

June 13, 1961

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PUMP CONSTRUCTION

2,988,003

Filed July 1, 1960

2 Sheets-Sheet 1

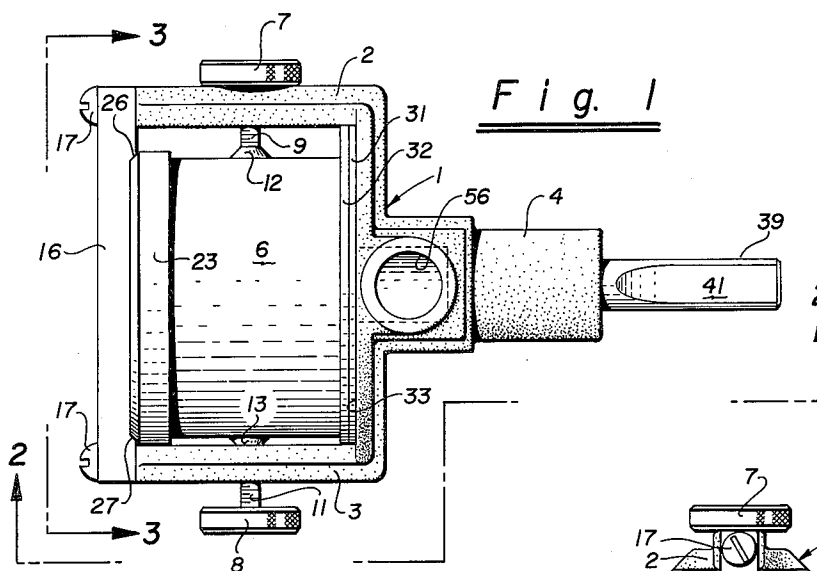


Fig. 3

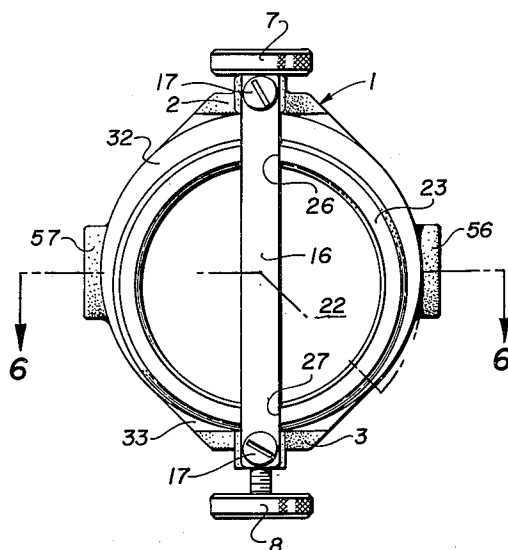
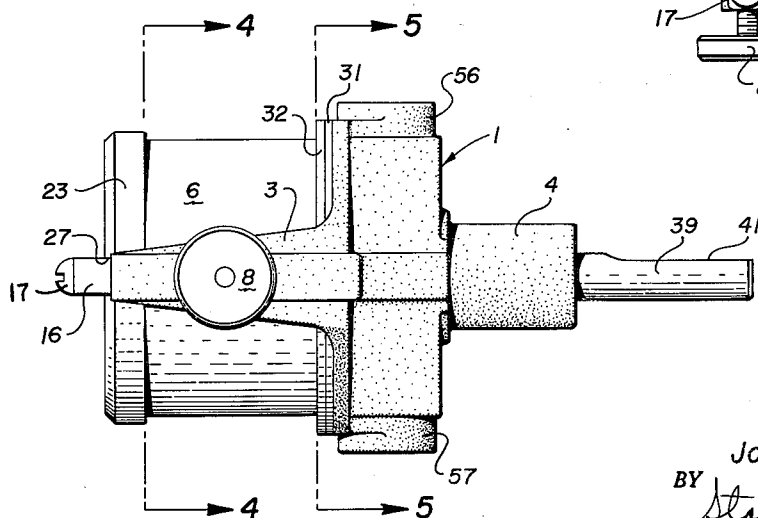


