

Dec. 27, 1955

P. G. LINDBERG

2,728,301

GEAR PUMP

Filed June 17, 1952

4 Sheets-Sheet 1

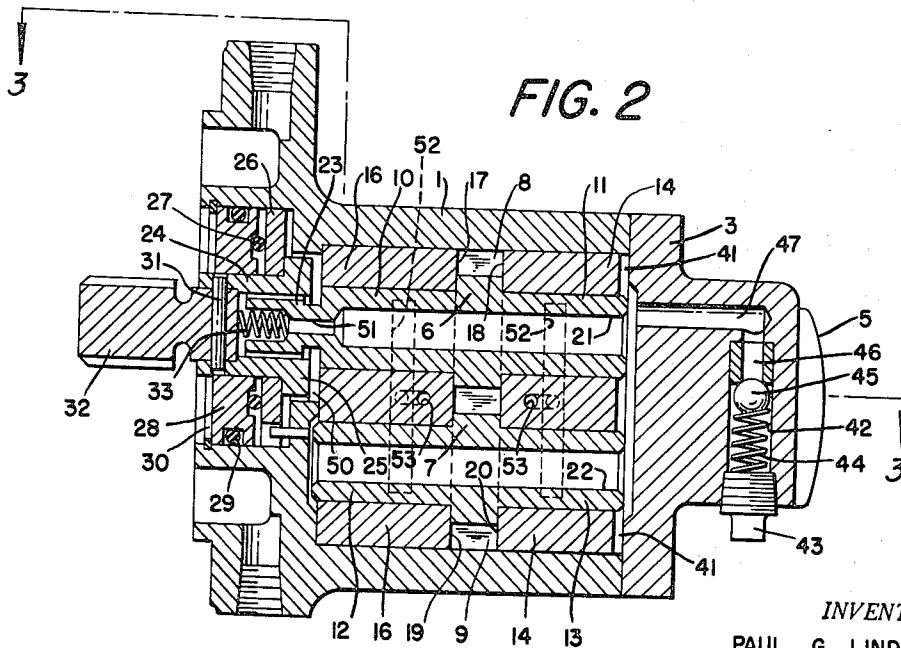
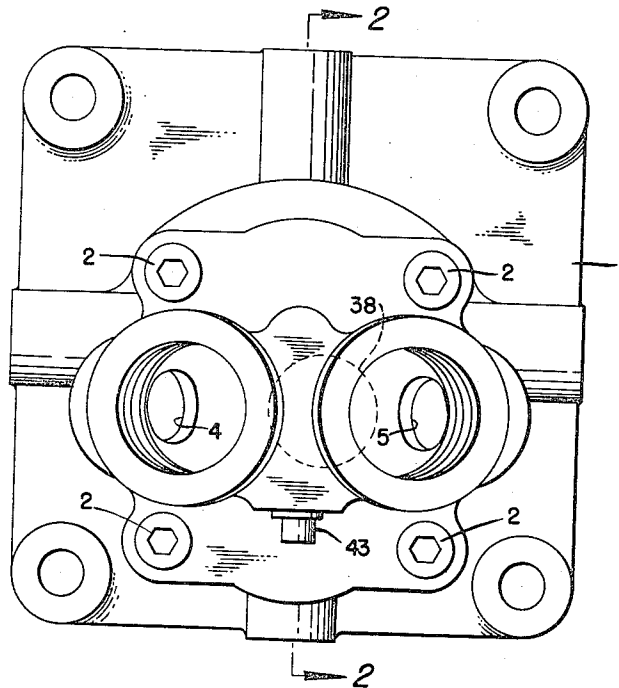


