June 23, 1942. S. F. ANDERSON 2,287,369

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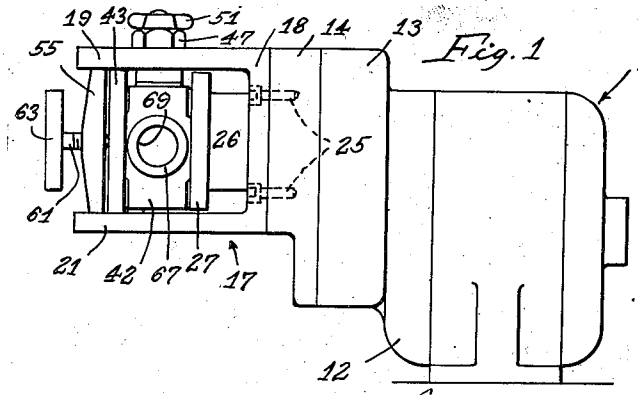


Fig. 1

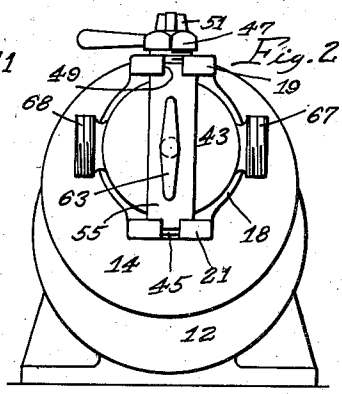


Fig. 2

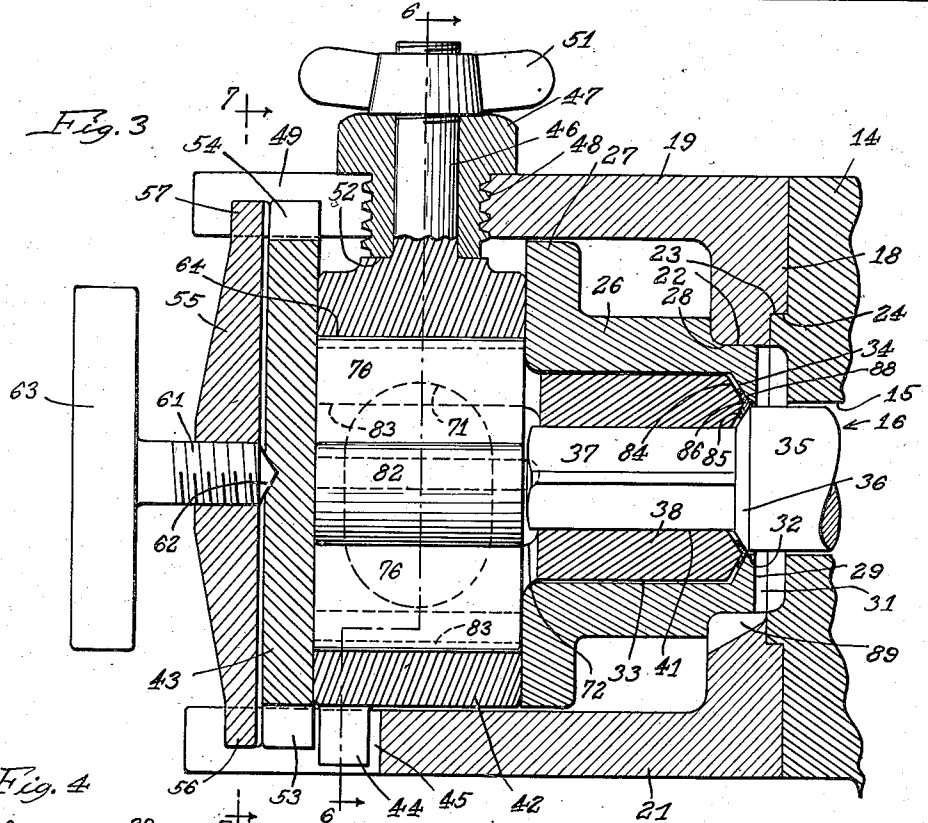


Fig. 3

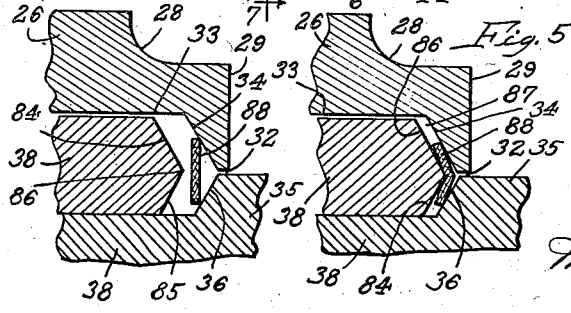


