Aug. 21, 1945. J. F. HOFFER 2,383,060

FLUID PUMP

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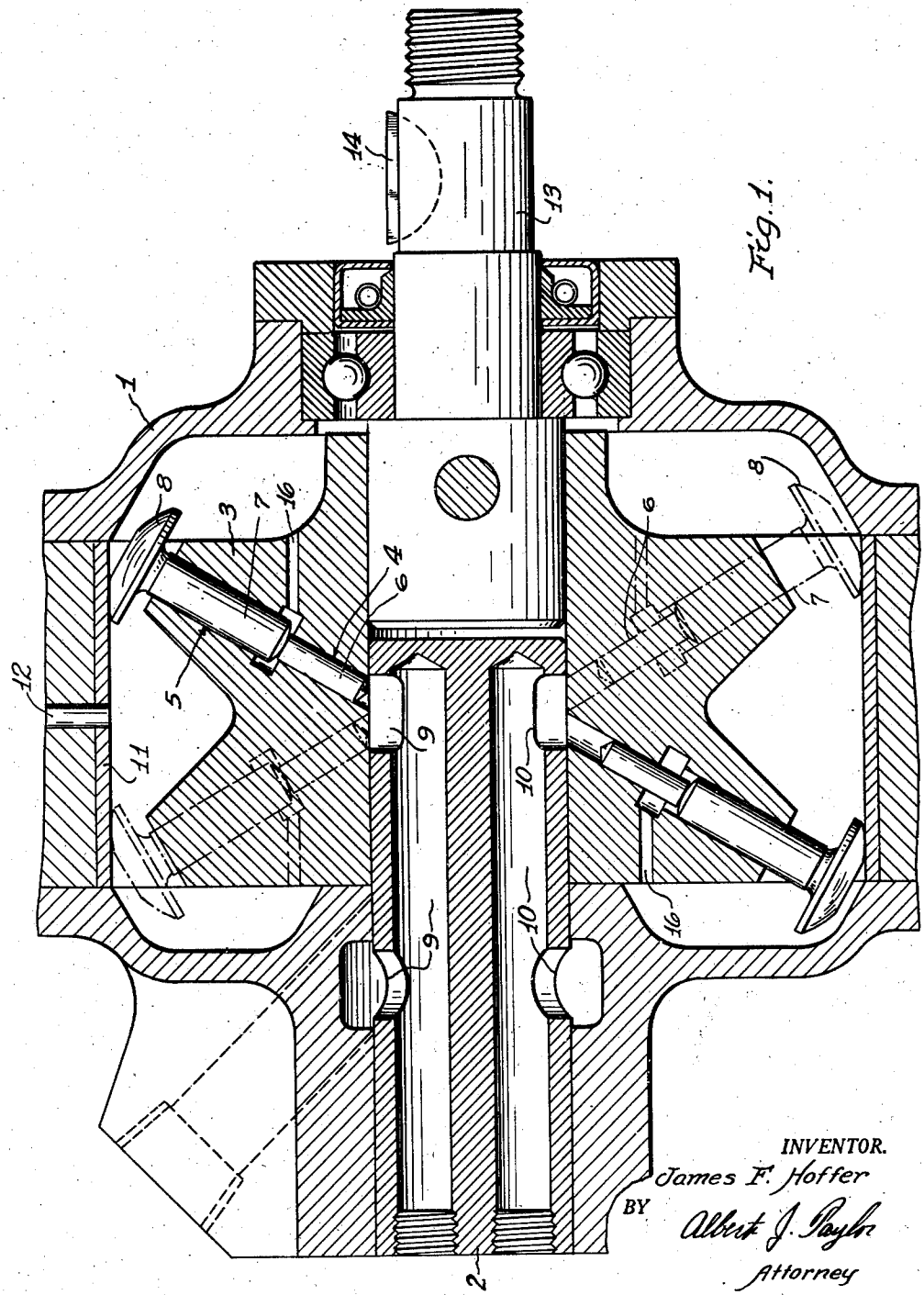


Fig. 1.

