July 19, 1938. W. P. SCHIRMER 2,124,377

ROTARY PUMP

Filed Feb. 19, 1936

FIG. 1

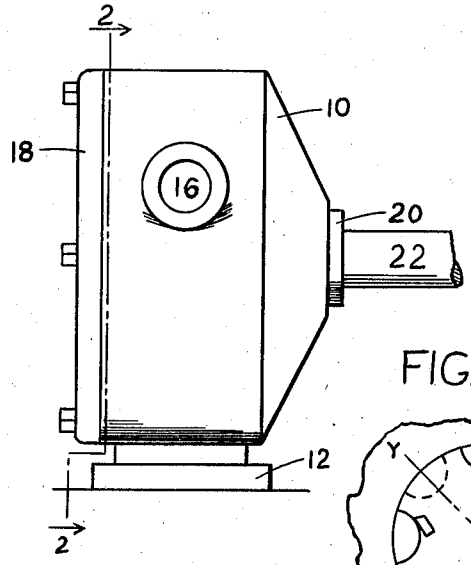


FIG. 3

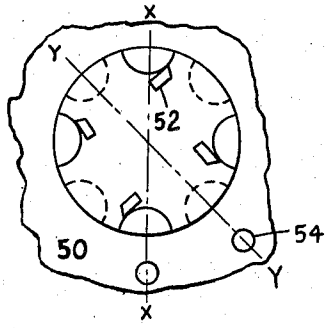
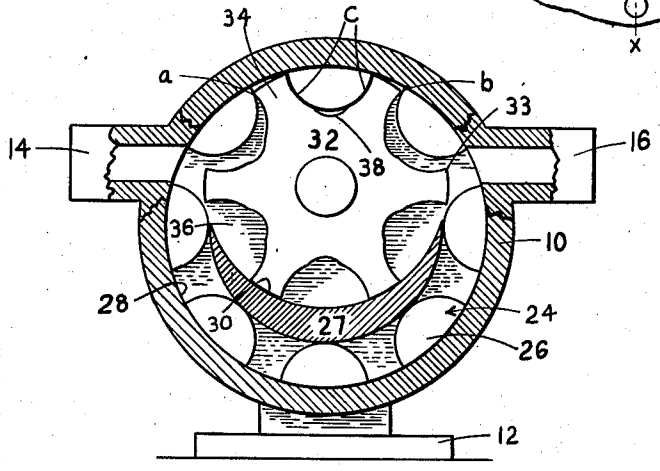


FIG. 2



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ROTARY PUMP

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2 Claims. (Cl. 103—126)

The improved rotary gear pump comprising the present invention is primarily adapted for use in pumping gasoline, although the principles of the invention are applicable to other uses, and the pump may be employed for moving or handling all manner of fluids or plastic materials.

Specifically, the invention relates to improvements in rotary gear pumps of the type having a casing and employing an outer driving gear and an inner driven gear provided with a lesser number of teeth than, and eccentrically mounted with respect to the outer gear in intermeshing relation thereto in such a manner that, upon movement of the gears, fluid is drawn into the casing and through certain interstices between the teeth of the outer gear and is subjected to increasing pressure exerted upon the same by the sealing action of the intermeshing teeth and other parts of the pump structure, and is finally discharged at a predetermined pressure from the casing through other interstices between the teeth of the outer gear.

The principal object of the invention is to provide a pump of the above described type in which the teeth, both on the outer driving gear and on the inner driven gear, are so designed that a better seal than has heretofore been made possible is obtained upon the liquid being pumped, thereby increasing the efficiency of the apparatus. In accomplishing the above mentioned object in accordance with the principles of the invention, numerous ancillary objects and advantages are obtained. The specific design of the teeth by which a better seal is obtained is conducive toward a rolling rather than a sliding contact, thereby not only eliminating wear upon the teeth themselves, but additionally eliminating rattle, chatter, wobble and play between the teeth, thus further increasing the overall efficiency of the pump and materially adding to the life of the operative parts of the same.

An additional object of the invention is to provide a high speed pump construction of compact design having an increased capacity which is obtained without increasing the diameter of the pump casing or of the internal gears contained within the same. Toward this end, the invention contemplates the provision of a pump of the type described in which the peripheral teeth on the outer driving gear have a greater cross sectional area which reaches its maximum dimensions at the extreme periphery of the gear, thereby permitting the teeth to be made longer than heretofore, to very materially increase the volume of liquid handled by the apparatus.

Yet another object of the invention is to provide a pump construction of the type described having an outer driving gear which lends itself toward a reduction in the steps necessary for machining the same, thus decreasing the manufacturing cost of the apparatus, as well as simplifying rapid mass production when required.

It is another object of the invention to provide a pump construction in which, although an absolute seal for the liquid being pumped is provided, provision is made for protecting the teeth and other working instrumentalities within the pump casing from the abrading action of dirt and other foreign material occasionally encountered in pumping liquids.