Fig. 2



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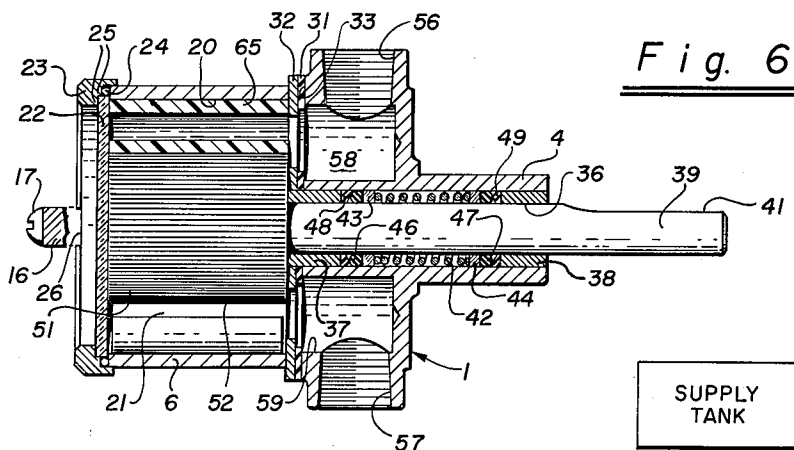


Fig. 6

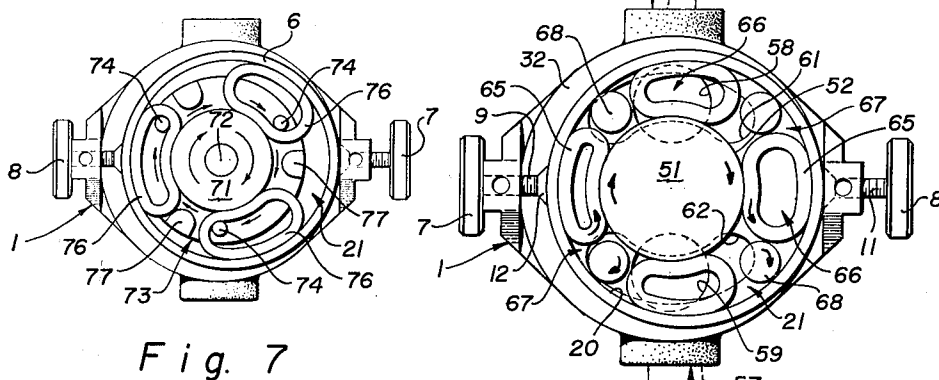


Fig. 7

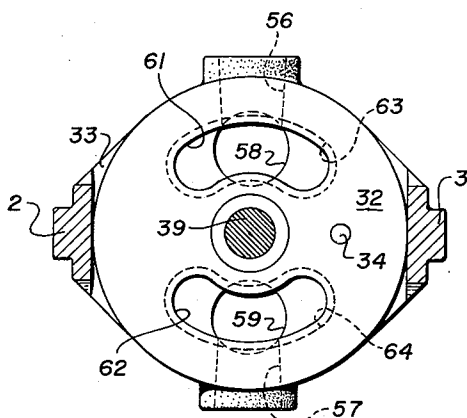


Fig. 5

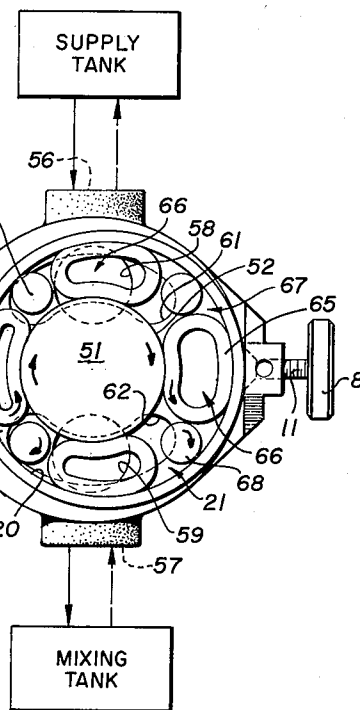


Fig. 4

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2,988,003

## PUMP CONSTRUCTION

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11 Claims. (Cl. 103—37)

This invention relates to a pump construction and more particularly to a rotary type pump for moving a flowable product in which product displacement may be varied selectively from a predetermined minimum or zero to a predetermined maximum. That is, the subject pump construction is adapted for constant or selectively variable product displacement between predetermined limits. Furthermore, the subject pump during operation is capable of effecting product displacement without surging or pulsation.

A further important feature of this pump development resides in the fact that the same is selectively adjustable so that the direction of product flow therethrough may be rapidly and easily reversed. As a result, the subject pump is particularly well suited for use in the mixing of two or more flowable products as will be described hereinafter.

The pump of this invention is simple in construction and comprises comparatively few component parts so that the same may be inexpensively manufactured with minimum machining required. In addition, the pump is inexpensive to operate and may be actuated by any suitable power source.

Summarizing this invention by stating certain of its objects, the present invention includes the provision of a pump construction in which product displacement therethrough may be varied within predetermined limits; the provision of a pump in which the direction of product displacement may be reversed by a simple pump adjustment; the provision of a pump which is capable of acting as its own valve to terminate selectively product flow; and the provision of a pump in which deformable and resilient pumping elements are employed in a product displacement passage for effecting product displacement during pump operation.

