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METHOD OF MAKING FLUID PUMP STRUCTURES

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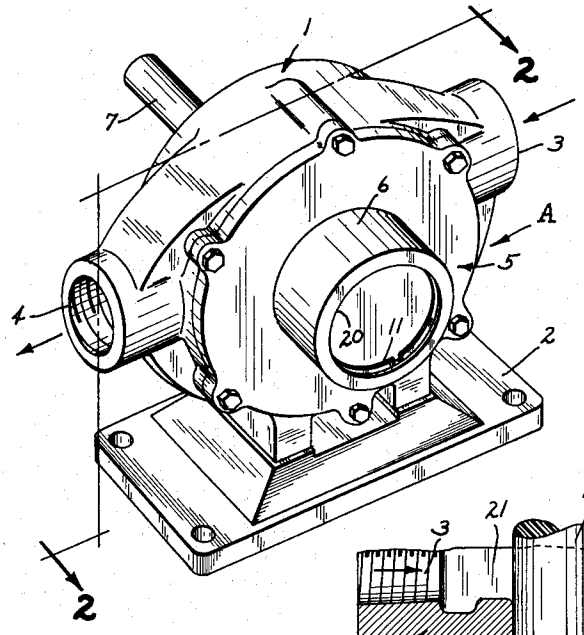



FIG. 1

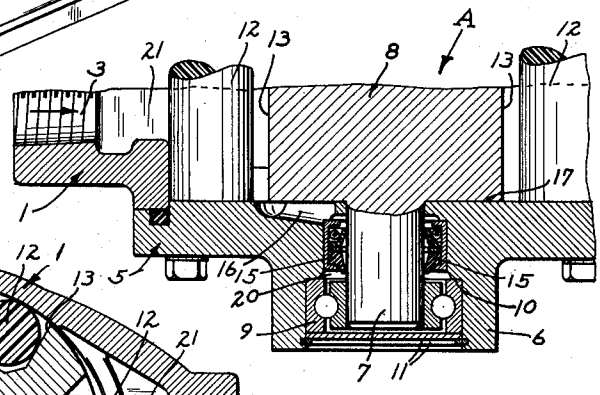



FIG. 3

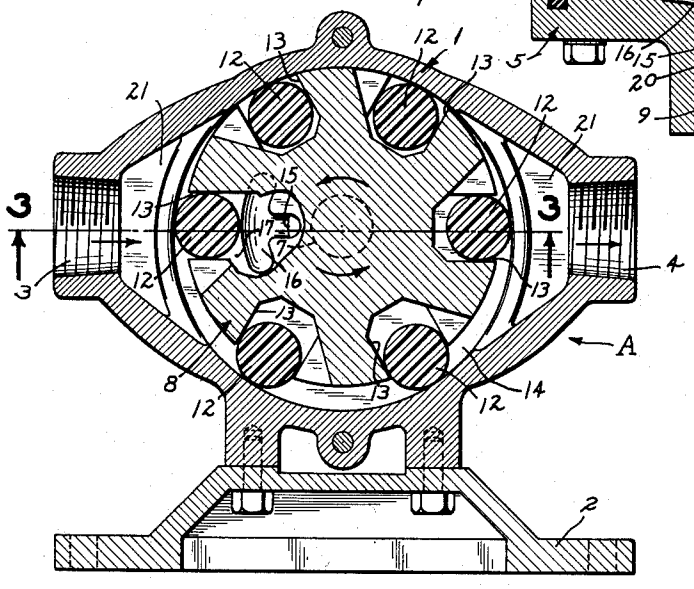



FIG. 2

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# METHOD OF MAKING FLUID PUMP STRUCTURES

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This invention relates to a novel pump structure and its method of manufacture; in particular it concerns a new and improved rotary pump construction adapted to provide for the displacement of liquid with improved means for exhausting the leakage from around the bearing seals of the impeller shaft. Novel means for fabricating the pump body and end plate is also disclosed wherein certain normally required drilling and machining operations are eliminated.

Rotary and centrifugal pumps comprise an exceedingly great variety of types, all of which have several common characteristics. Every pump consists of three principal parts: a rotor which forces the liquid into a rotary motion; the pump casing which directs the liquid into the rotor and leads it away under a higher pressure; and a drive to put the rotor into rotary motion. The latter includes pump shaft, supported by bearings, and driven through a flexible or rigid coupling by the drive.