FIG. 2

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FIG. 3

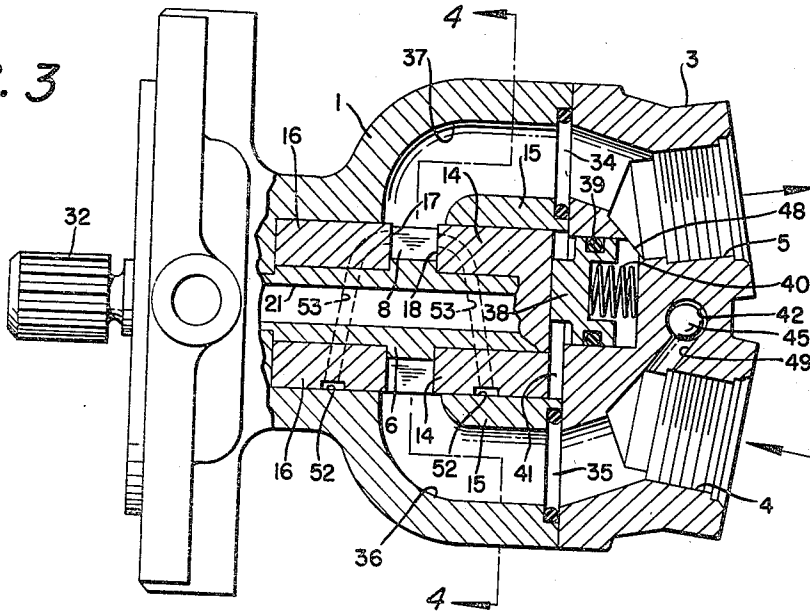


FIG. 4

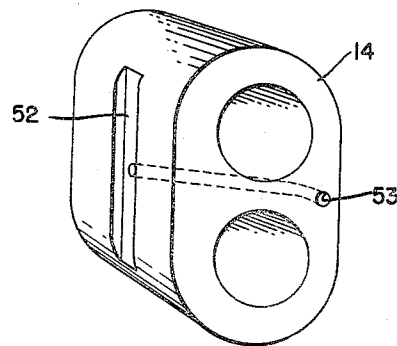
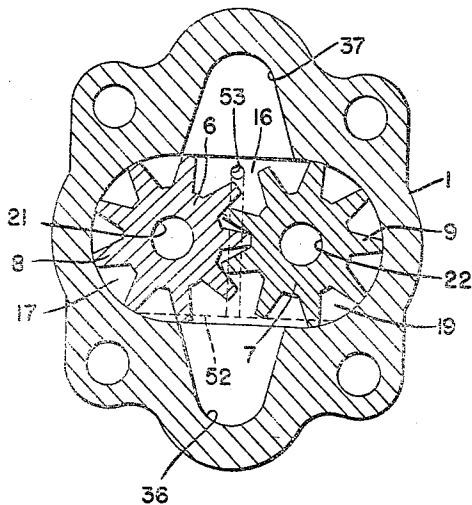


FIG. 5

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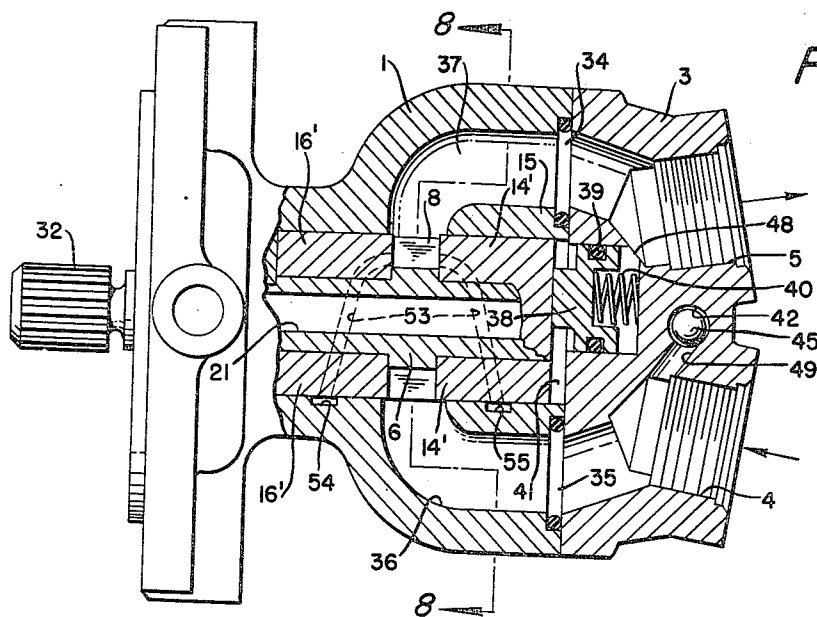