These and other objects will become apparent from a review of the following specification, for an understanding of which reference is directed to the accompanying drawings:

FIG. 1 is a plan view of the subject pump construction;

FIG. 2 is a side elevational view of the subject pump construction taken in the plane of line 2—2 of FIG. 1;

FIG. 3 is an end elevational view of the subject pump construction taken in the plane of line 3—3 of FIG. 1;

FIG. 4 is a vertical sectional view through the pump construction taken in the plane of line 4—4 of FIG. 2;

FIG. 5 is a vertical sectional view through the pump construction taken in the plane of line 5—5 of FIG. 2;

FIG. 6 is longitudinal vertical section through the pump construction taken in the plane of line 6—6 of FIG. 3;

FIG. 7 is a sectional view similar to FIG. 4 which illustrates internal details of a pump of modified construction.

Because of its novel internal construction to be described, the subject pump is well suited for pumping all sorts of flowable products, such as corrosive chemicals, fuels, oils and lubricants and other acid or alkali products. Furthermore, due to the nature of the pumping elements employed, the products to be handled may vary from those of a very thick and viscous nature to those of a very fluid nature. In addition products which have discrete particles or lumps of solids included therein also are pumpable with this structure.

The subject pump is capable of either constant or variable product displacement and is operable at varying preselected speeds, depending upon the capabilities of the

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power source employed therewith. Likewise, the size of the pump may be varied to meet requirements. The subject pump, if the same is preadjusted as will be described, also may act as a cut-off valve in which product displacement or flow is maintained at zero. In addition, the direction of product flow through the pump may be readily and easily reversed as desired.

Summarizing the construction of the pump before describing the same in detail, the same embodies a pump housing in which is provided a generally annular product flow or displacement passage. A product inlet port communicates with the displacement passage at a first predetermined location and a product outlet port communicates therewith at a second predetermined location. Positioned in the displacement passage for movement therein during pump operation are one or more deformable and resilient pumping elements which define and provide pockets or chambers in which product is to be carried through the pump. The pumping elements are arranged to move in sequence past the inlet and outlet ports to effect drawing of product into the passage and subsequently to effect discharge of the same through the outlet port. To minimize element wear and frictional drag during pump operation, the respective pumping elements are independently rollable about their axes in the passage.

Various means may be employed for effecting movement of the pumping elements in the displacement passage but it should be noted at the outset that gears and other conventional and expensive mechanisms are not employed with the subject construction. As a result, manufacturing costs are minimized due principally to the minimum machining operations required.

The walls of the annular passage are defined by the spaced peripheral surfaces of two members which are arranged one within the other. The relationship of the walls to each other may be selectively varied in line with the volume of product displacement desired. Means for adjusting and varying the relationship between the passage walls are provided in the subject pump construction. In this connection, the passage walls desirably are generally of circular cylindrical configuration. When the respective walls are concentrically arranged, product displacement will be maintained at a predetermined minimum or zero. However, if the passage walls are eccentrically arranged product displacement may be effected through the pump in a predetermined direction determined by the eccentric relationship of the walls.

Referring to FIGS 1 through 3, the subject pump comprises a compact fork shaped casing 1 which has extending axially thereof an integral pair of spaced diametrically opposed arms 2 and 3. A hollow boss 4 projects from the casing in the direction opposite from the spaced arms for the purpose to be described.

A cylindrical pump housing 6 is positioned between the arms of the casing and is mounted for selective adjustable movement therebetween. Means are provided in conjunction with the arms of the casing which are engageable with the outer surface of the housing to effect such adjustment. In the embodiment illustrated such means comprises a pair of thumb screws 7 and 8 which have extensions 9 and 11 threadably received through threaded bores provided in arms 2 and 3 of the casing. Such extensions terminate in heads 12 and 13 which engage the housing at diametrically opposite locations and cooperate in maintaining the housing immovable in a preselected location.

It is preferred that the housing is movable relative to the casing in a generally straight path, which desirably is defined by a line extending between the casing arms. For this purpose a housing guide bar 16 is removably engaged by means of screws 17 with the respective ends

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of the spaced arms 2 and 3 of the pump casing to maintain the housing in such path during movement thereof.

Referring now to FIGS. 4 and 6 which illustrate a preferred embodiment of the invention, it will be noted that housing 6 is provided with an inner periphery 20 generally in the form of a right circular cylinder. It is this inner peripheral surface of the housing which defines the outer wall of a product displacement passage 21 through which product being pumped is flowable.

