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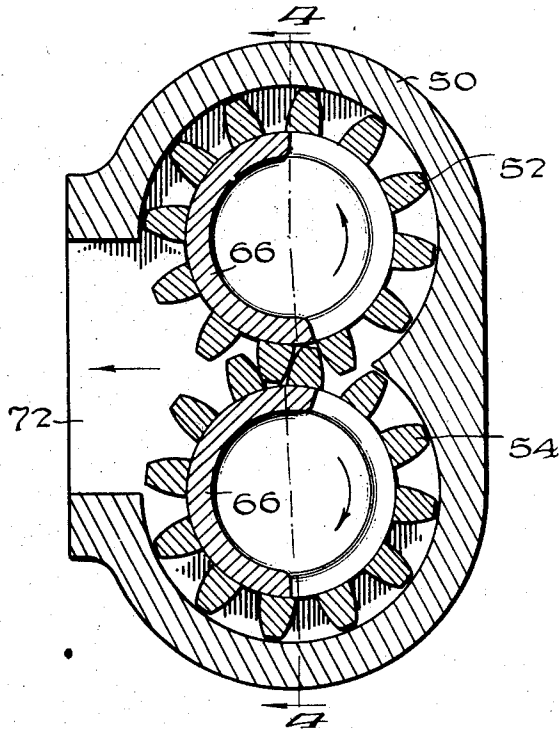
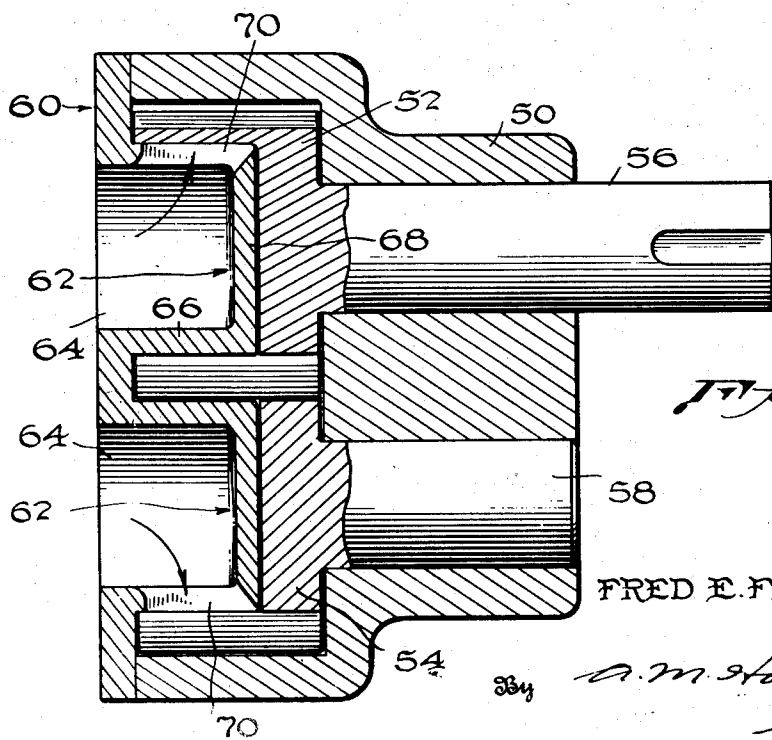
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GEAR PUMPING MECHANISM

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GEAR PUMPING MECHANISM

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This invention relates to rotary pumps of the gear type.

Yet more particularly the present invention contemplates the provision of rotary positive displacement pumps, of which the well-known gear pump forms an illustrative representation, particularly adapted to operation at high speed under reduced conditions of inlet pressure. In the operation, for example, of gear pumps of the internal-external gear type, as well as those employing spaced spur gears, the liquid pumped is usually introduced to the interdental gear tooth space adjacent the periphery of the gear on the suction side of the pump. At relatively high peripheral velocities, however, appreciable impairment of operation is experienced, presumably due to difficulty in accelerating the incoming oil into the rapidly moving gear spaces. This objection becomes quite serious when the pump is operated at high speed under conditions of reduced inlet pressure as, for example, at high altitudes. The tendency has hitherto been to overcome this difficulty by providing a centrifugal pump in series with and on the inlet side of the gear pump to act as a booster applying a positive feed pressure to the inlet. While such constructions do tend to assist acceleration of the oil into the expanding inlet chambers they are not completely satisfactory due to impositive operation, the increased complexity of construction and the resulting increase in weight and bulk.

In other constructions with which I am familiar wherein the inlet arrangement of the pump is modified, sufficient inactive pump volume is present to seriously reduce the volumetric efficiency of the pump, particularly at greatly reduced inlet pressure where the formation of gases or vapors in the clearance volume tends to place the pump under the necessity of acting as a compressor.

