant later by the first and second outlet sub-chambers, and a short time later by the second outlet sub-chamber only.

The improved abutment means of the first embodiment of the pump shown in Figs. 1–6, inclusive, will be more readily understood by reference to Figs. 3–6, inclusive. Abutment means 66 shown in Fig. 6 is made up of two separate abutment members 70 and 72, such abutment members confronting each other at their inner edges and having, respectively, rounded outer edge portions 74 and 76 which are engaged by the faces of cams 28 and 30. As stated the inner edges 78 and 80 of the abutment members 70 and 72 confront each other such edges lying close together, as shown in Fig. 4, when the abutment means is mounted in operative position in the way in the hub. The abutment members 70 and 72 are constantly urged apart and into contact with the face cams by means of the leaf spring members 82 and 84, spring member 82 being attached to the abutment member 70 at the top thereof, and spring member 84 being attached at its bottom to the bottom of abutment member 72. The free ends of such spring members may, of course, slide along the edges of the opposite abutment member, thereby allowing the two abutment members to slide toward and away from each other to a limited extent, and maintaining tight and sealing contact between the outer edges thereof and the face cams.

Each of abutment members 70 and 72 carries on its outer edge portion, shown at the top in Fig. 6, a guide roller respectively designated 88 and 92, each such roller fitting within a slot at the top edge of its abutment member, such slot being shown at 86 on member 70. The rollers are journalled upon vertical pintle pins, that on abutment member 70 being designated 90. The guide rollers 88 and 92 have diameters which are the same as, or initially very slightly smaller than, the thickness, that is, the dimension normal to the paper in Fig. 6, of the abutment members. Preferably rollers 88 and 92 will initially be in the neighborhood of .002 inch less than the thickness of the abutment members.

The portions of abutment members 70 and 72 above the dash line A—A in Fig. 6, run within the longitudinal slot 94 in the housing of the pump. Such slot is shown in Figs. 2 and 9. The provision of such slot in the housing of the pump and the particular configuration of the outer edges of the abutment members result in an almost perfect seal between the abutment members and the housing member, also reducing the wear between the abutment members and housing to a minimum. In order still further to minimize the wear between the abutment members and the slot 94 in the housing, such slot is preferably provided with longitudinal vertical walls which are very hard and thus wear and abrasion resistant. Such wear plates may take the form of the replaceable vertical side plates 96, preferably made of hardened tool steel or the like, such wear plates being maintained in place by means of the bottom spreader or wedging member 98 which need not be of hard steel.

The bottom edge of each of the abutment members 70 and 72 as shown in Fig. 6, that is, that portion below the dash line B—B, fits within the inner end of way 62 in the hub members 40. Each of the hub members has on each end thereof a smaller circular cylindrical hub which extends laterally into a central bore in the confronting face cam. One such small hub on hub member 40 is shown at 68 in Fig. 3. The bottom of way 62 is extended laterally to form shallow axially extending grooves in such hubs on the hub member. As a result of such construction, the abutment means made up of abutment members 70 and 72 is very stably guided for reciprocation in the way in the hub member, in the grooves in the small hubs of the hub member, and in the longitudinal slot or sealing groove 94 in the housing of the pump. The portion of each of abutment members 70 and 72 between lines A—A and B—B is imperforate; the imperforate portion of member 70 is designated 75, the corresponding part of member 72 being denoted 77.

In Figs. 7 and 8 there is shown a second embodiment of the invention, such embodiment differing from that previously described in the character of the abutment members making up the reciprocable abutment means therein. The structure shown in Figs. 7 and 8 is particularly of value in the pumps of the larger sizes, wherein the abutment members have dimensions adequate to allow the construction of the abutment member shown in Fig. 8. In Fig. 7 the parts of the apparatus shown which correspond to those shown in Fig. 5 are designated by the same reference characters with an added prime. In such second embodiment, the two abutment members forming the abutment means are designated 70′ and 72′. Since such abutment members 70′ and 72′ are essentially similar, detailed discussion is confined to that shown at 70′. Such member is made up of the upper plate member 100 and the lower plate member 102 spaced therefrom, such members carrying journalled therebetween the rollers 108 and 110, the pintle pins which carry such rollers being extended upwardly through the plate member 100 and carrying on their upper ends, respectively, the short upper rollers 104 and 106. The bottom plate 102 is slotted or gapped, as shown at the bottom thereof, such portion carrying within it the bottom roller 114 which is journalled on the short pintle pin 116.

