April 7, 1942. J. F. PATTON 2,278,795

HYDRAULIC PUMP

Filed Jan. 12, 1940 2 Sheets-Sheet 1

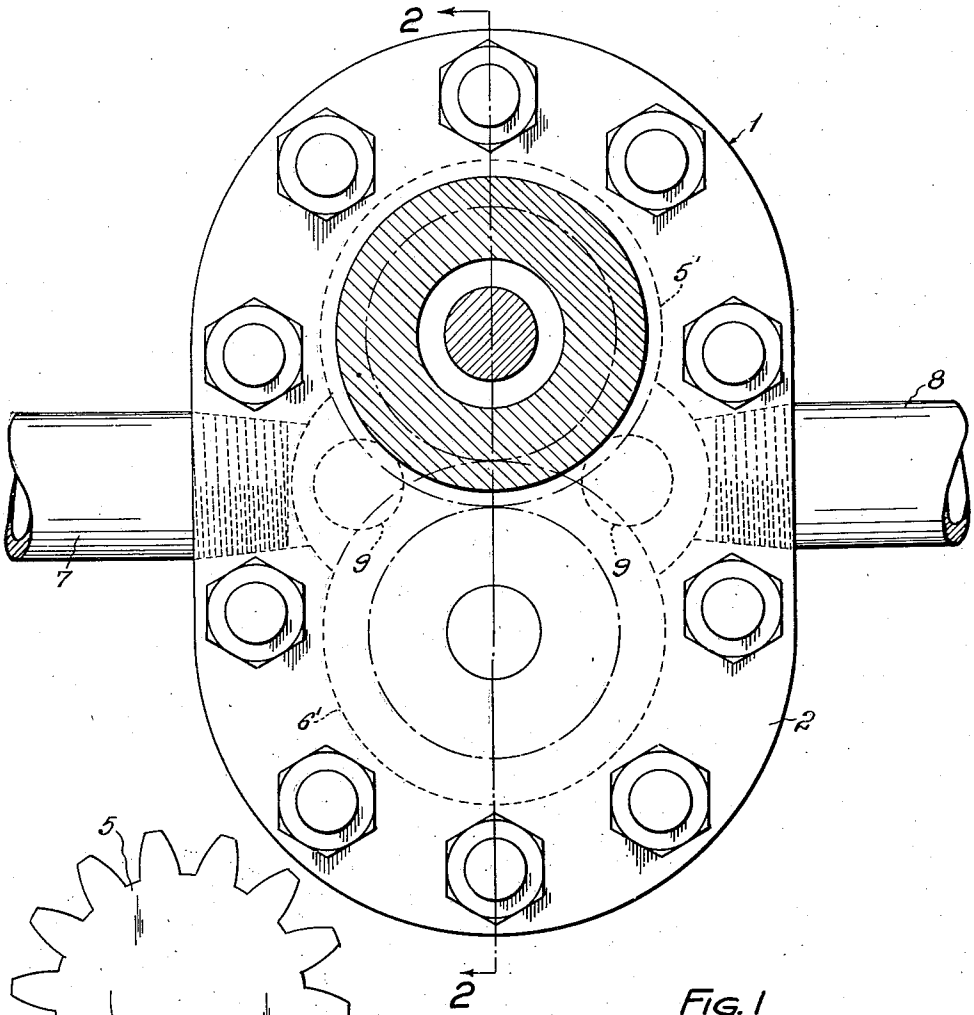


FIG. 1

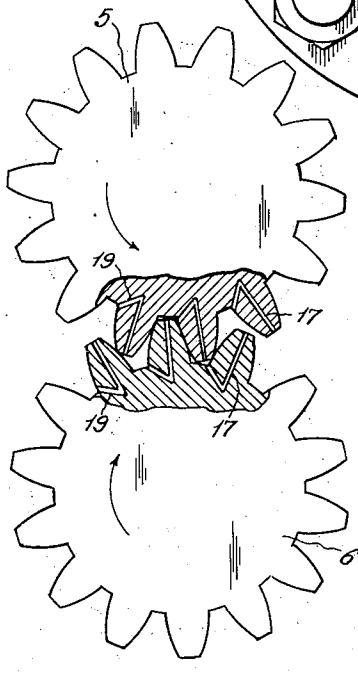


FIG. 3

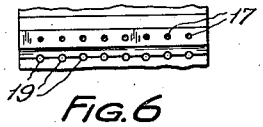


FIG. 6

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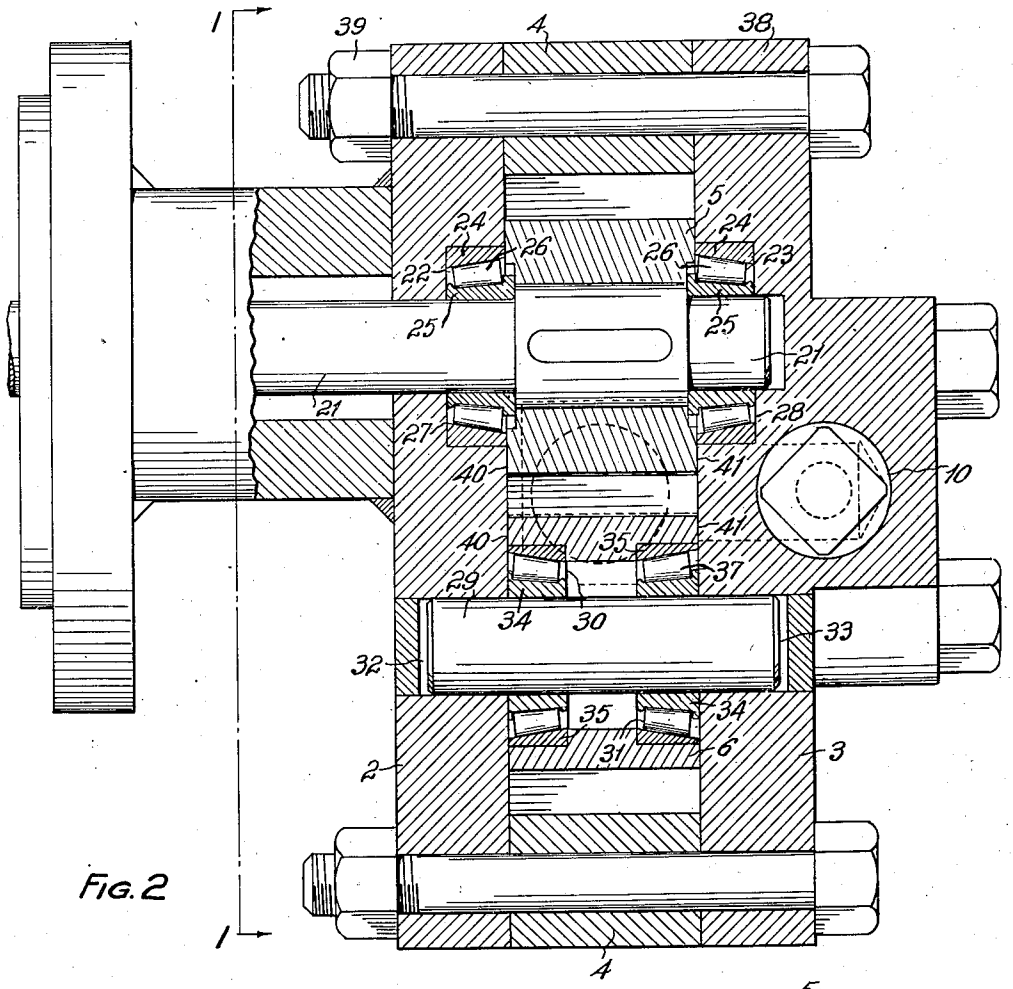


FIG. 2

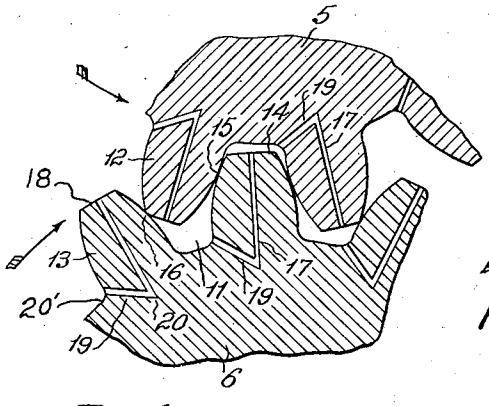


FIG. 4

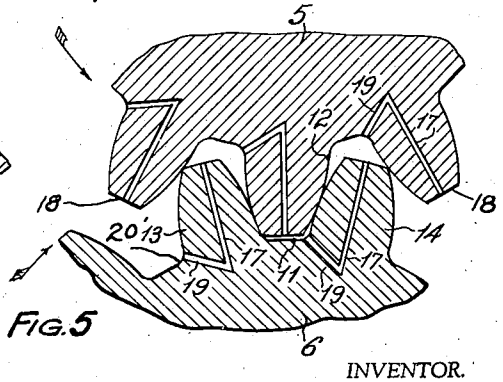


FIG. 5

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2,278,795

HYDRAULIC PUMP

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Application January 12, 1940, Serial No. 313,636

7 Claims. (Cl. 103—126)

This invention relates to gear pumps and more particularly to an improved construction of a gear pump for pumping hydraulic fluid under high pressure.

