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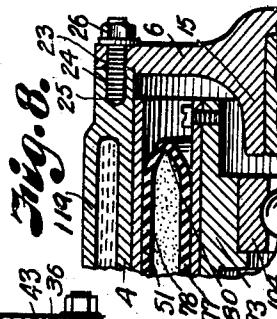
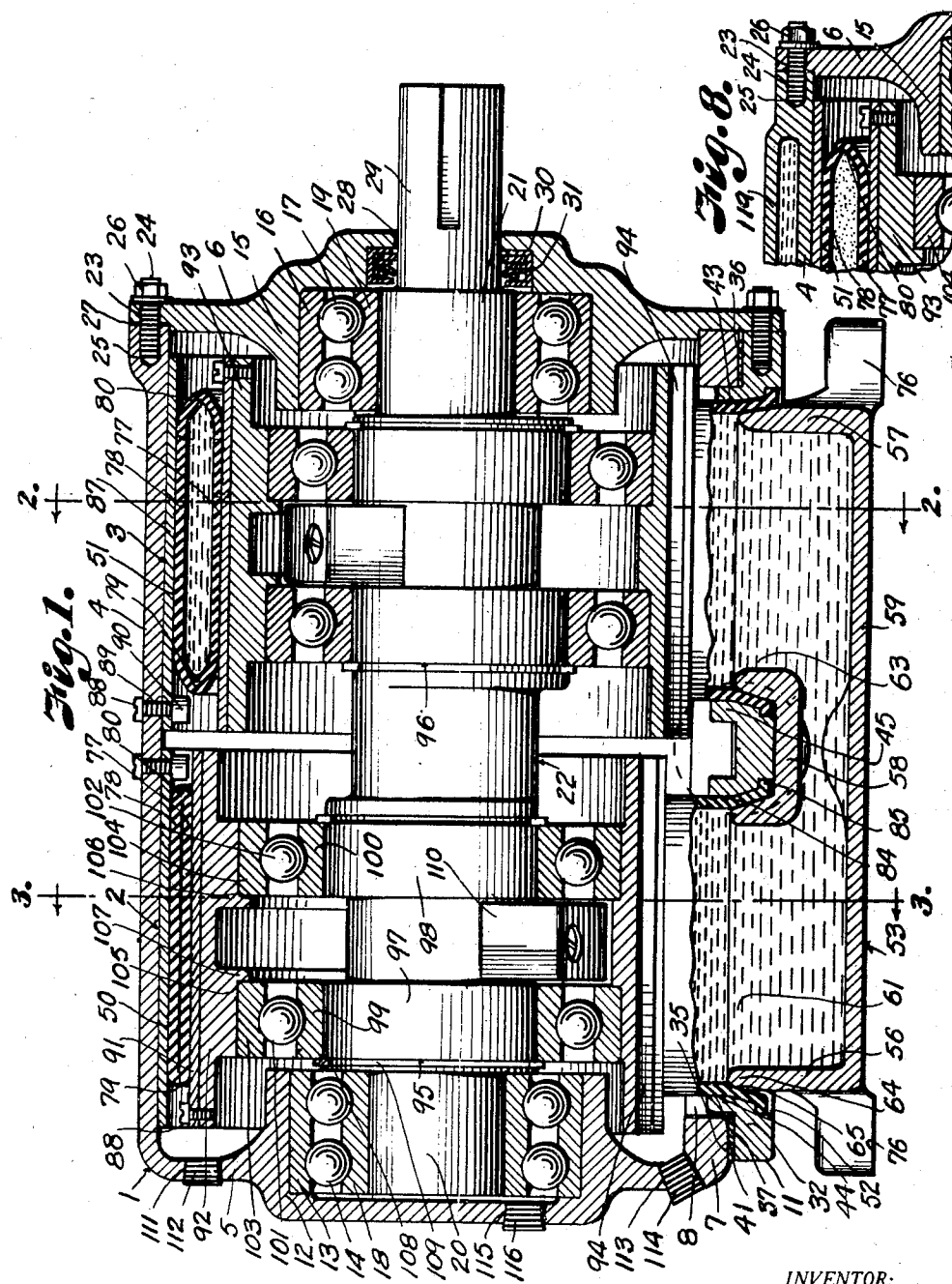
N. DOUGLAS

2,428,619

ROTARY PUMP OR THE LIKE

Filed Nov. 6, 1944

6 Sheets-Sheet 1



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Oct. 7, 1947.

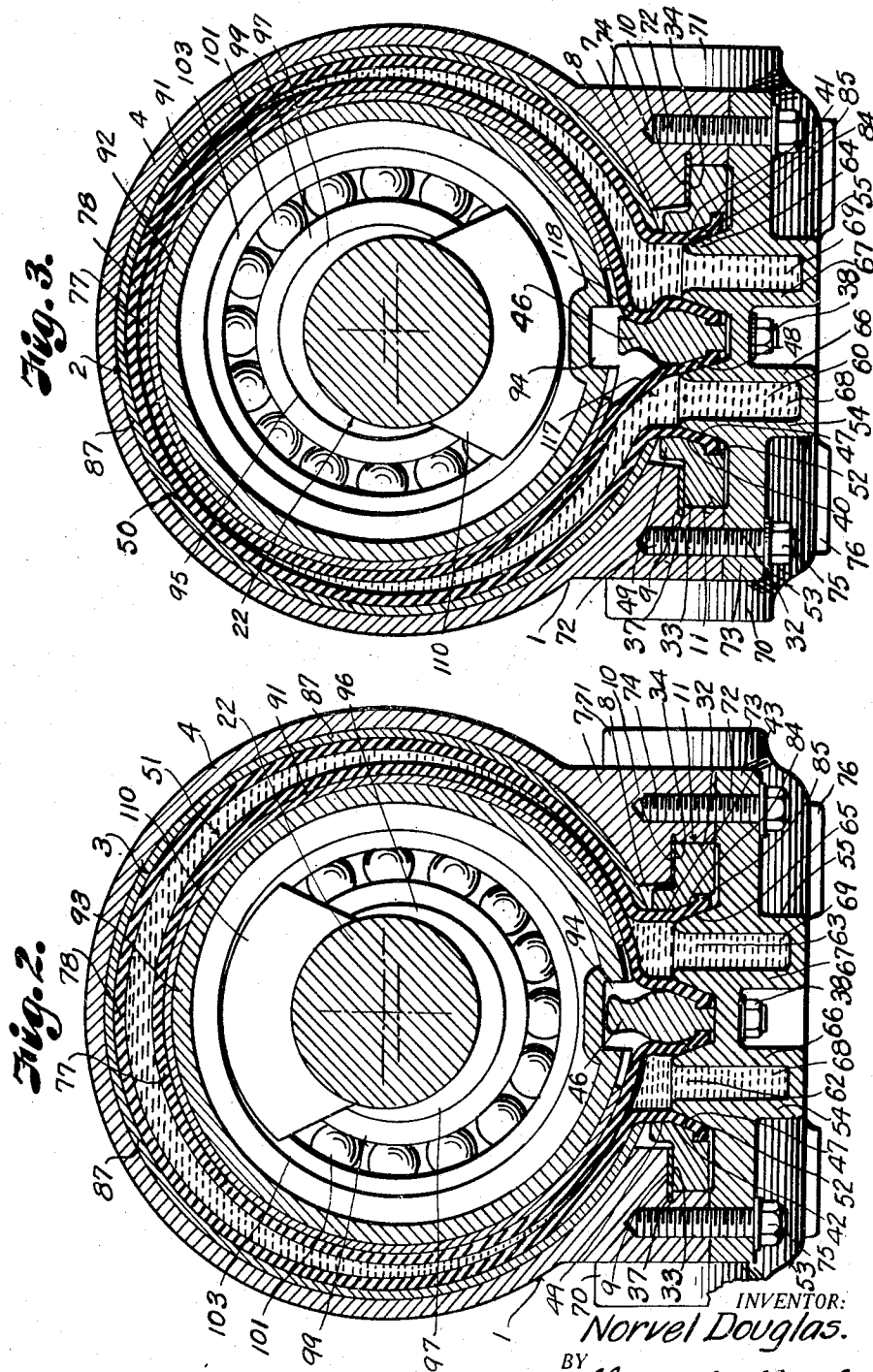
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6 Sheets-Sheet 2



