Oct. 7, 1952 E. L. MIDGETTE 2,612,837

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Fig 7

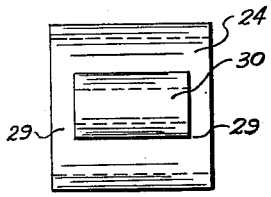


Fig 8

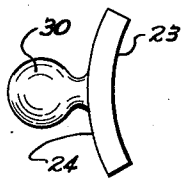


Fig 1

Fig 5

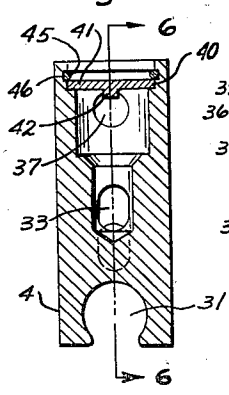
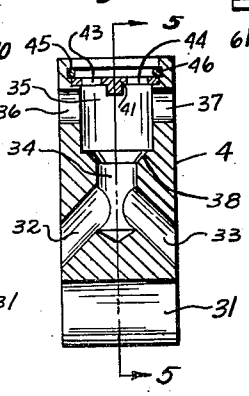


Fig 6



INVENTOR.
Ernst L. Midgette

BY

Attorney

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Fig. 2

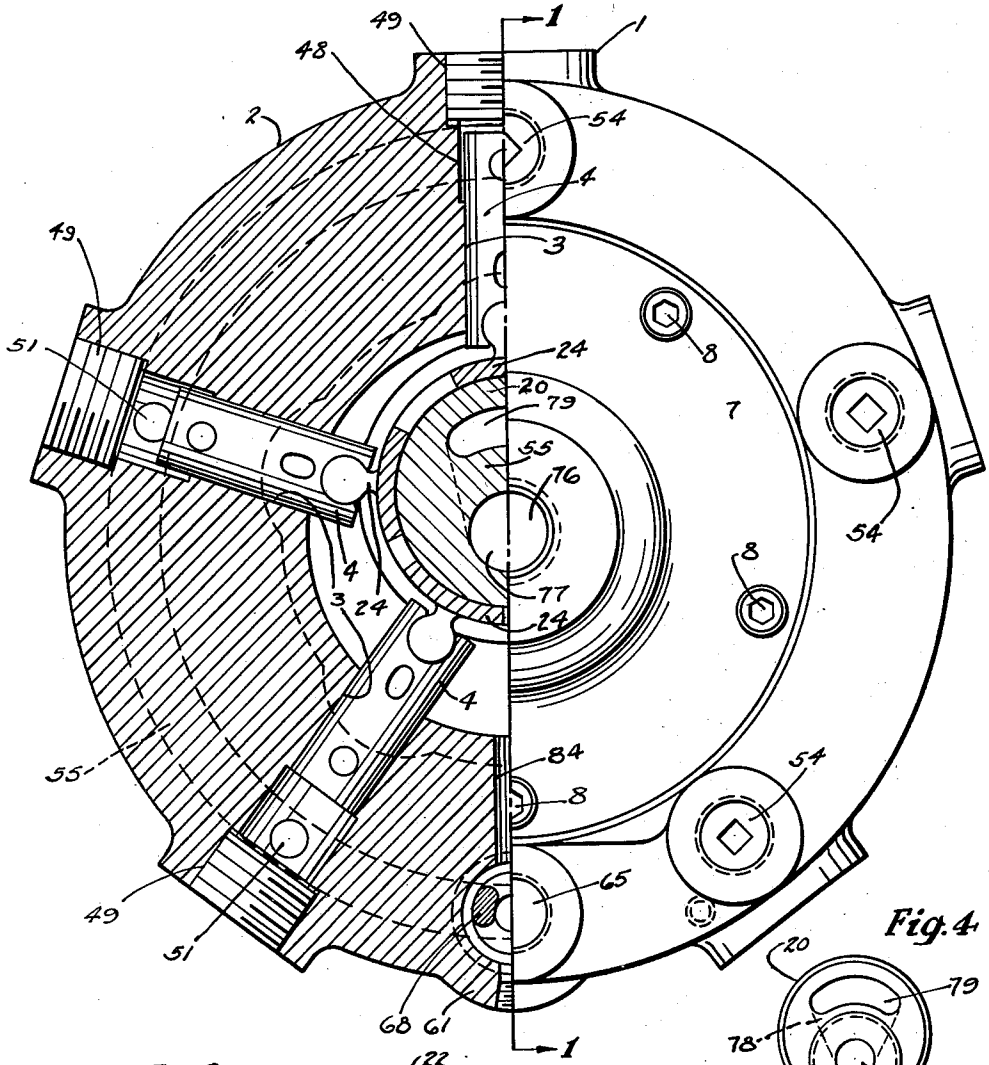


Fig. 3

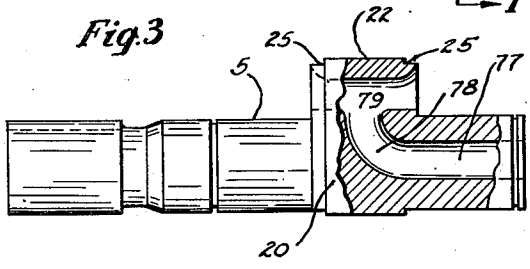


Fig. 4

INVENTOR.
Ernst L. Midgette

BY *Edward Kibbe*

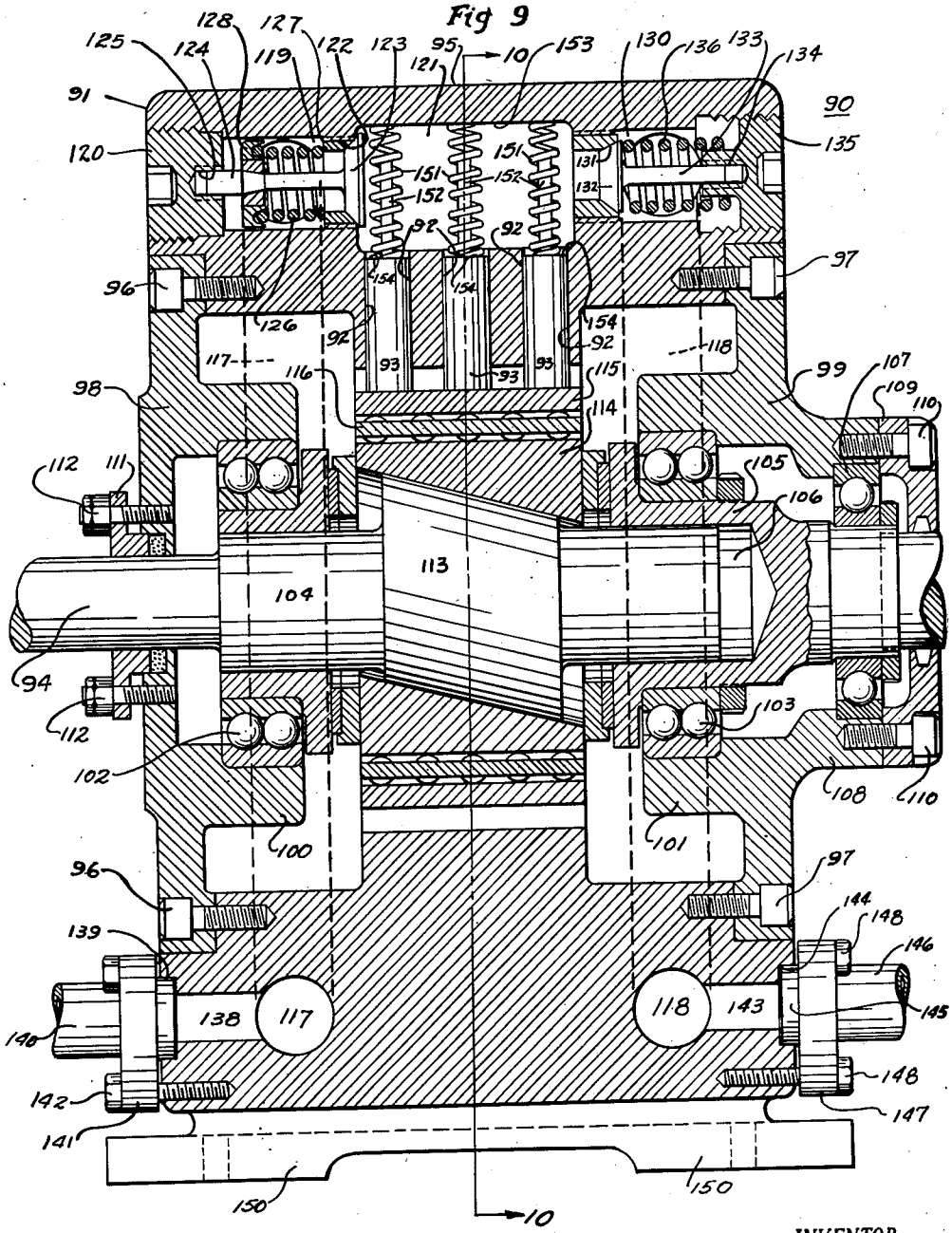
Attorney

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Fig 9