In gear pumps adapted to pump fluid under high pressure, it is well known that the efficiency of the pump decreases from the time it is placed into use and, in a comparatively short period of time, a point is reached where further use of the pump is rendered impractical. Such pumps employ a pump housing having a pair of intermeshing gears rotatable about parallel axes mounted therein and operable to pump fluid upon having a rotating movement imparted thereto. The decrease in efficiency of the pump is due to factors tending to cause disalignment of the axes of the pump gears thus causing the gear teeth or pumping vanes to ride against the sides of the pump housing. This action causes wear on the pump housing and increases the amount of clearance between the gear teeth and the side of the housing. After a period of use, the clearance will become so great from wear as to materially effect the efficiency of the pump.

In order to prevent axial disalignment of the pump gears, it has been common practise to provide gear pumps with heavy brass shims against which the end faces of the gears ride and by which the gears are held in proper position. After a period of use, the shims become worn and are no longer operable to prevent axial disalignment of the pump gears and if use of the pump is continued under such condition, the gear teeth will gouge out the surface of the pump housing and render the pump unfit for further use. Accordingly, it is necessary to freqently dismantle the pumping unit and replace the brass shims to prevent injury to the pump housing. Obviously, the cost of dismantling and replacement of shims is highly undesirable in pumps of the character referred to.

A factor tending to cause axial disalignment of pump gears and consequent injury to the pump arises from fluid entrapped between the intermeshing gear teeth. As the teeth come together, a pocket is formed between the teeth which is completely filled with liquid. As rotation of the intermeshing gears is continued, the teeth come closer together diminishing the size of the pocket and the fluid in such pocket is forced out under increased pressure. The fluid thus trapped between the intermeshing gear teeth exerts a considerable force against the pump gears tending to force them away from each other and cause axial disalignment of such gears.

To permit the escape of fluid, the customary practise has been to provide openings in the surface of the shims and the fluid trapped in the pockets is forced out of the pocket endwise with respect to the gear teeth into such openings. However, this method of permitting the escape of fluid trapped between intermeshing gear teeth is not entirely operative to prevent the forces referred to tending to cause axial disalignment of the pump gears.

Moreover, the common practise of keying the gears of a rotary gear pump to shafts and mounting the ends or parts of such shafts in bearings also contributes to the possibility of axial disalignment of the gears. A wearing action of the shafts riding in the bearings takes place thereby permitting the respective shafts of intermeshing gears to wobble with respect to each other.

Accordingly, one of the principal objects of this invention is to provide a rotary gear pump in which axial disalignment of the rotating gears is effectively prevented.

A further object is to provide gear wheels in a pump of the character referred to with means for preventing entrapping of fluid between intermeshing gear teeth.

A further object is to provide gear wheels in a pump of the character referred to with gear teeth having by-pass conduits or passages formed therein for conducting fluid away from pockets formed between intermeshing gear teeth to prevent the formation of pressure from fluid entrapped in such pockets.

A further object is to provide a novel mounting for rotatably supporting the gear wheels in a rotary gear pump which will effectively prevent axial disalignment of the gears and eliminate the necessity of providing brass shims customarily used in present day practise.

Other objects and advantages of the invention will become apparent during the course of the following description.

In the drawings there is shown a preferred embodiment of the invention. In this showing:

Figure 1 is a top plan view of a rotary gear pump, a part thereof being broken away, and shown in section.

Figure 2 is a sectional view taken substantially on the line 2—2 of Figure 1.

Figure 3 is a diagrammatic view showing a pair of intermeshing gears as used in a gear pump,

parts thereof being broken away and shown in section to illustrate the arrangement of the by-pass openings formed therein; and,

Figures 4 and 5 are enlarged partial sectional views of intermeshing gear teeth illustrating the manner in which pockets are formed between the teeth and the manner in which the openings and the gear teeth conduct fluid entrapped in such pockets away from the pockets as the size of the pockets is diminished.