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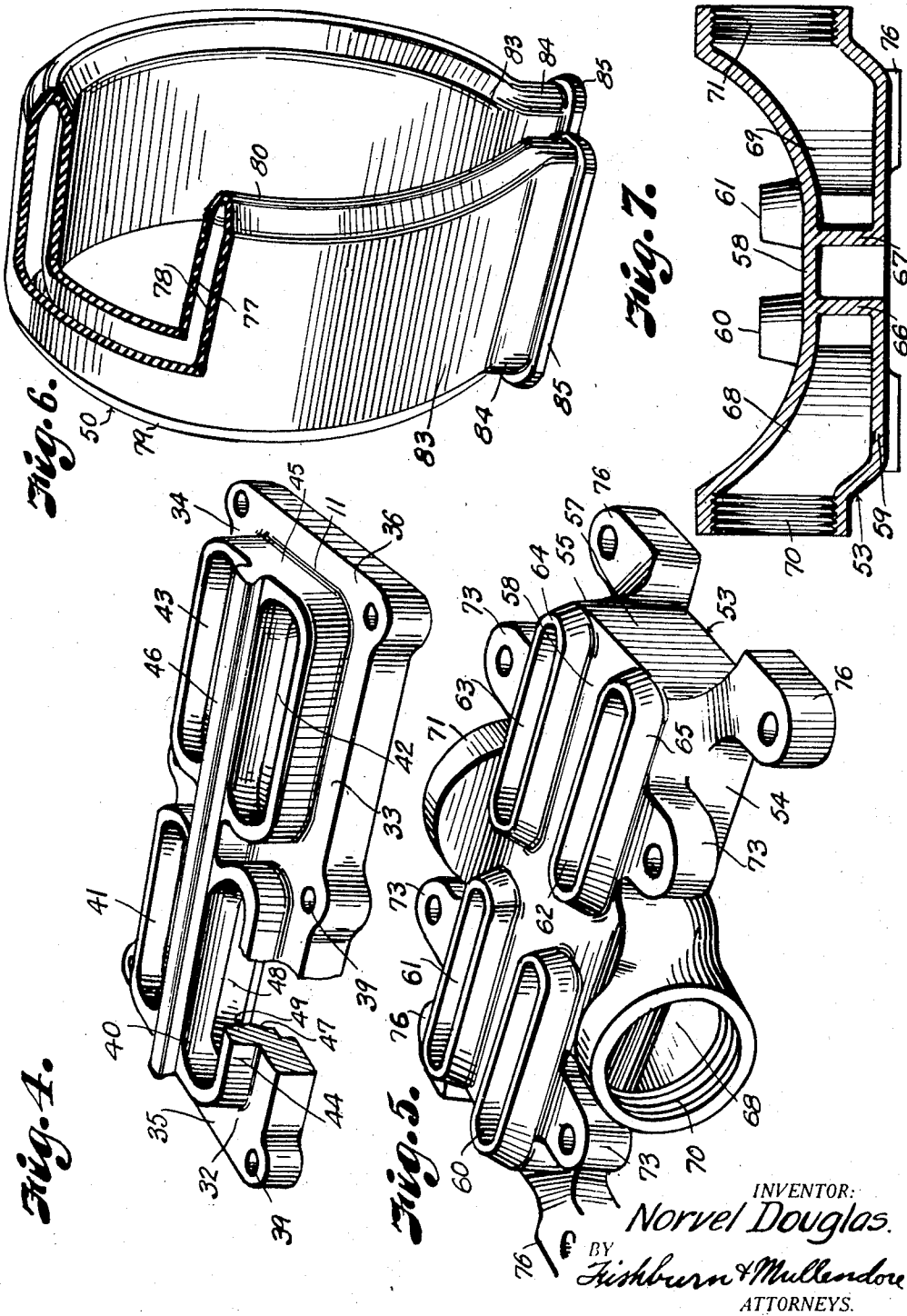
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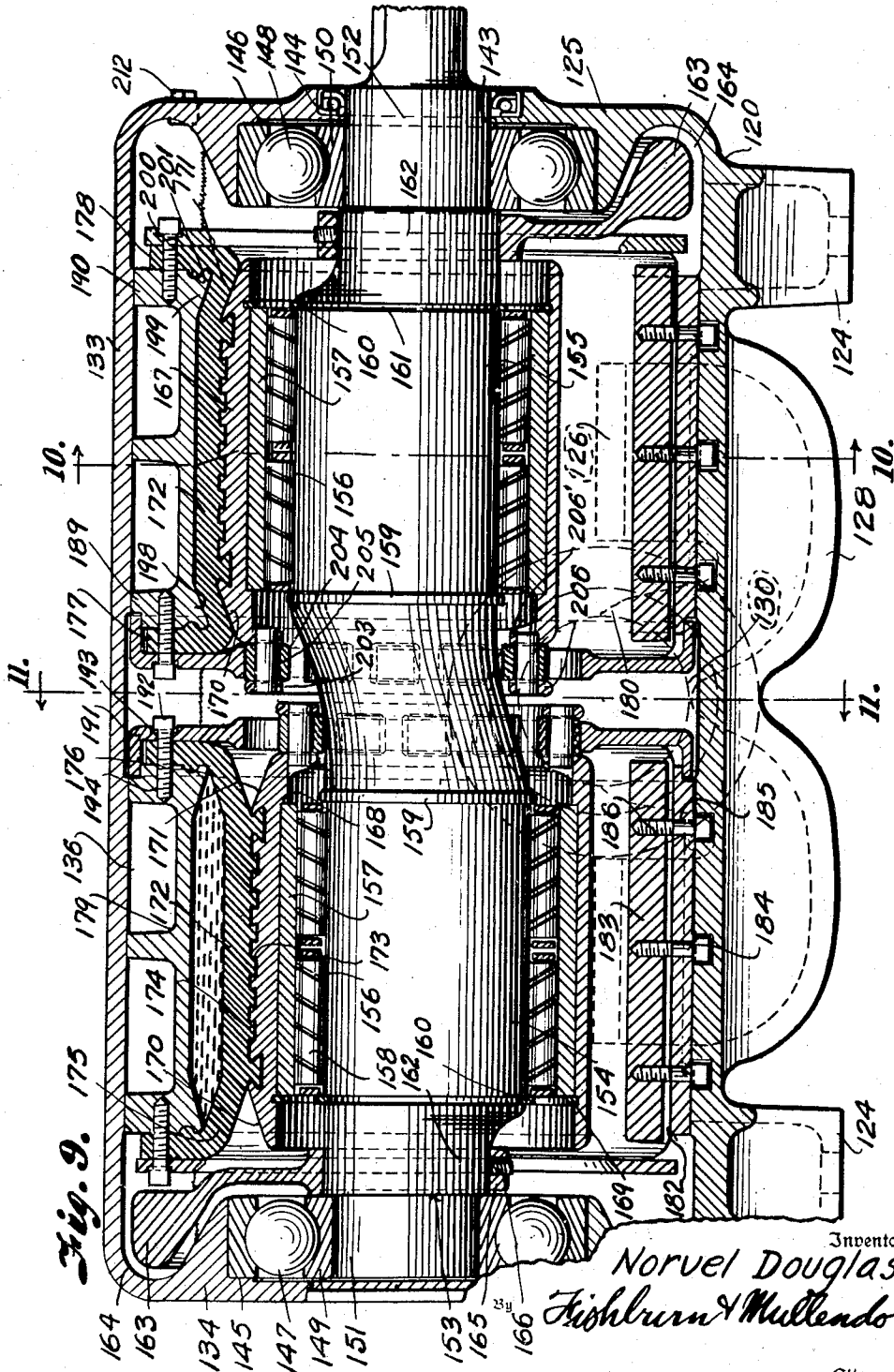
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ROTARY PUMP OR THE LIKE