FIG. 6

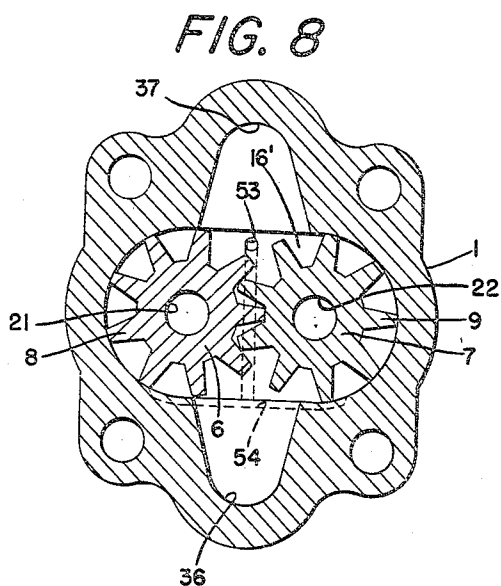


FIG. 8

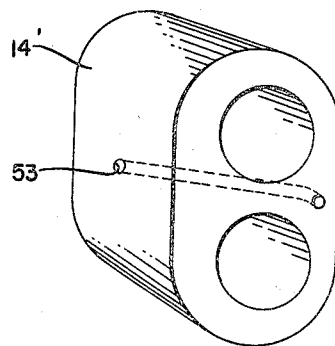


FIG. 7

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4 Sheets-Sheet 4

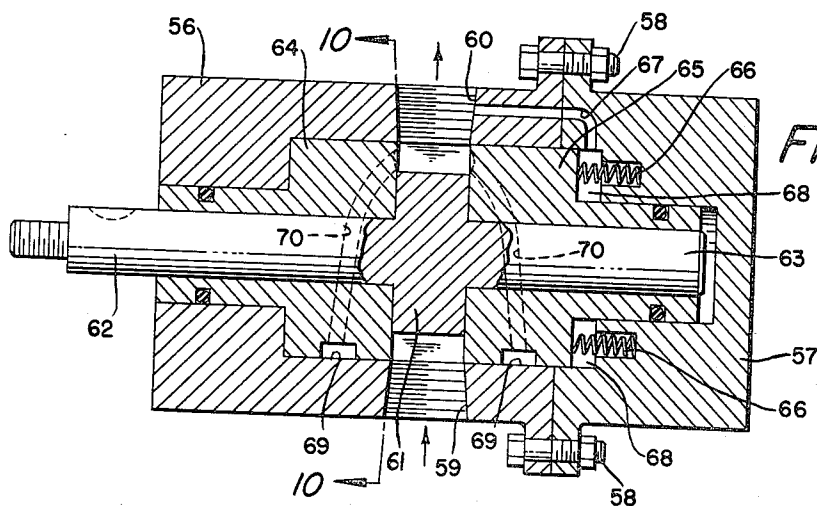


FIG. 9

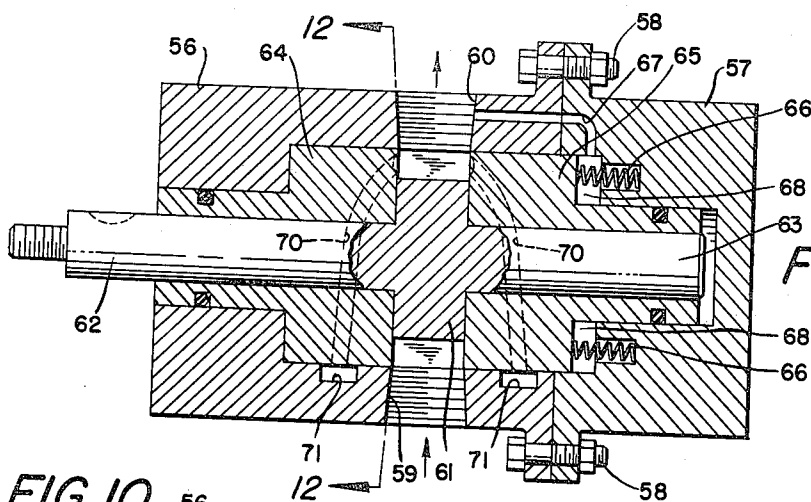


FIG. 11

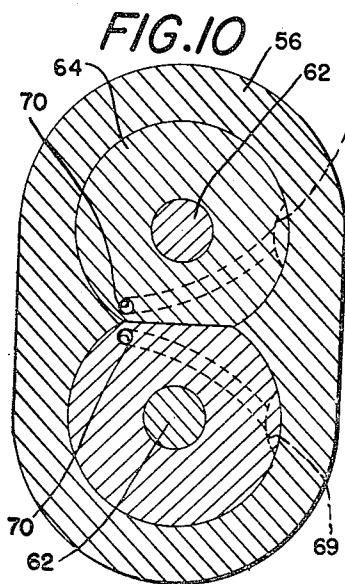


FIG. 10

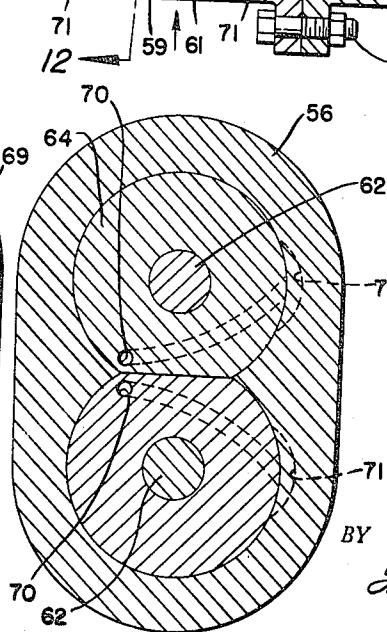


FIG. 12

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Application June 17, 1952, Serial No. 293,981

4 Claims. (Cl. 103-126)

This invention relates to pressure fluid gear pumps and has for one of its primary objects to provide an improved gear pump of simplified construction and increased efficiency, and is a continuation in part of co-pending application entitled Paul G. Lindberg Number 159,673, filed May 3, 1950, now Patent No. 2,641,192, for Gear Pump.

I have found that in gear pumps of such construction that provides for automatically maintaining pressure responsive longitudinally floating bearing bushings in sealed contact with the side faces of the associated gears, there is a tendency for the fluid pressure on the low pressure, or inlet, side to such an extent as to cause the bearing bushings to bind against the housing on the inlet side. This binding tendency is so pronounced as to cause serious malfunctioning and eventual erratic operation or damage to the gear pump.

It is therefore one of the primary objects of my invention to provide an improved gear pump of this type in which this binding tendency of the bearing bushings will be eliminated. Another object is to provide a simplified construction in which no additional parts are required and in which virtually no additional expense is involved in the modification of the assembly for accomplishing the elimination of this binding tendency of the bearing bushings.

A more specific object of the invention is to provide a means of communication of the excess fluid pressure from the high pressure side to a point between the adjacent surfaces of the bearing bushings and the housing on the low pressure side to counteract the force of the fluid pressure on the high pressure side tending to force the bearing bushings against the housing on the low pressure side sufficiently to avoid any resulting binding of the bearing bushings against the housing on the low pressure side.

