This invention relates to improvements in gear pumps and compressors of the type which embodies an internally toothed ring gear and a pinion of one tooth difference in mesh therewith, and it comprises more particularly an improved construction and arrangement of inlet ports in the ring gear communicating with the respective tooth spaces which constitute expanding and contracting fluid displacement chambers in operation of such pump.

Either of two forms of inlet are ordinarily employed in pumps of this general type: the pinion may be rotatably mounted on a fixed inlet pipe which has a port in its side wall presented in succession to outwardly directed ports in the pinion, so that fluid emerging from the pipe flows outwardly to fill the tooth spaces; or the ring gear may be ported, and a peripheral inlet employed, in which case the fluid flows inwardly through the ports in the ring gear to fill the tooth spaces.

The axial inlet has the advantage that centrifugal force assists the flow of fluid into the tooth spaces but it has the disadvantage that under high discharge pressure excessive leakage will occur between the gear teeth at the lower abutment. With the peripheral form of inlet the reverse is true; leakage is prevented and the pump is adequately sealed to withstand high pressure but since the flow is inward into the tooth spaces it is resisted by centrifugal force. Furthermore, if the ports in the ring gear are radial, the entering fluid must abruptly change direction and is suddenly accelerated by the advancing tooth, resulting in shock loss which resists the filling of the tooth spaces.

One of the objects of our invention, among others which will become apparent from the following description, is to provide a rotary positive displacement pump which avoids the aforementioned disadvantages of both forms of inlet, and which is especially adapted for operation under high discharge pressure with minimum leakage and shock loss. This is accomplished by providing obliquely inclined ports in the periphery of the ring gear, each of which presents an advancing tapered pickup lip merging into the contour of the tooth flank without break, whereby the fluid is in effect scooped up in rotation of the ring gear and in flowing along the face of the advancing tooth is evenly accelerated to the speed of and in the direction of rotation of the ring gear.

Reference is made to the accompanying drawings in which

Fig. 1 is a cross sectional view of an assembled pump;

Fig. 2 is a side view of one form of ring gear;

Fig. 3 is a sectional view of the ring gear along the line 2--2 of Fig. 2;

Fig. 4 is a side view of another form of ring gear; and

Fig. 5 is a sectional view of the modified form of ring gear along the line 5--5 of Fig. 4.

The pump casing 10 which may be of any suitable form and construction has an inlet 11 and an outlet 12 between which abutments 13 and 14 extend into contact with the ring gear 15 to seal against leakage around its periphery and at the same time to center it for rotation about an axis 16.

A pinion 17 which has one less tooth than the ring gear meshes with the ring gear and is driven by a shaft 18 to which it is keyed as at 19. The axis 20 of the drive shaft is spaced from the rotational axis of the ring gear with the result that as the pinion and ring gear rotate in the direction of the arrow in Fig. 1 the pinion tooth spaces 21 continuously expand on the inlet side of the pump between the abutments and similarly contract on the discharge side.

The ring gear is provided with a series of oblique ports communicating with the spaces between its adjacent teeth. Since all ports of the series are of similar configuration, a description of one of them will suffice for an understanding of this invention.

As shown in Figs. 1 to 3, inclusive, the center lines of ports 22 are offset from the center line of the tooth space and each port is so inclined that it provides a wedge-shaped pickup lip 23 which advances into the fluid, causing the fluid to flow along the inclined surface and to enter the tooth space. The wall 24 of the port, which defines the surface of the pickup lip, is tangent to the curve 25 of the tooth and accordingly merges into the tooth contour smoothly and without angular break or discontinuity, so that the entering fluid flows without change in velocity along the flank of the advancing tooth and is accelerated without sudden impact and consequent shock loss which acts to prevent complete filling of the tooth space.

It will be noted that in the form of the invention shown in Figs. 1 to 3, inclusive, the inclined ports 22 are of appreciable depth. Such a construction has been found to be of advantage where liquids without gas in admixture are being pumped. However, where the liquid being
handled contains gas or other compressible fluid, as well as where the device is operated as a gas compressor in a supercharger. It is desirable that the clearance volume represented by the ports be as small as practicable. To this end the ring gear 28 shown in Figs. 4 and 5 is cut away intermediate its ends practically to the root circle of the teeth as at 27, and the contour of the tooth itself in such case constitutes the surface of the tapered pickup lip 28.