Figure 6 is a detail of one gear tooth illustrating the arrangement of the by-pass openings.

Referring to the drawings, the numeral 1 indicates as a whole a rotary gear pump comprising a top member 2, a bottom member 3, and an intermediate housing member 4. Intermeshing gear wheels 5 and 6 are rotatably mounted in the housing member 4 between the top and bottom portions 2 and 3 in a manner to be described. The inner surface of the intermediate portion 4, as shown by the dotted lines 5' and 6' in Figure 1, corresponds to the addendum circle of the rotating gears in accordance with conventional practice. An inlet 7 and an outlet 8 are provided for the admission and exhaust of fluid in the pump 1. The bottom portion 3 of the pump is provided with openings 9 and a by-pass conduit 10 controlled by a suitable check valve for by-passing fluid from the exhaust to the inlet side of the pump. The by-pass 10 and check valve control are not shown in detail as such construction is well known in the art.

Referring to Figures 4 and 5, adjacent pairs of intermeshing gear teeth are shown enlarged to illustrate the manner in which pockets are formed between such teeth and in which fluid is trapped. It will be noted that the pocket 11 is formed initially by engagement of the tooth 12 with the teeth 13 and 14 at the points 15 and 16 respectively. As rotation of the gear wheels is continued, the pocket 11 will gradually decrease in size until the position shown in Figure 5 is reached, at which point the pocket 11 will be confined to the clearance between the gear wheels. Since the pocket 11 is filled with incompressible hydraulic fluid when in the position shown in Figure 4, it will be apparent that fluid must be forced out of such pocket as rotation of the gear wheels is continued, thereby causing a considerable increase in the pressure of the fluid trapped in the pocket 11. Such pressure will be effective to force the gears apart and out of axial alignment causing the teeth positioned diametrically opposite the intermeshing gear teeth to ride against the surface 5'—6' of the housing 4. As pointed out above, the common practice has been to attempt to permit the liquid to escape endwise from the pockets 11.

In order to permit the direct escape of the fluid from the pockets 11, a plurality of passages or conduits 17 are formed in the gear teeth and are spaced along the length of the teeth as best shown in Figure 6.

The passages 17 extend inwardly from the addendum 18 of the gear teeth and other passages 19 are provided to permit the escape of fluid from the passages 17. The passages 19 extend inwardly from the root 20' of the gear teeth and on the side thereof opposite to the direction of rotation of the gear wheels. The passages 17 and 19 intersect at 20 in order to provide a direct passageway for the fluid out of the pockets 11. Since the passages 19 extend inwardly with respect to the direction of rotation of the gear wheels, it will be apparent that the fluid from the pockets 11 will be permitted to escape to the exhaust or delivery side of the pump. In this manner, the pressure resultant from the trapped fluid in the pockets 11, tending to spread the gears apart and thereby effect axial disalignment of the gears, will be prevented.

The pump is operated by means of a drive shaft 21 to which the gear 5 is keyed and provided with a press-fit. Bearing assemblies 22 and 23 are provided for rotatably supporting the shaft 21 and gear 5 within the pump chamber. Each of the bearing assemblies comprises inner and outer hardened steel races 24 and 25 having frictionless bearings 26 mounted therebetween. The outer races 24 are provided with a press-fit in openings 27 and 28 respectively in the top member 2 and lower member 3. The inner races 25 are pressed on the shaft 21 thereby securing the inner races 25 to the shaft 21 for rotating movement therewith. Likewise, the press-fit of the outer races 24 rigidly secures the outer races against movement with respect to the casing of the pump.

The races 24 and 25 and the bearings 26 being formed of hardened steel, effectively hold the gear 5 against forces tending to axially disalign such gear. Moreover, no part of the shaft 21 is subject to wear and accordingly, the objectionable feature resulting from the shaft being permitted to ride directly on a bearing is thereby eliminated.

The gear 6 meshing with the gear 5 is provided with a central opening and is mounted on a stationary shaft 29 by means of bearing assemblies 30 and 31. The shaft 29 is provided with a press-fit in openings 32 and 33 respectively formed in the upper member 2 and lower member 3. Each of the bearing assemblies 30 and 31 comprise hardened steel inner races 34 pressed on the shaft 29 and hardened steel outer races 35 pressed on the inner surface of the annular gear 6. In this manner, the inner races 34 are fixed against movement with respect to the shaft 29 and the casing of the pump 1 and the outer races 35 are fixed to the gear 6 so as to be rotatable therewith. Hardened steel frictionless roller bearings 37 are provided between the inner and outer races. Since the shaft 29 occupies a fixed position with respect to the casing of the pump, it will be apparent that axial disalignment of the gear wheels 6 will be effectively prevented and the gear 6 will be rotated about the shaft 29 on the outer races 35.