Fig. 4

Fig. 5

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Fig. 6

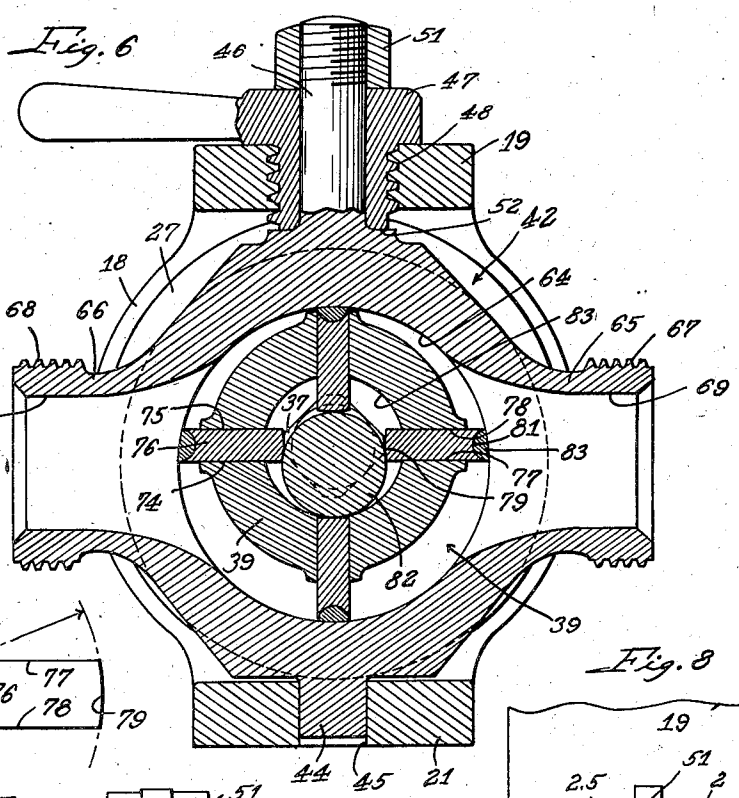


Fig. 6A

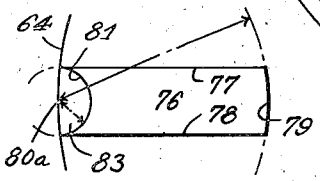


Fig. 8

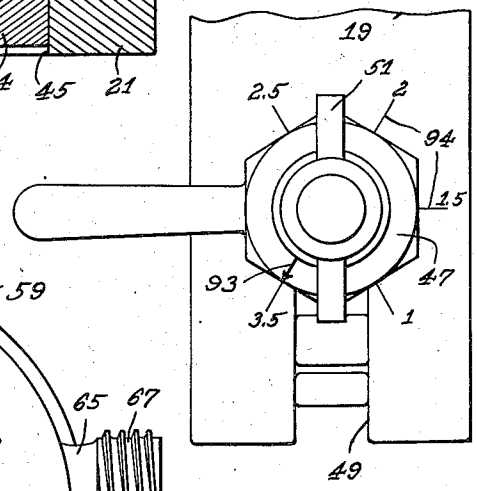
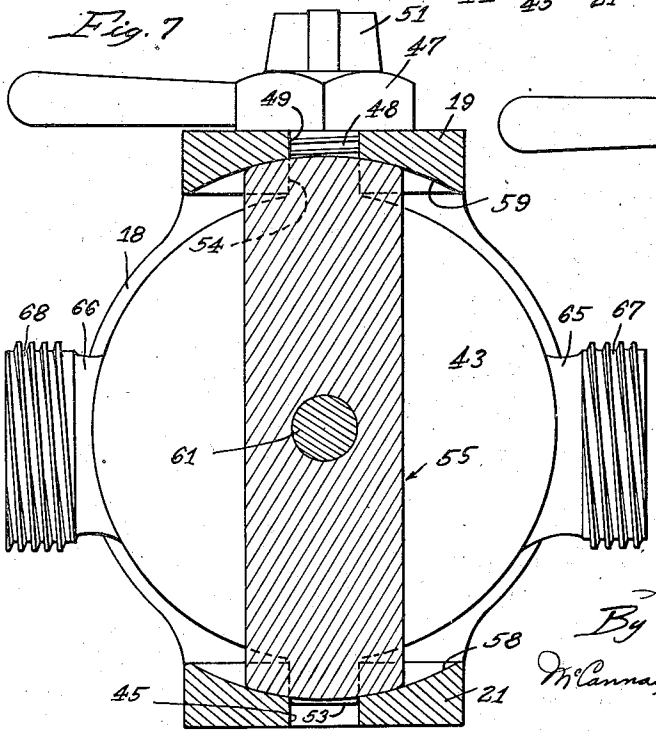