The rollers 104, 106, 108, 110, and 114 are all of the same diameter, such diameter preferably being the same or very slightly less than the thickness of the plates 102 and 100. Abutment members 70′ and 72′ have a dimension, measured between the dash lines A′—A′ and B′—B′, which is equal to the radial dimension of the respective face cams of the unit. The face cams of the unit engage the inner rollers, of which that of member 70′ is designated 110. The upper rollers 104 and 106 engage in the longitudinal slot in the pump housing, and the bottom roller 114 engages in the inner end of the way in the hub member and in the shallow axially extending grooves, formed as a prolongation of the way, in

the smaller inner hubs of the hub member. As a result of such construction, the abutment members will be stably held in the way in the hub member, in the groove in the smaller hubs of the hub member, and in the longitudinal abutment sealing groove in the pump housing. The portion of the abutment means above line A'—A' in Fig. 8 extends into the groove in the pump housing, whereas that below line B'—B' extends into the inner end of the way in the hub member and the above discussed grooves in the hubs thereof.

In both disclosed embodiments of the abutment members employed in the pump, a short period of wearing-in of the apparatus will result in the wearing of the plate elements of the abutment members, adjacent to the guiding rolls employed on such members, to a very slightly smaller dimension than the rollers, the rollers in turn being worn to a diameter which is very slightly less than the width of the grooves or ways in which they run. Consequently, the rollers in the main engage the surfaces past which the abutment members, slide during further operation of the pump, and prevent further wear of the immovable plate portions of the abutment members. The tolerance between the portions of the abutment members and the guide ways and grooves in which they slide may be made so small that there is very little leakage of fluid therepast, even under fairly high commercial pressures for which the pump may be employed.

Whereas for purposes of illustration I have shown and described two embodiments of the pump of the present invention, it will be understood that the invention is not limited to such disclosed embodiments but that it may vary considerably as to details. The scope of the invention is, therefore, to be defined by the claims appended hereto.

I claim as new the following:

1. Rotary apparatus of the class described, comprising a casing provided with a longitudinal bore therein and with an inlet and an outlet, a hub member fixed in the bore in the casing and having end walls and containing oppositely disposed chambers communicating respectively with said inlet and said outlet, means to seal the ends of said casing, a drive shaft mounted in said hub member, a way in the outer surface of the hub member extending longitudinally thereof, abutment means slidably mounted in the way, said abutment means separating the aforesaid chambers of the hub member, the casing having a longitudinal slot in the bore therein, the abutment means having its outer edge projecting outwardly of the hub member and into the slot in the casing in sealing relationship therewith, a pair of spaced face cams mounted in the bore in the casing to rotate with the shaft, the cams being mounted one on each side of the hub member and each having a sealing portion abutting the respective end wall of the hub member, the face cams engaging opposite ends of the abutment member to shift the abutment member longitudinally as the cams rotate, and ports positioned laterally of the abutment on the hub member and opened and closed by the face cams to form an opening and closing pump chamber as the cams rotate.

2. Rotary apparatus of the class described, comprising a casing provided with a longitudinal bore therein and with an inlet and an outlet, a hub member fixed in the bore in the casing and having end walls and containing oppositely disposed chambers communicating respectively with said inlet and said outlet, means to seal the ends of said casing, a drive shaft mounted in said hub member, a way in the outer surface of the hub member extending longitudinally thereof, abutment means slidably mounted in the way, said abutment means having sealing engagement with the way in the hub member and separating the aforesaid chambers of the hub member, the casing having a longitudinal slot in the bore therein, longitudinally extending hardened wear plates positioned on the side walls of the slot, the abutment means having its outer edge projecting outwardly of the hub member and into the slot in the casing in sealing relationship therewith, a pair of spaced face cams mounted in the bore in the casing to rotate with the shaft, the cams being mounted one on each side of the hub member and each having a sealing portion abutting the respective end wall of the hub member, the face cams engaging opposite ends of the abutment member to shift the abutment member longitudinally as the cams rotate, and ports positioned laterally of the abutment on the hub member and opened and closed by the face cams to form an opening and closing pump chamber as the cams rotate.