An important object achieved by the present invention resides in overcoming the foregoing difficulties by providing a positive displacement pump and particularly a pump of the gear type construction wherein the incoming liquid flow is accelerated into the interdental inlet spaces by centrifugal action of the rotating parts. To this end the oil or other fluid is introduced through the interior of the rotating impeller or pinion and is discharged at a suitable radially disposed point so that the centrifugal force developed by rotation assists entry into the volume spaces between the teeth.

Among other objects achieved by the present

invention are the provision of a gear pump as above, wherein inlet flow is conducted internally of the rotating impeller or pinion and passes radially outwardly through passages formed therein at points adjacent the inlet or suction side of the device; to provide an internally ported gear pump construction as above having means for sealing the internal ports at all angular positions on the pressure side of the pump; to provide a pump as above of materially limited inactive pump volume; and to provide a rotary, positive displacement type of pump capable of advancing the fluid through an outwardly progressing radial path of flow, wherein the outer housing may remain desirably fixed and operation is effected by power applied to the pinion or gear through which the incoming fluid is conducted.

Yet other and further objects will be apparent from the consideration of the following drawings and specification, wherein one preferred embodiment constructed in accordance with the present invention is disclosed in some detail for the purpose of affording complete understanding of the principles involved.

In the drawing,

Fig. 1 is a sectional view taken vertically through an internal gear pump embodying the features of the present invention;

Fig. 2 is a sectional view taken through the gear pump of Fig. 1 on the line 2—2 thereof;

Fig. 3 is a sectional view taken vertically and centrally through a modified gear pump, and

Fig. 4 is a sectional view taken through the gear pump of Fig. 3 on the line 4—4 thereof.

Referring more particularly to the gear pump of Figs. 1 and 2, there is shown an outer casing or housing 10 comprising an annular wall section 12 in which is disposed for rotation, an internal or ring gear 14 having a plurality of inwardly projecting teeth 16 separated by intervening interdental spaces. The righthandmost extremity of the housing, as viewed in Fig. 2, is provided with a journal section 18 rotatably supporting a driven shaft 20, the inner extremity of which supports an impeller, pinion or external gear 22. The pinion as shown is disposed on an axis eccentric to the rotational axis of the internal or ring gear 14 and has a plurality of teeth 24, the total number of which, however, amounts to one less than the number of teeth on the ring gear.

This arrangement, as is well known, yields a maximum volume displacement per revolution for a given size pinion. The invention, however, is not limited in this respect and as will herein-

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after appear more in detail, is applicable to other rotary positive displacement pumps as well as gear pumps of specifically different design and varying widely in tooth difference between the internal and external gear combination.

The housing is further provided with an outlet port 26 communicating with the outlet side of the gears, as indicated by the dotted lines in Fig. 1. It is apparent that rotation is imparted to the outer or internal gear through its intermeshing engagement with the positively driven impeller pinion 20, as shown. As the volumetric space between the gears becomes constricted, the fluid is exhausted into the port 26 and through outlet 28 to a suitable point of discharge.

It must be particularly noted that the pinion 22 is cut away, relieved or bored centrally to provide a cavity receiving a complementary inlet means 30 which comprises a hollow boss having an annular axially extending wall 32 terminating at its inner axial extremity in a lateral wall or baffle section 34. The outer axial margin of the cylindrical section 32 is integral with a radially extending flange 36 extending outwardly to the margin of the housing 12 and pinned thereto as at 38. A cover or side plate 40 is disposed over the flanges 36 and fixed, through the flanges, to the housing 10 by machine screws (not shown). The cover plate is provided with a central inlet conduit 42 communicating with the inlet boss 30. It will be appreciated from the foregoing that the boss 30 seats complementally within the central cavity of the pinion 22 to provide a free-running fit.

Particular attention is directed to the fact that the annular wall of the inlet boss is cut away or relieved, as at 44, opposite the inlet side of the pump to afford communication with the expanding interdental chambers formed by the rotating gear teeth, through radial slots 46 in the pinion defining shallow apertures. These slots are, as indicated, preferably located between the teeth of the pinion and provide communication with the intertooth spaces and the pinion cavity located radially inwardly thereof. It will be apparent from consideration of Fig. 1, that the apertures or slots 46 are closed on the outlet side of the pump by the fixed wall section 32 which provides a separating abutment. On the other hand, at points opposite the cut away section of the cylindrical wall 32 on the lower or inlet side of the pump, the slots 46 place the interdental tooth spaces in direct communication with the inlet compartment or passageway, thus permitting the expanding chambers to fill readily as the parts rotate.

