United States Patent

Kitchen

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[54] AXIAL PLUNGER PUMP

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[73] Assignee: **McNeil Corporation**, Akron, Ohio

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[52] **U.S. Cl.**.....**417/269,** 91/499, 91/472

[51] **Int. Cl.**.....**F04b 1/14,** F04b 1/02

[58] **Field of Search**.....417/269; 91/472, 499

[56] **References Cited**

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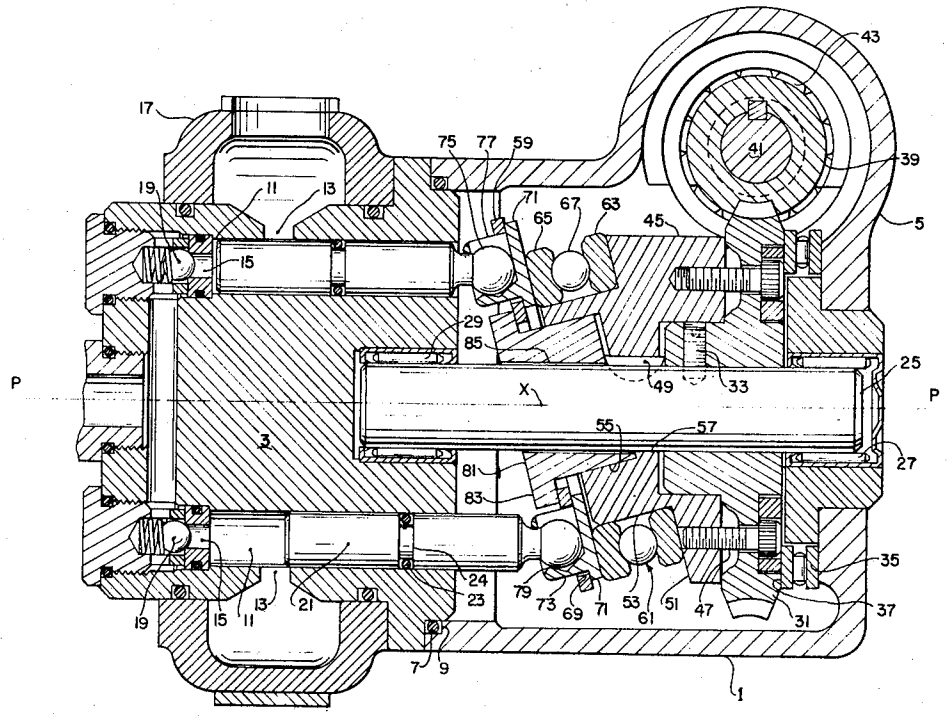
[57] **ABSTRACT**

An axial plunger pump of the class having a plurality of axial plungers reciprocated by a rotating wobble cam acting through a non-rotary cam follower means, and having an improved and simplified mode of assembly of the cam follower with respect to the wobble cam.