The end of housing 6 which is spaced from casing 1 is closed off by a generally circular plate 22 which is held in place against the end of the casing by an annular cap 23. Desirably, a leak preventing rubber or like material O-ring 24 is positioned in an annular recess defined by the housing end, the cap 23 and the circular closure plate 22 held in place thereby. As shown in FIG. 6, cap 23 is provided with internal annular shoulders 25 adapted to receive the housing end, the closure plate and the sealing ring as described.

Cap 23 is slidably receivable over the end of the housing and is retained in position thereon by the guide bar 16 mentioned previously. To gain access to the interior of the housing, it is merely necessary to remove guide bar 16 by disengaging screws 17 from the pump casing arms and to slide the plate 22 and cap 23 therefrom. In this connection, when guide bar 16 is removed, the entire housing may be separated from the pump casing so that pump maintenance and pumping element replacement, when necessary, is facilitated.

As seen in FIGS. 1 and 3, the rim of cap 23 is provided with guide bar receiving slot structure defined by a pair of diametrically arranged slots 26 and 27 in which guide bar 16 is slidably located. When thumb screws 7 and 8 are backed off from engagement with the housing, the housing may be moved in the straight line direction defined by the parallel side surfaces of the guide bar 16 for a purpose to be described.

Product leakage at the end of the housing adjacent casing 1 is precluded by means of a preformed rubber or like sealing gasket 31 which is interposed between a preformed metal bearing plate 32 and a generally annular bearing surface 33 of the casing. Desirably a small pin 34 or like fastening means (FIG. 5) is secured to casing surface 33 and extends through sealing gasket 31 and bearing plate 32 and precludes movement thereof relative to each other.

Still referring to FIG. 6, boss 4 of the casing is provided with a through bore 36 in which are spacedly located a pair of oilless bearings 37 and 38 respectively. A shaft 39 rotatably extends through the bearings. Such shaft is provided with a planar surface 41 intended to be operatively engaged with a power source, such as an electric motor, for effecting pump operation.

To insure the product being pumped will not leak from casing 1 through bore 36, a coil spring 42 is positioned around shaft 39 between the bearings. The spring is compressed so that the same urges in opposite direction a pair of metal washers 43 and 44. A pair of annular sealing rings 46 and 47 of rubber or like material surround shaft 39 and are interposed between washers 43 and 44 respectively and a second pair of annular washers 48 and 49, which in turn are engaged with ends of bearings 37 and 38. These latter washers are annularly beveled so that the action of spring 42 tends to force the sealing rings 46 and 47 radially to wedge the same against the shaft 39 and bore 36 to preclude product leakage.

Positioned internally of housing 6 and spaced from the inner periphery 20 thereof is a member 51 which cooperates with the housing in defining the product displacement passage 21 mentioned previously. Such member 51, as seen in FIG. 4, has a generally right circular cylindrical outer periphery 52 which defines the inner wall of the product displacement passage.

In the pump embodiment illustrated in FIGS. 4 and 6, cylindrical member 51 is directly secured to the inner end

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of rotatable shaft 39 so as to be directly rotatable thereby. That is, member 51 serves as a rotor member which rotates relative to the pump housing.

At this stage, it should be understood that housing 6 may be moved along the direction defined by guide bar 16 as described previously between positions of concentric relationship and eccentric relationship relative to rotor member 51. Such movement will result in a predetermined portion of the housing inner periphery 20 at one side of the pump being brought into proximity to a predetermined portion of the periphery of cylindrical rotor member 51 while the diametrically opposite portions of the rotor and housing peripheries are moved away from each other. Due to this construction, member 51 and housing inner periphery 20 may be selectively concentrically arranged or selectively eccentrically arranged in one of two directions relative to the reference location in which the surfaces are concentric.

As a result, the walls of annular passage 21 may be selectively concentrically or eccentrically arranged. When such walls are eccentric relative to each other they diverge for a predetermined peripheral extent of the passage and converge for the remaining extent of the passage. Because the surfaces which define the passage walls desirably are circular cylindrical in configuration, when the rotor member is eccentrically arranged relative to the housing inner periphery the passage walls diverge for approximately 180° and converge for the remaining 180°, as best seen in FIG. 4.

Referring again to FIG. 6 it will be noted that casing 1 is provided with a pair of generally diametrically opposite product ports 56 and 57 through which product may be introduced into and carried away from the pump. Desirably ports 56 and 57 are internally threaded to securely and threadably receive ends of product conduits (not shown).

Generally circular port extensions 58 and 59 are provided in the casing which extend generally at right angles to ports 56 and 57 respectively towards housing 6. As best shown in FIG. 5, bearing plate 32 is provided with a pair of opposite generally arcuate apertures 61 and 62. A pair of similar but slightly larger apertures 63 and 64 are provided in sealing gasket 31. Product ports 56 and 57 communicate directly with the annular passage 21 provided in pump housing 6 through these aligned apertures.