The provision of a pump of the type set forth above which is extremely simple in its construction, being comprised of a minimum number of moving parts, one which is rugged and durable and unlikely to get out of order, one which may be manufactured inexpensively with a minimum amount of skilled labor, yet one which is highly efficient in its operation and is possessed of a comparatively long life, are further desirable features that have been borne in mind in the development and production of the present invention.

Other objects and advantages of the invention, not at this time more particularly set forth, will become more readily apparent as the nature of the invention is better understood, and the same consists in the novel construction, combination and arrangement of parts shown in the accompanying single sheet of drawings forming a part of this specification, and in which

Figure 1 is a side elevation of an assembled pump manufactured in accordance with the principles of the present invention.

Figure 2 is a sectional view taken substantially along the line 2—2 of Figure 1 in the direction indicated by the arrows, and

Figure 3 is a plan view, diagrammatic in its representation, showing the manner in which a rotor, employed in connection with the invention, is machined.

In all of the above described views, like characters of reference are employed for designating like parts throughout.

The pump involves in its general organization a casing 10, which may be of any desired size or configuration, and which is preferably provided with a base or support 12. This casing, as shown in Figure 2, is provided with an inlet 14 for the fluid being handled by the pump, and an outlet 16. As shown, the inlet 14 and outlet 16 are substantially diametrically opposed with respect to

the casing and are in alignment, but it is to be distinctly understood that other arrangements of the inlet and outlet are contemplated. For example, the inlet and outlet may be arranged on the same side of the casing, or may pass through the end wall, or walls of the same. Irrespective however of these details in manufacturing, the essential features of the invention are always preserved.

The casing 10 is provided with a closure plate 18, bolted or otherwise secured in position, to permit access to the interior of the same to be had. An axial hub 20 extends from the rear of the casing and through this hub there extends a driving shaft 22 which is suitably journalled therein. Formed integrally on one end of the driving shaft 22 is an outer gear or rotor 24, generally of cup-shaped formation and provided with a series of spaced, axially extending, peripheral teeth 26. In this instance eight of these teeth are shown, but it is to be distinctly understood that a greater or lesser number of teeth may be provided, depending upon the engineering exigencies of the use to which the pump may be put. The teeth 26 formed on the periphery of the rotor 24 form an interrupted flange that fits snugly but rotatably within the annular casing 10 of the pump.

The outer surfaces of the teeth 26 are concentric with the axis of rotation of the rotor and with the axis of the pump casing, while the inner surfaces of the individual teeth are substantially of convex cylindrical formation, being widest at the periphery of the rotor where the outer surfaces of the teeth are (except for the interstices between the same) to all intents continuous with the peripheral line of the rotor.

Formed integrally with the closure plate 18, or otherwise positioned fixedly within the casing 10, is a crescent-shaped member 27 in the form of a partition that divides the interior of the casing generally into two chambers 28 and 30, the former of which contains in part the rotor 24, and the latter of which contains a revoluble pumping member or gear 32 which is a counterpart of the rotor 24. The chamber 30 is circular in form and is tangential with respect to the interior of the casing 10, while the gear 32 which fits snugly within this chamber 30 is in the form of a toothed follower wheel, the teeth of which extend radially from the axis of rotation of the same.

The pumping unit or gear 32 is shown as being provided with six radially extending teeth 34, but it will be understood that a greater or lesser number of teeth may be provided. The extreme outer edges of the teeth 34 are substantially concentric with the periphery of the gear 32 (except for filleted portions 33 which provide the necessary clearance for proper operation of the pump) while the troughs or inner edges of adjacent teeth form substantially arcuate pockets or chambers 36, machined on a radius to give them a size and concave configuration conforming to the size and convex configuration of the inner surfaces of the teeth 26 on the rotor 24.

The bottoms of the troughs 36 are machined on a smaller radius of curvature than the radius of curvature of the troughs themselves to provide a slight clearance 38, for the purpose of permitting dirt or other foreign material to pass between the parts without causing wear, while at the same time preserving the liquid seal between the pumping elements. Alternatively, the inner crests of the teeth 26 may be machined to provide this clearance and in either event, danger of clogging of the pump is materially lessened.

The device is designed primarily to be used as a pump, although the same is capable of use as a motor. When applied to the former use, the shaft 22 is rotated from any suitable source of power (not shown) and the rotor 24 which is integrally formed thereon floats within the casing 10, it being guided and supported in its rotation by the bearings (not shown) which support the shaft 22 within the hub 20. The inner idler wheel or gear 32 will, by virtue of its meshing engagement with the rotor 24, derive rotational movement therefrom, and fluid being pumped will enter the casing 10 through the inlet 14 and pass through the interstices between the peripheral teeth on the rotor 24 and thus through the casing 10 on opposite sides of the segment 27 in the direction of the pump outlet, it being motivated both by the teeth 26 of the rotor 24 and by the teeth 34 of the idler gear 32. As the teeth 26 on the outer gear or rotor 24 enter the troughs between the teeth 34 of the idler gear 32 in the region at and beyond the outlet 16, fluid issuing from both sides of the crescent-shaped segment 27, in the chambers 28 and 30, will be forced from the casing 10 through this outlet 16.