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6 Sheets-Sheet 4



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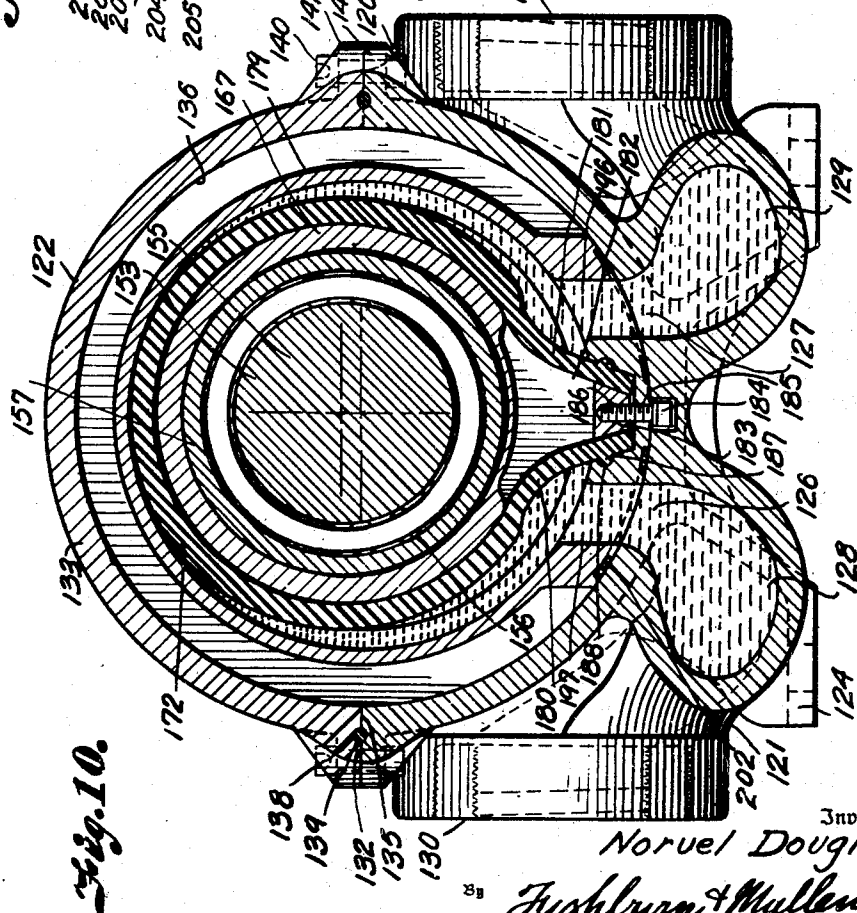
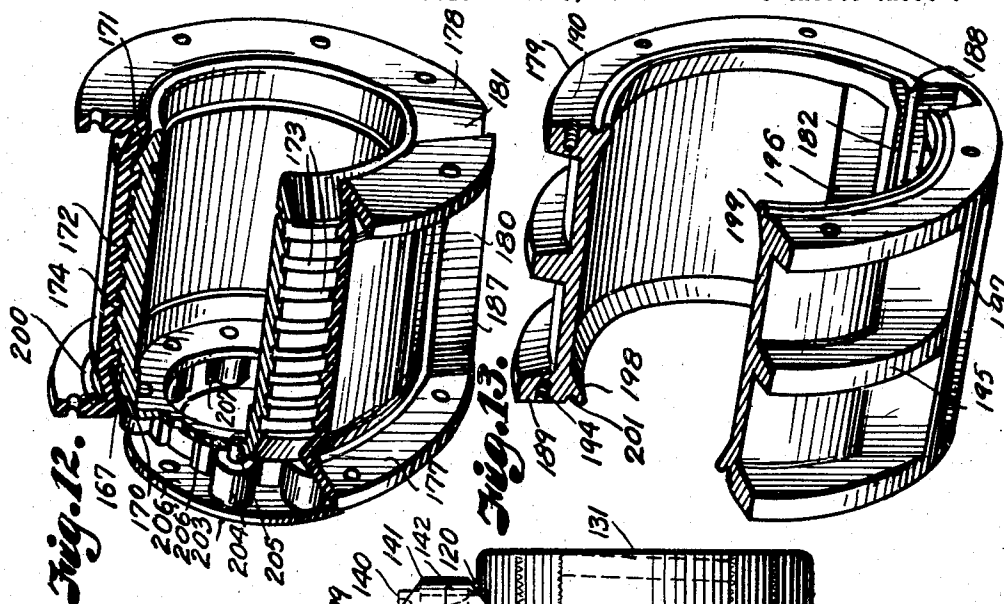
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6 Sheets-Sheet 5



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ROTARY PUMP OR THE LIKE

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Fig. 14.