With the foregoing and other objects in view, the invention resides in the combination of parts and in the details of construction hereinafter set forth in the following specification and appended claims, certain embodiments thereof being illustrated in the accompanying drawings, in which

Figure 1 is a view in elevation of the gear pump showing the inlet and outlet end;

Figure 2 is a view in section taken through the pump along line 2-2 of Figure 1;

Figure 3 is a view in section taken along line 3-3 of Figure 2, showing the bushings to have pressure equalizing slots in their faces adjacent to the housing;

Figure 4 is a view in section taken along line 4-4 of Figure 3;

Figure 5 is a view in perspective of one of the gear journal bushings, showing it to have a slot on the low pressure side and a bore therethrough;

Figure 6 is a view similar to Figure 3 showing communicating grooves from the high pressure side to a slot in the housing between the low pressure side of the bushing and housing, instead of the slot being in the bushing, as shown in Figure 3;

Figure 7 is an enlarged detailed view in perspective of one of the bushings shown in Figure 6, with no slot in its side face;

Figure 8 is a view similar to Figure 4 showing the pressure equalizing slot provided in the housing rather than in the bushings as shown in Figure 4;

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Figure 9 is a view in longitudinal section taken through a modified form of gear pump in which the pressure equalizing slots are provided in the bearing bushings on the low pressure side with bores therethrough communicating with the high pressure side;

Figure 10 is a view in section taken along line 10-10 of Figure 9;

Figure 11 is a view similar to Figure 9 showing the equalizing slots in the low pressure side of the housing, rather than in the bearing bushings as shown in Figure 9; and

Figure 12 is a view in section taken along line 12-12 of Figure 11.

Referring more particularly to the drawings, the main gear pump housing 1 has secured thereto by bolts 2 a housing 3 for the fluid inlet 4 and outlet 5.

The pump is shown to comprise two pump gears 6 and 7 with meshing teeth 8 and 9. On opposite sides of teeth 8, gear 6 is provided with journals 10 and 11 and on opposite sides of teeth 9, gear 7 is provided with journals 12 and 13. Journal 11 of gear 6 and journal 13 of gear 7 are mounted to rotate in an elongated unflanged one-piece straight side bushing 14 which is mounted to be longitudinally slidable on the inner surface of housing member 15 and which fills up the housing cavity. Such a bushing 14 is shown in perspective in Figure 7. Journal 10 of gear 6 and journal 12 of gear 7 are mounted to rotate in a similar elongated unflanged one-piece straight side bushing 16 that is likewise mounted to be longitudinally slidable on the inner surface of the housing and likewise fills up the housing cavity. The opposed faces 17 and 18 of bushings 14 and 16 are pressure loaded to engage the opposite side faces of gear teeth 8 of gear 6 in fluid sealing relationship, and the opposed faces 19 and 20 of bushings 14 and 16 are pressure loaded to engage the opposite side faces of gear teeth 9 of gear 7 in fluid sealing relationship. Gears 6 and 7 are provided with longitudinal bores 21 and 22.

Journal 10 of gear 6 has a reduced extension 23 that is splined to a coupling member 24 having a flange 25 that engages with a bearing ring 26, the opposite side of which presses against a flexible seal ring 27, that, in turn, presses against a collar 28 provided with an annular seal ring 29 between it and the housing and secured therein by a snap ring 30. Coupling member 24 is secured by pin 31 to the splined gear connector 32. A compression coil spring 33, bearing inwardly against gear journal 10 is provided to eliminate end play of gear 6 and affecting the seal assembly at this end of the gear.

Housings 1 and 3 when connected together are fluid sealed by rings 34 and 35. The fluid from inlet 4 passes through inlet chamber 36 to gear 7 and from gear 6 the fluid passes through outlet passage 37 to outlet 5.

Mounted in housing 3 is a spring and pressure loaded slidable pin 38 provided with an annular seal ring 39. It is normally urged by a compression coil spring 40 in the recessed head of the plug to initially resiliently force the one-piece gear bushing 14 to the left, as viewed in Figure 4, which leaves an axial chamber 41 between the housing 3 and bushing 14.

Fluid pressure is fed in from the high pressure side from passage 37 through passage 48 in behind and in the recessed head of floating pin 38 to force the pin 38 to the left to fluid pressure load the bushing 14. Pressure loaded pin 38 is located approximately opposite the center of internal pressure and on the horizontal centerline, but displaced outwardly from the vertical centerline, as shown in dotted lines in Figure 8. The resulting action of pressure fluid from the high pressure, or discharge, side on the pin 38 is to pressure load the bushings. Pressure fluid in space 50 behind bushing 16 and behind spring 33 is vented through passage 51 and bore 21 to space 1 behind bushing 14.