Fig. 7



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Fig. 10

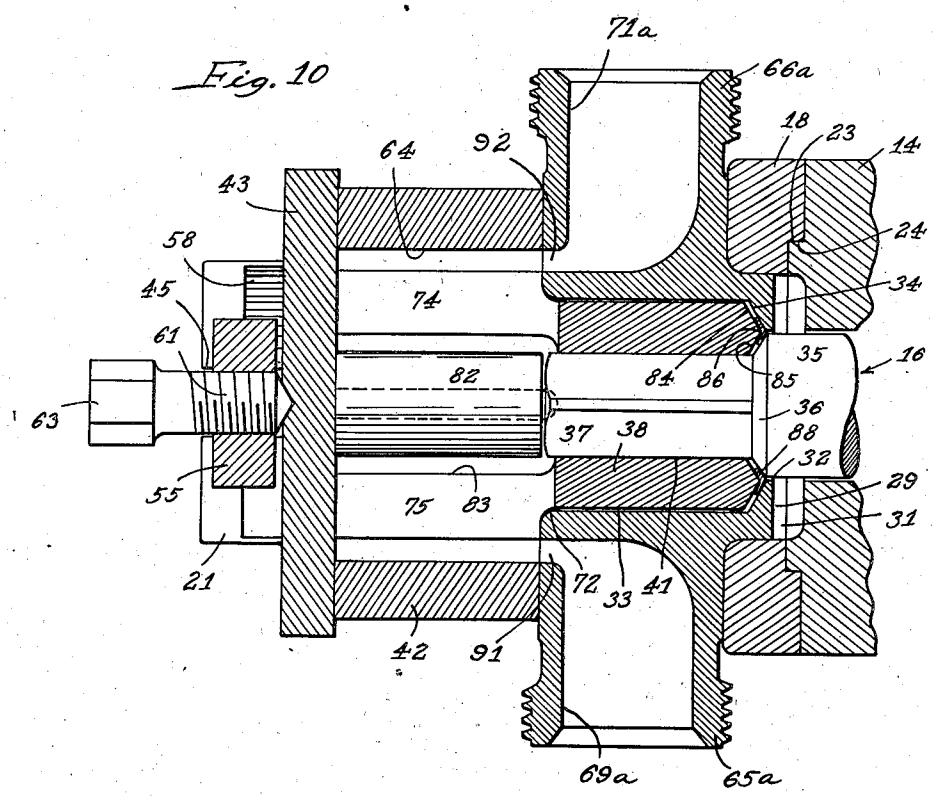
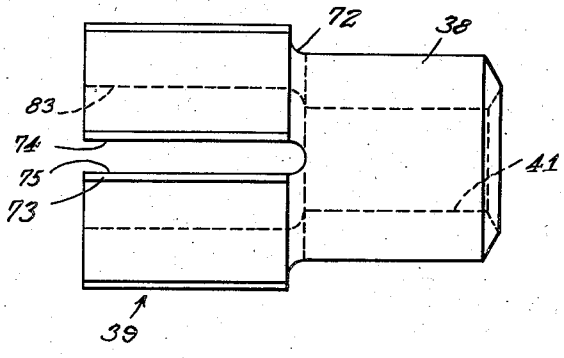


Fig. 9



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UNITED STATES PATENT OFFICE

2,287,369

PUMP

Swan F. Anderson, Rockford, Ill.

Application January 31, 1940, Serial No. 316,472

14 Claims. (Cl. 103—136)

This invention relates to pumps, and has special reference to a pump structure particularly well suited for handling semi-liquids or thick and viscous liquids, though equally capable of handling liquids of nigh fluidity.

An important object of the invention is the provision of a rotary pump of generally improved design including the provision of a simplified construction which may be made at lower cost, a construction which may be easily and thoroughly cleaned, and may be disassembled with a minimum of effort to accomplish the cleaning thereof, and including a novel arrangement of parts and a novel construction for preventing leakage from the pump.

Other objects and advantages will appear from the following description and the accompanying drawings, in which—

Figure 1 is a side view showing one embodiment of my invention;

Fig. 2 is an end view showing an adjusted position thereof;

Fig. 3 is a vertical section taken longitudnally through the pump;

Figs. 4 and 5 are fragmentary views through the spider hub showing the structure by which leakage is prevented;

Fig. 6 is a section on the line 6—6 of Fig. 3;

Fig. 6a is a diagrammatic view of a pump vane showing the structure thereof;

Fig. 7 is a section on the line 7—7 of Fig. 3;

Fig. 8 is a fragmentary top view showing the means for adjusting the capacity of the pump;

Fig. 9 is a side view of the pump spider, and

Fig. 10 is a horizontal section taken longitudinally through a modified form of the pump.

