March 15, 1960 D. W. KEEF ET AL 2,928,585

MULTI-ROTOR HYDROTURBINE PUMP

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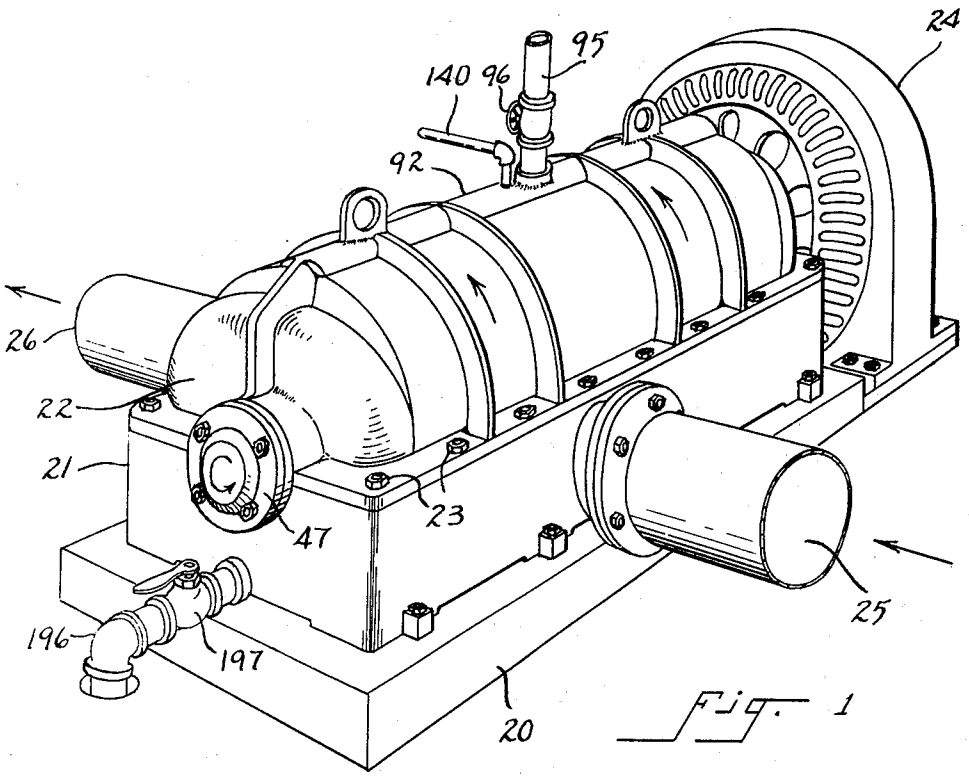


Fig. 1

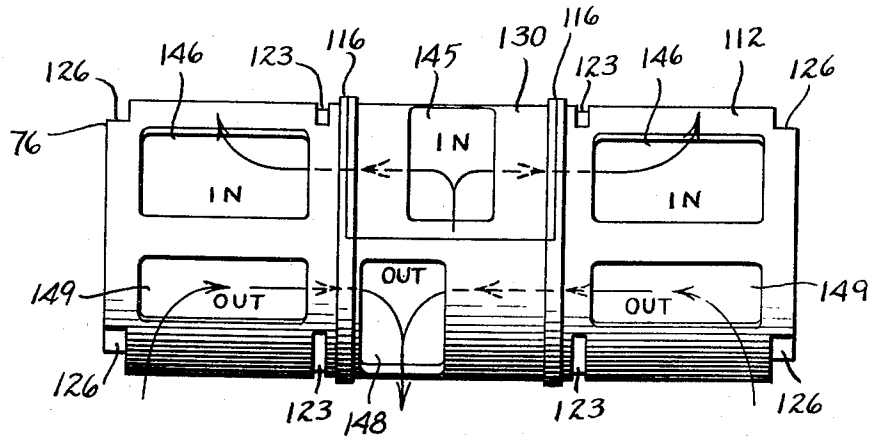


Fig. 5

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MULTI-ROTOR HYDROTURBINE PUMP

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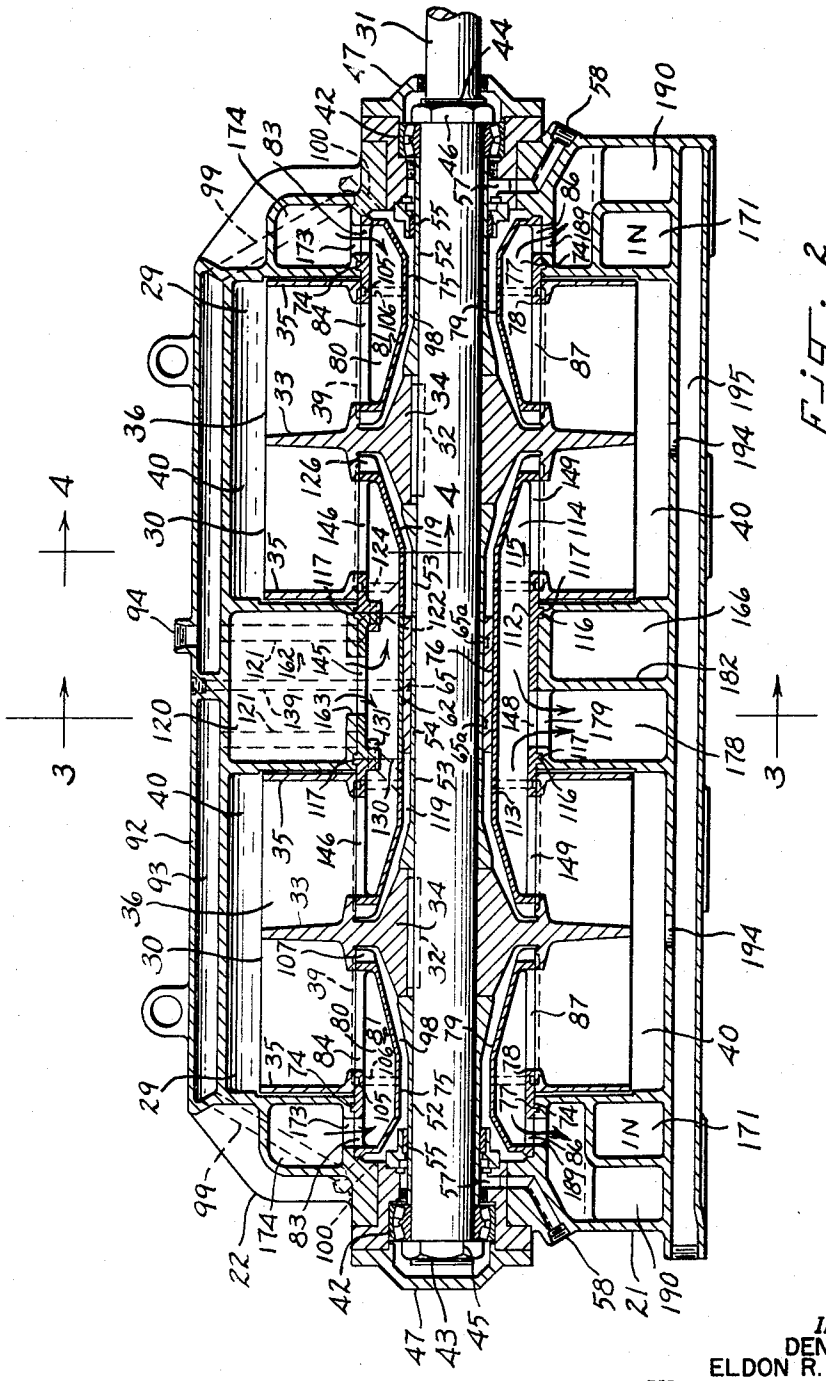