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Housing 3 is provided with a bore 42 to receive a retaining plug 43 and a coil spring 44, urging a ball valve 45 to normally close passage 46 that communicates with passage 47 leading to axial chamber 41. This provides a low pressure relief valve for venting chamber 41 to low pressure through passage 49 to the inlet passage 36.

The one-piece floating bushings 14 and 16 not only completely fill the housing cavities, but are also elongated and straight sided with no flanges. The intimate contact of their outer surfaces throughout their entire lengths with the inner surface of the housing provides for an effective seal against fluid leakage. They are thus self-sealing and require no additional sealing accessories. Another advantage of this one-piece floating bushing construction lies in the fact that it is self-aligning with respect to the gear journals, the gear faces and the housing, with virtually no tendency to cock in their pressure responsive sliding movements. This latter is especially true because the single bushing 14 is pressure loaded by the single pressure loaded pin 38 which is located approximately opposite the center of internal pressure.

In my gear pump construction, I have considerably reduced the number of essential operating parts. By reason of employing single one-piece straight sided floating bushings, I am able to employ a slidable pressure pin 38 for effectively pressure loading the bushing 14 by applying the fluid pressure from the high pressure side to the pin 38. Moreover, in such a construction I find it unnecessary to employ insert plugs to insure against leakage. The fluid that accumulates in space 41, upon movement of bushing 14, is readily vented past the low pressure ball check valve to the low pressure side. Thus I find it unnecessary to provide any relief recesses between the side faces of the gears and the bushings.

The above described gear pump construction is disclosed in Figures 1 to 7, inclusive, forms my invention as disclosed in my aforesaid co-pending application. My improvements thereover forming my present invention will now be described.

Referring to Figure 3, I have found that in actual practice conditions arise where fluid pressure builds up on the discharge, or high pressure, side sufficient to force the bearing bushings 14 and 16 transversely against the housing on the inlet, or low pressure, side with sufficient force to cause binding of the bushing with the housing, with resulting undue wear, damage to parts and erratic pump operation.

In carrying out my object to avoid this, I propose to introduce a fluid pressure force on the low pressure side that will counteract this undesired force on the bushings applied from the high pressure side. I also propose to accomplish this preferably without the necessity of additional parts and with the minimum amount of modification of the construction above described.

Still referring to Figures 3 and 5, I have shown bushings 14 and 16 to each be provided with an elongated pressure equalizing slot 52 in its face adjacent the housing on the inlet, or low pressure, side and a bore 53 communicating with the slot 52 and leading to the high pressure chamber side. In this manner, when excess pressure is built up on the high pressure side, enough pressure is transmitted to the pressure equalizing slots to counterbalance the force exerted from the high pressure side tending to bind the bearing bushings against the housing on the low pressure side.

As an alternative, I have shown in Figures 6 and 7, bushings 14' and 16' whose faces are not slotted. Instead, I may cut slots 54 and 55, comparable in dimensions to slots 52, in the housing adjacent bushings 14' and 16', and provide communication between slots 54 and 55 and the high pressure side through bores 53 in the bushings to accomplish a comparable result. In either event, the slots act as pressure equalizing slots for the expressed desired purpose.

In arriving at the proper dimensions of the pressure

equalizing slots 52 or 54 and 55, my purpose is to so design them that the sum of the forces produced by their existence approximately equals the opposing forces acting on the high pressure side of the bushings tending to force the bushings transversely against the low pressure side of the housing. Under ideal conditions where there is no leakage, the width of the two slots together should approximate the width of the gear. If leakage past the bushings occurs, the slot area should be increased accordingly.