INVENTOR.
Ernst L. Midgette

BY Cecil A. Gibbe

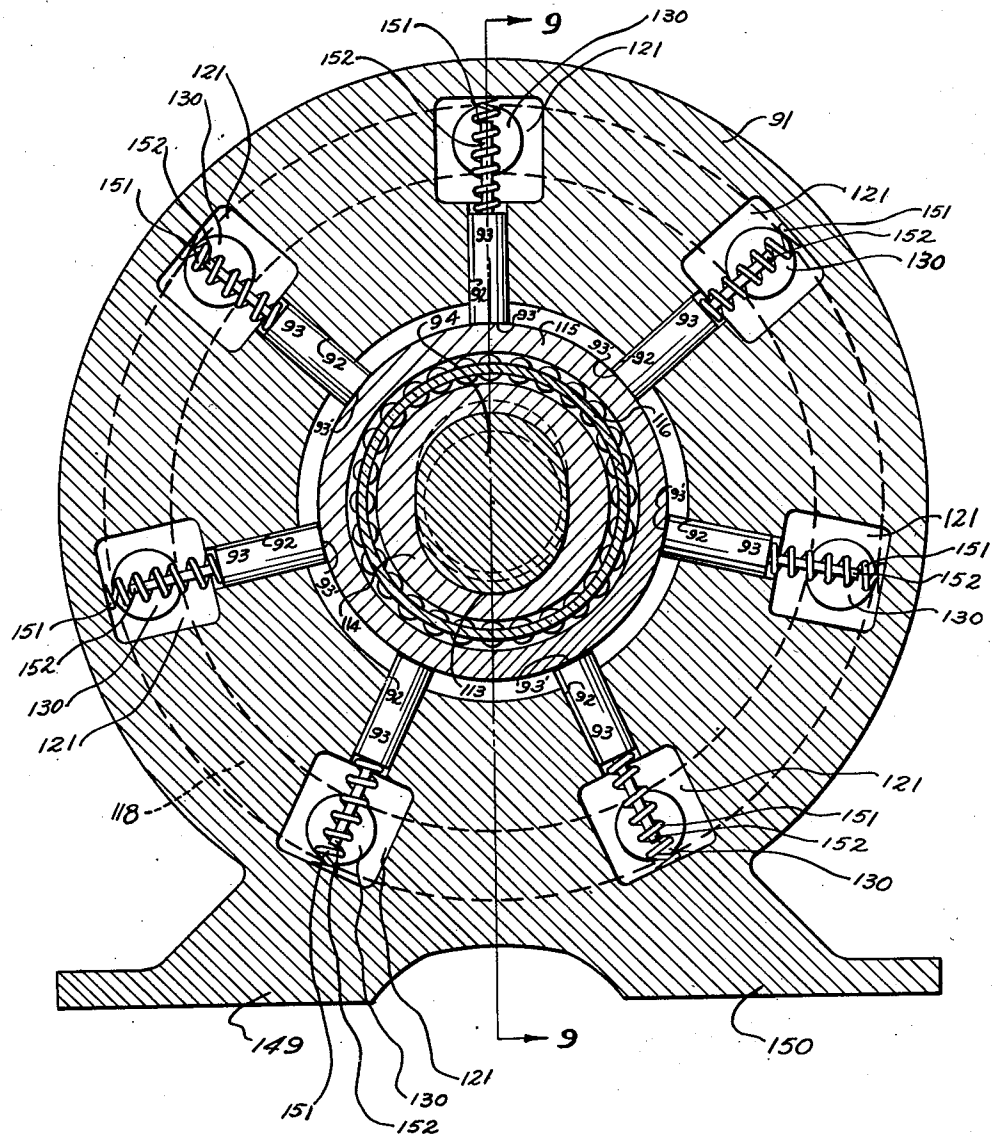
Attorney

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Fig 10



INVENTOR.
Ernst L. Midgette

BY Cecil V. Gibbs

Attorney

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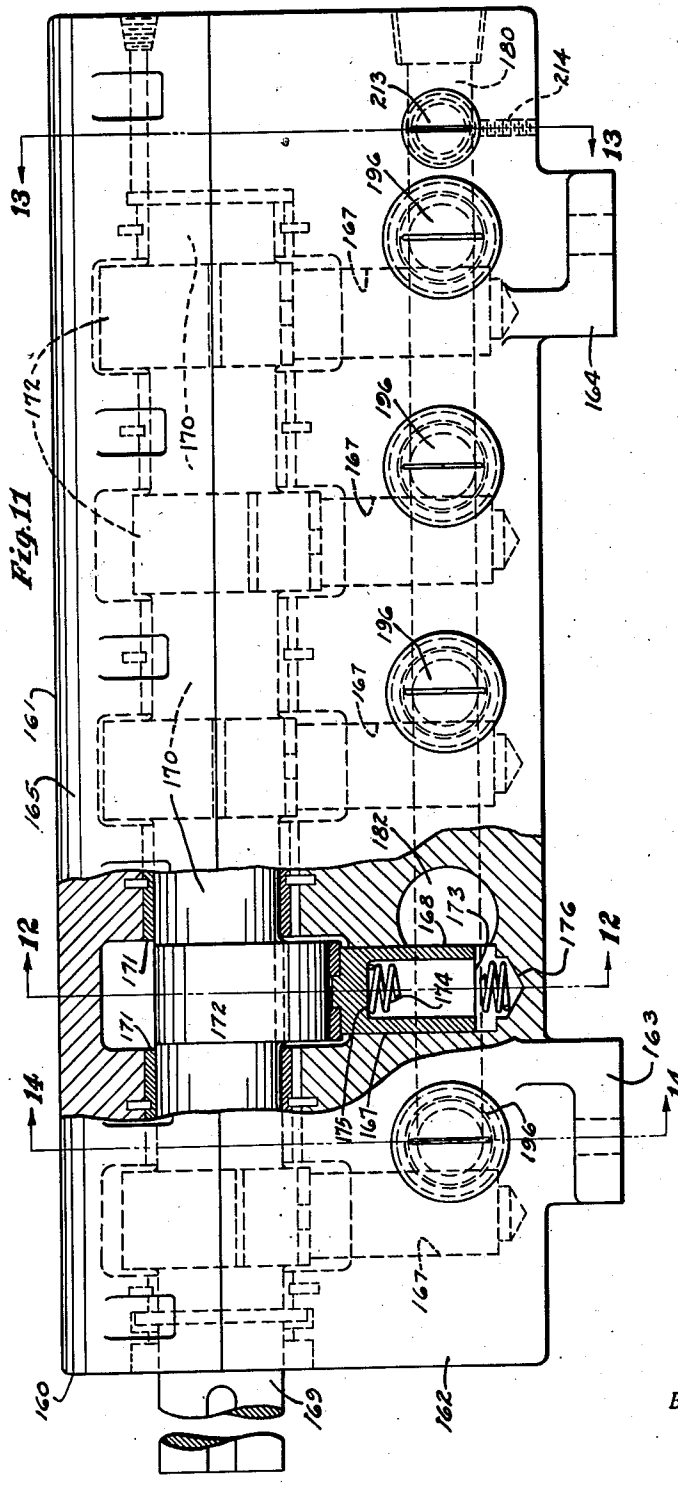


