Aug. 21, 1945. P. R. HOOPES 2,383,194

PUMP

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Fig. 1

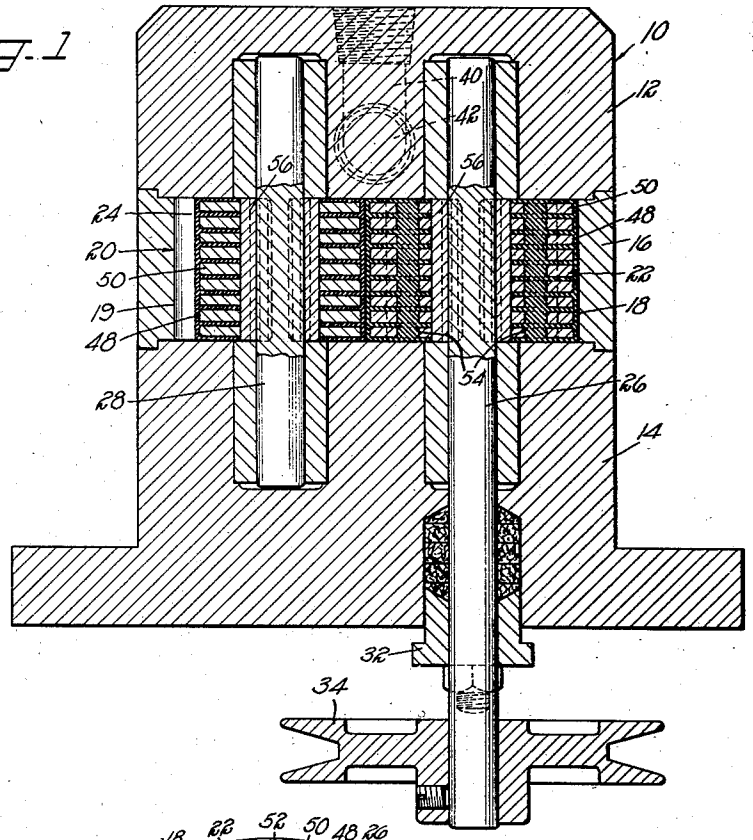
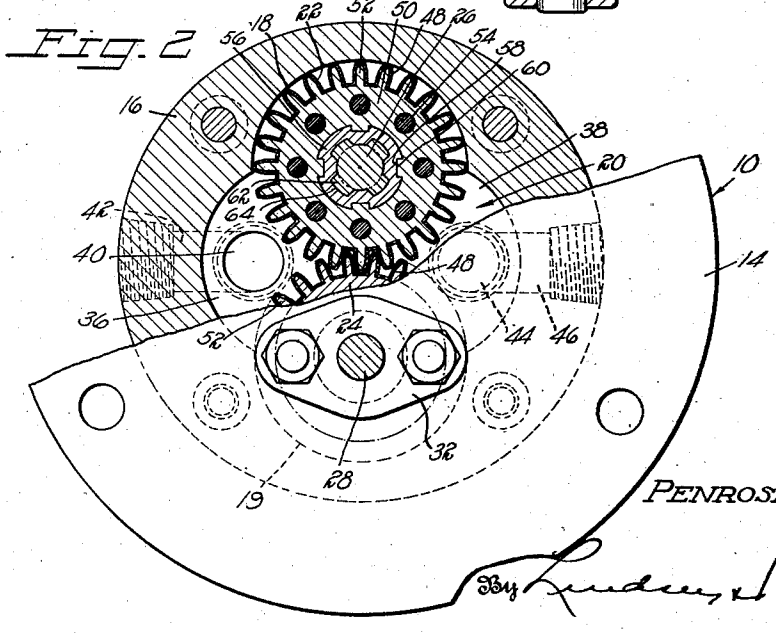


Fig. 2



Inventor

PENROSE R. HOOPES

By Lindsey & Prideaux

Attorneys

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Penrose R. Hoopes, Philadelphia, Pa.

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4 Claims. (Cl. 103—126)

The present invention relates to pumps and more particularly to pumps of the intermeshing gear type intended for high speed and high pressure operation.

An object of the present invention is to provide a gear pump of the above-indicated type which will secure and maintain a desired hydraulic efficiency; this being specifically accomplished by utilizing the developed pressure in cooperation with the pump parts to cause an automatic sealing upon the tendency of the liquid to back-flow from the high to the low pressure side of the pump.

