

March 7, 1967

T. M. KROPIWNICKI

3,307,480

AUTOMATICALLY REVERSIBLE GEAR PUMP

Filed Sept. 1, 1964

2 Sheets-Sheet 1

FIG. 1

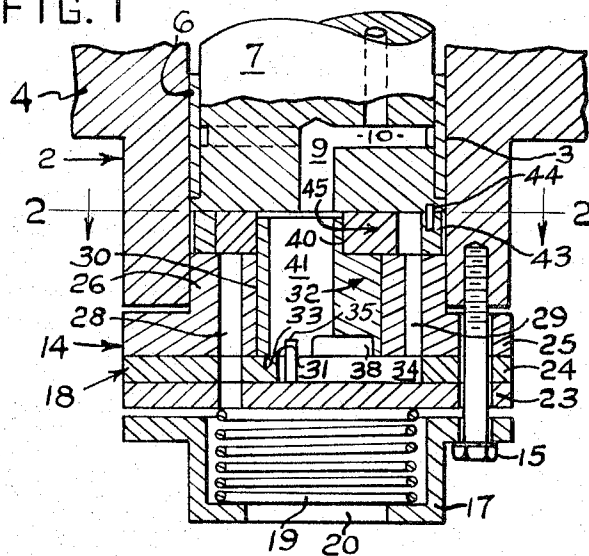


FIG. 2

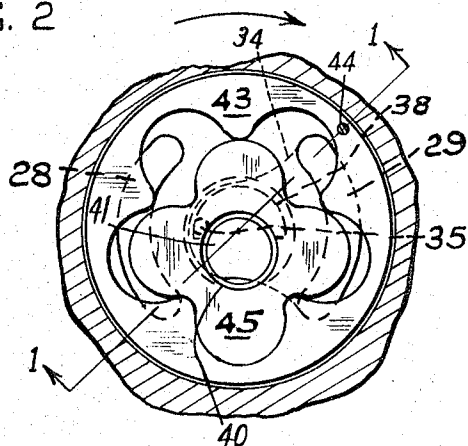
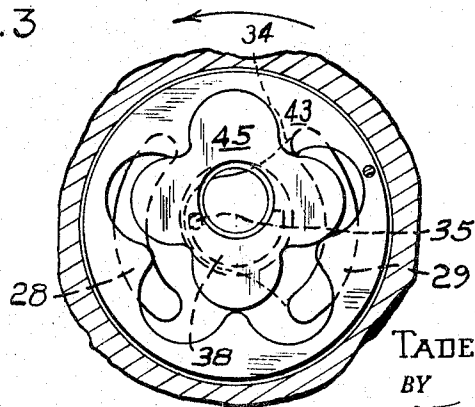


FIG. 3



INVENTOR.
TADEK M. KROPIWNICKI
BY
Frederick E. McMullen
ATTORNEY

T. M. KROPIWNICKI

AUTOMATICALLY REVERSIBLE GEAR PUMP

2 Sheets-Sheet 2

Fig. 5 is a cross-sectional view of a mechanical component, likely a valve or plug, showing internal features and a central cavity. The component is surrounded by a hatched area. Labels include 50, 58, 59, 70, 72, 74, 75, 76, 80, 82, and 90. Arrows indicate rotational movement.

INVENTOR.
TADEK M. KROPIWNICKI
BY
Frederick E. McWhorter
ATTORNEY

1

3,307,480

AUTOMATICALLY REVERSIBLE GEAR PUMP
Tadek M. Kropiwnicki, Syracuse, N.Y., assignor to Carrier Corporation, Syracuse, N.Y., a corporation of Delaware

Filed Sept. 1, 1964, Ser. No. 393,610
9 Claims. (Cl. 103—3)

This invention relates to pumps, and more particularly, to automatically reversible gear pumps.