In the embodiment of the invention herein shown, the pump is attached directly to the housing of a motor, but in certain phases the invention is not limited to such a construction, but may be independently mounted and driven from a motor in the usual manner. The structure herein shown is designed particularly for the handling of ice cream and other dairy products, and thus has certain features directed to a so-called sanitary pump in which all of the pump parts which come into contact with the material may be removed for washing and sterilization. Attention is directed to the fact that all inside corners are eliminated and are replaced by arcuate surfaces to prevent the deposit of unsanitary solids in such corners. The numeral 11 designates a conventional electric motor, in this instance having an end bell 12 to which is attached a gear casing 13 for the purpose of changing the speed of the shaft which projects therefrom to a speed different from that of the armature shaft. Attached to and forming the end wall of the gear casing 13 is a plate 14 having an opening 15 through which a driven shaft 16 projects. Attached to the plate 14 is a U-shaped yoke designated generally by the numeral 17 having a central portion 18 and outwardly extending arms 19 and 21. The central portion 18 is provided with a bore 22 through which the shaft 16 projects, and a counterbore 23 adapted to receive a boss 24 on the plate 14 for the purpose of locating the bracket with respect to the plate. The bracket is secured thereto by a plurality of cap screws 25 or by other suitable means. It will be understood, of course, that the yoke may take a number of different specific forms and the arms may be cylindrical portions and still perform the required function.

Seated between the arms 19 and 21 is a sleeve 26 having an annular end flange 27 and a portion 28 at the opposite end thereof, which portion is of reduced cross-section and seats within the bore 22, the end of the sleeve being spaced from the bottom of the counterbore 23 a short distance as shown at 29 to provide a narrow annular chamber 31 surrounding the shaft 16. The sleeve 26 has a bore 32 in the area 28 of reduced cross-section and a counterbore 33 of substantially greater diameter, the bore and counterbore being connected by a conical portion 34. The bore 32 is of slightly greater diameter than the shaft 16, and the shaft is received therein.

The shaft 16 has a cylindrical portion 35 which projects slightly beyond the bore 32, as best shown in Fig. 3, and thereafter tapers inwardly as shown at 36, terminating in a squared or other irregular shaped end portion 37, which squared end portion projects through the sleeve 26 to a point spaced slightly inward from the plane of the flanged end of the sleeve. A spider, best shown in Fig. 9 and having a hub portion 38 and a substantially cylindrical spider portion designated at 39, is in part positioned in the sleeve 26, the hub portion 38 having a square axial opening 41 receiving the squared end 37 of the shaft 16, whereby the hub portion 38 seats in the area betwen the squared portion 37 of the shaft and the counterbore of the sleeve 26. Preferably the hub portion has clearance with respect to the counterbore of the sleeve 26, as best shown in Fig. 3.

The flanged end 27 of the sleeve 26 forms one end member of a pump cylinder which also includes a pump cylinder member designated gen-

erally by the numeral 42 and an end plate 43. The cylinder member 42 has a depending lug 44 which seats freely in a slot 45 extending longitudinally of the leg 21 and has an upstanding pin 46 upon which is received for free rotation a nut 47 having a handle or lever and an exteriorly threaded offset sleeve portion 48 which seats in a threaded opening in the arm 19, which threaded opening communicates with a longitudinally disposed slot 49 extending from the end of the arm 19 inwardly. The upper end of the pin 46 is threaded for the reception of a wing nut 51 which co-acts with the nut 47 and threaded portion 48 to vary the position of the cylinder portion 42. The cylinder portion 42 has a shoulder 52 annularly of the pin 46 against which the lower end of the threaded sleeve portion 48 seats, whereby upon loosening of the nut 51 and rotation of the nut 47 in one direction, the cylinder member is forced downwardly with respect to Figs. 3 and 6, and upon rotation of the nut 47 in the offset direction the cylinder member is moved upwardly with respect to the remainder of the parts. The nut 51 also serves as a lock nut for the purpose of preventing accidental rotation of the nut 47. The lug 44 serves to locate the lower end of the cylinder member with respect to the arm 21. The pin 46 is of slightly lesser diameter than the width of the slot 49 whereby upon removal of the nuts 47 and 51 the cylinder member may be moved endwise to remove the cylinder from the yoke, the pin 46 and the lug 44 moving through the slots 45 and 49. The end plate 43 is of generally cylindrical shape, as best shown in Fig. 7, and has a depending lug 53 received in the slot 45 and an upstanding lug 54 freely received in the slot 49, so that the plate unless held as presently described, can be removed by merely sliding the plate toward the left facing Fig. 3 until the lugs 53 and 54 are disengaged from the slots 45 and 49.