Fig. 11

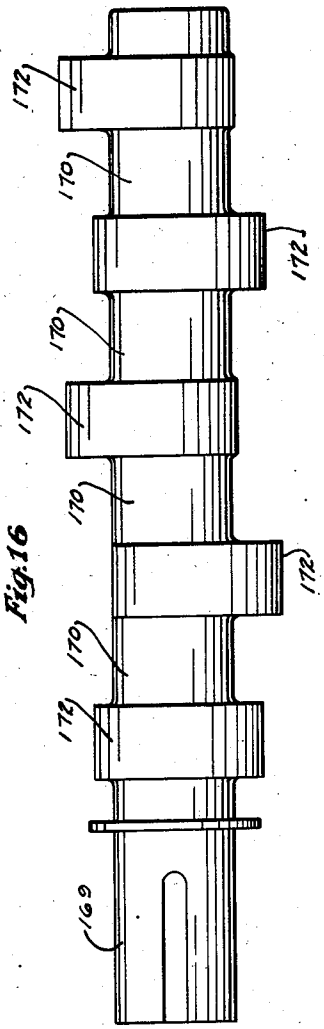


Fig. 16

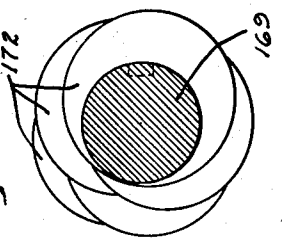


Fig. 17

INVENTOR.
Ernst L. Midgette

BY

Attorney

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Fig. 12

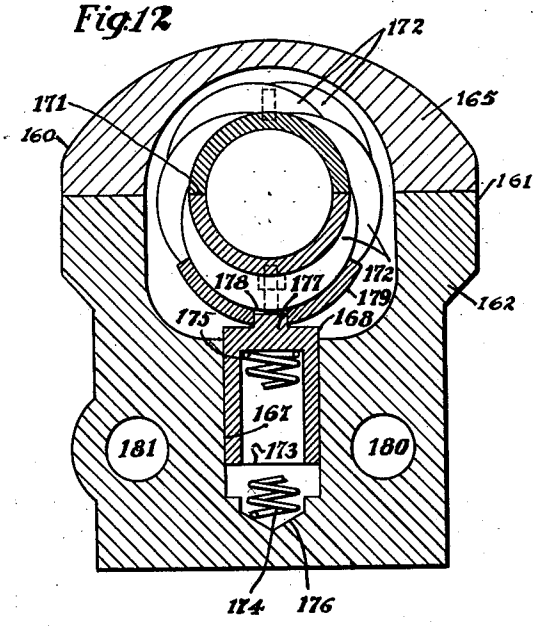


Fig. 13

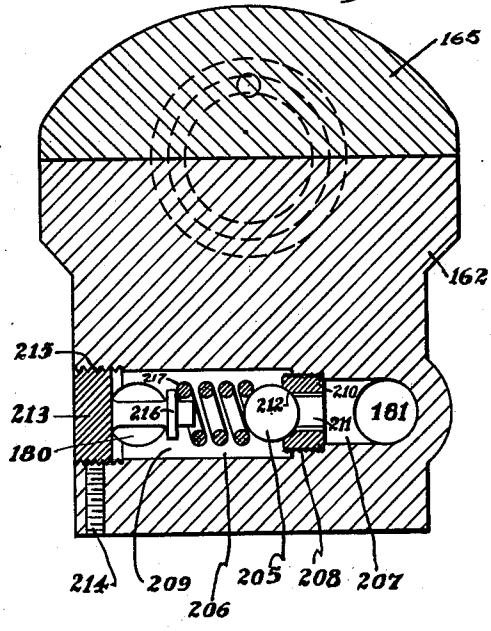


Fig. 14

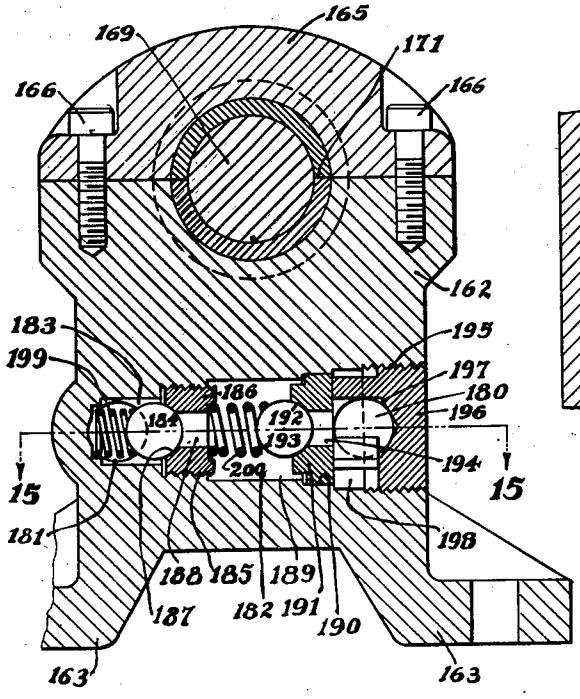
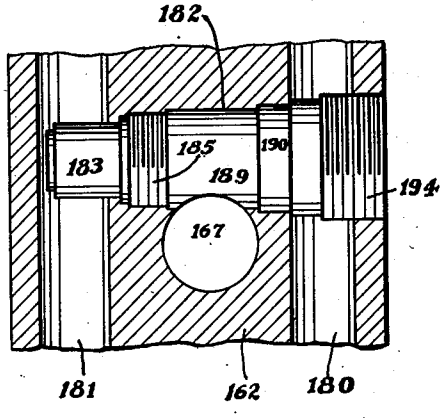


Fig. 15



INVENTOR.
Ernst L. Midgette

BY

Attorney

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UNITED STATES PATENT OFFICE

2,612,837

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Ernst L. Midgette, Philadelphia, Pa., assignor to American Engineering Company, Philadelphia, Pa., a corporation of Pennsylvania

Application May 21, 1946, Serial No. 671,308

5 Claims. (Cl. 103—5)

1

This invention relates to pumps and more particularly to pumps of the radial piston type.

One object of the present invention is to provide pumps of a simplified and generally improved construction.

Another object is to provide pumps of the radial piston type, having rotary cam means for operating the pistons thereof.

A further object is to provide pumps of the radial piston type, having rotary cam means for operating the pistons thereof and means for adjusting the strokes of said pistons.

A still further object is to provide pumps of the multi-row radial piston type, having rotary cam means for operating the pistons thereof.

A more specific object is to provide a pump comprising a series of pistons arranged for successive operation by cam means whereby a continuous flow of fluid is assured.

A still further object is to provide pumps of the stated character, having improved features of construction which produce highest operating efficiencies.

Other and further objects will become apparent as the description of the invention progresses.

Of the drawings:

Fig. 1 is a sectional view of a pump of preferred construction taken substantially along line 1—1 of Fig. 2.

Fig. 2 is an end view, partly in section, the sectional portion being taken substantially along line 2—2 of Fig. 1.

Fig. 3 is a side view, partly in section, of the cam shaft for actuating the pistons of the pump.

Fig. 4 is an end view of the shaft shown in Fig. 3.

Fig. 5 is a sectional view of one of the pistons taken substantially along line 5—5 of Fig. 6.

Fig. 6 is a sectional view of one of the pistons taken substantially along line 6—6 of Fig. 5.

Fig. 7 is a plan view of one of the slippers associated with the pump.