Fig. 2

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MULTI-ROTOR HYDROTURBINE PUMP

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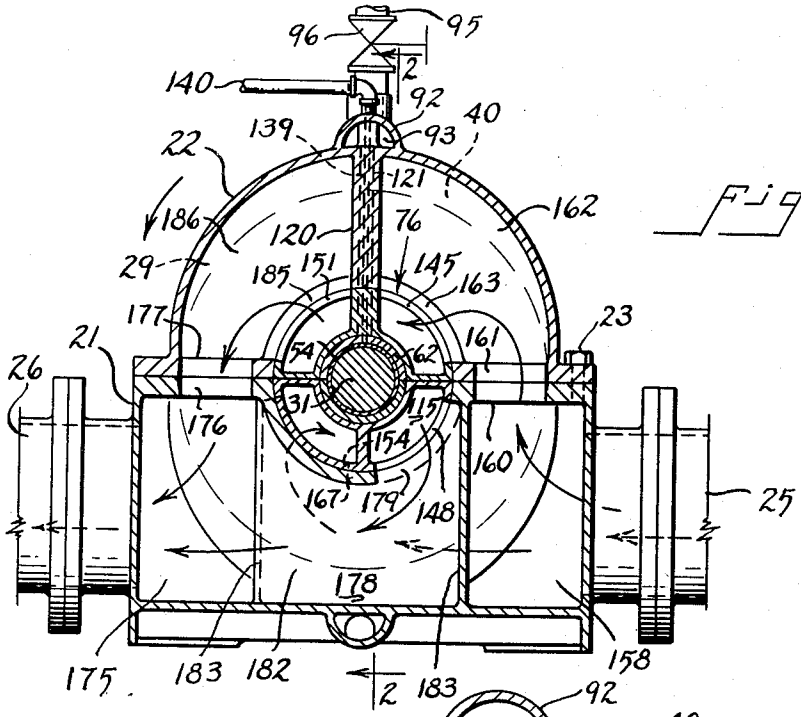


Fig. 3

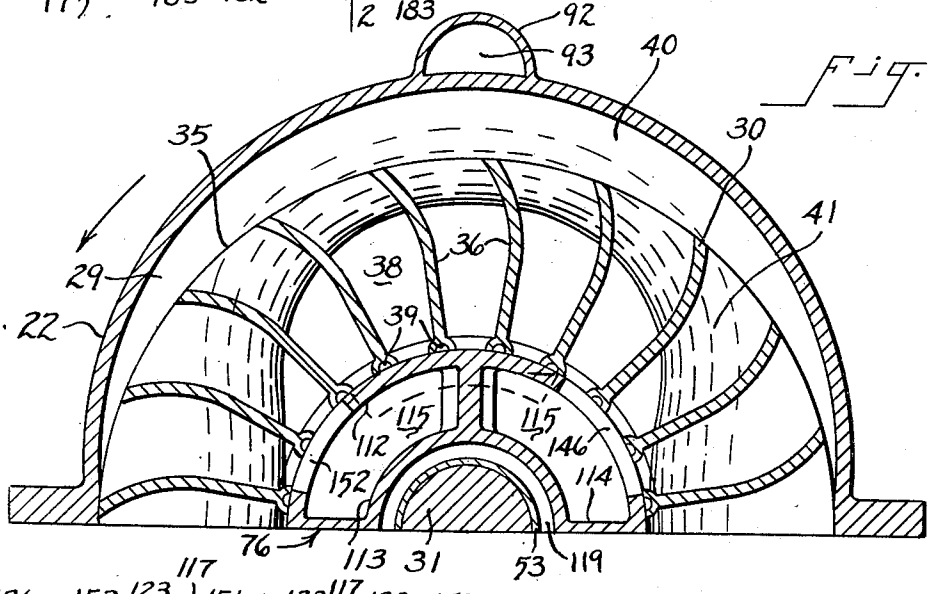


Fig. 4

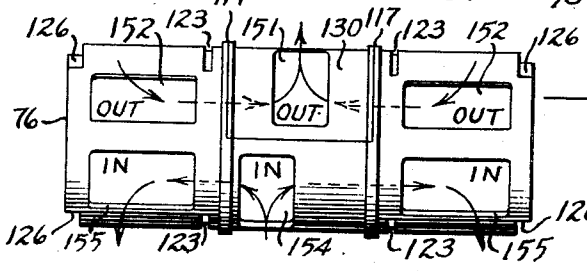


Fig. 5a

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MULTI-ROTOR HYDROTURBINE PUMP