The parts are held in assembled relation by a yoke bar 55 having a thickened central portion, the ends 56 and 57 of which are received in grooves 58 and 59 in the arms 21 and 19, respectively, these grooves extending transversely to the slots 45 and 49. The bar 55 is of greater width than the width of the slots 45 and 49 so that there is no possibility for the ends of the bar being displaced through the slots. The yoke bar 55 has a threaded central opening within which is disposed a yoke screw having a threaded portion 61 provided with a conical point 62 and a handle portion 63. In operation, the yoke bar 55 is seated against the end plate 43 and rotated so as to bring the ends of the bar into the grooves 58 and 59 in the manner shown in Fig. 7. Thereupon the yoke screw is rotated whereby to apply pressure to the end plate 43, which in turn applies pressure to the cylinder member 42 the pressure being transmitted therethrough to the sleeve 26, whereby the parts are compressed and firmly held in assembled relation. It will be seen that this forms a quick acting means for releasing the pump elements for assembling and disassembling. The inner face of the end plate 43, the face of the flange 27, and the opposed edges of the cylinder member 42 are smooth and plane, so that when compressed together there will be no leakage at the interface between these members. This arrangement permits of laterally adjusting the position of the cylinder member and thereby adjusting the capacity of the pump while in operation.

The cylinder member 42 has a cylindrical central bore 64 and laterally disposed flanges 65 and 66 provided with exterior threads 67 and 68 and central passages 69 and 71 for the transmission of fluid to and from the cylindrical bore 64, which bore forms the chamber of the pump (note Fig. 6). As will be noted from Fig. 9, the spider portion 39 is of somewhat greater diameter than the hub portion 38 and is connected thereto by an arcuate shoulder 72 extending annularly of the spider member. The spider portion has in this instance four vanes equally spaced around the spider portion, each of the vanes being seated in an opening 73. Each of these openings has parallelly disposed sides 74 and 75 adapted to bear against a vane 76 seated therein so as to substantially prevent the passage of fluid along the interface between the sides of the vane and the sides of the opening. Each of these vanes has parallelly disposed sides 77 and 78 and a convex edge 79 and a concave edge 81. The convex edge 79 of the vanes is adapted to bear against a plug 82 which is seated in an axial bore 83 within the spider portion 39, the relationship of the parts being such that the edges 79 of all of the vanes are continuously in seating contact with the plug 82 to maintain the vanes in sealing contact with the bore 64. Seated in the concave edge 81 of the vane is a rocker member 83 having an arcuate side corresponding in curvature to the concave edge 81 and an arcuate opposite side corresponding in curvature to the curvature of the bore 64 so that as the vane moves along the inner wall of the pump chamber, the rocker member rotates slightly against the convex edge whereby to maintain sealing contact against the chamber wall throughout substantially the width of the vane. The concave edge 81 and the convex edge 79 of the vane are generated about a single center 80a which falls on the interface between the rocker member 83 and the wall of the pump chamber, as indicated in Fig. 6a, and through this arrangement the inner edge 79 of the vane, the plug 82, the rocker member 83 and the inner wall of the pump chamber are maintained in contact throughout the full circumference of the pump chamber, regardless of the elevation of the cylinder member and the consequent eccentricity of the spider member with respect to the pump chamber.

It will be seen that up rotation of the shaft 16, the spider portion 39 and the vanes incorporated therein are rotated through the action of the squared end 37 and the squared bore 41. If the spider member is concentric with respect to the chamber 64, as shown in Fig. 2, no pumping action will occur, but with eccentricity therebetween, for example, as shown in Fig. 6, liquid will be drawn into the pump chamber through either the openings 69 or 71, depending upon the direction of rotation of the shaft and will be discharged through the other of said openings.

While the ends of the spider portion 39 are adapted to seat in close relationship with the end walls of the pump chamber, namely, the inner faces of the end plate 43 and flange 27 and the vanes are likewise adapted to seat in closely fitting relationship therewith, yet in some circumstances a certain amount of leakage may occur and the material may tend to pass outward along the hub portion 38. Novel means are provided for preventing this material from working inward along the cylindrical portion 35 of the shaft 16, and for preventing its escape from the chamber. This means includes the conical wall 34 connecting the bore 32 and counterbore 33,

the sloping shoulder 36 connecting the shaft portions 35 and 37, and also includes conical end walls 84 and 85 on the hub portion 38, which conical walls converge as shown at 86 (note Figs. 4 and 5). This structure produces an annular chamber 87, of V-shaped cross-section as shown in Fig. 5, the edge occurring at 86 being opposite the space between the bore 32 and the cylindrical portion 35 of the shaft. Positioned in this chamber is a washer 88 of relatively stiff yet flexible material, such, for example, as a fiber washer, the width of the washer being such that when the parts are drawn into the operating position as shown in Fig. 3, the washer is distorted as shown in Fig. 5 by action of the edge 86, thereby producing an annular line of contact between the edge 86 and the center portion of the washer, between the conical wall 36 of the shaft and the inner edge portion of the washer, and between the conical wall 34 and the outer edge of the washer, these areas of contact being best shown in Fig. 5. I have found that this is a very satisfactory structure for producing a seal at this point such that the parts may also be readily disassembled, and that this seal is highly effective for the purpose. However, I have provided a vent opening 89 extending from the lowermost point in the chamber 31 to the outside so that should there be any escape of material into the chamber 31, this material may drain out through the opening 89 and thereby avoid the production of pressure within the chamber 31 which might force the material back into the motor through the bore 15.