The bearing assemblies employed are known as the tapered type and are particularly important with respect to the construction in regards to their ability to absorb end as well as radial thrusts and provide new results with respect to the intermeshing gears and their supporting shafts.

Moreover, it will be apparent that each of the shafts 21 and 29 are provided with a pair of bearing assemblies supporting the gears at spaced points with respect to the housing of the pump. The inner and outer races and frictionless bearings being formed of hardened steel, it will be apparent that the gears 5 and 6 may be operated indefinitely without any appreciable wear taking place. Wobbling of the gears about their respective axes of rotation is thereby prevented and the gear teeth are likewise prevented from riding against the surface of the housing member 4.

In assembling the pump 1, the housing member 4 is placed on the bottom member 3 and the gears together with their associated parts are placed in

position within the intermediate housing member 4. The top is then placed on the member 4 and the parts are drawn together by means of a plurality of bolts 38 extending through aligned openings formed in the parts 2, 3 and 4, nuts 39 being provided for clamping the parts of the pump together.

From the foregoing, it will be apparent that the provision of bearing assemblies for each of the intermeshing gears having races substantially integral with the gears and other races substantially integral with the pump casing will be effective to hold the intermeshing gears against axial disalignment. By reason of the provision of such bearings, the necessity of providing brass shims riding against the end faces 40 and 41 of the gears is thereby eliminated.

Moreover, the provision of the passages 17 and 19 effectively eliminates the formation of pressure acting against and tending to axially disalign the intermeshing gears. Accordingly, it will be apparent that both the type of bearing assembly supporting the gears for rotating movement in the pump casing and the by-pass conduits formed in the gear body cooperate together for a common purpose to prevent movement of the gear teeth against the surface of the pump housing. The working surface of the pump housing will thus be protected against wear which would reduce the efficiency of the pump gearing.

It will be understood that the construction of the pump disclosed herein is particularly adapted for the pumping of fluid under high pressures. By the term "high pressure" is meant pressures usually considerably in excess of 200–300 pounds.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States, is:

1. In a gear pump, a housing having a pump chamber therein having opposing inner walls, a drive shaft, a drive gear in said chamber driven from said drive shaft, a second gear having recesses with inwardly extending radial flanges at the bottom of said recesses in its opposite sides and mounted in said chamber in intermeshing relationship with said drive gear, the sides of said drive and second gear disposed proximate the inner walls of the pump chamber, a stationary shaft rigidly mounted between said inner walls in said chamber, and means mounting said second gear on said stationary shaft for rotational movement with respect thereto comprising thrust bearing assemblies mounted in the recesses in each side of said second gear to resist axial thrust on said second gear within the pump chamber, each bearing assembly comprising an outer race fixed in one recess of the second gear, an inner race on said stationary shaft and having engagement with the proximate side wall of the pump chamber, and frictionless thrust bearing members mounted between each of the inner and outer races.

2. In a gear pump, a housing comprising top and bottom portions having spaced opposed surfaces and having a pump chamber therebetween, a drive shaft, a drive gear in said chamber between the opposed surfaces and driven from said drive shaft, a second gear in said chamber between the opposed surfaces and in intermeshing relationship with said drive gear and having race-receiving recesses with axial thrust surfaces in its opposite sides, a stationary shaft extending transversely of said chamber and having its end portions rigidly secured to said top and bottom portions, and thrust bearing means mounting said second gear on said stationary shaft for rotational movement with respect thereto and for preventing axial displacement of said second gear within said pump chamber comprising a pair of thrust bearing assemblies having inner and outer races and frictionless bearings between said races, the inner races of each of said assemblies being respectively secured to said stationary shaft at spaced points and engaging one of said opposed surfaces of said top and bottom portions, the outer races of said assemblies being rigidly secured to said second gear in said race-receiving recesses, whereby said outer races will rotate with said second gear with respect to said inner races and said stationary shaft, and said thrust bearing assemblies will absorb axial thrust and maintain said second gear in predetermined operative position between the opposed surfaces of the top and bottom portions.