3. Rotary apparatus of the class described, comprising a casing provided with a longitudinal bore therein and with an inlet and an outlet, a hub member fixed in the bore in the casing and having end walls and containing oppositely disposed chambers communicating respectively with said inlet and said outlet, means to seal the ends of said casing, a drive shaft mounted in said hub member, a way in the outer surface of the hub member extending longitudinally thereof, abutment means having sealing engagement with the sides and bottom of the way in the hub member slidably mounted therein, said abutment member separating the aforesaid chambers of the hub member, the casing having a longitudinal slot in the bore therein, longitudinally extending hardened wear plates positioned on the side walls of the slot, a plate at the bottom of the slot between the bottom edges of the wear plates and holding the latter in place, the abutment means having its outer edge projecting outwardly of the hub member and into the slot in the casing in sealing relationship therewith, a pair of spaced face cams mounted in the bore in the casing to rotate with the shaft, the cams being mounted one on each side of the hub member and each having a sealing portion abutting the respective end wall of the hub member, the face cams engaging opposite ends of the abutment member to shift the abutment member longitudinally as the cams rotate, and ports positioned laterally of the abutment on the hub member and opened and closed by the face cams to form an opening and closing pump chamber as the cams rotate.

4. Rotary apparatus of the class described, comprising a casing provided with a longitudinal bore therein and with an inlet and an outlet, a hub member fixed in the bore in the casing and having end walls and containing oppositely disposed chambers communicating respectively with said inlet and said outlet, means to seal the ends of said casing, a drive shaft mounted in said hub member, a way in the outer surface of the hub member extending longitudinally thereof, abutment means slidably mounted in the way, said abutment means separating the aforesaid chambers of the hub member, the casing having a longitudinal slot in the bore therein, the abutment means having an imperforate plate portion, said

plate portion having its outer edge projecting outwardly of the hub member and into the slot in the casing in sealing relationship therewith, such plate portion having sealing relationship with the outer side walls of the slot in the casing, the abutment having on its outer end at least one guide roller with its axis extending radially of the hub member, said guide roller snugly fitting between the side walls of the slot in the casing, a pair of spaced face cams mounted in the bore in the casing to rotate with the shaft, the cams being mounted one on each side of the hub member and each having a sealing portion abutting the respective end wall of the hub member, the face cams engaging opposite ends of the abutment member to shift the abutment member longitudinally as the cams rotate, and ports positioned laterally of the abutment on the hub member and opened and closed by the face cams to form an opening and closing pump chamber as the cams rotate.

5. Rotary apparatus of the class described, comprising a casing provided with a longitudinal bore therein and with an inlet and an outlet, a hub member fixed in the bore in the casing and having end walls and containing oppositely disposed chambers communicating respectively with said inlet and said outlet, means to seal the ends of said casing, a drive shaft mounted in said hub member, a way in the outer surface of the hub member extending longitudinally thereof, abutment means slidably mounted in the way, said abutment means separating the aforesaid chambers of the hub member, the casing having a longitudinal slot in the bore therein, the abutment means having its outer edge projecting outwardly of the hub member and into the slot in the casing, the abutment means comprising a plurality of abutment members closely positioned edge to edge in the way in the hub member, resilient means cooperating between the abutment members constantly to urge them apart, each such abutment member in that portion immediately outwardly of the hub member having an imperforate plate portion, such plate portion having sealing relationship with the outer side walls of the slot in the casing, the abutment member having on its outer end at least one guide roller with its axis extending radially of the hub member, said guide roller snugly fitting between the side walls of the slot in the casing, a pair of spaced face cams mounted in the bore in the casing to rotate with the shaft, the cams being mounted one on each side of the hub member and each having a sealing portion abutting the respective end wall of the hub member, the face cams engaging opposite ends of the abutment member to shift the abutment member longitudinally as the cams rotate, and ports positioned laterally of the abutment on the hub member and opened and closed by the face cams to form an opening and closing pump chamber as the cams rotate.