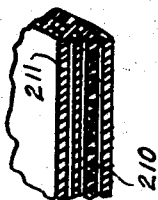


Fig. 15.

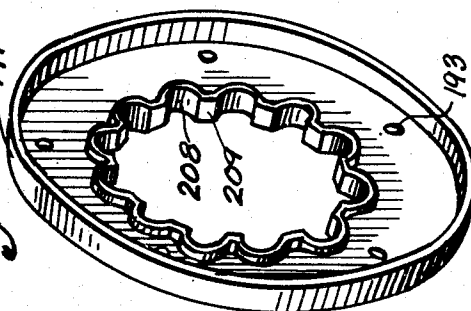
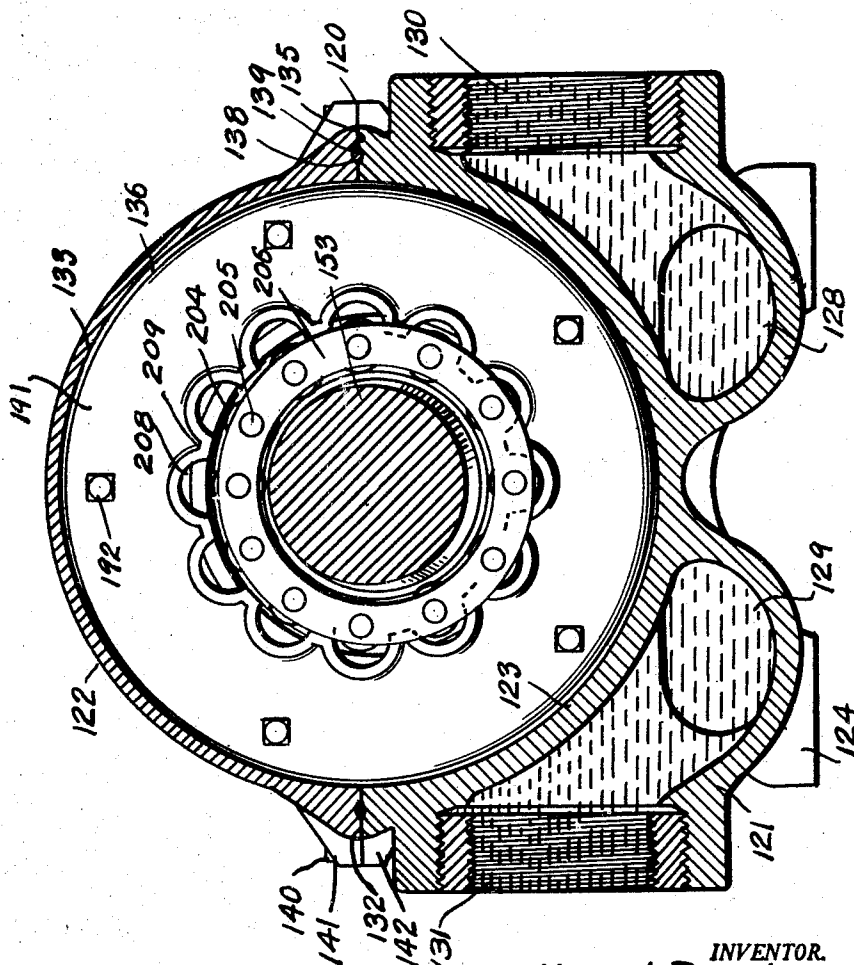


Fig. 11.



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UNITED STATES PATENT OFFICE

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ROTARY PUMP OR THE LIKE

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Application November 6, 1944, Serial No. 562,072

9 Claims. (Cl. 103—149)

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This invention relates to an apparatus for pumping fluids and has for its principal object to provide a simple, light-weight pump construction wherein fluid is acted upon in a chamber which is expanded and contracted progressively along the length thereof by a rotatable eccentric and which requires no valves, packing, or similar mechanisms to control flow and prevent leakage of fluid.

Other objects of the invention are to provide a pump structure especially adapted to build up relatively high prestresses on fluids containing abrasives and similar substances that in ordinary pumps as heretofore constructed are destructive to the packings, valves, and sliding surfaces; to provide a pump structure having large capacity at relatively low speeds; to provide a pump construction for maintaining a substantially continuous uniform pressure; and to provide a pump structure having long life and trouble-free operation even when handling abrasive fluids.

It is also an object to provide a pump structure which is adapted for construction from materials selected so that they are suited to the character of the fluid being operated on by the pump.

In accomplishing these and other objects of the invention, I have provided improved structure, the preferred form of which is illustrated in the accompanying drawings wherein:

Fig. 1 is a longitudinal section through a pump embodying the features of the present invention.

Fig. 2 is a cross section through the pump on the line 2—2 of Fig. 1.

Fig. 3 is a similar section on the line 3—3 of Fig. 1.

Fig. 4 is a perspective view of the subbase of the pump which cooperates with a base manifold for anchoring the fluid intake and displacement chambers of the pump.

Fig. 5 is a perspective view of the base manifold of the pump.

Fig. 6 is a perspective view partly in section of one of the fluid intake and displacement chambers.

Fig. 7 is a cross section through the base manifold particularly illustrating the fluid inlet and outlet connections of the pump.

Fig. 8 is a fragmentary section of a liquid-cooled gas compressor embodying the features of the present invention.

Fig. 9 is a longitudinal vertical section through a modified form of the invention wherein the pumping chamber is formed on one side by a rigid stator and on the other by an elastic member.

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Fig. 10 is a cross section through the pump on the line 10—10 of Fig. 9.

Fig. 11 is a cross section on the line 11—11 of Fig. 9.

Fig. 12 is a perspective view partly in section of one of the piston units of the pump illustrated in Fig. 9.

Fig. 13 is a perspective view partly broken away of one of the stator units.

Fig. 14 is an enlarged fragmentary section through the elastic member, particularly illustrating arrangement of the reinforcing cords.

Fig. 15 is a perspective view of one of the piston guides.

Referring more in detail to the drawings:

The pump illustrated includes a horizontally disposed, substantially cylindrical case 1 containing one or more operating units, here shown as two in number and generally designated 2 and 3 and arranged to operate 180° out of phase whereby substantially continuous uniform pressure is maintained on the discharge side of the pump.