Referring now to FIGS. 4 and 6, means are provided in annular passage 21 for effecting movement of product between port 56, which is the intake port of the embodiment as illustrated, and port 57, which is the outlet port of the embodiment as illustrated. Such means comprises at least one and desirably a plurality of pumping elements 65 each of which is deformable and resilient so as to be capable of readily, rapidly and repeatedly changing shape as the same move between the alternately diverging and converging passage walls during pump operation.

Each pumping element 65 desirably is of hollow tubular construction so that each element is provided with an internal product carrying pocket 66 for the reception and carrying of the product being pumped. While various materials may be employed for the deformable pumping elements, such as natural or synthetic rubber or various commercial plastic products, a material found well suited for this purpose is marketed under the trade name "Tygon" and is manufactured by U.S. Stoneware Co. of Akron, Ohio. This material is a synthetic vinyl plastic which is commercially available in tubular form of various lengths and diameters. "Tygon" is well suited because of its strength, elasticity and flexibility, as well as its toughness and resistance to various corrosive media. As plastic materials such as "Tygon" are available in many different formulations, the exact formulation chosen will be determined by the nature of the product being metered by the pump.

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While the tubular pumping elements 65 prior to insertion in the displacement passage 21 of the pump are of generally circular cross section, the configuration of the elements is somewhat flattened into generally elliptical shape when the elements are inserted into the pump and are frictionally engaged between the inner and outer walls of the displacement passage. As seen in FIG. 6, the elements desirably are of a length substantially equal to the axial length of passage 21. Upon rotation of rotor member 51 in the direction of the arrow of FIG. 4, the pumping elements will be moved in a circular path about the rotor member in the same general direction as the rotor moves. However, at the same time the pumping elements move about the axis of rotor member 51, they are rolled about their own axes by the rotor in the direction of the respective arrows shown thereon.

This arrangement is generally analogous to a well known epicyclic gear train arrangement with rotor member 51 acting as the rotating sun gear, the casing 6 acting as the stationary ring gear, and the respective pumping elements acting as planetary gears interposed therebetween. Because of the relationship of this construction to a gear train as mentioned, a definite speed ratio reduction of 2:1 is obtained between rotation of shaft 39 and the pumping elements rollably moved thereby. This factor is important in that it permits power source and prime mover economy.

FIG. 4 further shows that the respective pumping elements are maintained spaced from and independent of each other during operation of the pump. This condition produces additional product carrying pockets 67 between adjacent pumping elements. With this construction, the product is carried internally of the hollow elements and also between adjacent elements.

Means desirably is provided for maintaining the desired spacing between adjacent elements. In the embodiment of FIGS. 4 and 6, such spacing means comprises a series of freely rotatably cylindrical rods 68 interposed between adjacent pumping elements. Such rods may be of metal, such as steel, a suitable wear resistant plastic, or other non-metallic material, such as wood. These rods rotate generally about their own axes in the direction of the arrows shown thereon while at the same time they are moving about the housing axis during pump operations.

It should be understood that as the respective pumping elements roll past inlet port extension 58 upon rotation of rotor 51 that a change in pressure results due to such movement which produces a suction or vacuum at that location which results in product being drawn into and around the respective pumping elements. Such product thus drawn in is carried by and between the pumping elements through the passage to the generally diametrically opposite position at which it is discharged through outlet port 57.

That is, when the pump housing 6 is laterally shifted in a predetermined direction as illustrated in FIG. 4 so that the rotor member 51 and pump casing inner periphery 20 are eccentrically arranged, the shape of the respective elements will be continuously modified as the same move through the alternate converging and diverging extents of the displacement passage. As a pumping element is moved through passage 21, the cross-sectional configuration thereof will vary between the generally elliptical configuration shown to the right of FIG. 4 and the flattened elliptical configuration shown to the left of FIG. 4. That is, the respective elements are periodically changed in shape so as to be distended in the circumferential direction and contracted in the radial direction as the same move into and through the converging extent of the passage and vice versa as the same move into and through the diverging extent of the passage. As a result, product drawn into or between the elements will be forced therefrom as the elements pass through the converging extent of the displacement passage.

As further shown in FIG. 4, the generally arcuate

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apertures 61 and 62 through bearing plate 32 of the pump are positioned so that the same respectively commence and stop adjacent the two locations at which the passage walls are most closely related to each other and least closely related to each other when the walls are eccentrically arranged. As a result, product will be drawn into and between the respective pumping elements at the same begin to contract in the circumferential direction and distend in the radial direction. In similar fashion, product will be discharged by the elements at the same distend in the circumferential direction and contract in the radial direction. This results in automatic intake of product into the passage and discharge of product from the passage as the pumping elements alternately expand and flatten radially during pump operation.