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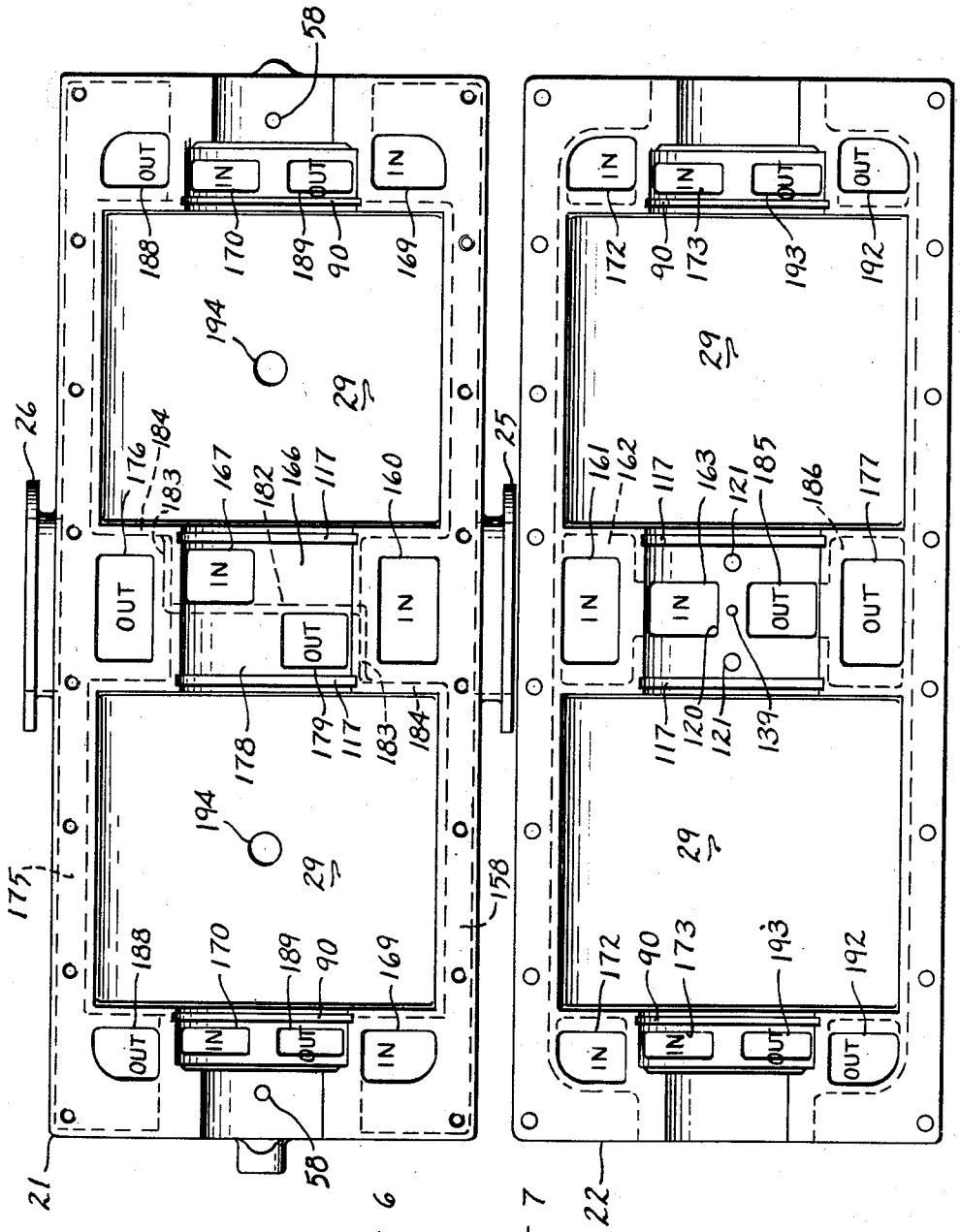


Fig. 6

Fig. 7

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MULTI-ROTOR HYDROTURBINE PUMP

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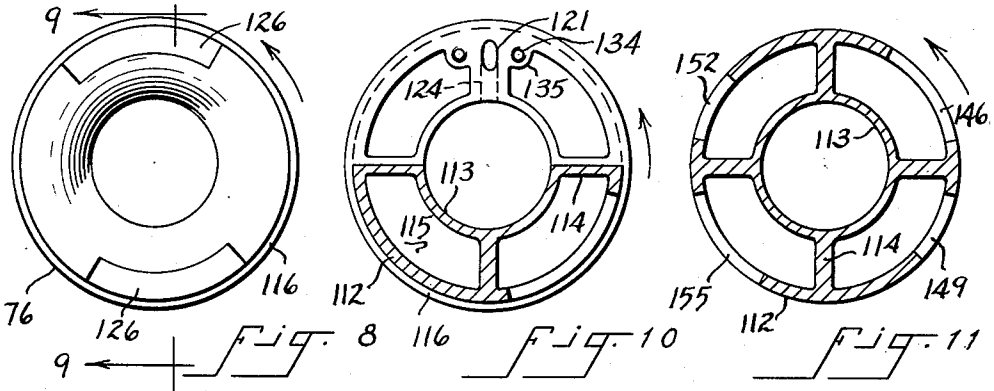


Fig. 8 Fig. 10 Fig. 11

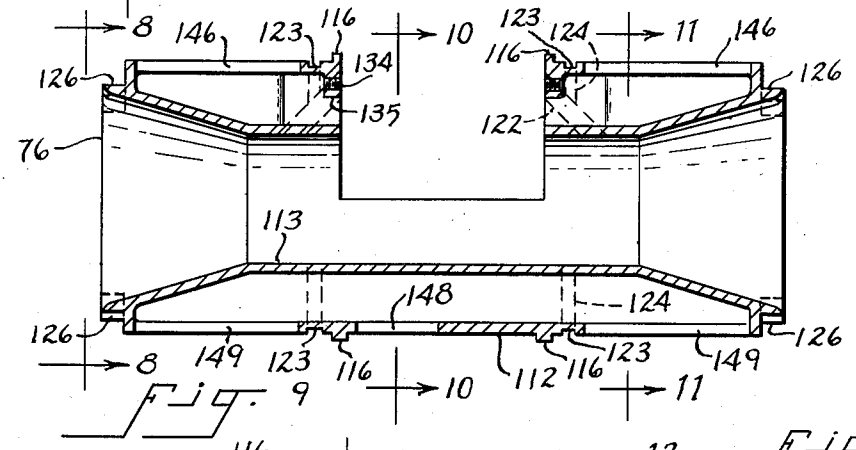


Fig. 9

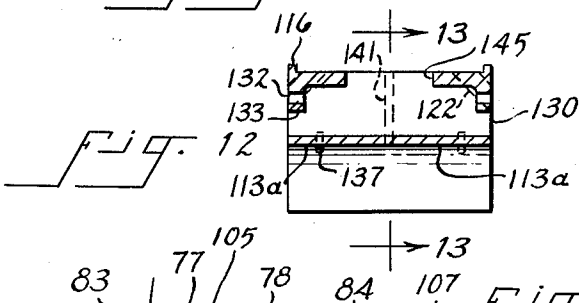
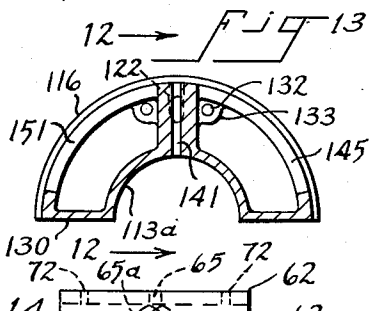