Gear pumps find wide spread application as a means for circulating lubricant in machinery as, for example, compressors and internal combustion engines. In certain applications, however, it is essential that the gear pump be able to sustain unidirectional flow whether pump rotation be in a clockwise direction or a counterclockwise direction; that is, that the pump be reversible. Where for example, the gear pump is employed as a lubricant circulating means for a motor driven compressor, the manner by which the compressor motor is connected across the power terminals determines the direction of motor rotation, and hence the direction of pump rotation. Since the compressor lubrication system fed by the gear pump is designed for the circulation of lubricant in one direction only, the gear pump must be capable of feeding lubricant in that direction whatever the rotational direction of the pump might be as a result of compressor drive motor rotation if the compressor is to be lubricated.

It is a principal object of the present invention to provide a new and improved automatically reversible gear type pump.

It is an additional object of the present invention to provide a gear type pumping mechanism, which, on reversal in the direction of pump rotation, effects immediate and foolproof reversal of the pump components to maintain unidirectional flow of the fluid being pumped.

It is an object of the present invention to provide an economical gear pump having a minimum number of parts effective to accommodate reversals in the direction of rotation of the pumping mechanism to sustain continuous output of pressurized fluid.

It is an object of the present invention to provide a gear pump incorporating a simplified reversing mechanism.

It is a further object of the present invention to provide an improved automatically reversible gear type pumping mechanism having reduced internal friction.

This invention relates to an automatically reversible gear pump mechanism comprising a rotatable internally toothed first gear; movable support means including a gear carrier member rotatable within the periphery of the first gear about the axis of the first gear, the axis of the gear carrier member being parallel to and spaced from the axis of the first gear, means limiting rotation of the gear carrier member to a predetermined arc; an externally toothed second gear rotatably positioned on the gear carrier member in meshing engagement with the first gear, the first and second gears when rotated forming intake and exhaust spaces therebetween; means for rotating the first gear; suction port means in the support means opposite the intake space formed by the first and second gears; and discharge port means in the support means opposite the discharge space formed by the first and second gears.

Other objects will be apparent from the ensuing description and drawings in which:

FIGURE 1 is a sectional view of the pump assembly taken along lines 1—1 of FIGURE 2 illustrating one embodiment of the invention;

FIGURE 2 is a sectional view of the pump assembly along lines 2—2 of FIGURE 1 illustrating the position of the pump parts on rotation in a clockwise direction;

2

FIGURE 3 is a sectional view similar to that of FIGURE 2 illustrating the position of the pump parts on rotation in a counterclockwise direction;

FIGURE 4 is a sectional view of a pump assembly illustrating a second embodiment of the invention; and

FIGURE 5 is a sectional view of the pump mechanism along lines 5—5 of FIGURE 4 illustrating the position of the pump parts on rotation in a counterclockwise direction.

Referring to the drawings, there is shown an automatically reversible pump mechanism embodying the invention for use as an oil pump in a compressor. It will be obvious that applicant's pump mechanism may be used to pump other fluids and in different environments equally as well.

In the embodiment shown in FIGURES 1—3 of the drawings, applicant's improved gear type pump mechanism, designated generally by the numeral 2, is operatively positioned in cavity 3 of compressor bearing head 4. Bearing head 4 rotatably supports, as by bearings 6, compressor crankshaft 7. To direct oil discharged from pump 2 to the various relatively movable parts of the compressor, such as bearings 6, crankshaft 7 has a lubricant feed passage 9 in communication with the discharge side of pump mechanism 2. Lateral passage 10 in crankshaft 7 directs oil from feed passage 9 to bearings 6.

Cap assembly 14, secured to bearing head 4 opposite cavity 3 by suitable means, such as bolts 15, includes an outside cover 17 and floating support or porting member 18. Spring 19, disposed between support member 18 and outside cover 17, biases support member 18 in an axial direction. Opening 20 in outside cover 17 communicates with a source of fluid to be pumped, for example, the compressor oil sump.

Pump support member 18 is comprised of base plate 23, backup or stop plate 24, and guide or journal plate 25 suitably secured together to form a unitary structure. Guide plate 25 includes a reduced diameter part 26 adapted to slidably fit within the bearing head cavity 3. The outside dimension of part 26 is slightly less than the dimension of cavity 3.

