United States Patent

Zippel et al.

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[54] GEAR PUMP

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **418/170**

[51] **Int. Cl.** **F01c 1/10**, F03c 3/00, F04c 1/06

[58] **Field of Search** ..... 418/126, 169, 170; 103/126 F

[56] **References Cited**

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[57] **ABSTRACT**

A gear pump having a power rotated pinion and an internal gear effecting positive displacement is provided including a filler or diverter element intermediate the toothed pumping elements for the purpose of directing flow into the recesses between the teeth of the rotative pinion from the suction side of the pump. Such diverter component insures filling of the recesses and avoids turbulence and cavitation thereby substantially decreasing pump noise, particularly at high speeds.

4 Claims, 3 Drawing Figures

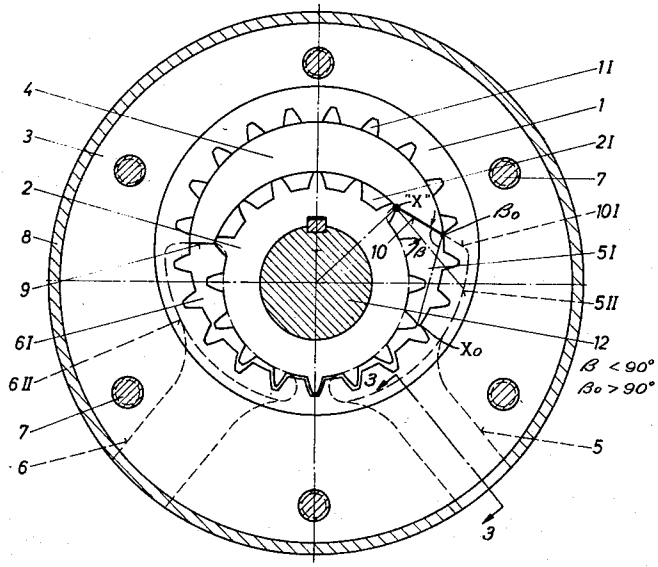


Fig. 1

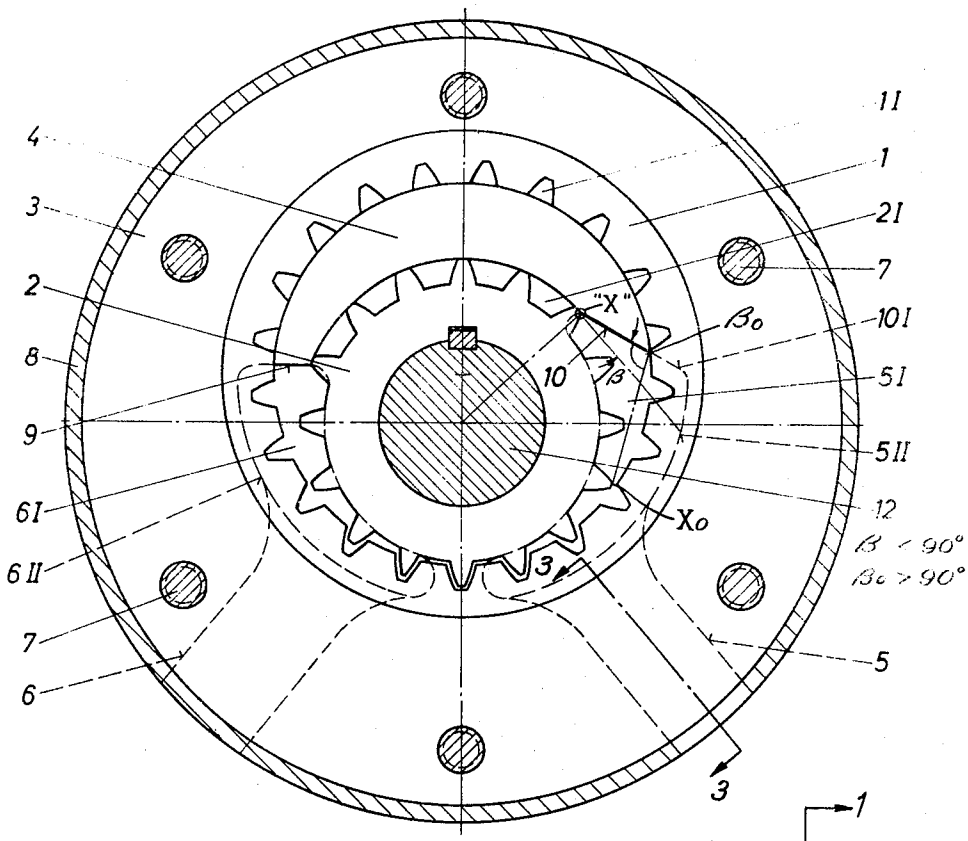


Fig. 2

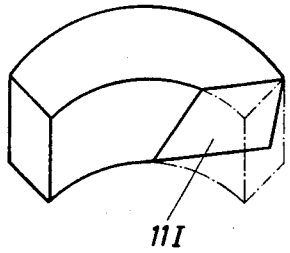
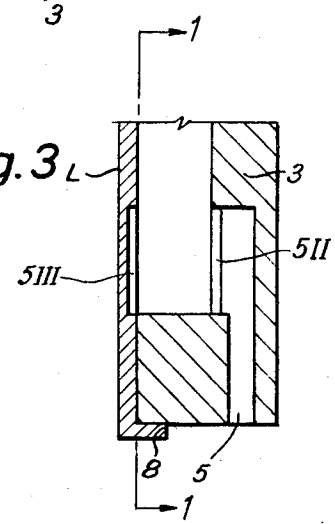


Fig. 3



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GEAR PUMP

Basically the invention comprises a pump body having a circular aperture with walls encompassing the internally toothed gear, the body being co-axial with the shaft on which the pinion or drive gear of the pump is mounted for rotation and the aperture being eccentric of such common axis in accordance with usual practice. However, in the crescent shaped space normally existent between the gear members a diverter element is utilized substantially closing such space for most of its crescent shape and being likewise of crescent shape. Such flow diverter element has an arcuate surface or concavity smoothly contiguous with the circumferential ends of the teeth of the pinion gear and an outer arcuate surface or convexity smoothly contiguous with the radially extending inner ends of the teeth of the internal gear. Accordingly, as the gears rotate, the diverter element being fixed to the pump body, the recesses between the teeth of the two gears are closed off in sweeping past the respective arcuate sides of the diverter