The case 1 includes a substantially cylindrical wall 4 closed at one end by a wall 5 and at the opposite end by a removable plate 6. The lower portion of the case has a depending offset 7 provided with a longitudinal opening 8 terminating short of the ends of the case and provided along the sides thereof with inset shoulders 9 and 10 to seat a subbase member 11. The end wall 5 is preferably formed integrally with the cylindrical wall of the case and has an axial bearing housing 12 facing inwardly of the case to mount the outer race 13 of an anti-friction bearing 14. The removable end plate 6 has a similar axially positioned bearing housing 15 facing inwardly to mount the outer race 16 of an anti-friction bearing 17, which bearings have inner races 18 and 19 mounting the journals 20 and 21 of a shaft 22 as later described. The end plate 6 has arcuately spaced openings 23 in the periphery through which fastening devices such as studs 24 are projected into threaded sockets 25 formed in the wall 4 at the open end thereof as best shown in Fig. 1, the studs being provided with nuts 26 by which the end plate is retained in sealing contact with a gasket 27 to retain lubricant within the case as later described. The axial portion of the plate 6 has an opening 28 therein through which a reduced end 29 of the eccentric shaft is projected for mounting a suitable driving element such as a gear, pulley, or the like, to couple the pump with a prime mover (not shown). The opening 28 is encircled by an annular recess 30 for mounting a packing element 31 to seal about the end of

the shaft and prevent escape of lubricant there-through.

The subbase 11 includes a plate portion 32 having marginal sides 33 and 34 and ends 35 and 36 seated against a gasket 37 bearing upon the shoulders 9 and which is retained in sealing contact by fastening devices 38 that are projected through openings 39 in the plate and into threaded sockets (not shown) in the offset portion of the case for closing the opening thereinto. The subbase has pairs of port-like openings 40-41 and 42-43. The port-like openings are formed in bosses 44 and 45 projecting upwardly into the opening 8 of the case and the ports of each pair are located on opposite sides of a longitudinally extending rib 46 for a purpose later described. Each port is of elongated form and has upwardly and inwardly converging side faces 47 and 48 terminating in collar-like faces 49 adapted to embrace the terminal ends of the elastic intake and displacement chambers 50 and 51 as later described. The lower face of the plate surrounding each of the ports has shoulder-like recesses 52 for accommodating flanged ends for a purpose later described.

The case 1 seats upon a base manifold 53 which includes an elongated hollow body having side walls 54-55, end walls 56-57, and top and bottom walls 58-59. The top wall 58 is provided with elongated pairs of ports 60-61 and 62-63 registering with the ports in the subbase and encompassed by upwardly extending flanges 64 having upwardly and inwardly converging outer faces 65 conforming to the taper of the faces 47 of the subbase, but which are spaced therefrom to accommodate thickness of the walls of the flexible chambers 50 and 51. The base manifold is divided longitudinally thereof intermediate the respective ports of the pairs of ports by longitudinal partitions 66 and 67 to provide separate inlet and exhaust manifold chambers 68 and 69 cooperating with threaded connections 70 and 71 adapted to be respectively connected with a fluid supply (not shown) and a fluid receiver (also not shown). The base manifold is secured to the bottom of the case by fastening devices such as studs 72 that are projected through apertured ears 73 extending laterally from the base manifold and into threaded sockets 74 formed in the depending extension of the base, the studs being provided with nuts 75 by which the base manifold is drawn into contact with the casing and for anchoring the previously mentioned elastic chambers. The base manifold also includes feet 76 projecting from the respective corners thereof for supporting the pump, the feet being provided with suitable openings through which fastening devices (not shown) may be inserted to anchor the pump to a suitable support.

The units 2 and 3 each includes an elastic tube having relatively flat parallel inner and outer walls 77 and 78 connected at the ends thereof as at 79 and 80 to form substantially horseshoe-shaped chambers 81 and 82. The legs 83 of the chambers terminate in collars 84 having flanges 85 adapted to seat within the shoulders 52 when the collars are clamped between the subbase and base manifold as shown in Figs. 1, 2, and 3 to form a leak-tight seal therebetween.

The elastic chambers may be formed of a plastic material such as rubber, synthetic rubber, or the like suitable for the fluid operated upon by the pump. The outer wall 78 of each elastic chamber is vulcanized or suitably ce-

mented to a sleeve-like liner 87, which liner is snugly sleeved within the case and anchored in position by fastening devices such as cap screws 88 projected through openings 89 in the wall 4 of the case and into threaded sockets 90 carried by the liner. The inner walls 78 of the elastic chambers are similarly fixed to sleeve-like liners 91 that are similarly attached to the peripheral faces of eccentrically supported cylinders designated 92 for the unit 2, and 93 for the unit 3. The cylinders have longitudinal grooves 94 on the undersides thereof which receive therein the rib 46 on the subbase which positions the cylinders and prevents rotation thereof upon operation of eccentrics 95 and 96 that are formed on the shaft 22. The eccentrics 95 and 96 each include a pair of circumferential raised portions 97 and 98 on the shaft for seating the inner and outer races 103 and 104 seated within internal shoulders 105 and 106 formed within the eccentrically-supported cylinders as best shown in Fig. 1. The outer races of the anti-friction bearings are retained from inward movement with respect to the eccentric cylinder by ribs 107 and the inner races are retained from outward movement on the eccentric portions of the shaft by lock rings 108 received in grooves 109 of the eccentrics so that the cylinders are anchored in fixed longitudinal position relative to the eccentric shaft by the anti-friction bearings. The eccentrics are counter-balanced intermediate the anti-friction bearings by counter-weights 110 that are attached to the shaft diametrically opposite the high portions of the eccentrics as shown in Figs. 1, 2, and 3.

The case may be provided with a lubricant insert opening 111 closed by a plug 112. The case may have a drain opening 113 in the bottom closed by a plug 114. If desired, the case may have an inspection opening 115 to determine level of lubricant in the case. This opening may be closed by a plug 116 as shown in Fig. 1.

In assembling the pump, the anti-friction bearings 101 and 102 are installed upon the eccentric shaft 21 with the outer races 103 and 104 engaging within the bearing seats 105 and 106 of the eccentrically-supported cylinders 92 and 93 while the shaft is exteriorly of the case. After inserting the lock rings 108 to retain the bearings on the shaft, the anti-friction bearings 14 and 17 are applied on the journals 20 and 21 of the shaft 22. The elastic chambers 50 and 51 are then cemented to the metal liners or sleeves 87 and 91 and the metal liners 91 are sleeved over the eccentric cylinders 92 and 93 and secured by the fastening devices 88. The shaft assembly is then placed in the case 1 so that the bearing 14 enters the housing 12. The four legs of the elastic chambers will slide freely into the opening 8 of the case and the grooves 94 in the eccentric cylinders 92 and 93 are located in registry with the rib 46, after which the fastening devices 88 are inserted through the case openings 89 to anchor the outer metal liners or sleeves 87. The removable end plate 6 is then slid into position on the shaft so that the bearing 17 enters the bearing housing 15 and the plate is secured to the case by means of the studs 24. The case is then turned upside down and the open ends or collars 84 of the chambers are pulled through the port openings 40-41 and 42-43 in the subbase 11, after which the subbase 11 is attached to the case by the fastening devices 38. The base manifold 53 is then set in position on the subbase with the tapering flanges 64 thereon entering within the open ends of the elastic cham-

bers so as to bell the walls thereof outwardly into sealing engagement with the subbase as shown in Figs. 1, 2, and 3. The studs 72 are then applied and the nuts 75 thereon drawn tight to assure a pressure-tight junction between the metal and the walls of the elastic chambers.