Support member 18 includes a generally arcuate suction port 28 therethrough. Generally arcuate discharge port 29 in guide plate 25 is opposite suction port 28.

Idle gear carrier 32 is rotatably positioned in opening 30 in guide plate 25. Opening 30 is coaxial with reduced diameter part 26 of guide plate 25. Opening 34 in backup plate 24 communicates opening 30 with discharge port 29 in guide plate 25. The radius of that portion of opening 34 coaxial with opening 30 in guide plate 25 is slightly less than the radius of opening 30 to form a generally arcuate stop surface 31. Stop surface 31 cooperates with base 33 of carrier 32 to limit inward movement of the gear carrier relative to support member 18.

Base 33 of gear carrier 32 is recessed at 38. Stop pin 35, fixed to base 23 of support member 18, cooperates with the opposite sides of recess 38 to limit rotational movement of gear carrier 32 to approximately 180°.

Gear carrier 32 has a generally cylindrical journal part 40 protruding therefrom. The axis of journal part 40 is parallel to and spaced from the axis of carrier 32. Discharge passageway 41 in carrier 32 communicates lateral opening 34 in backup plate 24 with the crankshaft feed passage 9.

Internally toothed gear 43 is rotatably disposed within bearing head cavity 3 adjacent crankshaft 7. The outer dimension of gear 43 is less than the dimension of cavity 3. Gear 43 is drivingly secured to crankshaft 7 by suitable means, such as drive pin 44. Externally toothed idler gear 45, having one less gear tooth than outer gear 43, is mounted for free rotation on journal part 40. The eccentric relationship established by the parallel but non-

3

concentric axes of rotation of gears 43, 45 is such that full tooth engagement between gears 43, 45 occurs at a single point only.

Referring particularly to FIGURE 2 of the drawings, rotation of crankshaft 7 in a clockwise direction as shown by the arrow, drives meshing outer and inner pump gears 43, 45, respectively, in a clockwise direction. Tooth pressure between gears 43, 45 tends to move gear carrier 32 in a clockwise direction against pin 35. The engagement of stop pin 35 with one side of recess 38 holds gear carrier 32 against clockwise movement. Lubricant drawn between the teeth of rotating gears 43, 45 opposite suction port 23 discharges through port 29, the discharged fluid passing through connecting passages 34, 41 into crankshaft lubricant feed passage 9.

On a reversal in the direction of rotation of crankshaft 7 and correspondingly meshing pump gears 43, 45 from a clockwise direction shown in FIGURE 2 to a counterclockwise direction shown by the arrow of FIGURE 3, tooth pressure between the meshing outer and inner gears 43, 45, respectively, moves gear carrier 32 in a counterclockwise direction through an arc of approximately 180° to bring the opposite side of recess 38 into engagement with stop pin 35. Operation of the pump mechanism 2 is unaffected by the reversal in the direction of crankshaft rotation, lubricant from suction port 28 drawn between the teeth of gears 43, 45 being discharged therefrom into discharge port 29 and the compressor lubrication system.

In the embodiment shown in FIGURES 4 and 5 of the drawings, there is provided an automatically reversible pump mechanism having laterally disposed suction and discharge passageways 50, 51, respectively, in communication with cylindrical cavity 52 in bearing head 53. It is understood that suction passageway 50 operatively communicates with a source of fluid to be pumped such as the lubricant sump of a compressor and that discharge passageway 51 operatively communicates with suitable passages for distributing fluid pumped such as compressor lubricant feed passages.

Compressor crankshaft 55 is rotatably disposed in cavity 52 in bearing head 53. Internally toothed outer pump gear 57 is rotatably disposed in cavity 52 adjacent crankshaft 55. The outer dimension of gear 57 is less than the dimension of cavity 52. Externally toothed inner pump gear 58 having one less tooth than outer pump gear 57 is positioned for rotation about an axis offset from the axis of outer pump gear 57. Gears 57, 58 have full tooth engagement at one point only. Outer pump gear 57 is drivingly connected to crankshaft 55 by suitable means such as drive pin 59.