It should be understood that this pump construction also is capable of operating as its own valve. That is, when rotor member 51 and inner periphery 20 of the housing 6 are concentrically arranged, substantially no product displacement therethrough will be effected by the pumping elements. Any slight product displacement due to the effects of centrifugal force which may result can be overcome by shifting housing 6 slightly beyond the concentric position to balance the centrifugal force effect and also to balance movement of residual product carried within the hollow pumping elements.

While in the embodiment shown in the drawings the pumping elements are of hollow tubular configuration, the same could be of solid deformable construction also. When of solid construction the pumping elements would have no internal product carrying pockets but the spacing therebetween would still be adapted to receive the product therein so that the primary function of the pump basically would remain unchanged. Irrespective of whether hollow or solid elements are employed, the same are to be deformable and resilient. As a result, products having discrete lumps or particles therein can be handled in that the pumping elements can deform to accommodate the same between the elements and the passage walls.

As seen in FIG. 4, pump housing 6 has been shifted to the right of the concentric position relative to the rotor member 51 so that port 56 will serve as the product inlet port when the rotor member is rotated in the clockwise direction. It should be understood, however, that if the housing were shifted to the left of the concentric position relative to the rotor member that the same clockwise rotation of such member would then result in reverse product flow so that the inlet port would then be port 57 and the outlet port would then be port 56. This factor is important in that the direction of product displacement may be readily and rapidly modified as desired merely by adjusting the thumb screws 7 and 8 to effect shifting of housing 6 to the right or left to give the product flow direction desired.

As an example of an important use of this aspect of the development, reference is directed to the schematic flow arrangement shown in conjunction with FIG. 4. Because the direction of flow of product through the pump is reversible the same is highly effective for mixing two or more products. For example, if a mixing tank is connected by conduits to port 57 and a predetermined quantity of a first product is positioned in such tank in any desirable manner, and if thereafter the pump housing is shifted to the right as seen in FIG. 4 to draw a predetermined quantity of a second product from a supply tank into port 56 and through the pump and discharge the same through port 57 into the mixing tank, mixing of two products therein may be readily effected. Thereafter, the same pump may be employed to withdraw the thoroughly mixed products from the mixing tank merely by shifting the housing to eccentrically offset the same in the opposite direction so that deformation of the respective pumping elements relative to ports 56 and 57 will

be reversed and the mixed products will be drawn from the mixing tank and transported back to the supply tank or to some other location.

In this connection, while thumb screw means have been illustrated for controlling the shiftable adjustment of the housing and rotor member 51 relative to each other, it should be understood that other mechanisms may be employed for effecting such shifting. If desired, pneumatic or hydraulic systems, servo motors or solenoids could be employed to effect rapid and automatic shifting of the housing from one position to another.

It should also be understood that the amount of eccentricity between the walls of the displacement passage will determine the rate of product displacement there-through with maximum eccentricity producing the largest flow volume.

As noted previously, the pumping elements are frictionally positioned between the rotor member 51 and the housing periphery so as to be drivably engaged therewith. If desired, the periphery of the rotor member and also the periphery of the housing may be roughened, knurled or otherwise modified to increase the frictional driving contact therebetween so that rolling of the elements will be insured. It would also be possible to provide the exterior of the rotor member 51 with teeth and to extrude the tubular pumping elements with cooperable external teeth for effecting a positive driving contact therebetween. However, because this latter alternative would increase the overall cost of the pump, it is not generally preferred. In this connection, the cost of the subject pump is maintained at a minimum because little machining is required on the elements thereof to ready the same for use.

While one embodiment of the means for driving the pumping elements through the displacement passage has been shown in FIGS. 4 and 6, various other modified means also may be employed. In this connection, reference is directed to FIG. 7 which shows a modified driving arrangement.

In this modified embodiment, the cylindrical member 71 which defines the inner wall of the displacement passage 21 is not rotatably driven but is merely mounted as an idler roller on an end of a shaft 72 which is to be operatively connected with the power source as described previously. However, connected to such shaft 72 for rotation therewith adjacent the pump casing 1 is a generally circular plate 73 which has projecting longitudinally of the pump housing a plurality of spaced pins 74 each of which is located internally of a pumping element 76 of the hollow tubular type described previously. With this construction it should be understood that upon rotation of shaft 72 and plate 73 therewith, pins 74 will effect rotation of the pumping elements about and through the annular product displacement passage for effecting product flow in the manner described previously.