Fig. 8 is an end view of the slipper shown in Fig. 7.

Fig. 9 is a sectional view of a pump of an alternative construction taken substantially along line 9—9 of Fig. 10.

Fig. 10 is a sectional view taken substantially along line 10—10 of Fig. 9.

Fig. 11 is a side view, partly in section, of a pump of a further modified construction.

Fig. 12 is a sectional view taken substantially along line 12—12 of Fig. 11.

Fig. 13 is a sectional view taken substantially along line 13—13 of Fig. 11.

Fig. 14 is a sectional view taken substantially along line 14—14 of Fig. 11.

Fig. 15 is a sectional view taken substantially along line 15—15 of Fig. 14.

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Fig. 16 is a side elevational view of the cam shaft for the pump shown in Figs. 11 to 15; and

Fig. 17 is an end view, partly in section, taken along line 17—17 of Fig. 16.

Referring to the drawings, the numeral 1 designates a pump, which consists generally of a casing 2 having a series of radially disposed cylinders 3 formed therein, pistons 4 operating in the said cylinders 3, and a cam shaft 5 for operating the said pistons 4. The casing 2 comprises a main cylinder block 6, which is open at the right side (Fig. 1) thereof, and an end cover block 7, which is secured to the open side of said cylinder block 6 by means of stud bolts 8.

The cam shaft 5 is mounted for rotation in aligned roller bearings 9 and 10 mounted in the central openings of the reduced portions 11 and 12 of cylinder block 6 and cover block 7, respectively. An oil sealing device 13 is fitted in the central opening of reduced portion 11, near the left hand end (Fig. 1) thereof, and comprises a casing member 15, substantially U-shaped in cross-section, having packing material 16 provided therein, which frictionally engages the shaft 5. Internally threaded openings 17 are provided in the reduced portion 11 of cylinder block 6 to enable attachment of the pump 1 to any suitable supporting structure (not shown).

Shaft 5 may be coupled to the drive shaft of an electric motor (not shown) or to any other suitable power mechanism. Shaft 5 has formed thereon intermediate its ends an eccentric or cam member 20.

Cam member 20, as shown more particularly in Figs. 1 and 3, is provided with an enlarged, relatively wide cylindrical intermediate portion 22 and a pair of reduced, relatively narrow cylindrical end portions 25, 25. In assembly, the periphery of intermediate portion 22 engages the inner arcuate surfaces 23 of the slippers 24 pivotally attached to the inner ends of the pistons 4.

The reduced portions 25, 25, in assembly, have secured thereto rings 26, 26. Each ring 26 has an inwardly extending flange 27 provided thereon, the inner periphery of which forming with the periphery of intermediate portion 22 of cam member 20 an annular recess 28. As shown more particularly in Figs. 1 and 2, the annular recesses 28, 28 receive the outer edges 29, 29 of slippers 24 and constitute circular guides for the latter. The flanges 27, 27 of rings 26, 26, it is seen, retain the slippers in position on cam member 20.

Each slipper 24 has formed thereon an elongated rounded retaining member 30 which in assembly extends into a correspondingly shaped slot 31 provided at the lower end of an associated piston. To assemble the slipper 24 in position on the said piston, the rounded member 30 is simply inserted in slot 31 and moved lengthwise

thereof until reaching the position shown in Fig. 1. Each piston 4 has provided intermediate the ends thereof a pair of downwardly and outwardly inclining passages 32 and 33 which communicate with a reduced vertical passage 34. Passage 34 terminates in an enlarged upper portion 35 having outlet passages 36 and 37 extending outwardly from either side thereof, as shown more particularly in Fig. 6.

A seat 38 is formed interiorly of each piston 4 at the upper end of reduced vertical passage 34 for a ball valve 39. The enlarged passage 35 terminates in an annular shoulder 40 forming a seat for a valve stop disc 41. Disc 41 is circular in construction and has provided centrally thereof a projection 42 which limits the upward movement of ball valve 39. Disc 41 has also provided therein a pair of openings 43 and 44, as shown in Fig. 6, through which fluid may pass as will appear more fully hereinafter. A spring retaining ring 45, which in assembly seats in an annular recess 46 provided near the upper end of piston 4, retains disc 41 in position on shoulder 40.

As shown in Figs. 1 and 2, each cylinder 3 terminates in an enlarged portion 48 and in a still further enlarged internally threaded portion 49. A plug 50 is secured in the enlarged threaded portion 49 of each cylinder 3 and closes the outer end thereof. By this construction machining of the cylinders 3 and assembly of the various elements of the pump generally are facilitated. Communicating with the enlarged portion 48 of each cylinder 3 is a passage 51 which communicates with an enlarged passage 52 terminating in a further enlarged internally threaded passage 53. A plug 54 is secured to the internally threaded passage 53, as shown in Fig. 1, and closes the outer end thereof. The enlarged passage 52 associated with each cylinder 3 communicates with a circular passage 55, which in turn extends around the periphery of the rim portion 56 of casing 2. A seat 57 is provided at the left hand end (Fig. 1) of enlarged passage 52 for a ball valve 58. Plug member 54 has secured to the inner end thereof a spring seat 59 for receiving one end of a coil spring 60, the other end of the latter of which engaging ball valve 58 to retain the said valve upon its seat 57. The compression of spring 60 may be varied by adjusting plug 54.

The lower end 61 of casing 2 has provided therein a chamber 63 which is connected by a relatively short communicating passage 64 to circular passage 55. Circular passage 55 is also connected to a discharge port 65 to which a discharge pipe (not shown) may be attached. A seat 66 is provided between chamber 63 and passage 64 for a ball relief valve 67. A coil spring 68 extends between valve 67 and an adjustable spring seat 69. Spring seat 69 engages the inner end of a plug 70 which closes the left hand end (Fig. 1) of chamber 63. A set screw 71 making threaded engagement with the internally threaded central opening of plug 70 engages the outerside of spring seat 69. Thus to adjust the compression of spring 68 it is only necessary to adjust set screw 71 toward or away from spring seat 69. To prevent accidental movement of adjusting screw 71, a cap member 72 is provided thereon, as shown in Fig. 1.