element. The diverter element is disposed so that one end aligns smoothly with pump suction chamber walls to direct flow therefrom to the spacings between the teeth of the pinion gear. The spacings become filled with the medium being pumped and carry such medium around to the outlet chamber with a minimum of turbulence and cavitation. The spacings between the teeth of the internal gear moving through the suction chamber are filled by the tangential movement of the liquid, a centrifugal force effect, such flow being tangential of the rotation of the pinion gear while at the same time moving outwardly radially in a well known manner. The recesses of the internal gear are then virtually sealed off in sweeping past the convex side of the diverter element and turbulence and cavitation are avoided not only in the filling of such recesses but in the movement of the trapped oil charges therein.

A detailed description of the invention now follows in conjunction with the drawing in which:

FIG. 1 is a cross section radial view taken on line 1—1 of FIG. 3 showing the essential components of the invention, and

FIG. 2 is a perspective of the diverter element,

FIG. 3 is a fragmentary radial section showing a portion of the pump body and lid, taken on section line 3—3 of FIG. 1.

Referring to the drawing, the invention comprises a pump body 3 of circular construction having a circular pump chamber eccentrically disposed in which is concentrically mounted a drive shaft 12 to which is keyed the pump pinion gear 2 having teeth meshing with the pump internal gear 1 which has rotative bearing support in the internal periphery of the chamber.

In view of the offset or eccentric relationship of the gears, a crescent shape opening is effected and in the case of the invention this opening is filled by a diverter element 4 of corresponding crescent shape beginning at the upstream side of the pump with a suction flow guide wall 10 and ending at the downstream side of the pump with an end wall 9. The element 4 will be understood to be suitably secured to the pump body 3 at the closed end of the pump chamber as by screws (not shown) coming through that wall and into element 4.