A still further object is to provide a gear pump of the above-indicated type of high hydraulic efficiency capable of delivering fluid at high pressure without loss of efficiency and which does not require a high degree of skill in its manufacture, but will, when constructed, operate without hammering or vibration.

Other objects will be in part obvious and in part pointed out more in detail hereinafter.

The invention accordingly consists in the features of construction, combination of elements, and arrangement of parts which will be exemplified in the construction hereafter set forth and the scope of the application of which will be indicated in the appended claims.

In the accompanying drawing:

Figure 1 is a sectional view through the pump housing showing the driving and driven gears constituting the pumping elements with the gears shown in cross section to illustrate the details of construction thereof; and

Fig. 2 is a plan view with the pump casing partly broken away and partly in section to illustrate details of construction.

Referring to the drawing, the pump is shown as including a casing 10 comprising generally top and bottom header members 12 and 14 and a central gear chamber 16. More particularly, the gear chamber 16 is in the form of a ring to provide a chamber 20 having cut from its inner surface diametrically opposite semi-cylindrical segments to define wall surfaces 18 and 19 which cooperate with the teeth of a pair of gears 22 and 24 to trap and deliver liquid from one side of the pump to the other. To obtain this cooperation, the gears 22 and 24 are respectively mounted on shafts 26 and 28; the latter being so located that the wall surfaces 18 and 19 are concentric therewith, and the gears are of such size that substantially half of each gear fits within the concentric segment with the two gears intermeshing centrally of the chamber.

For convenience in assembly, the shaft 26 of the gear 22 is journalled above the gear in the header 12 and below the gear in the header 14; the lower portion of shaft 26 being of such length that it extends outwardly of the casing through a stuffing box 32 and carries on its outer end a driving pulley 34. In like manner, the shaft 28 of the gear 24 is journalled above and below the gear in the headers 12 and 14.

With this arrangement, when the gears are in place within the chamber 20, the latter is divided into a low pressure or inlet side 36 and a high pressure or discharge side 38. To admit fluid to the low pressure side, there is provided a vertical inlet 40 in the header 12 leading directly to the low pressure chamber 36 and a second inlet 42 leading into the inlet 40. Either one of these inlets may be used and the other blanked off, depending upon the manner in which the pump is installed. In like manner, the header 12 is provided with outlets 44 and 46 for the discharge of liquid from the high pressure side.

As usual with this type of pump, upon rotation of the driven gear 22 in a clockwise direction (as seen in Fig. 2), the gear 24 will be simultaneously rotated in a counterclockwise direction, whereby as the teeth enter the concentric segments they cooperate with the casing walls 18 and 19 to trap a portion of liquid and carry it from the low pressure side 36 into the high pressure side 38.

As is well known with this type of pump, upon the trapping of the liquid in the low pressure side and carrying it towards the high pressure side, the liquid is subjected to gradually increasing pressure as it approaches the high pressure side; this increase in pressure tending to force the liquid back to the low pressure side. In accordance with the present invention, this increase in pressure is utilized in cooperation with the pump structure to create an automatic seal and prevent the forcing of liquid back to the low pressure side. More specifically, this is accomplished in the present instance by so constructing the gears that upon increase of pressure they will cooperate with one another and with the surfaces of the casing to form a seal and prevent a reverse flow of the liquid.

To accomplish the foregoing, the gears are of a metal-plastic construction having outer surfaces which are sufficiently resilient to yield and distort under increasing pressure to close any clearances and form a positive trap for the liquid being carried from the low to the high pressure side. In addition, the intermeshing teeth

will form a positive seal to prevent the return of liquid at that point. As best seen in Figs. 1 and 2, each gear consists of a plurality of spaced metal plates 50 completely embedded within a body 48 of suitable plastic such as natural or synthetic rubber. The plates 50 are preferably spaced apart a distance less than their thickness to provide in effect alternate laminations of plastic and metal, but as the metal plates are completely embedded, the entire outer surface of the gear is of plastic. Inasmuch as the metal plates 50 are provided with teeth 52, that portion of the plastic which overlies the teeth is sufficiently thin to permit it to yield together with the plastic laminations between the teeth of the plates when the gear is subjected to pressure. In this way, a sufficient distortion is obtained to seal any gap between the casing wall 18 and the teeth, which seals continuously move from the low to the high pressure side, positively trapping the liquid therebetween and preventing any back-flow from the high to the low pressure side. In like manner, at the point of intermeshing of the gear teeth the yieldability of the plastic automatically seals and compensates for the varying volume of the clearance therebetween by allowing the volume of the fluid trapped between the teeth to adjust itself by leakage past the low pressure face of the tooth. In this manner, the trapped fluid passes out of the space as the latter decreases in volume and is drawn in as the space increases. By providing this automatic sealing action, there will be no drop in efficiency as the speed of the pump increases with a consequent increase of pressure on the high pressure side.