The case is then righted and filled with lubricant to the level opening 111. It is thus obvious that all of the bearings operate in oil to assure free operation and efficient transmission of power in operating the pump. The oil also lubricates the exterior of the rubbing surface between the liners 87 and 91 and the elastic members.

When oil is used as a lubricant in the structure illustrated, the elastic members 50 and 51 must be constructed of a material that does not deteriorate in oil, for example, one of the synthetic plastics now on the market. However, the individual bearings may be sealed so that ordinary rubber might be used in formation of the elastic chambers without departing from the spirit of the invention. The pump is then mounted on a suitable base and connected with a prime mover capable of rotating the shaft at a desired speed, for example, 600 R. P. M. In operation, the eccentric shaft 22 is rotated causing rotation therewith of the inner races 99 and 100 of the anti-friction bearings 101 and 102. The balls of the bearings then planetate in the outer races 103 and 104 so that the eccentric cylinders remain in their same relative positions with respect to rotation, however, the axial centers of the eccentric cylinders will be caused to gyrate about the rotational axis of the shaft in an amount equivalent to the throw of the eccentrics.

At the maximum throw of the eccentrics, the inner and outer walls of the chambers are tightly compressed as in the case of the unit illustrated at the left-hand side of Fig. 1. Instead of a point or line contact of the walls, the actual contact is sufficient to effect a fluid-tight seal and the area of contact travels progressively around the elastic chambers from the intake to the discharge sides, thereby causing an intake of fluid through the inlet ports, which discharges are progressively moved ahead of the contact area to be expelled through the outlet ports when the eccentrics are in downward position as shown in Fig. 2.

The most critical part of the elastic chambers is the closed circular ends of the leg portions thereof and these parts may be reinforced by fabric or similar reinforcing material. A short distance from the open ends of the elastic chambers there is also a flexing as indicated at points 117 and 118. The point 117 in Fig. 3 illustrates how the pressure would slightly stretch the wall of the chamber out against the rib 46 under pressure so that the rib protects the collar portions 84 of the chambers from further expansion. On the suction side the liners are slightly stretched as shown at 117 (Fig. 3).

When the eccentrics are down closing both ports, the elastic material forming the chambers is pressed down by the eccentrics and the material is in unstretched condition (see Fig. 2). As the elastic material wears from abrasives from fluid running through it, the point of contact may be corrected by applying a shim between the inner sleeves 77 and eccentric cylinders 92 and 93.

It is thus obvious that the fluid is drawn through the ports 40 and 42 into the open ends of the elastic chambers and is formed progressively by the contact area of the walls through the elastic chambers to the discharge ports incidental

to rotation of the eccentrics. Pressing together of the inner and outer walls of the chambers makes a pressure-tight and continuous seal so that there is no loss in pressure or back leakage through the intake ports. It will be particularly noted that since the inner and outer walls are anchored respectively to the case and eccentric cylinders the elastic chambers will be forcibly opened thereby to effect full intake capacity thereof.

Since the eccentrics of the units are arranged in diametrically opposite directions relative to each other, one of the units will be drawing in of fluid while the other unit is discharging fluid. Thus, constant, uniform pressure is maintained in the discharge manifold of the manifold base.

If the pump is used for operating on an elastic fluid such as air, the case may be filled with oil and the oil pumped through a radiator (not shown) to absorb the heat of compression or the case may be provided with a jacket 119 through which a cooling medium is circulated as shown in Fig. 8.

The form of the invention illustrated in Figs. 9 to 15 inclusive includes one or more units, the operating chambers of which have one side formed of a flexible member. In this form, 120 designates a housing or casing composed of a base section 121 and an upper or cover section 122. The base section 121 has a semi-cylindrical wall 123 supported in horizontal position on legs 124 and the ends of the wall are closed by ends 125. The wall 123 has openings 126 and 127 (Fig. 10) disposed on opposite sides of the horizontal center thereof and arranged in pairs longitudinally spaced to connect with intake and discharge manifolds 128 and 129 which are illustrated as being formed as integral parts of the base. The manifolds have inlet and outlet connections 130 and 131 located intermediate the pairs of openings as shown in Fig. 10 and indicated in dotted lines in Fig. 9, the connections being suitably machined for receiving ducts (not shown) by which fluid is admitted into and discharged from the pump. The rim of the wall 123 and ends 125 are flanged outwardly to form a seating face 132 for the cover section 122. The cover section 122 also includes a semi-cylindrical wall portion 133 corresponding to the wall portion 123 and ends 134 registering with the walls 125 and which have faces 135 adapted to seat on the faces 132 to form an enclosed cylindrical compartment 136 housing the stator and operating elements of the pump later described. The seating faces of the sections are preferably grooved as at 138 to accommodate rod-like gaskets 139 of the respective sections when the sections are secured together by fastening devices 140 projectable through ears 141 and 142 projecting laterally from the respective sections as shown in Fig. 10 to provide fluid-tight seals for retaining lubricant in the casing. The end walls 125 and 134 of the respective sections are provided in the registering edges thereof at one end of the casing with an opening 143 counterbored to accommodate a sealing ring 144. The inner sides of the end walls are provided with recesses 145 and 146 in coaxial registry with the shaft opening to accommodate anti-friction bearings 147 and 148. The inner races 149 and 150 of the bearings journal the bearing portions 151 and 152 of a shaft 153. The shaft is provided intermediate the bearing portions with eccentrics 154 and 155 arranged substantially 180° out of phase with respect to each other for mounting the movable elements of the pump units. The eccentric portions 154 and

155 of the shaft are preferably hardened and ground to mount anti-friction bearings 156 having outer cylindrical races 157 of suitable length and diameter to accommodate the anti-friction elements such as rollers 158 therebetween. The anti-friction bearings are retained on the eccentrics by stop flanges 159 at one end and by snap rings 160 received in grooves 161 at the other end of the bearings as best shown in Fig. 9. The portions 162 of the shaft intermediate the grooves 161 and bearing portions 151 and 152 are shaped to accommodate counterbalance weights 163 for counterbalancing the eccentrics and the parts carried thereby. The counterbalancing weights are offset to gyrate in the spaces 164 circumferentially of the shaft bearings 147 and 148 and have collars 165 secured on the shaft in position to give the correct dynamic balance by set screws 166.

Pressed upon each of the races 157 are eccentric pistons 167 each including a substantially sleeve-like body having an inner diameter to accommodate the outer races 157 of the bearings and provide a stop shoulder 168 at one end co-operating with a lock ring 169 at the other for maintaining longitudinal position of the eccentric pistons as shown in Fig. 9. The circumferential faces of the eccentric pistons terminate at the ends in tapering end faces 170 and 171.