Thus, the pump body is open at the face viewed in FIG. 1, to be closed by a lid L (FIG. 3) fastened as by screws 7 to the pump body and having a collar 8 which closely fits the outer periphery of the pump body. The axis 0 of the pump body is also the axis of the arcuate surface of diverter element 4 concavely contiguous with the ends of the teeth of the pump pinion gear whereby the recesses 2I intermediate the teeth are isolated as the gear rotates in the direction of the curved arrow. Likewise the convex side of filler element 4 isolates the pockets 1I of the internal gear element as they move therepast.

The pump body is provided with a suction bore 5 communicating in a conventional manner with a suction chamber 5II machined into the closed wall of the pump chamber, and it will be understood that the lid has a similar and congruous suction chamber 5III recessed therein which is the mirror image of that shown on FIG. 1 in dashed lines, so that the medium being pumped can enter the suction region 5I between the gears from opposite axial directions.

Fluid medium flowing through the suction chamber is divided by the filler element into two partial flows, one of which passes through the pockets 1I and the other one through the pockets 2I. Both partial flows are carried around and join each other in the pressure chamber 6I. From there, fluid is transported to exhaust recesses such as 6II machined into the end wall of the pump chamber and into the corresponding mirror image recess (not shown) in the lid understood to cover the open face of the pump. These pressure or exhaust recesses communicate with the outlet bore 6 through the pump body.

Fluid particles passing through the recesses 2I have the natural tendency to be flung away out of the pockets 2I due to centrifugal forces. As a result, these pockets would not be filled for maximum pumping effect. As a further draw-back of the pumps known hitherto, a high suction pressure in the pockets and pump noise due to cavitation have occurred. However, by providing a suction flow guide wall 10 of the filler element disposed at an angle β substantially smaller than 90° from its plane to the tangent at tangential point "x" of the peripheral circle of pinion gear 2, flow is redirected or diverted towards the pinion gear recesses 2I, thus assuring a more complete filling of the same and a better pumping efficiency. The dynamic pressure caused by the fluid being flung against guide wall 10 and diverted towards the recesses 2I likewise assists to raise fluid pressure therein and to avoid cavitation and diminish gear noises. It is contemplated that angle β would be 15° to 20°.

The flow guide wall is further defined by the plane thereof being at an angle β_o which is greater than 90°, such angle being a tangent to the periphery of the pinion gear to the radially outer end of the guide wall, at the tangential point X_o of the pinion gear.

The effect of the invention is still improved by disposing the end wall 10I of the suction recess 5II to be in the same plane as the guide wall 10, or to fit smoothly thereto. It will be appreciated that the suction recess 5III provided in the lid likewise has an end wall being shaped in conformance with the end wall 10I.

Wall 10 may be either flat or curved. Wall 10, as viewed in FIG. 1, is flat and in a plane perpendicular to the plane of the paper.

FIG. 2 shows a diverter element having a suction end guide wall 11I which is inclined to the plane perpendicular to the drawing plane of FIG. 1, thus avoiding pressure shocks each time when a tooth of pinion gear 2 is entering into the circular range of face 10 of the filler element.

We claim:

1. A gear pump comprising a pump body having a pump chamber; an internal gear in said chamber and a pinion gear in said chamber off center of said internal gear and meshing therewith whereby a generally crescent shaped space is effected intermediate the teeth of said gears; means comprising a substantially crescent shaped member disposed in said space as a filler therefore to divide said pump body into a suction region and a pressure region; said member having an end providing a suction flow guide wall for guiding suction flow to the spacings between the teeth of said pinion gear from said suction region for delivery to said pressure region; the plane of said flow guide wall being at an angle (β) substantially smaller than 90° with the tangent of the tooth periphery of the pinion gear at the radially inner end of said guide wall, and the angle (β_o) of the plane of said guide wall with a tangent from said pinion gear to the outer end of said guide wall being greater than 90°.

2. A gear pump as set forth in claim 1, wherein said first angle is of the order of 15°– 20°.

3. A gear pump as set forth in claim 1; said member being secured to said pump body and said pump body having a suction chamber recessed therein and adjacent a portion of said gears and disposed at one side of the suction region for communication therewith; said chamber having an end wall in substantial planar alignment with the flow guide wall of said member and communicating with said suction region.

4. A gear pump as set forth in claim 3, a closure lid for said pump body having a suction chamber recessed therein and disposed at the opposite side of said suction region and having an end wall in planar alignment with said flow guide wall of said member.

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