From the foregoing it will be apparent that in operation and with the pinion rotating in the direction indicated by the arrow in Fig. 1, fluid is continually supplied to the inlet side of the pinion through the apertures 46 and discharged on the opposite or outlet side of the pump through the port 26. Acceleration of the incoming oil into the expanding displacement chambers, thus, is facilitated and assisted by centrifugal force and it is significant that this effect is enhanced by relatively high speed operation. The present construction materially compensates for the previous decrease in efficiency encountered at low inlet pressures and high peripheral speeds of operation.

It is to be noted that in the foregoing construction the fluid pumped proceeds radially, throughout the period within which it is being acted upon by the pump. More specifically, the

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disposition of the outlet port at a point radially outwardly from the inlet chamber enhances the foregoing effect. Accordingly, while it is advantageous to locate the outlet port or ports somewhere near the periphery of the gears, specific use of the side ported outlet shown in the figures is not critical. Radial or other corresponding types of outlet ports may be employed, although the inactive clearance volume thus introduced may be for many purposes disadvantageous. In any event, the present invention, in permitting the use of a fixed housing and a driven ring gear affords a wide latitude in pump outlet design.

In this connection it is thought important to point out that the present invention is of particular advantage in the limitation of inactive or clearance volume to a relatively small and insignificant proportion of the total pump displacement. Thus with a pinion of the type disclosed, it is possible to provide a central cavity, the walls of which extend extremely close to the root circumference of the gear. As a result the slots or apertures 46 are of insignificant radial depth and introduce only a small inactive volume amounting in most cases to not more than 2 per cent of the total pump volume. Usually in externally ported pumps of the present character, the inactive clearance volume necessarily amounts to a materially larger proportion of the pump capacity. It becomes thus apparent that the advantages inherent in the present invention tend to improve the volumetric efficiency of the pump particularly at greatly reduced inlet pressure where the formation of gases or vapors in the clearance volume would tend to place the pump under the necessity of acting as a compressor.

The modified embodiment disclosed in Figs. 3 and 4 illustrates the application of the present invention to a spur gear type of displacement pump having a housing 50 embracing a pair of spur gears 52 and 54 disposed in intermeshing relationship and rotating in opposite directions as indicated by the arrows. As shown more clearly in Fig. 4, the gear 52 is integral with drive shaft 56 journaled in the housing 50 and in turn drives the lower gear 54 similarly journaled in the housing through an agency of a supporting stub shaft 58. A cover or end plate assembly 60 fastened to the housing by machine screws (not shown) is provided with annular inwardly projecting housings or compartments 62 coaxial with the respective spur gears and adapted to reside within complementary internal cavities formed therein as described more in detail in connection with the previous embodiment. The projecting compartments or baffles 62 accordingly provide dual inlet chambers 64 defined by axially extending annular baffle walls 66 and transverse axial end walls 68. Each of the annular baffle walls 66 is relieved as at 70, providing communication between the inlet chamber and the expanding interdental spaces on the inlet side of the gears through apertures or spaces between the gear teeth.

More particularly it will be noted that the spur gears in the embodiment disclosed are relieved radially to a point coinciding with the root circle in the teeth, by reason of which the teeth comprise independent spaced sections of material free from intervening connection at their root portions. It will be apparent, therefore, that in operation free access of incoming fluid is provided to the interdental tooth spaces, adjacent the inlet side of the pump. In the vicinity of the

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outlet port 72, however, the baffle walls 66 occupy the spaces between the bases of the gear teeth thus sealing off communication between the intertooth spaces and the central inlet. In operation the present construction therefore utilizes the centrifugal action of the gears to facilitate the acceleration of inlet fluid into the tooth spaces on the inlet side, promoting high volumetric efficiency.

The present invention accordingly provides a unitary positive displacement pump construction which materially obviates the impairment in operating efficiency hitherto associated with use at high speeds and under reduced inlet pressures. In accordance with the invention the centrifugal forces created by the rotation of the parts are utilized to facilitate acceleration of the fluid into the pump chamber by coordinating the inlet feed and also the outlet conditions with the centrifugal forces normally acting within the pump. This effect is achieved with no material sacrifice in operating characteristics and in fact exhibits a substantial improvement in pump capacity under substantially all conditions when compared with peripherally ported pump constructions of the type now finding wide use. The final construction is moreover quite simplified over high speed gear pumps of the type with which I have been familiar and provides fully enclosed moving parts operable from a single driven shaft.

It is to be understood, however, that the invention is not limited to those specific types of pumps disclosed herein only for purposes of illustration. In particular the invention is most advantageous in connection with gear pumps of varying design, although it in its broadest aspect has applicability to rotary positive displacement pumps in general.