Inasmuch as the two sets of teeth substantially fully intermesh, and the circular convex surfaces of the teeth 26 completely fill the circular concave space between the teeth 34, fluid will be sealed against returning to the inlet 14 through the region of the casing 10 where the two compartments 28 and 30 are tangential. Further than this, (referring to Figure 2) it will be seen that fluid is prevented from passing between the intermeshing teeth by virtue of two lines of contact designated at *a* and *b*, and in addition by a large area of contact designated at *c*. Other positions of the pumping elements have not been illustrated but it is obvious that in no instance is the seal of fluid guarded by less than three lines of contact.

It is to be noted that the rotor 24 serves as a driving member to actuate the idler gear 32, but such a construction need not necessarily be resorted to. It is within the spirit of the invention to drive each of these elements in unison, thus further reducing the wear on the moving parts of the structure.

Referring now to Figure 3 wherein the machining operation by which the rotor 24 is formed is diagrammatically represented, the rough casting is shown as being mounted on the index plate 50 of any suitable forming machine (not shown) which may for example be a milling machine or a drill press. Suitable cutters 52, as for example cutters of the hollow mill type, are shown as engaging the inner faces of the teeth 26 for the purpose of machining the same. Inasmuch as eight teeth are disclosed in this instance, four such cutters are shown engaging the surfaces of alternate peripheral teeth. The axis *x*—*x* determines the initial indexing of the plate for the purpose of machining these four particular teeth. Indexing means designated generally at 54 are associated with this plate 50 for permitting the axis *y*—*y* to be shifted into position whereby the cutters 52 may engage the four remaining teeth. Thus it will be seen that by a single indexing operation, complete machining of the rotor may be effected, thus saving considerable time and labor in the manufacture of the articles, as well as reducing the chance of accumulated error to a minimum.

It will be understood that various other methods of machining the rotor **24** may be resorted to, and where a single indexing operation is employed, the spirit of the invention is preserved. Furthermore, the principles that have been applied to the machining of the rotor **24** are applicable as well to the machining of the idler gear **32**. It should be further understood that various changes in the details of construction of the pump assembly may be resorted to without departing from the spirit of the invention. The proportions shown in the patent drawing, the number of teeth shown on the pumping elements and other arbitrary details are not limiting. Only insofar as the invention has particularly been pointed out in the accompanying claims is the same to be limited.

I claim:

1. In a rotary pump, a cylindrical casing provided with aligned inlet and discharge openings, a pair of cooperating internal and external gears rotatably mounted within the casing and eccentrically disposed with respect to each other, said external gear comprising a body portion in the form of a circular plate the radius of which is substantially equal to the radius of curvature of said casing, said plate having formed thereon a plurality of elongated, axially extending, parallel peripheral teeth uniformly spaced from each other, there being interstices between adjacent teeth through which liquid being pumped is adapted to be drawn and expelled, the outer surface of each tooth coinciding with the circular peripheral edge of said circular plate and occupying a position within said casing in contact with the inner circumferential wall thereof at all points on said outer surface, the inner surface of each tooth being approximately semi-cylindrical with its substantially semi-cylindrical surface presented inwardly, the radial center of each tooth lying substantially on the periphery of said external gear, said internal gear being provided with peripheral troughs the surfaces of which are approximately semi-cylindrical in form, said troughs being adapted to be substantially and successively filled by said inwardly presented surfaces to provide a sealing area within said troughs, said troughs on said internal gear providing therebetween a series of radially extending teeth on said gear, the adjacent teeth on said internal gear, when the trough therebetween is filled by the inwardly presented semi-cylindrical portion of a tooth on said external gear, contacting the two teeth on said external gear adjacent said last mentioned tooth to provide lines of sealing contact therebetween in addition to the area of sealing contact between said last mentioned tooth and the trough which it fills, and a partition in said casing against which the crests of said inwardly presented curved surfaces bear in sealing relation on one side thereof and against which the outer surfaces of said internal gear bear in sealing relation on the other side thereof, said troughs having the extreme bottoms thereof arcuately grooved on a radius of curvature smaller than the radius of curvature of the troughs to provide a slight clearance between the bottoms of said troughs and the crests of said inwardly presented curved surfaces when said troughs and surfaces are in cooperating engagement.

2. A rotary pump comprising a casing having an intake and a discharge opening, a pair of cooperative internal and external gear wheels rotatably mounted within said casing and eccentrically disposed with respect to each other, a shaft connected with one of said gears, the teeth on said external gear being substantially semi-cylindrical in form with their cylindrical surfaces presented inwardly, the radial centers of said cylindrical teeth lying substantially on the outer peripheral surface of said gear wheel, said internal gear wheel being provided with cooperative recesses of corresponding semi-cylindrical design, the radial centers of said recesses adapted to coincide with the radial centers of said teeth when the said teeth and recesses are fully meshed.

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