6 Claims, 2 Drawing Figures



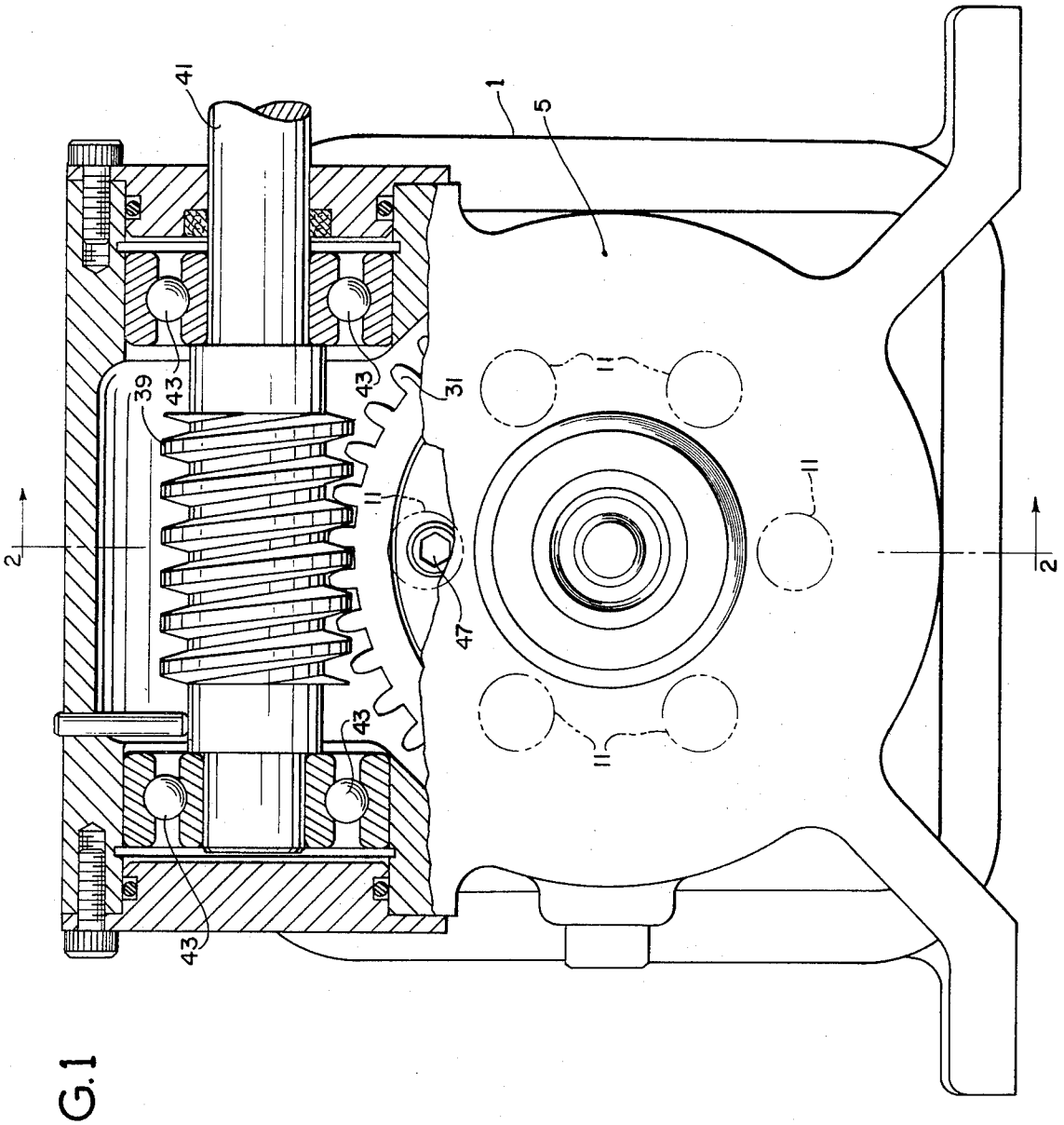


FIG.1

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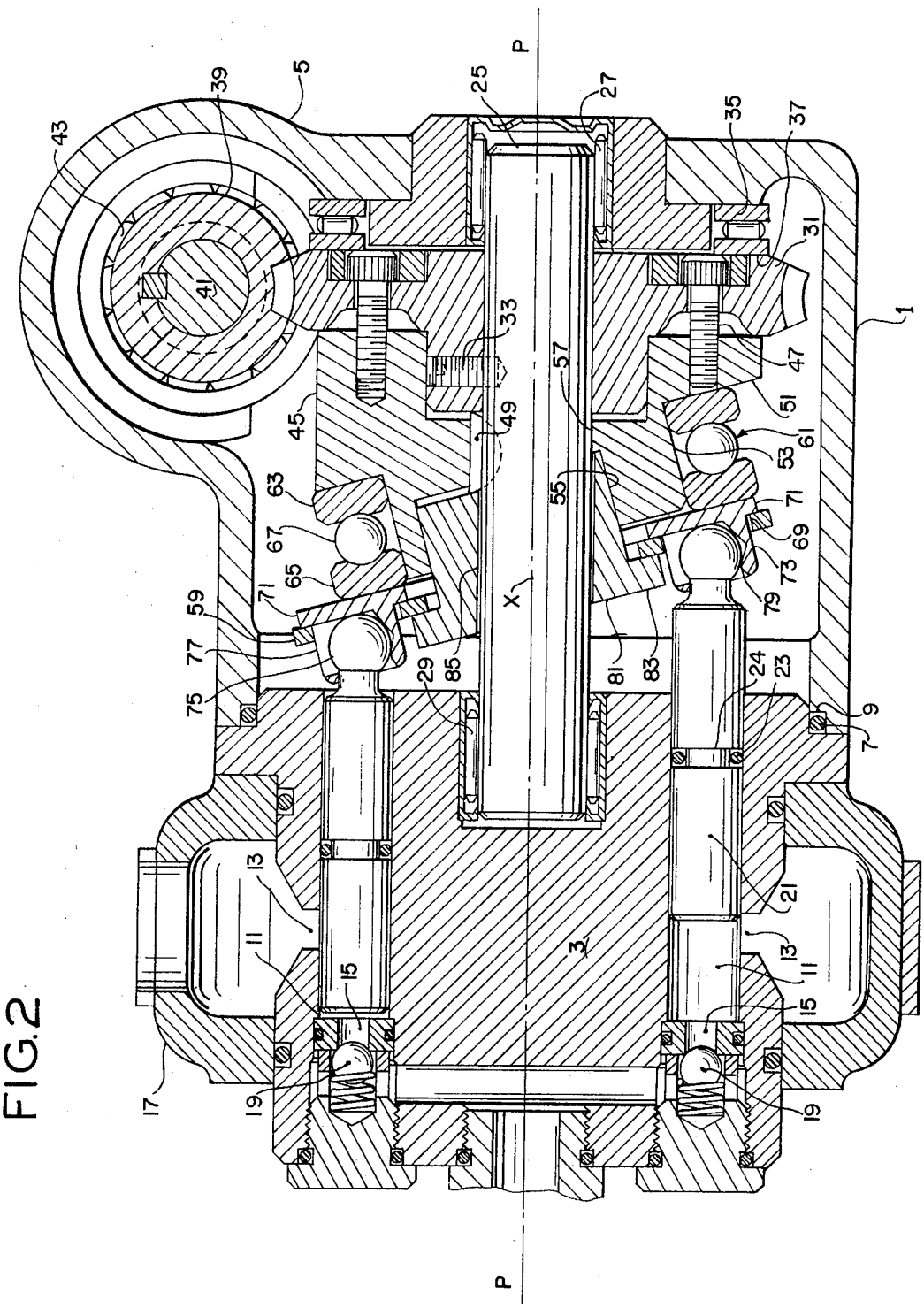
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FIG.2

AXIAL PLUNGER PUMP

BACKGROUND OF THE INVENTION

This invention relates to axial plunger pumps, i.e., pumps in which a plurality of plungers are axially reciprocated to pump a fluid, and more particularly to a wobble pump of this class.

In an axial plunger wobble pump, the plungers are reciprocated by means of a so-called wobble cam, that is, a cam rotating about the pump axis having an annular cam surface inclined with respect to the pump axis for axially reciprocating the plungers via a non-rotary wobble plate constituting a cam follower for actuating the plungers. Pumps of this class have presented problems in regard to simplifying the assembly of the non-rotary wobble plate with respect to the rotary wobble cam, and especially in regard to a wobble pump with positive plunger return motion (as distinguished from spring-biased plunger return).

SUMMARY OF THE INVENTION

Among the objects of this invention may be noted the provision of a wobble pump with an improved and simplified mode of assembly of the cam follower and the wobble cam of the pump; and the provision of a wobble pump with such an assembly wherein the plungers are positively returned (rather than spring-returned).

In general, a wobble pump of this invention comprises a block having a plurality of cylinders therein extending parallel to and spaced at intervals around a pump axis, with a plurality of slidable plungers, one in each cylinder. Means is provided for reciprocating the plungers comprising a drive shaft on said axis and a wobble cam fixed on said drive shaft for rotation therewith. The cam has an annular cam face on a plane inclined with respect to said axis and facing toward said block, and a cylindrical recess extending inwardly on an axis perpendicular to said cam face. The shaft extends obliquely through said recess. Cam follower means is provided operable by said wobble cam including an annular wobble plate surrounding said shaft. The plungers have end portions extending out of said block positively interconnected with said wobble plate for reciprocation of the plungers on wobbling of the wobble plate by the wobble cam. Means is provided for retaining the annular wobble plate in position on the drive shaft for wobbling by the wobble cam comprising a cylindric retaining member having a bore inclined with respect to its cylindric axis for receiving the drive shaft and slidably fitted in said recess, with means at the end of said retaining member opposite from the face of the wobble cam for holding the wobble plate in place. Other objects and features will be in part apparent and in part pointed out hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an end view of a pump of this invention with parts broken away; and

FIG. 2 is a section on line 2—2 of FIG. 1.