Stuffing boxes are provided in places where the shaft extends outside the pump casing and closely fitted wearing rings restrict leakage of high pressure liquid back to the pump suction. Rotary pumps are of the positive displacement type without valves and, except for leakage, can deliver a constant capacity against variable pressure. To maintain volumetric efficiency rotary pumps require very close clearances between rubbing surfaces. Several million rotary pumps are in service in domestic oil burners, refrigerators, lubricating oil circulators, and hydraulic controls for machinery.

The operation of the rotary pump depends on the formation of practically fluid-tight enclosed spaces filled with liquid on the suction side of the pump and the displacement of liquid on the discharge side. Thus, all of them are self-priming and work satisfactory under suction lifts to 20 feet. Although all rotary pumps can handle entrained air, gases and vapors, detrainment or separation of gases affects adversely the pump volumertic efficiency, particularly at high suction lifts. Also, they may become noisy and may vibrate and cause pulsating discharge pressure under such conditions. Entrainment of air and consequent foaming present a difficult problem in connection with circulation of lubricating oil for bearings, gears, and similar services.

Among other things, the prevention of air leaks and the elimination of cavitation within the pump casing reduces oil foaming and increases the volumetric efficiency of a pump. The reintroduction of high pressure liquids from the vicinity of the wearing rings or seals back to the suction side of the pump is accomplished by means of a passageway from the bearing bore to the inner face of the pump body or end plate. Heretofore, this has required several laborious operations including drilling a hole from the outside of the casing to the bearing bore, then milling an intersecting passageway from the inner face of the casing and providing the exterior portion of the drilled passageway with a threaded or tapered plug to direct the liquid flow into the pump. Moreover, the resulting passageway is necessarily characterized by sharp corners, reentrant angles and hollow voids of no utility.

It is apparent that such a channel or conduit for relieving the pressure from the pump seals is highly unsatisfactory. The machining, drilling and tapping operations alone account for a great deal of extra effort and expense. And the interior design of the channel produces



turbulent flow and cavitation resulting in excessive pump wear and loss of volumetric efficiency.

It is, therefore, a broad object of this invention to provide a new method of making an improved pump;

Another primary object of this invention is to provide a new and improved process for fabricating a pump body and end plate;

A further object of this invention is to provide a rotary pump characterized by greater volumetric efficiency;

Another object of this invention is to provide novel means for relieving the pressure from the bearing seals on a pump;

Still another object of this invention is to provide improved means for directing the high pressure liquid from the bearing seals on a pump to the suction side of the pump;

Another object of this invention is to provide in a pump having bearing seals on the shaft an improved method for fabricating an internal passageway between the seals and the inner cavity of the pump;

Yet another object of this invention is to provide in a rotary pump between the bearing bore and the suction side of the pump having superior flow characteristics and a minimum of hydraulic loss surfaces;

A further object of this invention is to provide a new and improved rotary pump having high volumetric efficiency and being simple in construction;

Another object of this invention is to provide an end plate and body for a rotary pump having novel passageways between the bearing bore and the inner surfaces thereof.

These and other objects and advantages of the present invention will become more fully understood from a consideration of the following detailed description and accompanying drawing, wherein like reference numerals indicate like parts in the several views thereof.

In the drawing:

FIG. 1 is a perspective view of a rotary pump;

FIG. 2 is a sectional view taken on the line 2—2 of FIG. 1, and

FIG. 3 is a fragmentary view, partially in section, taken on the line 3—3 of FIG. 2.

Although the invention is applicable to many types of pumps, including centrifugal pumps and the like, the point of departure for this discussion will be the rotary type pump.

FIG. 1 shows a typical rotary pump A having a casing **1** suitably mounted upon a base or stand **2**. An inlet port **3** and a discharge port **4** are provided integral with casing **1**. An end plate **5** is secured by suitable means to casing **1** to form with casing **1** a closed space for the passage of liquid. Both casing **1** and end plate **5** have a cylindrical hollow bearing support **6** defining a bearing bore **20** into which shaft **7** carrying rotor **8** is rotatably mounted. A suitable bearing **9**, provided for each end of shaft **7**, is restrained against axial movement by internal shoulder **10** and retaining ring **11** of bearing bore **20**.

Rotor **8** has a plurality of peripheral slots **13**, arranged at equal angles with each other into which rollers **12** reside. Rollers **12**, constructed of metal or plastic material are thrown out by centrifugal force during the rotation of rotor **8**, similar to the manner in which sliding or swinging vanes operate in pumps having those types of rotors. Rotor **8** is confined within pump casing **1** so as to form a volute **14** in cavity **21** of pump A adapted to force water from the suction side of the pump at inlet **3** to the discharge side at **4**.