Fig. 12



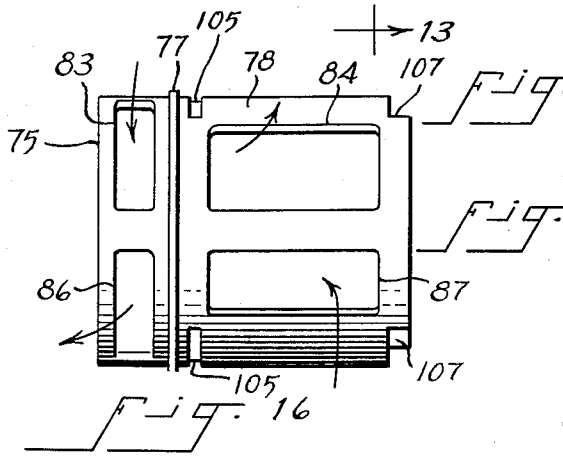


Fig. 16

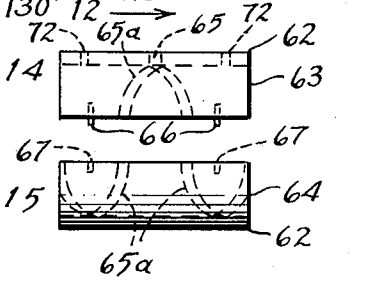


Fig. 14 Fig. 15

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2,928,585

MULTI-ROTOR HYDROTURBINE PUMP

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Application February 10, 1956, Serial No. 564,793

14 Claims. (Cl. 230—79)

This invention relates to improvements in hydroturbine gas pumps. A hydroturbine pump is one in which a ring of liquid is caused to rotate in an eccentric casing and form a displacement medium. Such pumps, which are also known as liquid piston pumps, are used either as vacuum pumps or pressure pumps under low or moderate pressures.

In designing large pumps of this type it has heretofore been the practice to increase the capacity of the pump by merely enlarging all the dimensions sufficiently to meet the requirements. However, when the capacity is increased in this manner the rotor and casing become too large in diameter for economical construction and peripheray speed limitations impose restrictions on the motor speed, necessitating an unduly large and expensive driving motor which will develop its rated power at a slower speed.

In the present pump a large capacity is obtained without increasing the pump diameter and without employing a slower motor. This is accomplished by elongating the casing and mounting a plurality of rotors on a common shaft. Thus, the capacity of a conventional single rotor pump may be doubled or trebled by adding more rotors, without encountering the disadvantages hereinabove mentioned.

A tandem rotor assembly, however, introduces new problems in bearing construction for supporting the shaft intermediate the ends of the casing, in the lubrication of such bearings and provisions for making them accessible for repair, in port plugs for admitting and discharging the pumped fluid between the rotors, in casing ductwork for distributing the pumped fluid, and in the control of the sealing liquid. The present invention is concerned with these and other problems resulting from the mounting of plural rotors in a single casing in a hydroturbine type pump.

A primary object of the invention is to provide a hydroturbine pump of the type described which employs a plurality of rotors operative on a common shaft.

A further object is to provide a novel double-ended port member for such pumps to direct the pumped fluid into and out of engagement with two rotors.

More specifically, it is an object of this invention to provide an improved port member for the type of pump described which has individual sets of end ports for cooperating with adjacent rotors, which has common inlet and outlet means for said sets of ports, which has means for receiving a novel bearing to support a shaft between the ends of a pump casing, and which has removable cap means adapted to expose said bearing.

A further object is to provide a pump casing for a multi-rotor hydroturbine pump which has common inlet and outlet passages communicating with working parts of the pump.

A further object is to provide a pump casing for a multi-rotor hydroturbine pump having novel means for introducing a sealing liquid to interior portions of the pump, and, in addition, it is an object to provide a pump

casing which facilitates inspection of interior working parts and repair thereof.

Still further objects are to provide a large capacity hydroturbine pump which is compact and efficient, and which is simple in structure and operation.

The aforementioned objects are accomplished by a pump structure of the liquid ring piston type in which two or more rotors are mounted on a common shaft. The rotors are disposed in eccentric chambers in a stationary casing and form rotating displacement chambers therein. Mounted in the ends of the casing are end port members which communicate with the outer ends of the rotors, and mounted in the casing between the rotors is a central port member which communicates with the inner ends of the rotors. The port members have sets of inlet and outlet ports communicating with common inlet and outlet passages in the casing. A novel split bearing is carried by the central port member to support the shaft intermediate the ends of the casing, the bearing being lubricated by water introduced thereto through passages in the casing. A bearing cap in the central port member is removable so that the bearing may be removed. In this connection, the pump casing is split on a horizontal plane and may be readily opened to gain access to the bearing and other working parts of the pump.

The pump casing itself is provided with a plurality of novel passages and ports for directing the flow of pumped fluid into and out of the port members and the rotors. The present structure is also provided with a sealing system to seal the clearances between the rotors and the port members.

The invention will be better understood and additional objects and advantages will become apparent from the following description taken in connection with the accompanying drawings which illustrate a preferred form of the invention. It is to be understood, however, that the invention may take other forms and that all such modifications and variations within the scope of the appended claims, which will occur to persons skilled in the art, are included in the invention.

In the drawings:

Figure 1 is a perspective view of the present pump;

Figure 2 is a vertical sectional view through the pump casing and working parts, taken on a line 2—2 of Figure 3 which is offset slightly from the longitudinal center line;

Figure 3 is a sectional view showing the direction of flow of pumped fluid in relation to the central port member, taken on the line 3—3 of Figure 2;

Figure 4 is a sectional view showing an eccentric rotor chamber with the rotor and liquid ring therein;

Figure 5 is a side elevational view of the central port member;

Figure 5*a* is an elevational view of the central port member showing the opposite side of that shown in Figure 5;

Figure 6 is a top plan view of the bottom half of the pump casing with the working parts of the pump removed;

Figure 7 is a plan view of the top half of the pump casing turned over to show its interior structure;

Figure 8 is an end elevational view of the central port member, taken on the line 8—8 of Figure 9;

Figure 9 is a longitudinal sectional view of the central port member, taken on the line 9—9 of Figure 8;

Figure 10 is a cross sectional view taken on the line 10—10 of Figure 9;

Figure 11 is a cross sectional view taken on the line 11—11 of Figure 9;

Figure 12 is a vertical sectional view taken through the center of a removable section of the central port member, on the line 12—12 of Figure 13;

Figure 13 is a cross sectional view of the removable section of the central port member, taken on the line 13—13 of Figure 12;

Figure 14 is an elevational view of the top half of the central bearing;

Figure 15 is an elevational view of the bottom half of said bearing; and

Figure 16 is an elevational view of one of the end port members.