Cap assembly 60 includes cover 64 secured to bearing head 53 opposite cavity 52 by suitable means and floating support or porting member 65 disposed within cavity 52. Suitable sealing means 61 are provided between cover 64 and bearing head 53. Support member 65, having an outer dimension slightly less than the dimension of cavity 52, is held against rotational movement by suitable means such as pin 66. Spring 67 disposed in chamber 69 between cover 64 and pump support member 65 biases support member 65 in an axial direction.

Support member 65 is recessed at 70, 72 opposite bearing head suction and discharge passageways 50, 51, respectively. Generally arcuate suction and discharge ports 74, 75, respectively, in support member 65 operatively communicate recesses 70, 72, respectively, with meshing pump gears 57, 58.

Generally cylindrical idler gear carrier 76 is rotatably positioned in opening 78 of support member 65. A suitable abutment, for example snap ring 79, on support member 65 limits axial movement of gear carrier 76 relative to support member 65. Stop pin 80 on support member 65 cooperates with semicircular recess 82 in gear carrier 76 to limit rotational movement of carrier 76 to approximately 180°.

4

Idler gear carrier 76 includes a generally cylindrical journal part 84 having an axis parallel to and spaced from the axis of carrier 76. Journal part 84 of carrier 76 rotatably supports gear 58 in engagement with outer pump gear 57. The eccentric relation established by the parallel but nonconcentric axes of rotating gears 57, 58, that of pump gear 57 being the axis of carrier 76, while that of pump gear 58 is the axis of bearing part 84, is such that full tooth engagement is obtained between pump gears 57, 58 at one point only.

Passage 77 in support member 65 communicates discharge recess 72 with chamber 69. By means of passage 77, relatively high pressure fluid discharged from the pump is introduced into chamber 69 to counteract the thrust of pump head pressure on the floating support member 65 and maintain, in cooperation with spring 67, support member 65, and pump gear 58 journaled thereon, in operative position.

Rotation of crankshaft 55 in a counterclockwise direction as shown by the solid line arrow of FIGURE 5 of the drawings, rotates meshing pump gears 57, 58 in a counterclockwise direction. Tooth pressure between gears 57, 58 forces gear carrier 76 counterclockwise against stop pin 80, pin 80 preventing further counterclockwise movement of the gear carrier. Lubricant from suction port 74 drawn between the rotating pump gears 57, 58 is discharged through discharge port 75 into discharge passageway 51.

Rotation of crankshaft 55 and accordingly pump gears 57, 58 in an opposite or clockwise direction, as shown by the dotted line arrow of FIGURE 5, moves carrier 76 in a clockwise direction through an arc of approximately 180° against stop pin 80. The axis of inner pump gear 58 similarly moves through an arc of approximately 180° to establish the point of full tooth engagement between pump gears 57, 58 at a point substantially diametrically opposite the point of full tooth engagement shown in FIGURE 5 of the drawings. The rotation of gears 57, 58 in a clockwise direction draws lubricant from suction port 74 between the gear teeth for discharge through discharge port 75 into discharge passageway 51.

By the present invention, applicant has provided a gear pump which provides certain reversal of the pump on a reversal in the direction of rotation of the pump driving means; an improved gear pump having a simplified construction rendering the pump suitable for varied application.

While I have described a preferred embodiment of my invention, it will be understood that my invention is not limited thereto since it may be otherwise embodied within the scope of the following claims.

I claim:

1. In an automatically reversible gear pump mechanism, the combination of a rotatable internally toothed first gear; axially movable supporting means; a gear carrier having an axis parallel to and spaced from the axis of said first gear supported on said supporting means; an externally toothed second gear rotatably positioned on said gear carrier in meshing engagement with said first gear, said first and second gears when rotated forming intake and exhaust spaces therebetween; means for rotating said first gear; suction port means in said supporting means opposite the intake space formed by said first and second gears; discharge port means in said supporting means opposite the discharge space formed by said first and second gears; said gear carrier being rotatable relative to said supporting means so that, upon rotation of said first gear rotating means in a reverse direction, tooth pressures developed between said first and second gears rotate said gear carrier in said reverse direction; and stop means on said supporting means engageable with said gear carrier to limit rotation of said gear carrier relative to said supporting means in said reverse direction to a predetermined arc whereby the intake and exhaust spaces formed between

5

said first and second gears remain substantially opposite said suction and discharge port means.