From the foregoing description it is seen that should the pressure in pump 1 exceed a predetermined value as determined by the pressure of spring 68, valve 67 will move away from its seat 66 and permit the fluid in passage 55 to enter chamber 63, causing an immediate reduction of the pressure in the system.

Fluid enters the pump through the inlet port 76 provided centrally of cover block 7. Port 76 communicates with a passage 77 provided in shaft 5 near the right hand end thereof. The inner end of passage 77 is curved upwardly, as shown at 78, and terminates in a transverse passage 79 provided near the upper end of cam member 20. Thus fluid entering the pump through port 76 flows through passages 77 and 79 and discharges from either end of the latter into a central chamber 80 of casing 2. The fluid completely fills chamber 80 and then flows into the interior of pistons 4 through passages 32, 33, 34 and 35. This action takes place while the pistons 4 move inwardly toward the axis of shaft 5, at which time valve 39 will have moved away from its seat, permitting the fluid to enter the enlarged passage 35. The fluid flowing into pistons 4 discharges therefrom into the upper enlarged portions 48 of the cylinders 3 through passages 36, 37, 43 and 44. Now as the pistons are moved outwardly by cam 20, valve 39 moves onto its seat, thereby trapping the fluid in the enlarged portion 48. As the pistons 4 move outwardly the fluid in enlarged portions 48 is forced through passages 51, unseating valves 58 against their springs 60. The fluid then flows into passages 52, and thence into circular passage 55. This pumping action of the pistons 4 takes place successively during a complete rotation of shaft 5, and the fluid so drawn into each chamber 48 discharges therefrom into the associated passages 52, and thence to circular passage 55, as previously described, and then discharges from the pump through port 65. In the event that the pressure of the fluid should exceed a predetermined value as determined by the setting of spring 68, relief valve 67 will move away from its seat to permit the fluid in passage 55 to flow into chamber 63, thereby relieving the pressure in the system.

Fluid is drawn into the pump 1 through port 76 by the suction action of the pistons 4 as they move toward the center of cam shaft 5. It is also seen that the rotation of cam member 20 of the shaft 5 produces a radial acceleration of the fluid causing it to flow through the transverse passage 79 thereof and into chamber 80 under a positive pressure. During rotation of shaft 5 the fluid in chamber 80 therefore is under a slight pressure which is sufficient to cause it to completely fill the cylinders 3, including the upper enlarged portions 48 thereof during the suction stroke of the pistons 4. The splash action produced by cam member 20 during rotation of shaft 5 also tends to cause the fluid to flow through the passages of pistons 4 and into the cylinders as previously described.

A drain port 81 communicating with chamber 63 is provided at the lower end of casing 2. A plug 82 normally closes opening 81. Chamber 63 is also connected to central chamber 80 by a communicating passage 84. Thus by removing plug 82 the fluid may be drained from the pump 1.

Figs. 9 and 10 illustrate a modified pump construction 90 which consists generally of a casing 91 having formed therein series of radially disposed cylinders 92, pistons 93 operating in the cylinders 92, and a cam shaft 94 for operating the said pistons 93. Casing 91 consists of a main cylinder block 95 and a pair of cover plates 98 and 99, the latter being secured to said cylinder block by bolts 96 and 97, respectively. Cover plates 98 and 99 are provided with inwardly ex-

tending annular flanges 100 and 101 in which are mounted, respectively, roller bearings 102 and 103 for the shaft 94.

As shown more particularly in Fig. 9, shaft 94 is of sectional construction and comprises an axially movable member 104 and a non-axially movable member 105. Member 105 is mounted for rotation in the roller bearing 103 provided in the internal flanged portion 101 and in a second roller bearing 107 provided in the outwardly extending flanged portion 108 of end plate 99. An end retaining plate 109 is secured to the flanged portion 108 in any suitable manner, such as by cap bolts 110. The member 104 of shaft 94 is journalled intermediate its ends in roller bearing 102, as previously described, and the inner end thereof extends into the central bore 106 of member 105 and is keyed to the latter so as to permit relative axial movement of said members. Thus upon rotation of shaft 94, members 104 and 105 thereof will rotate in unison.

A packing gland 111 secured to end plate 98 by bolts 112 is provided to prevent oil leakage past shaft 94.

Member 104 of shaft 94 has provided intermediate the ends thereof an enlarged inclined cylindrical portion 113 which operates in a correspondingly shaped inner bore of an eccentric member 114. A cylindrical member 115 is mounted on eccentric member 114, a roller bearing 116 being provided therebetween. As shown in Fig. 10, the inner ends 93' of pistons 93 are in engagement with the periphery of cylindrical member 115. Thus when shaft member 104 has been adjusted, as will presently appear, to move members 114 and 115 out of concentric position with respect to the axis of shaft 94, an outward movement will be imparted to pistons 93 upon rotation of the said shaft 94.

As shown in Fig. 9, three rows of pistons 93 are provided, there being seven radially disposed groups of such pistons as shown in Fig. 10. It is to be understood, however, that a greater or lesser number of rows of pistons 93, as well as a greater or lesser number of groups of such pistons, may be provided without departing from the invention. Each group of cylinders 92 terminates at the outer end thereof in an enlarged chamber 121, as shown in Figs. 9 and 10.

Cylinder block 95 has provided therein near the opposite sides thereof a circular inlet passage 117 and a circular outlet passage 118. A relatively short transverse communicating passage 119, closed at the outer end thereof by a plug 120, connects circular passage 117 with each of the chambers 121. A valve seat 122 is provided near the inner end of passage 119 for a valve 123. Valve 123 has secured centrally thereof a stem 124 which is guided for movement in the central bore 125 of plug 120. A coil spring 126 extending between an annular shoulder 127 provided near the right hand end of passage 119 and a spring seat 128 secured to valve stem 124 retains valve 123 on its seat 122.