Referring first to Figure 1, the pump of the present invention is supported on a base 20 and comprises a casing having a bottom rectangular section 21 and a semi-elliptical cover section 22 removably secured to the section 21 by a plurality of screws 23. The pump is driven by an electric motor 24, and has inlet and outlet conduits 25 and 36, respectively, in the bottom casing section 21 for receiving and discharging pumped fluid.

The interior of the pump casing has a pair of elliptical or eccentric chambers 29, Figures 2, 3 and 4, having rotatable therein rotors 30 keyed to a shaft 31 by keys 32. Each rotor comprises a hub 34 having as an integral part thereof a central shroud 33 and end shrouds 35, between which are secured a plurality of blades or vanes 36 forming a series of displacement chambers or pockets 38. Each of the vanes 36 has a groove 39 in its inner face. The rotors are of cylindrical shape and closely fit the interior of the pump casing at the minor or horizontal axis of its ellipse but are spaced therefrom at the major or vertical axis of its ellipse, forming upper and lower lobes 40.

As is well known, in a liquid ring piston pump a liquid ring 41, Figure 4, established by the rotor, is rotated by the vanes 36 in the eccentric chamber to accomplish the pumping action. The liquid recedes from the inner portions of certain of the displacement chambers 38 by centrifugal force as the outer portions of said chambers move toward the major axis and into communication with the lobes, and this recession constitutes a suction stroke which draws fluid to be pumped through the intake or inlet side of the pump which is in communication with the inner portions of said chambers. As the chambers 38 move out of communication with the lobes and away from the major axis, the liquid ring is forced back into the chambers to perform a compression stroke and force the pumped fluid through the discharge side of the pump which is then in communication with the inner portions of said chambers.

In a two-lobe pump as illustrated herein, the suction and compression strokes occur twice during each revolution of the rotor. The present invention is particularly concerned with a novel construction and arrangement of port members for connecting the pump inlet with rotor chambers which are in a suction phase and connecting the pump outlet with rotor chambers which are in a compression phase. The port members will hereinafter be described in detail.

Shaft 31 is journaled at opposite ends of the pump housing in bearings 42 and has threaded portions 43 and 44 for receiving, respectively, nuts 45 and 46 covered by end caps 47, the shaft 31 projecting through one of the caps 47 and being operatively connected to motor 24. Rotors 30 are thus driven on a common shaft, and the arrangement thereof constitutes a hydroturbine pump or compressor utilizing a plurality of rotors which rotate with a common shaft but operate in separate pumping circuits except for common inlet and outlet means, as will hereinafter be seen. The multiple rotor structure makes for greater over-all efficiency and compactness than a single rotor of large size and can operate at a higher speed because of the small radius of the rotors.

Referring specifically to Figure 2, a pair of spacer sleeves 52 are mounted on the shaft 31 adjacent opposite ends thereof. These sleeves are disposed in abutting relation between the hubs 34 and the bearings 42, and are rotatable with the shaft. A pair of spacer sleeves 53 are mounted on the shaft between the two rotors to abut against the two hubs 34. Between the sleeves 53 is a bearing sleeve 54. The five sleeves hold the rotors in fixed axial position on the shaft. Stuffing boxes 55 are provided for the shaft on each end of the housing and are spaced a short distance inwardly from the bearings 42 to form annular drain passages 57 communicating with drain outlets 58 for discharging fluid which may escape through the packing in the stuffing boxes 55.

Supporting the sleeve 54 between the rotors is a stationary bearing member 62 in the form of a split sleeve, Figures 14 and 15, comprising a pair of halves 63 and 64. The bearing half 63 has an aperture 65 communicating with a spiral groove 65*a* provided in the inner surface of the bearing, and, in assembled position, the two half portions are held in longitudinal register with each other by pins 66 in the bearing half 63 engageable in aligned bores 67 in the opposite bearing half 64. Bearing half 63 has a pair of pin receiving apertures 72 in its top surface.

Mounted within the casing concentric with the shaft 31 is a pair of port members 75, Figures 2 and 16, disposed adjacent opposite ends of said shaft, and a central port member 76, Figures 3, 5, 5*a* and 8–13. Port members 75 are of identical structure, except for the hand of their inlet and outlet ports, and are snugly fitted in the casing with a very slight running clearance with the rotor. An annular tongue 77 on the periphery of the port members 75 is engageable with a groove 74 in the casing sections 21 and 22 to maintain the port members in a stationary position in the casing.

Each of the port members 75 has an outer cylindrical wall 78 and an inner tapered wall 79, the interior of the port members having longitudinal radial partitions 80, Figure 2, forming a plurality of chambers 81 therebetween. Outer wall 78 is provided with a pair of transverse inlet ports 83 adjacent one end which open into chambers 81, and the wall 78 also has longitudinally disposed outlet ports 84 leading out of the same chambers 81 which are provided with the inlet ports 83 whereby fluid may enter through ports 83, pass through chambers 81, and then pass through ports 84 into displacement chambers 38 between the rotor vanes 36 which are in suction position.

For use in a two-lobe pump, the structure has four of the partitions 80, and two of the chambers 81 therebetween are provided with the ports 83 and 84. The outer wall 78 also has a pair of transversely disposed outlet ports 86 and a pair of longitudinally disposed inlet ports 87, the ports 86 and 87 communicating with the chambers 81 which are in compression position. In operation, fluid is forced from displacement chambers 38 into chambers 81 through ports 87, and then is discharged through ports 86.

The function of the two end port members comprising the ports and chambers, above described, is to direct the flows of the main pumping fluid into and out of the outer ends of the two rotors. There is also associated with the port members a sealing system which is intended to prevent the pumping fluid from leaking back from compression chambers into oncoming suction chambers through the clearances between the rotor vanes and the peripheral wall 78 of the port members. To accomplish this purpose, the cover section 22 of the casing has a top longitudinal tubular projection 92 forming a cavity or passage 93 having an intake port 94 connected to a pressured water supply pipe 95, Figure 1, valved at 96. The inner wall 79 of the port members is spaced slightly from the shaft sleeves 52 to form an annular passage 98 therebetween, and these passages communicate with the cavity 93 by inclined passages 99 and 100 in the end portions of the casing section 22, whereby in operation of the pump, fluid under pressure is supplied to the annular passage 98.