Mounted on the eccentric pistons are flexible liners 172 formed of elastic material; for example, rubber, and molded upon the eccentric pistons to provide the necessary shape therefor. To facilitate anchorage of the liners, the eccentric pistons are preferably provided with a series of dovetail grooves 173 extending circumferentially thereof to receive portions 174 of the rubber therein so that the intermediate portions of the liners are firmly anchored to the pistons; however, the end portions 175 and 176 are free of the tapered portions 170 and 171 to permit flexing thereof upon actuation of the pistons as later described.

The liners are provided with flanges 177 and 178 for attachment to the stators 179. The annular portions of the liners terminate at points substantially over the ports 126 and 127 in flaps 180 and 181, the ends of which are received in a substantially V-shaped longitudinal recess 182 of the stators 179 and are clamped therein by longitudinal wedges 183. The wedges 183 are drawn into clamping engagement by screws 184 having shanks extending through openings 185 in the stators and into threaded sockets 186 of the wedges as shown in Fig. 10. In order to enhance the seal and more securely anchor the flaps, the flaps are preferably provided with longitudinal ribs 187 engaged in grooves 188 in the sides of the recesses. The flanges 177 and 178 overlie flanges 189 and 190 of the stators and are secured thereby by clamping rings 191 by fastening devices 192 extending through openings 193 in the clamping rings and into threaded sockets 194 of the flanges 189 and 190.

The stators are also of sleeve-like formation and the end flanges 189 and 190 cooperate with an intermediate rib 195 to center the stator within the cylindrical compartment 136 of the housing. The walls of the stators have inlet and outlet ports 196 and 197 registering with ports 126 and 127 previously described, which ports are located on the respective sides of the wedge-shaped recesses 182. The inner portions of the stators substantially conform to the contour of the pistons but are of larger diameter so that the pistons are constructed to press the outer faces of the

liners into contact with the inner faces of the stators progressively from the inlet port toward the exhaust port to effect movement of fluid there-through substantially in the manner described in the first form of the invention. The ends of the stators therefore, have inwardly tapering ends 198 and 199 corresponding to the tapers 170 and 171 of the pistons.

In order to enhance the seal and gripping engagement of the flanges of the liners, the flanges are preferably provided on the facing sides thereof with arcuate ribs 200 engaged in corresponding arcuate grooves 201 of the stators. A seal is effected around the ports 196 and 197 by gaskets 202 inserted between the stators and the casing 120.

In order to prevent rotation of the piston members, and thus reduce stress in the flexing positions of the liners ends thereof terminate in annular ring-shaped extensions 203 of substantially channel-shaped cross section to accommodate rollers 204 therein, the rollers being retained on pins 205 having the ends thereof fixed in suitable openings in the side flanges 206 and 206' of the extensions, the rollers being positioned in openings 207 formed in the web portions of the ring-like extensions whereby the major portion of the rollers are adapted to engage in spaces 208 formed between teeth 209 within the inner diameter of the clamping rings 191 as shown in Fig. 1. Therefore, when the eccentrics are rotated the piston members are prevented from rotating by reason of engagement of the rollers between the teeth of the clamping rings, however, the pistons move eccentrically with rotation of the eccentrics so that the rollers progressively enter the spaces between the respective teeth and are retracted therefrom incidental to gyration of the eccentrics.

As shown in Fig. 14, the liners are reinforced to withstand the hydrostatic pressure with one or more layers of circumferential cords 210 with one or more layers of transverse cords 211. The cords are preferably of cotton, rayon, nylon, or steel strands, and are completely surrounded by the rubber or other flexible plastic from which the liners are formed.

The form of the pump just described is assembled as follows:

The liners 172 are molded on the eccentric pistons and are firmly secured thereto when the rubber composing the liners is vulcanized, a mechanical bond being maintained by the annular dovetail grooves and through bonding of the rubber to the metal.

The guide rollers 204 are then installed by means of the pins 205 on which the rollers turn. The eccentric pistons carrying the liners are inserted within the stators 179 and the flanges of the liners are clamped to the flanges of the stators by the clamping rings 191, the rings being secured by the fastening devices 192 so that the flanges of the liners are anchored concentrically of the stators and in sealed relation therewith. The flexible end flaps 180 and 181 of the liners having been inserted in the recesses 182, are drawn into sealing engagement with the walls of the recesses by tightening the screws 184 to draw the wedges 183 therebetween. In applying the liners to the stators, care is taken that the beads or ribs engage in the grooves of the stator. Since the grooves are slightly smaller than the beads or ribs, they provide a tight seal for the fluid spaces or courses of the piston chambers which is that space between the eccentric pistons and the inner faces of the stators. The bearing races 152 are then pressed into the pistons and retained

by the lock rings 160. The anti-friction bearings 156 are then applied to the eccentric portions of the crank shaft 153 and the piston assemblies are sleeved thereover, after which the retainer rings 160 are applied to the grooves 161 of the eccentric shaft to retain the assemblies from longitudinal movement. The gasket rings 202 are then mounted in recesses of the stators and preferably cemented in position to encompass the intake and discharge ports 196 and 197. The counterweights 163 are then applied to the ends of the shaft followed by the anti-friction bearings 147 and 148 and the seal ring assembly 144.

The entire shaft assembly is then inserted into the lower section of the pump casing so that the ports in the stators register with the openings in the casing. The counterweights may then be adjusted and secured by the set screws 166 to provide dynamic balance.

The top section of the casing is then set in place with the gasket 139 in the grooves of one of the sections. The parts of the casing are then drawn tightly together by the fastening devices 140 thus clamping the outer races of the shaft bearings 147 and 148 and the stators firmly in position.

A lubricating oil is then poured into the crankcase up to the level of the opening for a plug 212. The lubricating oil is preferably of light weight and serves the dual purpose of lubricating the outside of the liners 172 where they contact and rub slightly the tapered surfaces of the eccentric pistons and to lubricate the anti-friction bearings. After insertion of the lubricating oil, the plug is applied in the opening so that the lubricating oil is retained in the casing with all the working parts of the pump submerged. The inlet and outlet connections for the pump are then connected with suitable ducts through which fluid to be acted upon by the pump is admitted to the inlet side, and discharged under pressure from the outlet side. The projecting end of the shaft is connected in any suitable manner to a source of power to effect rotation thereof.

The crankshaft of the pump may be rotated in either direction and as the shaft rotates, the eccentric pistons are forced to execute such motion that each point thereof traverses in phase a circle of diameter equal to twice the eccentricity crank 153 in a plane perpendicular to the crankshaft axis. The liners are thus caused to be pressed tightly against the inner surfaces of the stators forming a pressure-tight seal across the piston chambers or ducts between the inlet and outlet ports which seal traverses around the chambers in phase with the eccentrics on the crankshaft to force the fluid being pumped from the inlet ports into the outlet ports.