Another advantage of a pump here disclosed is that it can readily handle fluid containing particles of sand, grit, or other solid material as the resilient faces of the gears will permit such solid particles to pass without the destruction of the sealing surfaces. In operation, the solid particles merely sink into the sealing surfaces, are carried through, and are then forced out by the spring-back of the plastic material as the particles reach the high pressure side of the gears.

In order to give the gears greater strength, the metal plates 50 may also be provided with openings 54 (see Fig. 2) whereby each lamination of plastic is secured to the next lamination. Likewise, for greater strength the metal plates and plastic body may be secured to a central core 56, which core is provided on its outer surface with a plurality of recesses 58 for receiving tongues 60 provided on the metal plates to thus non-rotatably lock the plates to the core. Obviously the plastic will likewise form into the recess 58 and thus nonrotatably lock the plastic portion of the gear. The interior of the core may be formed as clearly indicated in Fig. 2 to receive the supporting shaft; the latter having a plurality of fixed splines 62 receivable within ways 64 provided in the inner face of the core. Although the core of the gear is shown as being of metal, it could be of some hard material, such, for example, as laminated synthetic plastic, hard rubber, or fiber.

With the gear so constructed, it will be seen that the essential characteristic is that it has a stiff and strong core and body to resist major deformations with a comparatively soft resilient surface of wear-resisting material capable of undergoing small elastic deformations. Likewise it will be noted that the comparatively soft resilient outer surface is integral with the plastic which forms the body portion of the gear, and thus upon any deformation occurring it will be absorbed throughout the plastic, thus eliminating the possibility of rapid wear and tear of the light outer surface.

It will also be seen that by constructing a pump in the manner heretofore described high standards of workmanship are not required. This is due to the fact that the soft surface of the gears will compensate for any variations in clearances, while still retaining a perfect sealing. Because of this, the pump will operate without hammering or vibration and is thus capable of high speed operation without the loss of efficiency which has heretofore resulted in pumps of this kind.

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the language used in the following claims is intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

I claim as my invention:

1. In a liquid gear pump of the character described, a casing having a chamber therein, a pair of mating gears having intermeshing teeth and mounted in said chamber and dividing said chamber into a low pressure and a high pressure side, said low pressure side being provided with an inlet port and said high pressure side with an outlet port, the interior wall of said chamber including wall portions concentric with a portion of each of said gears, each of said gears including a rigid core and a plurality of alternate laminations of metal provided with radially extending teeth on their peripheries and plastic nonrotatably secured to said core, and an outer face of resilient plastic completely covering the teeth of the gear and contacting the concentric wall portions of the casing, said central core and metal laminations resisting major deformations of the gear, and said plastic laminations and face allowing small distortions of the gear to maintain positive contact with the casing wall to provide a seal trapping the liquid between the gear and the casing wall.

2. For use in a gear pump, a gear having a plurality of radially extending teeth disposed about its periphery and comprising a relatively heavy central core, a plurality of metal plates secured to said core and spaced apart from one another at lesser distances than the thicknesses of the plates, said plates having a plurality of aligned, radially extending teeth disposed about their peripheries, and a molded resilient plastic interposed and forming thin partitions between said metallic plates and having peripheral teeth enclosing and covering the teeth of said metallic plates.

3. For use in a gear pump, an essentially metallic gear comprising a plurality of thick metal plates composing the preponderantly great mass of the gear and having numerous small closely spaced teeth on the edges thereof with angled corners between the bases of the teeth and the

plate peripheries, a molded plastic resilient continuously-circumferential thin covering over said teeth and in and about the angled corners thereof, and plastic resilient thin partitions enclosing the plates and having peripheral teeth of the same material integral with the teeth covering of the plate teeth.

4. A gear according to claim 3 in combination with a part-cylindrical pump chamber wall of a circumferential length to simultaneously receive numeral teeth of the plates and partitions, said partitions being in one homogeneous integral molded mass with said teeth and teeth coverings.

PENROSE R. HOOPES.