In Figures 9 to 12, inclusive, I have shown my invention as applied to another type of gear pump not employing my novel form of bearing bushing of the type shown in Figures 1 to 8 nor the sliding piston 24 shown therein. In this construction, as shown in Figures 9 to 12, the two parts 56 and 57 of the housing are joined together by bolts 58. The fluid flows into inlet 59 and discharged through outlet 60. The gears 61 have trunnions 62 and 63 supported by longitudinally movable floating bearing bushings 64 and 65. Springs 66 are interposed between housing 57 and the adjacent face of bushing 65. Instead of employing a sliding piston of the type shown at 24 in Figures 3 and 6, a passage 67 is provided to lead pressure fluid from the high pressure, or discharge side, 60 into chamber 68 in back of bushing 65.

This construction is conventional, but to it I propose to show that the addition of my new and novel pressure equalizer system, described in connection with Figures 1 to 8, inclusive, is also applicable here. Accordingly, I have, in Figures 9 and 10, shown pressure equalizer slots 69 formed in bushings 64 and 65 on the low pressure side with bores 70 leading therefrom to the discharge, or high pressure, side 60.

In Figures 11 and 12, I have eliminated the pressure equalizer slots in the bushings 64 and 65 and substituted for them, pressure equalizer slots 71 in the housing on the low pressure side to communicate through bores 71 with the high pressure, or discharge, side 60.

Thus, it will be seen that I have provided a simple and efficient means of sufficiently counteracting the tendency of the floating bearing bushings from being forced transversely, by excess pressure from the high pressure side, into binding relationship with the housing on the low pressure side.

I claim:

1. A gear type pump comprising a hollow housing having a fluid inlet and output, said housing having a gear chamber and an auxiliary chamber in said housing between said gear chamber and said outlet, a pair of meshing gear members mounted in said gear chamber, each of said gear members having journals extending from the opposite faces thereof, an elongated one-piece bushing having flat front and back end faces, said bushing having straight side walls connected by curved ends, said bushing being mounted to have its entire periphery longitudinally slidable in contact with the inner surface of said hollow housing, said bushing being arranged axially of the adjacent axial faces of both of said gear members, said bushing surrounding and supporting the adjacent parallel journals of both of said gears and having a front axial face cooperable with the adjacent axial face of its associated gear members to provide a seal between said bushing and said gear members and a piston slidably mounted in said auxiliary chamber in said hollow housing and in axial contact with the back face of said bushing and a fluid passage leading from the pump discharge outlet to said auxiliary chamber on the back face of said piston to provide a fluid pressure loading on the back of said bushing to urge said bushing against said gears, the fluid intake opening in said housing being arranged on one side of the meshing area of said gears to constitute the low pressure side of said pump and the fluid outlet opening in said housing being arranged on the opposite side of said gears to constitute the high pressure side of said pump, the bushing bearings and the adjacent inner

surface of said housing transverse of said bushing bearings being so formed as to provide fluid reservoirs therebetween on the low pressure side, said bushings having bores extending therethrough for supplying fluid to said reservoirs from the high pressure side to counteract the fluid pressure force from the high pressure side tending to force said bearing bushings transversely into binding relationship with said housing on the low pressure side.

2. A gear type pump comprising a hollow housing having a fluid inlet and outlet, said housing having a gear chamber and an auxiliary chamber in said housing between said gear chamber and said outlet, a pair of meshing gear members mounted in said gear chamber, each of said gear members having journals extending from the opposite faces thereof, an elongated one-piece bushing having flat front and back end faces, said bushing having straight side walls connected by curved ends, said bushing being mounted to have its entire periphery longitudinally slidable in contact with the inner surface of said hollow housing, said bushing being arranged axially of the adjacent axial faces of both of said gear members, said bushing surrounding and supporting the adjacent parallel journals of both of said gears and having a front axial face cooperable with the adjacent axial face of both of its associated adjacent gear members to provide a seal between said bushing and said gear members, a piston slidably mounted in said auxiliary chamber in said hollow housing, said auxiliary chamber being axially removed from said bushing, said piston being in axial contact with the back face of said bushing and a fluid passage leading from the pump discharge outlet to said auxiliary chamber on the back face of said piston to provide a fluid pressure loading on the back face of said bushing to urge said bushing against said gears, the fluid intake opening in said housing being arranged on one side of the meshing area of said gears to constitute the low pressure side of said pump and the fluid outlet opening in said housing being arranged on the opposite side of said gears to constitute the high pressure side of said pump, the faces of the bushing bearings adjacent the inner surface of said housing having pressure equalizing slots formed therein to provide fluid reservoirs between the bushings and the housing on the low pressure side, said bushings having bores extending therethrough for supplying fluid to said reservoirs from the high pressure side to counteract the fluid pressure force from the high pressure side tending to force said bearing bushings transversely into binding relationship with said housing on the low pressure side.