The structure heretofore described and shown in Figs. 1 to 9, inclusive, has the advantage of simplicity, but it will be noted from Fig. 6 that with movement of the cylinder member 42, the connecting members 65 and 66 also move upward and downward, which has the disadvantage in some instances of disturbing the pipe connections. Where this is objectionable a structure such as shown in Fig. 10 may be employed, wherein comparable inlet and outlet connections designated as 65*a* and 66*a* are provided on the sleeve portion 26 (which may be integral with the yoke if desired), rather than on the cylinder member 42, and have openings 71*a* and 69*a* which connect with ports 91 and 92, which ports pass through the flange 27 and communicate with the pump chamber directly adjacent the bore 64 of the cylinder member 42. These ports 91 and 92 are in the nature of elongated slots so as to maintain communication in any adjusted position of the cylinder member 42. It will be seen with this arrangement that the pipe connections remain stationary with adjustment of the capacity of the pump.

The capacity of the pump being variable by rotation of the nut 47, this capacity can be indicated in the manner shown in Fig. 8, wherein the nut has an arrow or other indication as shown at 93 adapted to cooperate with a scale 94 positioned on the upper surface of the arm 19.

It will be seen that the pump structure is particularly well adapted for the handling of viscous or semi-fluid liquids. This particular pump is designed for the handling of ice cream, but it should be noted that while designed for this purpose, it is equally well suited for the handling of more fluid liquids. It will be seen that the pump can be entirely disassembled or assembled by merely rotating the yoke screw through a part of a turn or sufficient to remove the conical point 62 thereof to a point below the plane of the inner face of the yoke bar 55, and by removing the nut 47. Thereupon all of the parts of the pump may be lifted out. This is accomplished entirely without the use of tools of any kind. When disassembled, it will be seen that the parts of the pump are provided with arcuate corners, and that no sharp recesses are present within which material may collect to render the device unsanitary.

Of particular importance in this structure is the construction which permits of ease and rapid disassembly, the provision of improved means for preventing the escape of fluid from the pump, the construction of the pump vane, the manner in which the capacity of the pump may be altered without disturbing other parts of the pump, and similar features heretofore described.

I claim:

1. The combination in a demountable pump of a yoke comprising a central portion and spaced arms extending therefrom disposed in parallel disposed spaced relation and forming a fixed frame for the pump, a pump casing comprising a one-piece cylinder of relatively thick rigid material disposed between said arms having plane ends, projecting portions anchored in said arms to retain the same against rotation, and laterally disposed inlet and outlet flanges, a rotary movable vane impeller in said cylinder, an end member disposed between one end of said cylinder and said central portion, said end member and said frame being shaped for reception of the end member in free locating abutment with said frame, an end member disposed against the opposite end of said cylinder shaped for locating abutment with respect to said arms, said end members having plane accurately finished faces arranged to abut the ends of said cylinder in sealing relationship to form therein a pump chamber, and a clamp acting between said arms and the last mentioned end member manually operable to compress said end members and said cylinder against said central portion to press said faces against the ends of said cylinder member and thereby seal the junction therebetween against leakage, said arms and said clamp being the sole means for securing the parts together.

2. The combination in a demountable pump of a yoke comprising a central portion and spaced arms extending therefrom disposed in parallel disposed spaced relation and forming a fixed frame for the pump, a shaft extending through said central portion, a pump casing comprising a cylinder of relatively thick rigid material disposed between said arms having plane ends and shape characteristics for engagement with said arms for non-rotative longitudinal and lateral movement of said cylinder with respect to said arms, the space between said arms and said cylinder being unobstructed for lateral movement of said cylinder with respect to said yoke, an end member disposed between one end of said cylinder and said central portion, said end member and said frame being shaped for reception of the end member in free locating abutment with said yoke, and an end member disposed against the opposite end of said cylinder shaped for sliding and non-rotating abutment with said arms, said end members having plane accurately finished faces abutting the ends of said cylinder in sealing relationship to form therein a pump chamber, said casing having inlet and outlet ports to said chamber, a sliding vane rotary impeller in said chamber having driving engagement with said shaft, a clamp acting between said arms and the last mentioned end member manually operable to

compress said end members and said cylinder against said central portion to hold said yoke, cylinder and end members in assembled relation and to press said faces against the ends of said cylinder member and thereby seal the junction therebetween against leakage, said arms and said clamp being the sole means for securing the parts together, and means acting between said cylinder and one of said arms for securing said cylinder in any of a plurality of fixed adjusted positions laterally between said arms.