Port members 75 have a pair of disconnected groove portions 105 on their outer periphery which communicate with radial passages 106 in partitions 80, there being one of said grooves 105 for each passage 106. The port members also have end notches 107 corresponding in number and longitudinal alignment with the grooves 105. Grooves 105 and notches 107 communicate with opposite ends of the grooves 39 in the inner face of each of the rotor vanes 36. From the annular passage 98 between shaft sleeve 52 and the port member 75, the sealing water is forced through the radial passages 106 into groove portions 105 and water also is forced into notches 107, whereby the opposite ends of the grooves 39 in the vanes are arranged to communicate with the respective grooves 105 and notches 107.

As the rotors are rotated, the vanes 36 revolve about the port members in rapid succession, their travel being alternately over the surface of the peripheral wall 78 and over the port openings 84 and 87 which register with the openings between the vanes 36. As each vane 36 passes over the surface of the port member between the port openings, the ends of the groove 39 are brought into communication with the grooves 105 and notches 107, and sealing water is forced into the groove 39 under sufficient pressure to form a seal between the vanes and the peripheral wall of the port member. When the vanes 36 reach the port openings, the grooves 39 no longer communicate with the grooves 105 and notches 107 and the supply of sealing water to the groove 39 is shut off. During the time the vanes are passing over the port openings of the port member, the grooves 39 retain the greater part of the sealing water therein because of the centrifugal force exerted by rotation of the rotor. A small portion of the water may be lost from the grooves 39, however, but the amount lost is immediately restored as the vanes and the wall of the port member again present contiguous surfaces, at which point the groove 39 comes into communication with the grooves 105 and notches 107.

Referring now to Figures 2, 5, 5*a* and 8–13, the central port member 76 is similar in certain features of construction to the end port members 75 and comprises a double ended port plug which controls the flow of pumped liquid and sealing water in the casing intermediate the two rotors. The central port member 76 has an outer cylindrical wall 112 and an inner cylindrical wall 113 which is tapered outwardly at its ends, the interior of the port member having radial partitions 114 forming a plurality of chambers 115 therebetween. Outer wall 112 has a pair of peripheral tongues 116 engageable in grooves 117 in the casing sections.

Port member 76 houses the bearing 62 which is located centrally thereof to support the shaft intermediate its ends. The structure of the port member thus eliminates a separate bearing housing or support for the central portion of the shaft, as well as to insure the concentricity of the port member and the rotors in operation.

The inner wall 113 is spaced from the shaft sleeve 53 to form a passage 119 on each side of the bearing 62 for receiving the sealing water. Upper pump casing 22 has a short central wall section 120 provided with a pair of vertical passages 121 communicating with the upper longitudinal cavity 93 which receives pressured sealing water from the water supply pipe 95. Inclined passages 122 in one of the partitions 114 of the port member 76 establish communication between the passages 119 and 121.

Longitudinal passage 93 provides a manifold to insure equal supply and flow of sealing water to all the port plugs and pump chambers, which is necessary to attain the highest pump efficiency. In practice, the efficiency of the present two-rotor pump is higher than that of two separate pumps. By locating the sealing water manifold passage 93 in the top of the casing, the bottom section of the casing is available for manifold passages for the pumped fluid without restriction.

Similar to the end port members 75, the port member 76 has disconnected groove portions 123 which communicate with radial passages 124 in the partitions 114. Also, the port member 76 has end notches 126 corresponding in number and longitudinal alignment with the grooves 123. Grooves 123 and notches 126 communicate with grooves 39 in the inner face of the rotor vanes 36 and a similar sealing action is accomplished as was described in connection with the end port members.

Referring particularly to Figures 8–13, the port member 76 has a removable central segment 130 comprising a bearing cap, the port member being shown with the cap removed in Figure 9. Cap 130 is held in fixed position in the port member by screws 131, Figure 2, arranged to pass through apertures 132 in web portions 133 in the cap and threadedly to engage tapped bores 134 in web portions 135 in the port member. The cap has an arcuate inner wall section 113*a* which aligns with the inner wall 113 of the port member when the cap is mounted in the port member, and the wall 113*a* has vertical pins 137 which, in assembled position of the parts, engage in the pin receiving apertures 72 of the bearing 62 to hold the bearing in a fixed position relative to said port member. As seen in Figures 2 and 12, a portion of the inclined passages 122 pass through the bearing cap 130.

Bearing 62 is preferably water lubricated and for this purpose the pump casing section 22 has a vertical passage 139, Figures 2 and 3, in the wall section 120. Passage 139 is connected at its upper end to a water supply pipe 140 and communicates at its lower end with a passage 141 in the bearing cap 130, Figures 12 and 13. Passage 141 communicates with the aperture 65 in the bearing half 63 and water is thus suppled to communicating spiral groove 65*a* for water lubrication of bearing surfaces.

If necessary to replace the split bearing 62, easy access may be had thereto by first removing the casing section 22 and then removing the bearing cap 130. The top portion of the bearing is lifted off and the bottom half may be easily brought into position for removal by rotating it around the sleeve 53 by a suitable tool or by using the other bearing half. This is accomplished without the necessity for removing the shaft and rotors.

Referring particularly to Figures 5 and 5*a*, communication between the chambers 115 in the port member 76 and the displacement chambers 38 between the rotor vanes is accomplished by a plurality of ports in the outer peripheral wall 112. One side of the port member is seen in Figure 5 and on this side there is provided at the upper portion thereof a central "in" port 145 and a pair of end "in" ports 146. At the lower portion of the port member is an offset "out" port 148 and a pair of end "out" ports 149. On the opposite side of the port member, Figure 5*a*, there is a central "out" port 151 and a pair of end "out" ports 152, and at the lower portion thereof there is an offset "in" port 154 and a pair of end "in" ports 155.

The terms "in" and "out" as applied to the various port openings refer to the direction of the flow of fluid in relation to the chambers 38, the "in" ports referring to means as a whole for directing pumped fluid into engagement with the rotors and the "out" ports referring to means as a whole for receiving fluid being discharged from the rotors. As shown, for a two-lobe pump, there are two sets of "in" and "out" ports, and the respective sets are diametrically disposed. Each of the ports in the port members which direct fluid into the rotor displacement chambers, i.e., ports 84 in the members 75 and ports 146 and 155 in members 76, are larger than ports which receive fluid from said chambers, i.e., ports 86 in members 75 and ports 149 and 152 in member 76.