Corresponding reference characters indicate corresponding parts throughout the views of the drawings.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 2, a pump made in accordance with this invention is shown to comprise a housing 1 with a cylinder block 3 located at one end of the housing (its left end as shown in FIG. 2). The opposite end of the housing (its right end as viewed in FIG. 2) is closed as indicated at 5. The housing and cylinder block are secured together by bolts (not shown) and an O-ring 7 is provided in a groove 9 at the end of the housing to seal the interface between housing 1 and cylinder block 3 to prevent the leakage of lubricating oil contained within the housing. The axis of the cylindrical block 3 (and of the pump) is indicated at P—P. A plurality of axial cylinders 11 are provided in cylinder block 3 equally spaced about axis P—P on a common circle. As indicated in FIG. 1, there are six such axial cylinders, but it will be understood that any number of such

cylinders could be provided. Each axial cylinder 11 has an inlet 13 and an outlet 15. An annular manifold 17 surrounds cylinder block 3 and provides for delivery of fluid to be pumped from a source to the inlets 13. A spring-biased ball check valve 19 is provided in each outlet 15 to prevent backflow of fluid into said cylinders from said outlet. A pump plunger 21 is slidable in each axial cylinder 11, an O-ring 23 being provided in annular grooves 24 in each plunger for plunger sealing purposes.

A drive shaft 25, having one end journalled in end wall 5 of the housing by bearing 27, extends through said housing along axis P—P to cylinder block 3 where the other end of said drive shaft is journalled in bearing 29. A worm gear 31 is secured on shaft 25 adjacent end wall 5 by means of a set screw 33. An annular thrust bearing 35 surrounds shaft 25 between a face 37 of worm gear 31 and end wall 5 reacting against the axial thrust loads generated in driving the reciprocating plungers as will be hereinafter explained. As shown in FIG. 1, worm gear 31 meshes with a worm 39 fixed on a transverse shaft 41 journalled in housing 1 by bearings 43. Shaft 41 extends out of housing 1 at one end so that it may be driven by conventional driving means (not shown).

Means is provided for reciprocating plungers 21 comprising a wobble cam 45 attached to worm gear 31 by a plurality of cap screws 47. This wobble cam is secured for rotation with drive shaft 25 by a key 49. The wobble cam has an annular cam face 51 facing cylinder block 3 with said cam face being inclined with respect to and surrounding drive shaft 25. It has a cylindric hub 53 projecting perpendicularly outwardly from inclined cam face 51. Hub 53 has a cylindrical recess 55 on an axis perpendicular to cam face 51. Cam 45 has an axial bore 57 on axis P—P receiving shaft 25 such that the shaft passes through recess 55. The axis of the hub 53 is offset from the axis of the cam face 51, and the axis of the recess 55 is farther offset from the axis of the cam face.

At 59 is indicated a non-rotary wobble plate in the form of a flat ring adapted to be wobbled about a horizontal axis transverse to axis P—P (as indicated at point X in FIG. 2) by wobble cam 45. Interposed between this wobble plate and cam face 51 of the wobble cam is an antifriction rolling bearing assembly 61 comprising a ring 63 engaging the cam face 51 and a ring 65 adjacent the wobble plate with balls 67 between the rings. The bearing rings 63 and 65 are received on the cylindric hub 57 of the wobble cam, with ring 65 being at the outer (left) end of the hub. The wobble plate 59 has an annular series of circular holes 69 therein spaced at intervals corresponding to the spacing of the cylinders 11 and in line therewith. Extending forward (toward the cylinder block 3) through each hole 69 in wobble plate 59 from a head 71 at the back face of the wobble plate (its face toward the cam face 51) is a ball socket member 73 of smaller cross sectional area than hole 69. Each plunger 21 has a ball end 75 at its outer end (its right end as viewed in FIG. 2) socketed in the respective socket member 73, the latter being slotted as indicated at 77 for assembly of the plunger ball end therewith, and having a retainer flange 79 at the left end (as shown in FIG. 2) of the socket member to prevent the plunger ball end from becoming disengaged during reciprocation of the plungers. It should be noted that a portion of wobble plate 59 covers a portion of slot 77 in the socket member 73 to prevent the plunger ball end 75 from becoming disengaged from the socket member.