It is to be understood that the angle at the advancing marginal edge of the port, i.e., the angle of taper of the pickup lip, can be varied to give the best results for filling the tooth spaces at high speed. The proper angle for best results under various circumstances may be calculated, the tangent of the included angle of the pickup lip being equal to the mean radial velocity of the fluid through the port divided by the tangential velocity at the diameter of the port. Thus, with the proper angularity as above determined for any particular operating condition, the entering fluid is not suddenly accelerated in the direction of the rotating teeth but keeps the same general direction and velocity of flow and rolls along the advancing tooth contour of the ring gear, there being no angular interruption or break where the inner marginal edge of the port meets the tooth contour such as would give rise to shock loss.

What we claim as our invention is:

1. In a pump having an encased internally toothed ring gear and a pinion of one tooth difference in mesh therewith, the improvement comprising a ring gear formed with a series of oblique ports extending inwardly from the periphery thereof to the spaces between adjacent teeth, each such port having a wall which constitutes a tapered pickup lip, the profile of which merges with the contour of the advancing tooth.

2. In a pump having an encased internally toothed ring gear and a pinion of one tooth difference in mesh therewith, the improvement comprising a ring gear formed with a series of oblique ports extending inwardly from the periphery thereof to the spaces between adjacent teeth, each such port having a wall which constitutes a tapered pickup lip following in contour the contour of the advancing tooth flank.

3. In a pump having an encased internally toothed ring gear and a pinion of one tooth difference in mesh therewith, the improvement comprising a ring gear formed with a series of oblique ports extending inwardly from the periphery thereof to the spaces between adjacent teeth, each such port having a wall tangent to the tooth contour and forming a tapered pickup lip at the periphery of said ring gear.

4. In a pump having an encased internally toothed ring gear and a pinion of one tooth difference in mesh therewith, the improvement comprising a ring gear provided with a series of ports extending from its periphery into communication with the spaces between adjacent teeth, each such port being angularly directed with respect to the radial center line of the tooth space with which it communicates and forming a tapered pickup lip at the advancing edge of the port, the wall of the port in such case constituting the tapered surface of the pickup lip being tangent to the curve of the advancing tooth bounding such tooth space.

5. In a pump having an encased internally toothed ring gear and a pinion of one tooth difference in mesh therewith, the improvement comprising a ring gear provided with a series of ports extending inwardly from its periphery into communication with the spaces between adjacent teeth, the internal margin of the port opening in the tooth space being unsymmetrically located with respect to the center line of the tooth space, and a pickup lip at the external margin of the port, the profile of which is a continuation of the contour of the advancing tooth bounding such space.

6. A rotary gear pump comprising a casing provided with an inlet and an outlet, and spaced internal abutments therebetween, an internally toothed ring gear centered by said abutments for rotation in sealing contact therewith, said ring gear being provided with a series of oblique ports communicating with the spaces between adjacent teeth, each such port defining a tapered pickup lip which in profile is an unbroken continuation of the tooth contour, whereby fluid picked up by the lip will flow without change in velocity along the tooth surface to fill the space, and a pinion mounted eccentrically with respect to the axis of the ring gear.

7. A rotary gear pump comprising a casing provided with an inlet and an outlet, and spaced internal abutments therebetween, an internally toothed ring gear centered by said abutments for rotation in sealing contact therewith, and of such reduced diameter between its ends as to be not substantially greater than the diameter of its root circle, a circumferential series of ports communicating with the tooth spaces of said ring gear, each such port having an undercut wall in the flank portion of the leading tooth bounding such space and having a marginal tapered edge opposed to said wall, said tapered edge constituting a pickup lip delineated by the profile of the following tooth.

8. In a pump having an encased internally toothed ring gear and a pinion of one tooth difference in mesh therewith, the improvement comprising a ring gear provided with a series of ports extending from its periphery into communication with the spaces between adjacent teeth, each such port being angularly directed with respect to the radial center line of the tooth space with which it communicates and forming a tapered pickup lip at the advancing edge of the port, the tangent of the included angle of the pickup lip being equal to the mean radial velocity of the fluid through the port divided by the tangential velocity at the diameter of the port, and the tapered surface of the pickup lip being tangent to the curve of the advancing tooth bounding such tooth space.

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