If desired, longitudinally extending spacing elements 77 may be fixedly mounted on plate 73 to rotate therewith in the displacement passage to insure proper spacing and freedom from contact between adjacent pumping elements during pump operation. In this connection while FIG. 7 illustrates simultaneous use of both driving pins 74 and spacing elements 77 in the modified pump, it should be understood that the pins and spacers can be used independently of each other to effect movement of the pumping elements. If the spacers are employed without the pins, the spacer elements will be effective to engage from the rear and roll the pumping elements through the displacement passage. In other respects, the construction shown in FIG. 7 is generally the same as that described previously with pump housing 6 being laterally and adjustably shiftable relative to the cylindrical idler member 71 in the same manner previously described.

From the foregoing, it should be noted that this invention involves an adjustable flow pump construction which embodies a displacement passage for fluid products which

has alternately converging and diverging extents. In such passage, at least one and preferably a plurality of separate freely rollable deformable pumping elements are located. Because such elements are free of direct physical connection with the pump driving means and are free to rotate about their own axes as they move through the displacement passage, frictional drag between the elements and the passage walls as well as undue wear of the elements is greatly decreased.

While several embodiments of the subject invention have been described herein, it should be understood that modifications thereof which may become obvious to a person of ordinary skill in the art also are contemplated as falling within the purview of this invention and the same should be interpreted in light of the appended claims.

I claim:

1. A pump comprising a housing which has a product displacement passage therein the walls of which diverge relative to each other through a predetermined extent of said passage and converge relative to each other through another predetermined extent of said passage, a product inlet port communicating with said passage at one location and a product outlet port communicating with said passage at another location, a deformable and resilient pumping element movably positioned in said passage between the walls thereof, said element being frictionally engaged with said walls and rollable about its axis during movement through said passage, said element being adapted periodically to distend in one direction and contract in another direction and vice versa as the element moves between the converging and diverging walls of said passage, and means mounting one of said passage walls for movement relative to the other passage wall whereby upon movement of such one wall said element is rollably movable through said passage to cause such distention and contraction thereof.

2. A pump comprising a housing which has an annular product displacement passage therein the walls of which diverge relative to each other through a predetermined extent of said passage and converge relative to each other through the remainder of said passage, a product inlet port communicating with said passage at one predetermined location and a product outlet port communicating with said passage at another predetermined location, a plurality of separate deformable and resilient pumping elements movably positioned in said passage between the walls thereof, said elements being frictionally engaged with said walls and rollable about their respective axes therebetween, said elements being adapted periodically to distend in one direction and contract in another direction and vice versa as the same move through said passage between said converging and diverging walls, and means mounting one of said passage walls for movement relative to the other passage wall whereby upon movement of such one wall said elements are rollably movable through said passage to cause such distention and contraction thereof.

3. A pump comprising a housing which has an annular product displacement passage therein the walls of which diverge relative to each other through a circumferential extent of about 180° and converge relative to each other through the remainder of said passage, a product inlet port communicating with said passage at one predetermined location and a product outlet port communicating with said passage at another predetermined location, a plurality of separate deformable and resilient pumping elements movably positioned in said passage between the walls thereof, said elements being frictionally engaged with said walls and rollable about their respective axes therebetween, said elements being adapted periodically to distend in one direction and contract in another direction and vice versa as the same move through said passage between said converging and diverging walls, said elements being spaced from each other in said passage whereby product carrying pockets are provided there-

between, means for maintaining said elements spaced during movement thereof through said passage, and means mounting one of said passage walls for movement relative to the other passage wall whereby upon movement of such one wall said elements are rollably movable positively through said passage to cause such distention and contraction thereof.

4. The pump of claim 3 in which said elements are of hollow tubular configuration whereby additional product carrying pockets are provided internally of said elements.

5. A pump in which the product flow may be adjusted and varied within predetermined limits comprising a housing which has an annular product displacement passage therein, said passage being defined by a generally circular cylindrical outer wall and a generally circular cylindrical inner wall, said passage walls being eccentrically arranged so that said walls diverge relative to each other through a predetermined extent of said passage and converge relative to each other through the remainder of said passage, a product inlet port communicating with said passage commencing at a predetermined location adjacent the location at which said eccentrically arranged walls are most closely related, and a product outlet port communicating with said passage commencing at a predetermined location adjacent the location at which said walls are least closely related, a plurality of deformable and resilient pumping elements movably positioned in said passage for rolling movement between said passage walls, said elements having product carrying pockets therebetween, means mounting one of said passage walls for movement relative to the other passage wall whereby upon movement of such one wall said elements are rollably movable through said passage and past said ports, said elements periodically distending in one direction and contracting in another direction as the same are moved through said passage and vice versa to successively draw product into said housing and subsequently discharge the same therefrom, and means for selectively modifying the eccentric relationship between said passage walls whereby the product displacement therethrough may be selectively varied.