The pump casing sections 21 and 22 have a plurality

of passages and openings for directing fluid into and out of the port members 75 and 76, best seen in Figures 6 and 7. Fluid enters through the inlet 25 and flows into a longitudinal passage 158, which extends the length of casing section 21, shown in Figure 3 and also in Figure 6 in dotted lines. Passage 158 has an upper central "in" opening 160 which communicates with an "in" opening 161 in the upper casing section. Opening 161 communicates with a chamber 162 on one side of the wall section 120 and the chamber 162 has an opening 163 communicating with the "in" port 145 in the port member 76. Incoming fluid in the passage 158 also flows into a passage 166 in the bottom casing section 21, and the passage 166 communicates with an "in" opening 167 which in turn communicates with the offset "in" port 154 in the central port member.

The ends of the passage 158 communicate with "in" openings 170 by suitable passages 171 in the lower section of the pump casing, the openings 170 communicating with one of the ports 83 in the end port members 75. Passage 158 also communicates with "in" openings 172 in the upper casing section through openings 169, and these openings communicate with "in" openings 173 by suitable passages 174. Openings 173 communicate with the other port 83 in the port members 75.

The lower pump casing section is provided with a longitudinal passage 175 on the opposite side from the passage 158. Passage 175 communicates with the outlet 26 and has an "out" opening 176 which is in alignment with "out" opening 177 in the upper pump casing when the casing is in assembled relation. Opening 176 communicates by means of transverse passage 178 with an offset "out" opening 179 which in turn communicates with offset "out" port 148 in the central port member, the passages 166 and 178 in the lower pump section being separated by a wall 182 having offset portions 183 and 184, the wall portions 184 joining with one side wall of the passages 158 and 175. Opening 177 communicates with an "out" opening 185 by a passage 186 in the upper pump section, the opening 185 communicating with the "out" port 151 in the central port member 76.

The ends of passage 175 communicate with passage 190 which in turn communicates with "out" openings 189. Each of openings 189 communicates with a port 86 in the port members. The upper casing section also has "out" openings 192 which are in alignment with "out" openings 188 in the lower pump casing when the casing is in assembled relation and communicate by suitable passages with "out" openings 193 which in turn communicate with the other of the ports 86 in the port members.

The rotor chambers 29 are provided with outlet orifices 194 at the bottom thereof, Figure 2, which open into a longitudinal drain duct 195 having at one end a discharge conduit 196, Figure 1, valved at 197. The sealing liquid in the pump is drained out when the pump is not in operation whereby, when the pump is to be started, it will not have to start under load. During operation of the pump the valve 197 is closed and the duct 195 is filled with the sealing liquid.

With the structure thus described and with the pump in operation, the liquid ring piston revolves with respect to the casing and alternately approaches and recedes from the center or hub of the rotor. A suction is created on the inlet side of the pump and the pumped fluid is drawn in through inlet 25 into the longitudinal passage 158. The fluid then moves in through "in" openings 160 and 161 and discharges through "in" openings 163 and 167 into the port openings 145 and 154, respectively, on opposite sides of the central port member 76. Fluid is also drawn through "in" openings 169 and 172 at the ends of the passage 158 and is discharged through "in" openings 170 and 173, respectively, into the pair of ports 83 in the end port members 75. The pressure and suction strokes of the liquid piston cause fluid to flow in through the ports 145 and 154 in the central port member and out their respective ports 146 and 155 into the displacement chambers 38. The fluid is also caused to flow in through the pairs of ports 83 in the end port members and out the respective ports 84. Fluid under compression is forced out of the displacement chambers 38 into the "out" ports 149 and 152 and is discharged into the pump casing through the respective ports 148 and 151 in the central port member and through ports 86 in the end port members.

The present pump structure thus comprises a multi-rotor hydro-turbine pump with adjacent halves of the rotors served by a common double ended port plug 76 and the remaining halves served by single port plugs. The double ended port plug has common inlet ports 145 and 154 which feed pumped fluid to adjacent halves of the rotors and also has common outlet ports 148 and 151 which receive fluid from adjacent halves of the rotors. This feature is accomplished by the offset relation of the ports 148 and 154 in the port member 76 in combination with the openings 179 and 167 in the respective passages 178 and 166 separated by the transverse wall 182 and the offset portions 183 and 184. Furthermore, the fluid flow into and out of the displacement chambers is divided in the central port plug itself and such structure eliminates the need of complicated passage structure in the casing sections for directing fluid to each of the adjacent rotor halves. Easy access may be had to the interior of the pump by merely removing the upper or cover section 22 which exposes the rotors and centrally exposes the bearing cap 130, the casing preferably being split in a plan horizontal to the shaft axis. Bearing cap 130 is removable by taking out the screws 131, and replacement of the split bearing 62 can be easily accomplished.

In effect, the structure illustrated comprises two pumps in one casing in that each of the rotors, while rotating with a common shaft, operates in a fluid circuit independently of the other. Common inlet and outlet means are provided in the port member 76 and the pump casing serves to eliminate a network of passages or piping which would be required separately in conjunction with two independent pump units. The present arrangement of parts also makes for a compact structure which reduces the cost of manufacture.

It will be apparent to persons skilled in the art that the principles of the invention are also applicable to pumps having three or more rotors on a common shaft in a single casing. The novel port members 76 provide shaft support and port facilities between each pair of rotors, regardless of the number.

Having now described our invention and in what manner the same may be used, what we claim as new and desire to protect by Letters Patent is:

1. A pump comprising a casing, a shaft journaled at opposite ends of said casing, a plurality of rotors on said shaft, a port member removably mounted in said casing between two of said rotors for controlling the flow of fluid into and out of said rotors, a bearing removably mounted in said port member for said shaft, a groove in the bearing surface of said bearing for receiving a lubricant, and registering passages in said casing and said port member communicating with said groove for introducing said lubricant thereto.

2. A hydroturbine pump comprising an elongated casing having a base section and a removable top section, a plurality of eccentric rotor chambers in said casing, port members for said chambers mounted in shaft openings between said two sections, longitudinal inlet and outlet manifold passages in said base section having transverse branch passages communicating with said port members for conveying pumped fluid, a longitudinal hollow stiffening rib protruding outwardly along the top of said top section constituting a sealing liquid manifold passage, and

branch passages in said top section connecting said sealing liquid manifold passage with said port members.