Obviously, therefore, the invention is not limited to the specific structural arrangements disclosed but is capable of further modifications and changes without departing from the spirit and scope of the disclosure.

What I claim is:

1. A rotary gear pump comprising a housing, a pair of meshing gears mounted for rotation within said housing, one such gear being formed with apertures extending inwardly from the bottoms of the tooth spaces thereof and communicating with a central cavity therein which is of a diameter approximating the root circle of the gear, the apertures being shallow and of less depth than width, a fixed inlet member mounted with running fit in the cavity of said gear, said inlet member being formed with a fluid passageway which discharges outwardly through a port in the wall thereof, the unported portion of said inlet member within the cavity serving to seal the said apertures in the region of meshing interengagement of the pair of gears, and a discharge member in said region of meshing interengagement.

2. A rotary gear pump comprising a housing, a pair of meshing gears mounted for rotation within said housing, one such gear being formed with apertures extending inwardly from the bottoms of the tooth spaces thereof and communicating with a central cavity therein which is of a diameter substantially coinciding with the root circle of the gear, the apertures being shallow and of less depth than width, a fixed inlet member mounted with running fit in the cavity of said gear, said inlet member being formed with a fluid passageway which discharges outwardly through a port in the wall thereof, the unported

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portion of said inlet member within the cavity serving to seal the said apertures in the region of meshing interengagement of the pair of gears, and a discharge member in said region of meshing interengagement.

3. In a rotary gear pump comprising a housing having an inlet and an outlet communicating therewith, a pair of meshing gears the interengaging teeth of which form volumetric displacement chambers expanding in the region of the inlet and contracting in the region of the outlet, at least one gear of the pair being formed with a large central cavity of a diameter approximating that of the root circle of said gear and shallow apertures offering communication between the bottoms of the tooth spaces thereof and the cavity, a fixed inlet member mounted with running fit in such cavity and formed with a port directed outwardly to provide a passage for admitting fluid to the displacement chambers in the region of their expanding volume, the wall of said inlet member on either side of the port serving to cover the apertures in the region of the contracting displacement chambers, the said outlet being so located that the displacement chambers are presented to it in the region of their contracting volume.

4. A pump of the rotary positive displacement type comprising a housing, a ring gear and meshing pinion eccentric thereto, and of at least one tooth difference, mounted for rotation in said housing and by interengagement of their teeth defining volumetric displacement chambers in the interdental spaces, such displacement chambers contracting in volume on one side of a position of full mesh, in which a tooth of one gear substantially entirely fills a corresponding space between adjacent teeth of the other, and expanding in volume on the other side of such position of full mesh, the said pinion being formed with a large central cavity of the maximum diameter permissible without intersecting the contours of the tooth spaces of said pinion, and said pinion further being formed with shallow apertures of greater width than depth extending between the tooth spaces thereof and the central cavity, a cylindrical inlet member closely fitting into the central cavity and opening outwardly to discharge fluid through apertures exposed to it in the region of the expanding volumetric displacement chambers constituted by interengagement of the gear and pinion teeth, the inlet member covering the apertures therebeyond in the region of the contracting volumetric displacement chambers, and sealing off communication of the volumetric displacement chambers with the inlet in such last-named region, and an outlet member to which the volumetric displacement chambers are presented as the same are contracting and the teeth are approaching full mesh, whereby substantially completely to expel fluid entrapped therein to said outlet.

5. A pump of the rotary positive displacement type comprising a housing, an internally toothed ring gear and a meshing pinion of at least one tooth difference mounted eccentrically with respect to the ring gear for rotation in said housing, the gear and pinion being so designed and arranged that in rotation their teeth enclose interdental volumetric displacement chambers expanding on one side of a position of full mesh and contracting on the other, the said pinion being formed with a large central cavity in one face and shallow apertures in the bottoms of its tooth spaces communicating with such cavity, an inlet

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member comprising a plate secured to the housing and forming a part thereof, said plate being formed with a projecting hollow boss fitting within the cavity in said pinion, said boss being closed at its end and having a port in its side wall to direct entering fluid substantially radially outward through the shallow apertures presented to it and into the expanding volumetric displacement chambers, said boss covering the apertures in the region of the contracting volumetric displacement chambers to seal the latter against communication with the inlet, and an outlet means to which the contracting volumetric displacement chambers are presented until the position of full mesh is reached, at which latter position the interengaging teeth substantially completely fill corresponding tooth spaces, and the shallow apertures, sealed by the inlet boss, offer a minimum volume retaining pumped fluid.

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