The bearing assembly 61 and wobble plate 59 are held in position relative to the wobble cam 45 with the back face of heads 71 engaging the outer ring 65 of the bearing by means of a cylindric retaining member 81. The latter has a flange 83 (at its left end as viewed in FIG. 2), and a bore 85 generally extending through the length of the retainer member inclined with respect to its cylindric axis. The retainer is inserted through the center of wobble plate 59 so that flange 83 slidably engages the inner margin of the wobble plate around its central opening. The retainer is slidably received within recess 55 of wobble cam 45. The axial relation between the retainer 81 and wobble cam 45 is fixed by inserting drive shaft

25 through bore 57 in wobble cam 45 and through bore 85 in the retainer, and the retainer is constrained to rotate with the wobble cam.

On rotation of the wobble cam 45 with the shaft 25 in the operation of the pump, the wobble plate 59 carrying the ball socket members 73 is wobbled about a transverse axis indicated at X, and functions to reciprocate the pump plungers 21 for pumping fluid through the cylinder outlets 15. The retainer 81 holds the wobble plate 59 in its proper position relative to the wobble cam 45, and is itself held in position (without any other fastening means) simply by the shaft 25 in conjunction with the fit of the retainer in recess 55.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A wobble pump comprising a block having a plurality of cylinders therein extending parallel to and spaced at intervals around a pump axis, a plurality of slidable plungers, one in each cylinder, and means for reciprocating the plungers comprising a drive shaft on said axis, a wobble cam mounted on said drive shaft for rotation therewith, said cam having an annular cam face on a plane inclined with respect to said axis and facing toward said block, said cam having a cylindrical recess extending inwardly on an axis perpendicular to said cam face, said shaft extending obliquely through said recess, cam follower means operable by said wobble cam including a non-rotary annular wobble plate surrounding said shaft, said plungers having end portions extending out of said block interconnected with said wobble plate for reciprocation of the plungers on wobbling of said wobble plate by said wobble cam, and means for retaining said wobble plate in position for actuation by the wobble cam comprising a cylindric retaining member having a bore inclined with respect to its cylindric axis receiving the drive shaft and slidably fitted in said recess with means at the end of said cylindric retaining member opposite from said cam face of said wobble cam for holding the wobble plate in place.

2. A wobble pump as set forth in claim 1 wherein the wobble cam has a hub projecting from its inclined cam face perpendicularly thereto with said cylindrical recess extending inwardly on an axis perpendicular to said cam face, and said drive shaft extends obliquely through said recess and hub.

3. A wobble pump as set forth in claim 2 wherein said retaining member is axially fixed on the drive shaft and rotates with the wobble cam and drive shaft when said retaining member is slidably fitted within said cylindrical recess in said wobble cam and said drive shaft is inserted through the wobble cam and cylindrical recess, said means on the retaining member comprising a flange in rotary engagement with the inner margin of the non-rotary annular wobble plate.

4. A wobble pump as set forth in claim 3 wherein said annular wobble plate has a plurality of holes, one for each said plunger, and wherein members are provided in said holes positively interconnected with said plunger end portions, each of said members having a head bearing against said wobble plate.

5. A wobble pump as set forth in claim 4 having bearing means for transmitting the reciprocating motion of the rotating wobble cam to the wobble plate between said cam face on said wobble cam and the wobble plate, said bearing means surrounding said hub.

6. A wobble pump as set forth in claim 5 wherein said bearing means comprises an antifriction rolling bearing having a first ring in contact with said cam face, a second ring in contact with said heads, and rolling means located between said rings, said rings being received on said hub.

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