3. A hydroturbine pump comprising an elongated casing having a plurality of stationary eccentric rotor chambers therein, end walls in said casing, transverse walls in said casing between said chambers, aligned shaft openings in said walls, inlet ports radial to the shaft opening in each of said walls, a longitudinal inlet passage within said casing extending along one side thereof, inlet passages in each of said walls interconnecting said longitudinal inlet passage and said inlet ports, outlet ports radial to the shaft opening in each of said walls, a longitudinal outlet passage within the said casing extending along the opposite side thereof, and passages in each of said walls interconnecting said longitudinal outlet passage with said outlet ports.

4. A hydroturbine pump comprising an elongated casing having a base section and a removable upper section, transverse end and intermediate walls in said sections defining a plurality of eccentric rotor chambers, aligned shaft openings in each of said transverse walls for a longitudinal rotor shaft extending through all of said chambers, said shaft opening in each wall lying in the joint between said base and upper sections and extending into the walls of both sections, inlet and outlet ports radial to the shaft opening in each of said transverse walls of both casing sections, a longitudinal inlet passage in one side of said base section, passages in each of said transverse walls of both sections connecting said longitudinal inlet passage with all of said inlet ports, a longitudinal outlet passage in the other side of said base section, and passages in each of said transverse walls of both sections connecting said longitudinal outlet passage with all of said outlet ports.

5. A hydroturbine pump comprising an elongated casing having transverse end and intermediate walls defining a plurality of eccentric rotor chambers, aligned shaft openings in said walls for a rotor shaft extending through all of said chambers, cylindrical port members in said end walls concentric with said shaft openings extending into said rotor chambers, a cylindrical port member in each intermediate wall concentric with said shaft opening and extending into said rotor chambers, a longitudinal inlet passage in said casing, passages in each of said transverse walls connecting said inlet passage with said port members, a longitudinal outlet passage in said casing, passages in each of said transverse walls connecting said outlet passage with said port members, a longitudinal sealing water passage in said casing, and passages in each of said transverse walls connecting said sealing water passage with said port members.

6. A liquid ring piston pump comprising a casing, a shaft journaled at the ends of said casing, a plurality of rotors on said shaft operative in eccentric chambers in said casing for creating a pressure differential in the pump, a plurality of end and intermediate port members communicating with said rotors, a bearing in each intermediate port member for supporting said shaft between said rotors, and a removable section in each intermediate port member providing access to the bearing therein.

7. A hydroturbine pump comprising a casing, a plurality of eccentric rotor chambers in said casing, a shaft in said casing, rotors on said shaft in said chambers having displacement chambers operative with a liquid ring in said rotor chambers to create a pressure differential in the pump, a port member in said casing concentric with said shaft between two of said chambers and having ports cooperating with rotors in said chambers to create a pressure differential in said pump, a bearing member between said shaft and said port member, and removable cap means in said port member for exposing said bearing.

8. A liquid ring piston pump comprising a casing having a bottom section and a removable top section, a horizontal shaft journaled at opposite ends in said casing sections, a plurality of rotors on said shaft, a port member mounted between said casing sections and between said rotors and having ports communicating with adjacent rotors, a bearing for said shaft in said port member for supporting a shaft intermediate said rotors, and a removable cap on said port member engaged by said top section providing access to said bearing when said top casing section is removed.

9. In a hydroturbine pump having a shaft with a plurality of rotors, a double end cylindrical port member and bearing housing surrounding said shaft between a pair of said rotors, a removable shaft bearing in said port member, and removable cap means in said port member providing access to said bearing.

10. In a hydroturbine pump having a plurality of rotors on a common shaft, a double end cylindrical port member and bearing housing surrounding said shaft between said rotors, a removable bearing member for said shaft mounted in said port member intermediate the ends thereof, a removable cap on said port member intermediate its ends to provide access to said bearing member, and means connecting said cap with said bearing member to secure said bearing member in said port member.

11. In a hydroturbine pump having a horizontal rotor shaft and a casing with a base section and a removable upper section, a plurality of eccentric rotor chambers in said casing, mating transverse walls in said base and upper sections separating said rotor chambers, mating semicircular recesses in said walls receiving port members surrounding said shaft, spaced semicircular grooves in said recesses, a double end cylindrical port member having spaced circular tongues seated in the grooves of said base section, a shaft bearing in said port member, a removable central cap section in said port member, and semicircular tongues on said cap member seated in said grooves of said upper section of the casing.

12. In a hydroturbine pump having a plurality of rotors on a common horizontal shaft, a cylindrical double end port member mounted in the pump concentric with said shaft between two of said rotors, said port member having end portions each equipped with two pairs of inlet and outlet ports for communication with said rotors, an inlet port in a lower central portion of said port member communicating with inlet ports in both ends of said member, an outlet port in a lower central portion of said member communicating with outlet ports in both ends of said member, a bearing support wall in said lower central portion of said member for a shaft bearing, a removable cap enclosing the upper central portion of said port member, an inlet port in said cap communicating with other inlet ports in the ends of said port member, and an outlet port in said cap communicating with other outlet ports in the ends of said port member.

13. In a hydroturbine pump, a shaft, a rotor assembly comprising a plurality of rotors keyed on said shaft in axially spaced relation, cylindrical bearing members on said shaft between said rotors and at opposite ends of the rotor assembly, spacer sleeves on said shaft between and abutting said rotors and said bearing members, and a pair of nuts having threaded engagement on said shaft at opposite ends of said assembly for tightening said bearing members, sleeves and rotors one against another in an axial direction and for adjusting the axial position of said rotors on said shaft.

14. A hydroturbine pump comprising an elongated casing having a base section and a removable upper section, transverse end and intermediate walls in said sections forming a plurality of eccentric rotor chambers, a longitudinal rotor shaft extending through all of said chambers and having a rotor in each chamber, a longitudinal inlet manifold passage in one side of said base section extending from end to end thereof, inlet passages in said transverse walls of both sections communicating with said longitudinal inlet manifold passage, a longitudinal outlet manifold passage in the other side of said base

section extending from end to end thereof, outlet passages in said transverse walls of both sections communicating with said longitudinal outlet manifold passage, cylindrical port members in said end walls concentric with said shaft projecting into rotors adjacent said end walls, radial openings in said port members communicating with said inlet and outlet passages, a cylindrical double end port member in each intermediate wall concentric with said shaft and projecting in opposite directions into adjacent rotors, radial openings in said last port members communicating with said inlet and outlet passages, and longitudinal inlet and outlet passages in said last port members communicating with the respective openings and said adjacent rotors whereby each end of each rotor is provided with inlet and outlet connections in parallel circuits.

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