A cylindrical hollow resilient seal **15** is interposed in bearing bore **20** on shaft **7** between bearing **9** and rotor **8** which serves to stop the flow of liquid into the bearing bore. However, under high pressure operation, liquid

is sometimes forced into the space between rotor **8** and seal **15**. Under these conditions it becomes necessary to relieve the resulting pressure on seal **15** and evacuate the liquid in order to prevent damage to the seal and possible breakdown of the mounting assembly. For this purpose a passageway **16** affording access from bearing bore **20** to the inner cavity **21** of casing **1** is provided which allows the high pressure liquid in bore **20** to be exhausted into the area of low pressure within the pump.

Passageway **16** is formed in the inner face **17** of end plate **5** and the corresponding inner face (not shown) of casing **1** during the casting of end plate **5** and casing **1**. As shown in FIG. 2, passageway **16** is characterized by a T-shaped configuration so as to allow continual communication of cavity **21** with bore **20** during the rotation of rotor **8**. The particular shape illustrated allows slots **13** to be in constant communication with passageway **16** so as to prevent any buildup of pressure on the seals. In the sliding or swinging vane type of rotary pump, or in the case of a centrifugal pump, the inner configuration of passageway **16** may be altered so as to provide a similar result. It can be seen that there are no sharp corners in passageway **16** to cause turbulent flow and cavitation. Moreover, the normal elongated pocket resulting from a radial hole in bearing support **6** in communication with a milled or drilled axial hole in end plate **5** is completely eliminated. The absence of these sharp and jagged internal shoulders and pockets greatly increases the efficiency of fluid flow from seal **15** to the suction area within cavity **21**, improves the volumetric efficiency of the pump and obviates the difficulties encountered due to cavitation and air entrainment.

Several production operations are also dispensed with in the process of fabricating the end plates and casing of the pump. Indeed, the old method of providing shaft seal relief in a hydraulic pump is reduced to a minimum of steps. For example, previously (considering only the end plate) the end plate, after the casting thereof and the machining of the bearing bore, had to be drilled in a radial direction from a point on the exterior surface of the bearing bore to a point on the interior surface of the bore adjacent the inner face. Then a passageway extending from the inner face of the casting to the previously drilled hole had to be machined, as with an end mill, into the end plate. Inasmuch as the surface end of radial hole had to be closed off, a further tapping operation was required to permit a threaded plug to be screwed in the hole. Thus several time-consuming and expensive machining and drilling operations, in addition to the setting up of fixtures and tools, were necessary to provide a suitable passageway from the inner surface of the bearing bore to the inner face of the casting. An the resulting internal structure of the passageway was entirely devoid of any consideration for the proper flow of fluids therethrough. Pockets, sharp corners and reentrant angles all contributed to an unstable and inefficient means of conducting fluid.



The process of providing a passageway in the current invention is, on the other hand, extremely simple. The end plate (and the casing) is cast with the required passageway molded therein. When the bearing bore is machined, the cutting tool automatically breaks through into the passageway previously cast into the plate to provide a smooth hydraulically correct communication from the bore to the inner face of the end plate or casing. The problem of providing an optimum hydraulic design for the internal shape of the passageway is taken from the production specialist and put in the hands of the designer where it properly belongs.

A new and improved hydraulic pump structure has thus been described, one that affords greater efficiency and simplicity of manufacture in addition to economy of design. A novel process for fabricating a pump structure of the type described has also been pointed out, a process that eliminates several steps in the manufacture of pump end plates and casings while at the same time producing a superior product.

Although the invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and methods may be resorted to without departing from the spirit and scope of the invention as hereinafter claimed.

What we claim is:

In the production of a self-exhausting leak-proof rotary shaft seal and bearing bore in a rotary pump casing end wall member; the method comprising member said casing with a suction area and an exhaust area and an end wall closure extending therebetween having a planar annular inner face surrounding a rotary shaft bore therein; forming during casting a laterally open passageway in said planar face with the inner end thereof in radially spaced relation to said rotary shaft bore and its radially outer end in communication with said suction area; and thereafter counterboring said rotary shaft bore inwardly from the outer end thereof for an axial distance short of the planar inner face of said wall and for a radial extent to provide within said wall a sealing chamber around the rotary shaft and to intersect the inner end of said passageway; whereby to provide a through exhaust passageway between said counterbored portion of said shaft aperture and the suction area in said end wall member and thereby maintain an exhaust action on said sealing chamber.

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