6. Rotary apparatus of the class described, comprising a casing provided with a longitudinal bore therein and with an inlet and an outlet, a hub member fixed in the bore in the casing and having an end wall and affording oppositely disposed chambers communicating respectively with said inlet and said outlet, means to seal the ends of said casing, a drive shaft mounted in said hub member, a way in the hub member extending longitudinally thereof, abutment means slidably mounted in the way, said abutment means separating the aforesaid chambers of the hub member, the casing having a longitudinal slot in the bore therein, the abutment means having its outer edge projecting outwardly of the hub member and into the slot in the casing, the abutment means comprising a plurality of abutment members closely positioned edge to edge in the way in the hub member, resilient means cooperating between the abutment members constantly to urge them apart, each such abutment member in that portion immediately outwardly of the hub member having an imperforate plate portion, such plate portion having sealing relationship with the outer side walls of the slot in the casing, the abutment member having on its outer end a plurality of guide rollers each with its axis extending radially of the hub member, the rollers being spaced longitudinally of the abutment member, said guide rollers snugly fitting between the side walls of the slot in the casing, a pair of spaced face cams mounted in the bore in the casing to rotate with the shaft, the cams being mounted one on each side of the hub member and each having a sealing portion abutting the respective end wall of the hub member, the face cams engaging opposite ends of the abutment member to shift the abutment member longitudinally as the cams rotate, and ports positioned laterally of the abutment on the hub member and opened and closed by the face cams to form an opening and closing pump chamber as the cams rotate.

7. Rotary apparatus of the class described, comprising a casing provided with a longitudinal bore therein and with an inlet and an outlet, a hub member fixed in the bore in the casing and having an end wall and affording oppositely disposed chambers communicating respectively with said inlet and said outlet, means to seal the ends of said casing, a drive shaft mounted in said hub member, a way in the hub member extending longitudinally thereof, abutment means slidably mounted in the way, said abutment means separating the aforesaid chambers of the hub member, the casing having a longitudinal slot in the bore therein, the abutment means having its outer edge projecting outwardly of the hub member and into the slot in the casing, the abutment means comprising a plurality of abutment members closely positioned edge to edge in the way in the hub member, spring means cooperating between the abutment members constantly to urge them apart, each such abutment member in that portion immediately outwardly of the hub member having an imperforate plate portion, such plate portion having sealing relationship with the outer side walls of the slot in the casing, the abutment member having on its outer end a plurality of guide rollers, each with its axis extending radially of the hub member, the rollers being spaced longitudinally of the abutment member, the rollers being positioned in slots extending through the body of the abutment member at its outer end, said guide rollers and the unslotted portions of the outer end of the abutment member snugly fitting between the side walls of the slot in the casing, a pair of spaced face cams mounted in the bore in the casing to rotate with the shaft, the cams being mounted one on each side of the hub member and each having a sealing portion abutting the respective end wall of the hub member, the face cams engaging opposite ends of the abutment member to shift the abutment member longitudinally as the cams rotate, and ports positioned laterally of the abutment on the hub member and opened and closed by the face cams to

form an opening and closing pump chamber as the cams rotate.