3. The combination in a demountable rotary pump comprising a U-shaped frame having a central portion and spaced arms, a demountable pump casing comprising an inner end member shaped to interfit with said frame adjacent the bottom of the U-shaped frame, a cylinder member slidable from the open end of the frame into position against a face of said end member, said cylinder interfitting with said arms to prevent rotation of the cylinder, and a second end member also slidable from the open end of said frame into position against the end of said cylinder to form a pump chamber and interfitting with said arms to prevent rotation of said second member, said casing having inlet and outlet ports to said chamber, the ends of said cylinder being plane and the faces of said end members contacting said cylinder being plane through an area substantially greater than the end of said cylinder, a clamp fitting between said arms and said second end member to urge said members into assembled relation against said central portion of the frame, a rotary impeller in said cylinder, means extending through the first mentioned end member for driving said impeller, and screw threaded means acting between said arms and said cylinder member for sliding said cylinder member laterally between adjusted operating positions to vary the capacity of the pump.

4. The combination in a rotary type sanitary pump, of a casing comprising an end member having a plane face positioned to form one end of a cylinder chamber and spaced arms integral therewith projecting therefrom, the opposite ends of said arms being free, an end plate having a plane face positioned to form the other end of a cylinder chamber, a driving shaft extending through said end member and into the space between said arms, a cylinder member having a smooth cylindrical inner surface and parallel relatively wide plane end faces seating in metal to metal contact against the plane faces of said end member and said end plate to complete the cylinder chamber, said faces being plane to a degree to provide a metal to metal seal at the ends of said cylinder, said casing having inlet and outlet ports communicating with said chamber, a rotatable pump member removably seated on said shaft within said cylinder member, the foregoing parts being shaped for free reception one against the other along the axis of said shaft, said pump member being slidable onto said shaft over the end thereof and having vanes operative against the inner walls of said cylinder member, and means at the outer ends of said arms urging the cylinder member, the rotatable pump member, and the end plate together into assembled relation with said shaft and against said end member to secure the pump in assembled, sealed relationship.

5. The combination in a demountable sanitary pump of a frame member having spaced arms, a pump casing comprising a cylinder member between said arms having plane ends and a central cylindrical opening forming a pump chamber, end members having plane faces of substantially greater area than the ends of said cylinder member shaped to seat against the ends of the cylinder member to complete the pump chamber and to permit sliding lateral movement of the cylinder member with respect to the end member, one of said end members seating in locating abutment against said frame member, said casing having inlet and outlet ports communicating with said chamber, and a quick releasable clamp acting between said arms and the other of said end members to urge the end members against the cylinder and apply pressure therebetween to confine the cylinder member therebetween and prevent leakage from said chamber, a rotatable vane type impeller within said pump chamber, and manually operable means for moving the cylinder member laterally between fixed operating positions to adjust the normal capacity of the pump.

6. The combination in a demountable sanitary pump of a casing comprising a cylinder member having plane ends and an opening forming a pump chamber, and end members having plane faces shaped to seat against the ends of said cylinder member to confine the ends of the pump chamber and align the cylinder member, said casing having inlet and outlet ports communicating with said chamber, a rotary vane type impeller in said chamber, spaced arms fixed with respect to one of said end members, interfitting shape characteristics on said cylinder member and said arms to prevent rotation of the cylinder member, clamp means acting between said arms and the other of said end members for confining the cylinder between the end members and applying pressure therebetween, and manually operable means acting between said arms and said cylinder member for moving the cylinder member transversely with respect to the end members and said impeller to adjust the relative eccentricity of the cylinder member and impeller between any of a plurality of fixed positions to adjust the normal capacity of the pump.

7. The combination in a pump of a frame structure having a central portion and parallel arms, a pump casing comprising a cylinder member disposed between said arms having open ends provided with parallel plane faces and laterally disposed openings therein providing inlets and outlets thereto, a flanged member seated in said frame structure between said arms in abutting relation with said frame structure and having a plane surface in metal to metal abutting relation with one end face of said cylinder member, a rotatable vane impeller positioned in said cylinder in endwise abutting relationship with said flanged member and said end plate, and quick releasable means acting between said frame and said end plate for urging together into sealed operative relationship said end plate, cylinder, flanged member, and rotatable vane impeller constituting all parts of the pump contacting material being pumped, and for simultaneously releasing the same to separate to disassembled relationship for cleaning.