6. A pump in which the product flow may be adjusted and varied within predetermined limits comprising a housing which has an annular product displacement passage therein, said housing having a generally circular cylindrical inner periphery which defines the outer wall of said passage, a generally circular cylindrical member positioned internally of said housing and spaced from the inner periphery thereof, the outer periphery of said member defining the inner wall of said passage, means for laterally moving said housing and member relative to each other whereby said member and said housing may be selectively eccentrically or concentrically arranged relative to each other, a product inlet port communicating with said passage at a predetermined location and a product outlet port communicating with said passage at another predetermined location, a plurality of deformable and resilient pumping elements movably positioned in said passage each of which is distendable in one direction and contractable in another direction and vice versa as the same move through said passage, means movable in said passage for maintaining said elements spaced during such distention and contraction thereof, and means mounting said cylindrical member for rotary movement relative to said housing periphery whereby upon rotation of such member said elements are rollably movable in unison through said passage past said ports whereby product flow through said housing may be selectively effected in relationship to the eccentric arrangement of said passage walls.

7. The pump of claim 6 in which said elements are frictionally engaged between said member and said housing inner periphery, and in which said pump includes mechanism for rotating said member within said housing

whereby said elements roll within said passage upon rotation of said member.

8. A variable discharge pump through which a flowable product may be moved selectively in quantities variable from zero to a predetermined maximum, comprising a pump casing, a housing operatively engaged with said casing and slidably adjustable relative thereto, said housing having a generally circular cylindrical inner periphery, a rotor member which has a generally circular cylindrical outer periphery positioned in said housing and rotatably supported therein on a shaft which extends through said casing into said housing, said inner periphery of said housing and said outer periphery of said rotor member defining outer and inner walls respectively of an annular product displacement passage provided therebetween, a product inlet port extending through said casing into said housing into communication with said passage at a first predetermined location, and a product outlet port communicating with said passage at another predetermined location and extending therefrom into and through said casing, a plurality of hollow generally tubular deformable and resilient pumping elements rollably positioned in said passage for movement therein past said inlet and outlet ports, said hollow elements providing product carrying pockets therein, spacer means mounted for movement in said passage for maintaining said elements separated whereby additional product carrying pockets are provided between adjacent elements, said elements being frictionally positioned between and engaged with the walls of said passage and being rollable therebetween, and means mounting said housing for sliding adjustment relative to said rotor member whereby said housing and rotor member may be concentrically arranged or selectively eccentrically arranged in one of two directions relative to each other, said pump when said housing and rotor member are eccentrically arranged in one direction being capable of effecting product displacement through said passage from said inlet port to said outlet port, said pump when said housing and rotor member are eccentrically arranged in the other direction being capable of reversing the direction of such product displacement, such displacement being generally zero when said housing and rotor member are concentrically arranged.

9. The pump of claim 8 in which said housing is provided with a guide slot at an end thereof, and a guide bar located in said slot, said bar being secured to said casing and holding said housing adjustably engaged therewith.

10. A pump structure which includes an annular product passage defined by two generally circular cylindrical peripheral surfaces of two members which comprise said structure one of which is arranged within the other, product inlet and outlet ports through said structure in communication with said passage, means for moving rotatably one of said members and its peripheral surface relative to the other, deformable pumping elements positioned in said passage for movement therein, said elements being frictionally engaged between said surfaces and rollable therebetween in response to rotation of said one surface, and means mounting said two members for adjustment relative to each other, whereby said surfaces of said members may be selectively concentrically or eccentrically arranged, said structure being capable of producing product displacement from zero to a predetermined maximum depending upon the relationship of said surfaces to each other, said displacement being zero during operation of said structure when said surfaces are substantially concentrically related.

11. A pump comprising a housing having a product displacement passage therein the walls of which converge relative to each other for a predetermined extent of said passage and diverge relative to each other for the remainder of said passage, product inlet and outlet ports in communication with said passage at predetermined locations, a plurality of deformable pumping elements posi-

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tioned in said passage for movement past said ports, each of said elements having a hollow generally elliptical, cross-sectional configuration whereby product carrying pockets are provided internally of said elements, said elements being spaced from each other whereby additional product carrying pockets are provided between adjacent elements, and means mounting one of said passage walls for movement relative to the other passage wall whereby upon movement of such one wall said elements are rollably movable through said passage past said ports, the cross-sectional configuration of each element periodically

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varying between said generally elliptical configuration and a distended and flattened elliptical configuration as such element moves between said converging and diverging walls of said passage, whereby product is drawn into said pockets at said inlet port and discharged therefrom through said outlet port.

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