8. Rotary apparatus of the class described, comprising a casing provided with an inlet and an outlet, a hub member fixed therein and having end walls closing a pair of oppositely disposed longitudinal chambers of said hub member, the chambers communicating respectively with said inlet and said outlet, means to seal the ends of said casing, a drive shaft mounted in said hub, a way extending longitudinally of the hub member, abutment means slidably mounted in the way and adapted to extend alternatively beyond the corresponding end walls of the hub member, said abutment means separating the aforesaid chambers of the hub member, the casing having a longitudinal slot in the bore therein, the abutment means having its outer edge projecting outwardly of the hub member and into the slot in the casing, the abutment means comprising a plurality of abutment members closely positioned edge to edge in the way in the hub member, resilient means cooperating between the abutment members constantly to urge them apart, each such abutment member in that portion immediately outwardly of the hub member having an imperforate plate portion, such plate portion having sealing relationship with the outer side walls of the slot in the casing, each abutment member having on its outer end at least one guide roller with its axis extending radially of the hub member, said guide roller snugly fitting between the side walls of the slot in the casing, an elongated roller on the outer side edge of each abutment member, each such elongated roller extending radially of the hub member, and face cams mounted to rotate with said shaft, the respective faces of the cams being adapted sealingly to engage with the elongated roller on said abutment means and having a sealing portion abutting the corresponding end walls of the hub member.

9. Rotary apparatus of the class described, comprising a casing provided with an inlet and an outlet, a hub member fixed therein and having end walls closing a pair of oppositely disposed longitudinal chambers of said hub member, the chambers communicating respectively with said inlet and said outlet, means to seal the ends of said casing, a drive shaft mounted in said hub member, a way extending longitudinally of the hub member, abutment means slidably mounted in the way and adapted to extend alternatively beyond the corresponding end walls of the hub member, said abutment means separating the aforesaid chambers of the hub member, the casing having a longitudinal slot in the bore therein, the abutment means having its outer edge projecting outwardly of the hub member and into the slot in the casing in sealing relationship therewith, the abutment means comprising a plurality of abutment members closely positioned edge to edge in the way in the hub member, resilient means cooperating between the abutment members constantly to urge them apart, each such abutment member in those portions immediately outwardly of the hub and adjacent the bottom of the way having imperforate plate portions, such outer plate portion having sealing relationship with the outer side walls of the slot in the casing, the abutment member having on its outer end at least one guide roller with its axis extending radially of the hub member, said guide roller snugly fitting between the side walls of the slot in the casing, the plate portion adjacent the bottom of the way having sealing relationship with the way, the bottom edge of said bottom plate portion having at least one roller thereon, the axis of said roller extending radially of the hub, the last named roller snugly fitting within the bottom of the way in the hub member, and face cams mounted to rotate with said shaft, the respective faces of the cams being adapted to engage with the outer edges of said abutment means and having a sealing portion abutting the corresponding end walls of the hub member.

10. Rotary apparatus of the class described, comprising a casing provided with an inlet and an outlet, a plurality of spaced aligned hub members fixed therein, each hub member having end walls closing a pair of oppositely disposed longitudinal chambers of said hub members, corresponding chambers of the hub members communicating respectively with said inlet and said outlet, means to seal the ends of said casing, a drive shaft mounted in said hub members, a way in the outer surface of each of the hub members extending longitudinally of such member, abutment means slidably mounted in each of the hub members and adapted to extend alternatively beyond the corresponding end walls of the respective hub members said abutment means separating the aforesaid chambers of the respective hub members, the casing having a longitudinal slot in each portion of the bore therein opposite the ways in the hub members, each of the abutment means having its outer edge projecting outwardly of the hub and into the respective slot in the casing in sealing relationship therewith, the abutment means in those portions immediately outwardly of the hub member and adjacent the bottom of the way having substantially imperforate plate portions, such outer plate portion having sealing relationship with the outer side walls of the respective slot in the casing, and a plurality of pairs of face cams with the cams in each pair facing each other mounted to rotate with said shaft, one such cam being located at each end of each hub member, the face of each of the respective cams being adapted to engage with an end of the respective abutment means and having a sealing portion abutting the corresponding confronting end wall of the hub member, the face cams of each unit made up of a hub, abutment means, and a pair of cams being substantially displaced angularly about the drive shaft from the face cams of another of such units, and ports positioned laterally of the abutment in each such unit and opened and closed by the face cams to form an opening and a closing pump chamber as the cams rotate.