8. The combination in a pump of a cylinder member having an opening forming a pump chamber, a rotary vane type impeller in said chamber, end members shaped to seat against the ends of said cylinder member to confine the ends of the pump chamber, one of said members having inlet and outlet ports communicating with said pump chamber, spaced arms fixed with re-

spect to one of said end members and having longitudinal slots therein, key means projecting from said cylinder member for reception in said slots to locate the cylinder member and prevent rotation thereof, quick releasable clamp means acting between said arms and the other of said end plates for confining the cylinder between the end members and maintaining alignment thereof, and screw means acting between the projecting means of said cylinder member and said arms for moving the cylinder member laterally across said end member to vary the degree of relative eccentricity between the cylinder member and the impeller to change the capacity of the pump.

9. The combination in a demountable pump of a pump casing comprising a yoke having a central member and spaced arms integral therewith extending therefrom disposed in parallel disposed spaced relation and forming a fixed frame for the pump, a cylinder member of relatively thick rigid material disposed between said arms having plane ends, a central pump chamber, and portions anchored to said arms to retain the same against rotation, the space between said arms and said cylinder being substantially unobstructed, an end member disposed between one end of said cylinder and said central member and an end member disposed against the opposite end of said cylinder, said end members having plane faces arranged to abut the ends of said cylinder to close the openings therein and form a pump chamber, said casing having spaced inlet and outlet ports communicating with said chamber, a vane type impeller in said chamber, and a clamp acting between said arms and the last mentioned end member manually operable to compress said end members and said cylinder against said central member to press said faces against the ends of said end member and thereby seal the junction therebetween against leakage, said arms and said clamp being the sole means for securing the parts together.

10. The combination in a demountable pump of a pump casing comprising spaced end members having plane opposed faces, and a heavy walled cylinder disposed between said faces having plane ends positioned to abut said plane faces to seal the ends of said cylinder and form a pump chamber, said casing having inlet and outlet ports to said chamber, a sliding vane type rotary pump element within said cylinder, a shaft projecting through at least one of said end members to drive said pump element, means for urging said end members together to press said faces against the ends of said cylinder and thereby seal the cylinder against leakage, said cylinder being the sole means for spacing said end members, and means for sliding said cylinder laterally with respect to said end members between any of a plurality of fixed operating positions while so compressed to adjust said pump to preselected capacities.

11. The combination in a rotary pump of a yoke having a central portion and parallel spaced arms, each of said arms having open ended slots extending inwardly from the ends thereof, one of said slots terminating in a threaded opening, a pump casing supported on said yoke comprising a cylinder member having projections on opposite sides thereof receivable in said slots to support the cylinder member and confine said member against rotation, screw means acting between said threaded opening and one of said projections to move said cylinder member transversely of its axis to adjust the capacity of the pump, end members positioned to abut against the ends of said cylinder member to form a pump chamber, said casing having inlet and outlet ports communicating with said chamber, quick acting means on said arms for urging said members together to form a pump casing, and a rotary vane type impeller in said cylinder member.

12. The combination in a rotary pump of a pump casing comprising a cylinder member having a pump chamber, and means for closing the end of the pump chamber comprising an end wall having an opening, said casing having inlet and outlet ports communicating with said chamber, a shaft projecting into said chamber through said opening, a rotary pump impeller positioned in said chamber and driven by said shaft, said end wall and said shaft each having walls diagonally disposed with respect to the longitudinal center line of said opening shaped to provide a chamber of V-shaped cross-section having the point thereof terminating at the interface between the shaft and said opening, and a flat ring of gasket material seated in said chamber and distorted to a V-shaped cross-section to seal the junction between the parts.

13. The combination in a rotary pump of a cylinder member having a pump chamber, a rotary pump member positioned therein and having a hub portion, a shaft projecting into said hub portion, and means for closing the end of the pump chamber comprising an end wall having an opening for said shaft, said hub, said end wall and said shaft being shaped to provide a chamber of V-shaped cross-section having the point thereof terminating at the interface between the shaft and said opening, and a flat ring of gasket material seated in said chamber and distorted to a V-shaped cross-section to seal the junction between the parts.

14. The combination in a pump of an end member having an opening, a shaft disposed in said opening, said end member and said shaft each having an annular surface tapering toward the junction between the shaft and the end member, a hub disposed within the end member and carried on said shaft, said hub having an end tapering to a circular outwardly disposed edge opposite the junction between said shaft and said end member, and a resilient distortable washer ring engaged at the midpoint of its periphery by said edge, the edges of said washer bearing against said sloping surface and being distorted by said edge to close the junction between the shaft and the end member.

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