3. In a high pressure gear pump, a housing comprising spaced side wall portions defining opposing inner walls of a gear pump chamber, meshing pump gears operatively disposed between said side wall portions with the sides of said gears proximate the opposing inner walls, means for driving at least one of said gears, a stationary shaft for supporting another of said gears, anti-friction thrust bearing means for each of said gears comprising a pair of thrust bearing assemblies, one of said assemblies being disposed between and engaging each side of each gear and the proximate inner wall of the housing to positively prevent axial displacement of said thrust bearing assemblies and the gears with respect to the inner walls.

4. In a high pressure gear pump, a housing comprising spaced side wall portions defining opposing inner walls of a gear pump chamber, meshing pump gears having peripheral gear portions and operatively disposed within the pump chamber with the peripheral gear portions of said gears proximate the opposing inner walls of the chamber, means for driving one of said gears, a stationary shaft for supporting another of said gears, anti-friction thrust bearing means for each of said gears comprising a thrust bearing assembly disposed between each side of each gear and the adjacent inner wall to prevent axial displacement of the gear toward the proximate side wall of the housing, one of said gears being formed with race-receiving recesses in its opposite sides with axial thrust surfaces at the bottom of said recesses and radially inward of its peripheral gear portion, said thrust bearing assemblies comprising inner and outer races and intermediate rolling means, one of the bearing assemblies being positioned in each recess of the last-mentioned gear and the inner race of each assembly engaging the side wall of the housing proximate said gear.

5. In a high pressure gear pump, a housing comprising spaced side wall portions defining opposing inner walls of a gear pump chamber, meshing pump gears operatively disposed within the pump chamber with the sides of said gears proximate the opposing inner walls of the housing, means for driving one of said gears, shaft means for supporting another of said gears, anti-friction thrust bearing means for each of said gears comprising a thrust bearing assembly between each side of each of the gears and the proximate inner wall of the housing to prevent axial displacement of the gear toward the proximate inner wall, said opposing inner walls proximate each side of one of said gears being formed with annular race-receiving recesses, extending into the side wall portions and having a bottom

engaging one side of a thrust bearing assembly positioned therein, said thrust bearing assemblies associated with said last-mentioned gear comprising outer bearing races seated in said annular recesses, inner races engaging the sides of said last-mentioned gear, and rolling means between said races.

6. In a high pressure gear pump, a housing comprising spaced side wall portions defining the opposing inner walls of a gear pump chamber, a drive shaft, meshing pump gears driven by said shaft and having peripheral gear portions and operatively disposed within said pump chamber with the side portions of said gears disposed proximate the opposing inner walls of the pump chamber, one of said gears supported on a stationary shaft, anti-friction thrust bearing means for said gears disposed between the sides of the gears and the proximate inner walls of the pump chamber to prevent axial movement of the gears toward the proximate inner walls, each of said bearing assemblies comprising annular inner and outer races and rolling means therebetween, one of said gears having a race-receiving recess with an axial thrust surface in each of its sides inwardly of its peripheral gear portion for receiving the outer race of a thrust bearing assembly and for securing said race against inward axial movement, the inner races of the thrust bearing assemblies of the last mentioned gear disposed on said stationary shaft with one side of the last-mentioned inner races engaging the side walls of the pump chamber to prevent axial outward movement of the inner races in the recesses in the sides of the last-mentioned gear.

7. In a gear pump, a housing having spaced opposing side walls defining a pump chamber therebetween, a drive shaft, a drive gear in said chamber driven from said drive shaft, a second gear in said chamber in meshing relation with said drive gear, said drive and second gears having their sides disposed proximate the inner walls of the pump chamber, a stationary shaft for said second gear rigidly mounted in the side walls of said housing, anti-friction thrust bearing assemblies rotatably mounting said drive gear and shaft and said second gear on said stationary shaft and for preventing axial displacement of said gears with respect to the proximate inner walls of the housing comprising a pair of thrust bearing assemblies for each gear, one of said assemblies being disposed between each of the sides of the gears and the proximate side of the housing, said second gear being formed with an annular race-receiving recess with an axial thrust surface in each side thereof radially inward of its peripheral gear portion, said thrust bearing assemblies for the second gear comprising annular outer races seated in the said recesses in the second gear, annular stationary inner races disposed on said stationary shaft in the recesses of the gear and fixed against axial movement by the side walls of the housing proximate the second gear, and rolling means between the said inner and outer races.

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