2. A pump mechanism according to claim 1 including means urging said supporting means toward said first gear.

3. A pump mechanism according to claim 2 in which said means urging said supporting means toward said first gear includes means for applying pump discharge pressure to said supporting means.

4. A pump mechanism according to claim 3 including a recess in said gear carrier defining opposed stop surfaces, said stop means comprising a pin secured to said supporting means having a portion disposed within said recess and cooperable with said recess stop surfaces to limit rotation of said carrier.

5. A pump mechanism according to claim 1 in which said discharge port means includes a passage in said gear carrier.

6. Fluid porting means for use with an automatically reversible pump of the type having meshing inner and outer gears, the inner gear being rotatably supported by a carrier having a fluid discharge passage therethrough for rotation about an axis offset from the axis of the outer gear, comprising in combination a journal member having suction and discharge ports therethrough and an opening therein, said opening being dimensioned to rotatably receive said carrier, a stop member having a suction port and a discharge opening therethrough engaging said journal member so that said journal member suction port cooperates with said stop member suction port to form an uninterrupted suction passage and said journal member discharge port communicates with said stop member discharge opening, a part of said stop member overlapping said journal member opening to limit axial movement of said carrier in said journal member, and a base member having a suction port therethrough engaging said stop member so that said base member suction port cooperates with said journal member suction port and said base member suction port to form an uninterrupted suction passage, said stop member discharge opening being sized to overlap a part of said journal member opening to communicate said carrier fluid discharge passage with said journal member discharge port.

7. Fluid porting means for use with an automatically reversible pump of the type having meshing inner and outer gears, the inner gear being supported by a carrier for rotation about an axis offset from the axis of the outer gear, comprising in combination a generally cylindrical piston-like member having an opening therein coaxial therewith for rotatably receiving said carrier, the inner gear

6

supporting portion of said carrier being adapted to protrude without one end of said member, the outer periphery of said member having first and second circumferentially spaced recesses therein between opposite ends thereof, said member first recess being adapted to communicate with a source of fluid to be pumped, said member second recess being adapted to receive fluid discharged by said pump, said member having suction and discharge ports therein between said one end thereof and said first and second recesses, respectively, stop means for limiting insertion of said carrier within said member opening.

8. A pump mechanism according to claim 5 in which said supporting means includes a first part having an opening therethrough dimensioned to rotatably receive said gear carrier and a second part engageable with said first part and overlaying a portion of one end of said first part opening to limit insertion of said gear carrier within said first part opening, said discharge port means including interconnecting passages in said first and second parts, said second part passage communicating with said discharge passage in said gear carrier.

9. A pump mechanism according to claim 8 in which the end of said gear carrier engageable with said second part includes a recessed portion defining a pair of opposed stop surfaces, said support means including a third part engageable with said second part, said stop means comprising an abutment on said third part projecting through said second part discharge passage and terminating within said gear carrier recess, said abutment cooperating with said gear carrier stop surfaces to limit rotation of said gear carrier to said predetermined arc.

References Cited by the Examiner

UNITED STATES PATENTS

1,486,836	3/1924	Hill	230—138
2,151,482	3/1939	Neeson	103—126
2,225,228	12/1940	Neeson.	
2,380,783	8/1945	Painter	103—126
2,525,619	10/1950	Roth et al.	
3,027,846	4/1962	Schindler	103—126
3,165,066	1/1965	Phelps et al.	103—126

FOREIGN PATENTS

476,515	12/1937	Great Britain.
---------	---------	----------------

DONLEY J. STOCKING, *Primary Examiner.*

SAMUEL LEVINE, MARK NEWMAN, *Examiners.*

W. L. FREEH, *Assistant Examiner.*