The two eccentric pistons operating 180° out of phase causes a substantially uniform flow of fluid. The loose portions of the liners adjacent the tapered portions of the pistons cross the sides of the piston chambers and flex to and from contact with the inward tapers 198 of the stators and points thereon traverse approximately the surface of a cone, the apex of which is stationary where the liners are secured to the stators. The end flaps of the liners, that is, the moving portions thereof, flex inwardly into the spaces between the pistons and the wedges 183 somewhat as described in the first form of the invention. Stresses are partially relieved from these flaps and the circular flexing section of the liner through engagement of the rollers 204 with the teeth on the guides 191.

To take the pump apart for maintenance pur-

poses, it is only necessary to remove the fastening devices 140 and lift the upper section of the casing from the lower section. The inlet and outlet piping to the pump need not be disturbed. The crankshaft assembly can then be lifted out of the lower section of the casing and the two pump assemblies removed from the ends of the shaft, after which the pump assemblies may be repaired or new assemblies installed as previously described.

From the foregoing it is obvious that I have provided a simple, light-weight pump structure which has a large capacity at relatively low speed and which is adapted to operate on fluids which contain abrasives such as the drilling fluid used in drilling of wells. It is also obvious that the apparatus illustrated and described may be adapted to actuate as a motor by supplying an operating fluid under pressure to the inlet thereof so that the fluid will effect actuation of the eccentric shaft.

What I claim and desire to secure by Letters Patent is:

1. An apparatus of the character described including, a casing, a shaft, means rotatably mounting the shaft in the casing, an eccentric on the shaft, a cylinder supported on the eccentric, sleeve-like liners removably mounted within the casing and upon the circumference of the cylinder, a flexible duct having opposite walls connected with the sleeve-like liners, said case having inlet and outlet connections with the respective ends of said duct, and means for rotating the shaft to effect gyration of the axis of the cylinder about the axis of the shaft incidental to rotation of the eccentric to effect progressive expansion and contraction of the duct about the cylinder.

2. A device of the character described including, a case, a subbase mounted on the case and having spaced ports, a manifold base having ports registering with the ports in the subbase, flanges encircling said ports, a substantially horseshoe-shaped duct formed of flexible material and having a side wall connected with the case, a shaft, means rotatably mounting the shaft concentrically of the case, an eccentric on the shaft, a cylinder carried by said eccentric for supporting the opposite wall of the duct and necks on the end of said ducts engaged between said flanges, means connecting the manifold base with the subbase to effect a leak-tight connection with said necks, and means for rotating the shaft to effect gyration of the axis of the cylinder about the axis of the shaft and progressive contraction and expansion of the duct incidental to rotation of the eccentric.

3. A device of the character described including, a case, a subbase mounted on the case and having spaced ports, a manifold base having ports registering with the ports in the subbase, flanges encircling said ports, a substantially horseshoe-shaped duct formed of flexible material and having a side connected with the case, a shaft, means rotatably mounting the shaft concentrically of the case, an eccentric on the shaft, spaced bearings on the eccentric, a cylinder carried by said bearings for supporting the opposite wall of the duct and necks on the end of said ducts engaged between said flanges, means connecting the manifold base with the subbase to effect a leak-tight connection with said necks, and means for rotating the shaft to effect gyration of the axis of the cylinder about the axis of the shaft and progressive contraction and expansion of the duct incidental to rotation of the eccentric.

sion of the duct incidental to rotation of the eccentric.

4. In an apparatus of the character described including inner and outer annular members cooperating to provide a space between said members, means including flexing portions closing ends of said space and having connection with the members to provide a duct between said members, inlet and outlet connections in said duct, means supporting said members with one of the members in eccentric relation to the other for providing a restriction in said duct, one of said members being movable relative to the other for advancing said restriction from one of said connections toward the other, an annular guide on one of the members having spaced teeth arranged circumferentially about the axis of said member, and means carried by the other member for engaging in the spaces between said teeth for preventing relative rotation of said members.

5. In an apparatus of the character described including an annular stator, an annular piston within the stator to provide a space between said piston and stator, means including flexing portions closing ends of said space for forming a substantially annular duct, inlet and outlet connections with said duct, means supporting the piston in eccentric relation to the stator for providing a restriction in said duct, means for rotating said supporting means for advancing said restriction from one of said connections toward the other, and means on the piston having intermeshing connection with the stator for preventing rotation of the piston within the stator.

6. In an apparatus of the character described including an annular stator, a sleeve-like piston in the stator and cooperating therewith to provide a space therebetween, a flexible liner fixed circumferentially of the piston and having flexing portions closing ends of said space and connected with the stator to provide a duct between said members, said stator having inlet and outlet openings flaps on said liner having connection with the stator intermediate said openings, means supporting said piston in eccentric relation with the stator for providing a restriction in said duct, and means for rotating the supporting means for effecting movement of the piston for advancing said restriction from one of said openings toward the other.

7. In a device of the character described, a piston assembly including an annular stator having inlet and outlet ports, a casing including a substantially semi-circular base section provided with openings registering with said ports of the stator when the piston assembly is inserted in said section, a semi-cylindrical cover section for said base section for closing over the top of the pump assembly, gasket means between said piston assembly and the base section for sealing about said ports and registering openings, and fastening devices for drawing the sections together about the piston assembly.

8. In a device of the character described, a shaft having an eccentric portion and spaced bearing portions at the ends thereof, anti-friction bearings on the bearing portions of said shaft, a sleeve-like piston on the eccentric portion, an annular stator encircling the piston and having an inner diameter to provide a space therebetween, said stator having spaced ports connected with said space, a flexible liner attached to the piston and having flexible side portions attached to the stator, flaps on ends of the liner and anchored to the stator intermediate said ports, a housing including a base section having openings registering with the ports of the stator, gasket means encompassing the ports and said openings to effect a seal between the stators and said base section, a cover section for said housing extending over the top of the stator, said cover and base section having recesses for receiving the bearings, and fastening devices for drawing the sections together to clamp the stator from movement in said housing.

9. An apparatus of the character described including, an outer annular member, an inner annular member cooperating with the outer annular member to provide a space therebetween, resilient means fixed circumferentially to one of the members and having flexing flanges closing the sides of said space and fixed to the other member to provide a duct between said members for passage of fluid, fluid inlet and outlet connections on the outer annular member for said duct, flap means on the resilient means and anchored to said other member for forming a division between the inlet and outlet connections, means supporting the outer of said members in fixed position, an eccentric supporting the inner annular member with its axis eccentrically of the axis of the outer annular member to provide a restriction in said duct, means for rotating the eccentric to effect progressive movement of said restriction from the inlet connection toward the outlet connection, and intermeshing means on said members for preventing relative rotation of said members during rotation of the eccentric.

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