Circular passage 118 is also connected to each chamber 121 by a communicating passage 130. A seat 131 is provided near the inner end of each passage 130 for a valve 132. Each valve 132 has secured thereto a stem 133, the outer end of which being guided for movement in the central bore 134 of a plug 135. As shown in Fig. 9, the plugs 135 close the outer ends of passages 130. A coil spring 136 extends between the inner side of plug 135 and valve head 132 and functions to retain the said valve in seated position.

Fluid enters the circular inlet passage 117 through an inlet passage 138. As shown in Fig. 9, an annular seat 139 is provided near the outer end of passage 138 for receiving the inner end of a fluid inlet pipe 140. A pipe clamp 141 secured to the lower end of cylinder block 95 by bolts 142 retains the pipe 140 in proper position. Fluid is discharged from pump 90 through a discharge passage 143 which communicates with circular passage 118. An annular recess 144 is provided near the outer end of passage 143 for receiving the inner end 145 of a discharge pipe 146. A pipe clamp 147 secured to the lower end of cylinder block 95 by bolts 148 secures the discharge pipe 146 in position.

The cylinder block 95 has provided at the lower end thereof pedestal supports 149 and 150 which may be bolted or otherwise secured to any supporting structure.

In operation the pistons 93 are actuated outwardly upon rotation of shaft 94, as previously described. The pressure in chambers 121 operating on the outer ends of pistons 93 urges them inwardly. Coil springs 151 surrounding the stems 152 provided at the outer ends of pistons 93 and extending between the outer walls 153 of chambers 121 and the outer ends 154 of the said pistons also operate to urge the latter inwardly.

From the foregoing description it is seen that fluid enters the system through pipe 140, inlet passage 138, circular passage 117 and communicating passages 119. The pressure of this fluid entering the system is sufficient to overcome the compression of springs 126, thereby opening the associated valves 123 and permitting the fluid to enter chambers 121. When springs 151 are employed the pistons are urged inwardly, thereby creating sufficient suction to open valves 123. No initial pressure therefore is necessary to unseat the valves 123. This takes place as the pistons begin moving inwardly toward the axis of shaft 94 after a pressure operation. As the shaft continues its rotation, the pistons 93 are moved outwardly by cam member 114 and cylindrical member 115, thereby compressing the fluid in chambers 121. This pressure closes valves 123 and opens valves 132, causing the fluid so compressed by the pistons 93 to enter communicating passages 130 and circular passage 118, and thence to flow to discharge through outlet passage 143 and discharge pipe 146.

When the parts are in the position shown in Fig. 9, inclined member 113 is centralized with respect to eccentric member 114 and the axis of the latter coincides with that of shaft 94. Consequently no movement will be imparted to pistons 93 upon rotation of shaft 94 when the said inclined member 113 is in this centralized position. However, upon movement of member 104 of shaft 94 to the right or left, as the case may be, a corresponding radial movement will be imparted to eccentric member 114, moving the latter out of concentric position with respect to the axis of shaft 94. Now upon rotation of shaft 94 a reciprocatory movement will be imparted to the pistons 93, which function to pump fluid as previously described. From the foregoing description it is seen that the greater the axial movement of inclined member 113 from its central position, the greater will be the strokes of the pistons 93.

Figs. 11 to 17 illustrate a pump 160 of a further modified construction. Pump 160 comprises a casing 161 consisting of a lower cylinder block portion 162, having pedestal supports 163 and

164 provided at the lower end thereof and a cover plate 165. Cover plate 165 is secured to the cylinder block 162 by stud bolts 166. Cylinder block 162 has formed therein at spaced points therealong a series of substantially vertical cylinders 167, in each of which is mounted a piston 168. A cam shaft 169 is provided for operating the pistons 168, and has provided over the length thereof a series of journal portions 170, which, in assembly, are mounted in spaced bearings 171 provided in cylinder block 162 and cover plate 165, as shown more particularly in Figs. 11, 12 and 14. Shaft 169 has formed thereon in spaced relation over the length thereof a series of cam members 172, one for each of the pistons 168. The cam members 172 are so formed on the shaft 169 that the pistons 168 are successively operated during a complete rotation of the cam shaft 169. This, obviously, reduces the effort required to rotate the pump 160.

In the illustrative embodiment the pistons 168 are of substantially hollow construction and are open at the lower ends thereof, as shown at 173. A coil spring 174 extends between the inner end 175 of the hollow interior of each piston 168 and the lower reduced end 176 of the associated cylinder 167.

As shown more particularly in Figs. 11 and 12, each piston 168 has provided at the upper end thereof a reduced portion 177, which seats in an aperture 178 provided in a shoe 179. The shoe members 179 are arcuate in construction and are engaged by the cam members 172.

Cylinder block 162 has provided at the opposite sides thereof long inlet and outlet passages 180 and 181, respectively. These passages extend substantially the entire length of the pump casing 161 and terminate adjacent the cylinder 167 disposed to the left (Fig. 11) of the pump 160. The cylinders 167 extend substantially at right angles to the passages 180 and 181 and lie substantially midway between said passages, as shown more particularly in Fig. 12. Passages 180 and 181 are connected by transverse passages 182, which intersect the right hand sides of cylinders 167, as shown more particularly in Fig. 11. Each passage 182 is provided with a reduced inner portion 183 in which is mounted a ball valve 184. Adjacent the reduced portion 183 of passage 182 is a slightly enlarged internally threaded portion 185, which is adapted to receive a correspondingly threaded member 186. Member 186 is provided with a seat 187 at the left hand end thereof for ball valve 184, and is provided with a central opening 188 which establishes communication between reduced portion 183 and a slightly enlarged central portion 189 of passage 182. Adjacent central portion 188 of passage 182 is a slightly enlarged portion 190 in which is mounted a disc member 191, having a seat 192 at the left hand end (Fig. 14) thereof for a ball valve 193. Member 191 is provided with a central opening 194, which establishes communication between central chamber 189 and inlet passage 180. A relatively large, internally threaded portion 195 is disposed adjacent portion 190 for receiving a correspondingly threaded plug member 196, which closes the right hand end (Fig. 14) of passage 182. Plug 196 is provided with an internal bore 197, having openings 198 at spaced points around the inner end thereof to permit the passage of fluid from inlet passage 180 to communicating passage 194. A coil spring 199 extending between the left hand end (Fig. 14) of reduced portion 183 and ball valve 184 retains the latter on its seat 187. Similarly a coil spring 200 extending between the right hand side (Fig. 14) of member 186 and ball valve 193 retains the latter on its seat 192.