3. A gear type pump comprising a hollow housing having a fluid inlet and outlet, said housing having a gear chamber and an auxiliary chamber in said housing between said gear chamber and said outlet, a pair of meshing gear members mounted in said gear chamber, each of said gear members having journals extending from the opposite faces thereof, an elongated one-piece bushing having flat front and back end faces, said bushing having straight side walls connected by curved ends, said bushing being mounted to have its entire periphery longitudinally slidable in contact with the inner surface of said hollow housing, said bushing being arranged axially of the adjacent axial faces of both of said gear members, said bushing surrounding and supporting the adjacent parallel journals of both of said gears and having a front axial face cooperable with the adjacent axial face of its associated adjacent gear members to provide a seal between said bushing and said gear members, a piston slidably mounted in said auxiliary chamber in said hollow housing, said auxiliary chamber being axially removed from said bushing and of greater axial length than said piston, said piston being in contact with the back face of said bushing and a fluid passage leading from the pump discharge outlet to said auxiliary chamber on the back face of said piston to provide a fluid pressure loading on the back face of said bushing to urge said bushing against said gears, the fluid intake opening in said housing being

arranged on one side of the meshing area of said gears to constitute the low pressure side of said pump and a fluid discharge opening in said housing being arranged on the opposite side of said gears to constitute the high pressure side of said pump, the faces of the bushing bearings adjacent the inner surface of said housing having pressure equalizing slots formed therein to provide fluid reservoirs between the bushings and the housing on the low pressure side, said bushings having bores extending therethrough for supplying fluid to said reservoirs from the high pressure side to counteract the fluid pressure force from the high pressure side tending to force said bearing bushings transversely into binding relationship with said housing on the low pressure side.

4. A gear type pump comprising a hollow housing having a liquid inlet and outlet, said housing having a gear chamber and an auxiliary chamber in said housing between said gear chamber and said outlet, a pair of meshing gear members mounted in said gear chamber, each of said gear members having journals extending from the opposite faces thereof, an elongated one-piece bushing having flat front and back end faces, said bushing having straight side walls connected by curved ends, said bushing being mounted to have its entire periphery longitudinally slidable in contact with the inner surface of said hollow housing, said bushing being arranged axially of the adjacent axial faces of both of said gear members, said bushing surrounding and supporting the adjacent parallel journals of both of said gears and having a front axial face cooperable with the adjacent axial faces of both of said gear members to provide a seal between said bushing and said gear members, a piston slidably mounted in said auxiliary chamber in said hollow housing, said auxiliary chamber being axially removed from said bushing and of greater axial length than said piston, said piston being in contact with the back face of said bushing to urge said bushing against said gears, a liquid passage leading from the pump discharge outlet to said auxiliary chamber on the back face of said piston to provide a liquid pressure loading on the back face of said bushing and venting means for venting liquid from any space between said bushing and said gear journals and between said bushing and said housing to the low pressure inlet side of said pump, the fluid intake opening in said housing being arranged on one side of said gears to constitute the low pressure side of said pump and the fluid outlet opening in said housing being arranged on the opposite side of said gears to constitute the high pressure side of said pump, the inner surface of said housing adjacent said bushing bearings having pressure equalizing slots formed therein to provide fluid reservoirs between the bushings and the housing on the low pressure side, said bushings having bores extending therethrough for supplying fluid to said reservoirs from the high pressure side to counteract the fluid pressure force from the high pressure side tending to force said bearing bushings transversely into binding relationship with said housing on the low pressure side.

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