11. Rotary apparatus of the class described, comprising a casing provided with an inlet and an outlet, a plurality of spaced aligned hub members fixed therein, each hub member having end walls closing a pair of oppositely disposed longitudinal chambers of said hub members, corresponding chambers of the hub members communicating respectively with said inlet and said outlet, means to seal the ends of said casing, a drive shaft mounted in said hub members, a way in the outer surface of each of the hub members extending longitudinally of such member, the ways in the respective hub members being aligned, abutment means slidably mounted in each of the hub members and adapted to extend alternatively beyond the corresponding end walls of the respective hub members, said abutment means separating the aforesaid chambers of the respective hub members, the casing having a lon-

gitudinal slot in the bore therein, each of the abutment means having its outer edge projecting outwardly of the hub and into the slot in the casing in sealing relationship therewith, each of the abutment means in those portions immediately outwardly of the hub member and adjacent the bottom of the way having substantially imperforate plate portions, such outer plate portion having sealing relationship with the outer side walls of the slot in the casing, and a plurality of face cams with the cams in each pair facing each other mounted to rotate with said shaft, one such cam being located at each end of each hub member, the face of each of the respective cams being adapted to engage with an end of the respective abutment means and having a sealing portion abutting the corresponding confronting end wall of the hub member, the face cams of each unit made up of a hub, abutment means, and a pair of cams being substantially displaced angularly about the drive shaft from the face cams of each of the other of such units, and ports positioned laterally of the abutment in each unit and opened and closed by the face cams of said unit to form an opening and a closing pump chamber as the cams rotate.

12. Rotary apparatus of the class described, comprising a casing provided with an inlet and an outlet, a plurality of spaced aligned hub members fixed therein, each hub member having end walls closing a pair of oppositely disposed longitudinal chambers of said hub members, corresponding chambers of the hub members communicating respectively with said inlet and said outlet, means to seal the ends of said casing, a drive shaft mounted in said hub members, a way extending longitudinally of each of the hub members, the ways in the respective hub members being aligned, abutment means slidably mounted in the way in each of the hub members and adapted to extend alternatively beyond the corresponding end walls of the respective hub members, said abutment means separating the aforesaid chambers of the respective hub members, the casing having a longitudinal slot in the bore therein, each of the abutment means having its outer edge projecting outwardly of the hub and into the slot in the casing in sealing relationship therewith, each of the abutment means comprising a set of a plurality of abutment members closely positioned edge to edge in the way in its respective hub member, resilient means cooperating between the abutment members of each set constantly to urge them apart, each such abutment member in those portions immediately outwardly of the hub member and adjacent the bottom of the way having imperforate plate portions, such outer plate portion having sealing relationship with the outer side walls of the slot in the casing, each abutment member having on its outer end at least one guide roller with its axis extending radially of the hub, said guide roller snugly fitting between the side walls of the slot in the casing, the plate portion adjacent the bottom of the way at the central portion of the hub member having sealing relationship with the way, the bottom edge of said bottom plate portion having at least one roller thereon, the axis of said roller extending radially of the hub, the last named roller snugly fitting within the bottom of the way in the hub, and a plurality of face cams with the cams in each pair facing each other mounted to rotate with said shaft, one such cam being located at each end of each hub member, the respective faces of the cams being adapted to engage with the respective abutment means and having a sealing portion abutting the corresponding end walls of the hub member, the face cams of each unit which comprises a hub, abutment means, and a pair of cams being substantially displaced angularly about the drive shaft from each of the other of such units.

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**References Cited** in the file of this patent

UNITED STATES PATENTS

| Number | Name | Date |
|---|---|---|
| 878,600 | Berrenberg | Feb. 11, 1908 |
| 1,460,988 | Thompson | July 3, 1923 |
| 1,690,727 | Jaworowski | Nov. 6, 1928 |
| 1,690,728 | Jaworowski | Nov. 6, 1928 |
| 1,936,467 | Deubel | Nov. 21, 1933 |
| 2,142,867 | Deubel | Jan. 3, 1939 |
| 2,250,726 | Sacknus | July 29, 1941 |
| 2,401,376 | Sherman | June 4, 1946 |

FOREIGN PATENTS

| Number | Country | Date |
|---|---|---|
| 61,825 | Germany | Aug. 5, 1892 |
| 666,396 | Germany | Oct. 20, 1938 |