It, therefore, is seen that upon movement of pistons 168 toward the axis of shaft 169, suction is created in cylinders 167, causing valves 193 to move away from their respective seats against the action of springs 200, thereby permitting fluid to enter cylinders 167 through communicating passages 193 and central passages 189. The pressure of the fluid entering the system through passage 180 may also be sufficient to unseat valves 193 and thereby permit fluid to enter central portions 189 of passages 182. The fluid entering cylinders 167 in this manner completely fills them and the hollow interiors of pistons 168, as well as the voids in passages 182. When the pistons 168 are moved downwardly by their cams 172, the pressure created by the compression of the fluid in cylinders 167 closes valves 193 and opens the valves 184 against the compression of springs 199, thereby forcing the fluid from chambers 189 into discharge passage 181 through the passages 188 and 183. This action of the pistons 168 takes place successively and consequently a relatively large quantity of fluid is delivered by the pump 160 at a relatively small operating effort. In the illustrative embodiment five pistons are shown, it being apparent, however, that a greater or lesser number of pistons may be provided, if so desired, without departing from the invention.

In order to prevent excessive pressures in the system a relief valve 205 is provided. As shown in Figs. 11 and 13, a passage 206 connecting inlet and discharge passages 180 and 181, respectively, is provided near the right hand end of casing 161. Passage 206 is provided with a reduced portion 207 near the right hand end (Fig. 13) thereof adjacent discharge passage 181. A slightly enlarged, internally threaded portion 208 is disposed between reduced portion 207 and a central portion 209 for receiving a correspondingly threaded member 210, having an opening 211 provided centrally thereof which establishes communication between reduced passage 207 and the said central passage 209. Member 210 is provided with a seat 212 at the left hand end (Fig. 13) thereof for ball valve 205. The central portion 209 of passage 206 communicates with inlet passage 180. A plug 213 adapted to be held in adjusted position by a set screw 214 is secured to the internally threaded left hand end 215 of passage 209. Plug 213 has provided centrally thereof a spring seat 216 which engages one end of a coil spring 217, the other end of which engages the ball valve 205. Accordingly, in the event that the pressure in passage 181 should exceed the desired predetermined value as determined by spring 217, valve 205 will move away from its seat and thereby permit fluid from passage 181 to flow into passage 180 through reduced passage 207, opening 211 and central passage 209. The compression of spring 217 may be adjusted by manipulating plug 213. After plug 213 has been properly adjusted it is held in position by tightening set screw 214.

From the foregoing description it is seen that simplified and highly efficient pumps have been provided. The pumps are constructed of but a few parts and the elements thereof are so arranged that machining of the cylinders and other parts may be readily performed. It is also seen that assembly of the elements may be expedi-

tiously effected, thereby further facilitating the manufacture of the pumps.

It is also apparent that the structures of the pumps are such that pumps of various sizes and capacities may readily be made without undergoing material changes in design.

While the embodiments herein shown and described are adapted to fulfill the objects primarily stated, it is to be understood that it is not intended to limit the invention thereto, since it may be embodied in other forms, all coming within the scope of the claims which follow.

What is claimed is:

1. A pump comprising a fixed casing having one or more cylinders therein, a piston operating in each of said cylinders, a shaft rotatably mounted in said casing, cylindrical cam means carried by said shaft, a slipper pivotally attached to each of said pistons and engaging said cam means, said slipper having freedom for movement with respect to the said piston axially of the said pivot, and means for slidably retaining said slippers in engagement with said cam means, whereby upon operation of the latter by said shaft reciprocatory movements are imparted to said pistons, said retaining means comprising slipper-retaining elements together with means for fixing said elements axially of the shaft with respect both to the cam means and to the slippers so as to immobilize the slippers with respect to the cam means in direction axially of the latter.

2. A pump according to claim 1 including abutment means for preventing movement of the said retaining elements in the casing in the said axial direction.

3. A pump according to claim 2 wherein the slipper-retaining elements consist of a pair of annular members seated in recesses at opposite ends of the cam at opposite sides respectively of the slippers, and having flanges overlapping and closely embracing the edge portions of the latter, said annular members being closely fitted to the cam and to the slippers and having their outer faces in abutment with confronting surfaces of the casing.

4. A pump comprising a casing having a fluid supply chamber and one or more radially disposed cylinders provided therein, a substantially hollow piston operating in each of said cylinders, a shaft mounted for rotation in said casing, cam means mounted on said shaft, said cam having means for operatively connecting said pistons to said cam means whereby upon rotation of the latter alternate suction and pressure movements are imparted to said pistons, means forming inlet passages in said casing, shaft and cam means, said passages communicating with said fluid supply chamber whereby fluid completely fills the latter, each of said pistons having fluid inlet ports provided therein whereby fluid from said supply chamber enters said cylinders during the suction stroke of said pistons, valve means provided in said pistons for preventing a reverse flow of the fluid entering said cylinders, means forming discharge passages communicating with said cylinders whereby the fluid drawn into said cylinders is discharged therefrom into said discharge passages during the pressure strokes of said pistons, and means for preventing a reverse flow of the fluid in said discharge passages.

5. A cam shaft comprising an elongated body portion, a cam member formed on said body portion, said cam member having a relatively wide portion and a relatively narrow reduced portion at each side of and coaxially with said relatively wide portion, a transverse passage in the relatively wide portion extending to an end of the cam member, and said body portion having a central passage extending inwardly from one end thereof and having an inner radial terminal portion communicating with the transverse passage in said cam member.

ERNST L. MIDGETTE.

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