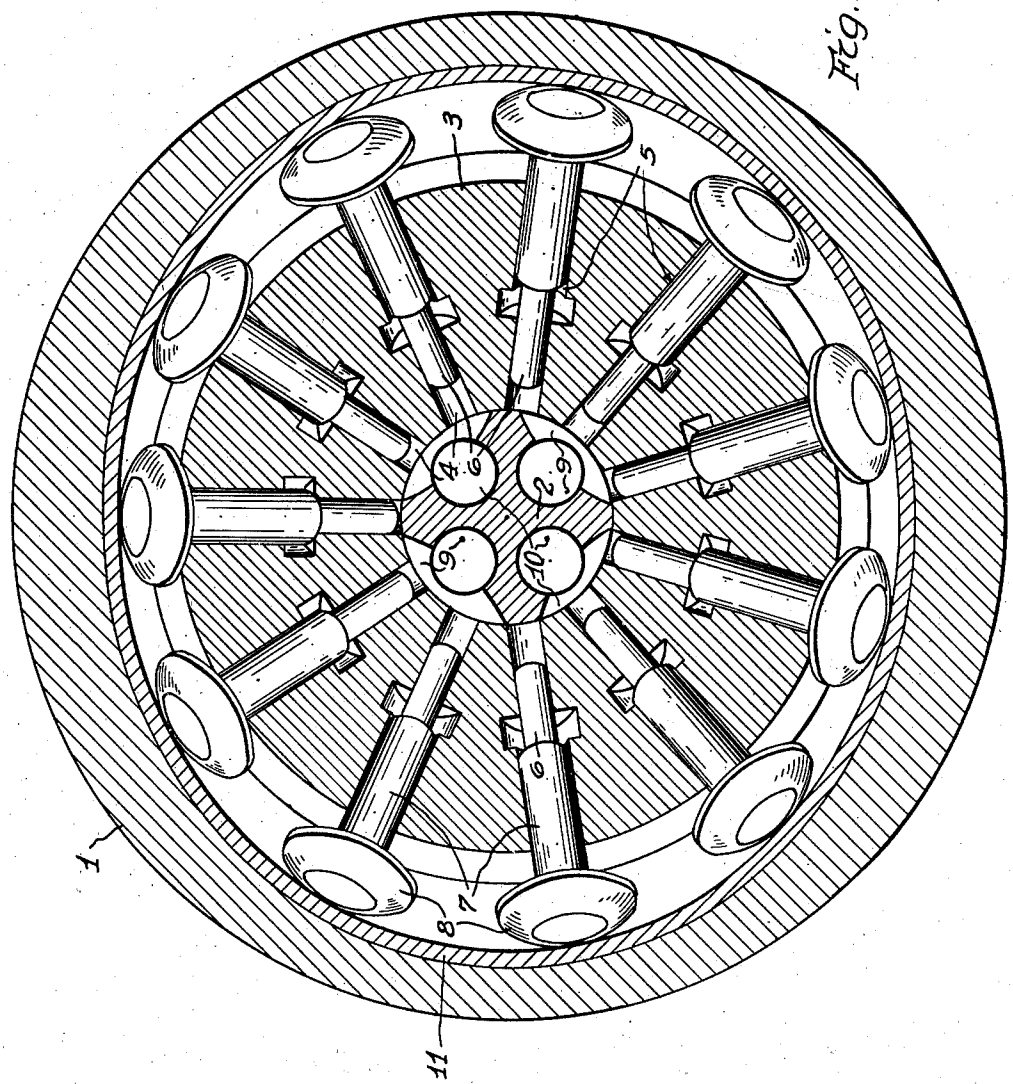
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Fig. 2.



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FLUID PUMP

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Application August 26, 1942, Serial No. 456,222

2 Claims. (Cl. 103—161)

This invention relates to fluid pumps and has for its primary object to provide a pump which is capable of operating at extremely high speeds and for developing extremely high pressures. In some respects the invention constitutes an improvement over the pump mechanism shown in my co-pending application Serial No. 425,090, filed December 31, 1941. The invention referred to in the co-pending application discloses and claims a novel reaction ring whereas this invention has to do more particularly with a piston and tappet arrangement designed particularly for operation at high speeds, to develop extremely high pressures.

The means herein disclosed may be considered as being either a pump or a motor for the reason that it may be operated by power from an external source to pump fluids, or it may be operated by fluid under pressure to impart rotation to a member to be driven. For convenience in describing the invention, and in order to avoid confusion which might result from continued reference to both a pump and a motor, the invention is consistently referred to throughout the specification and claims as a pump. It will be understood, however, that reference to a pump is merely for descriptive purposes and that it is not intended by way of limitation.

Generally described, the pump herein disclosed comprises a rotor having a multiplicity of radially movable pistons and tappet members associated therewith and adapted to move outwardly under centrifugal force to provide an intake stroke, and adapted to be forced inwardly by a reaction member which surrounds the rotor to force the pistons inwardly and thereby provide the delivery stroke. The pistons and their associated tappets are arranged in multiple banks with the banks inclined with respect to each other at angles which are equal and opposite. This angularity of the pistons and the tappets causes the tappets to engage the reaction member at points offset from their axes so that the frictional contact of the tappets with the reaction member causes the tappets to rotate and roll, rather than slide, over the surface of the reaction member.

The angularity of the pistons and tappets is such that the force exerted inwardly thereon by the reaction ring is divided into two components, one of which is directed axially of the pistons and tappets, and the other of which is directed radially of the pistons and tappets and therefore substantially lengthwise of the rotor. Because the pistons and tappets are disposed at angles which are equal and opposite the endwise components are balanced within the rotor but nevertheless they tend to produce wear by pressing the tappets toward one side of the tappet-guide bores. The wear conditions obviously become more pronounced as the speed and the pressure increases.

In accomplishing the object first stated the invention provides comparatively small diameter pistons with relatively large diameter tappets. The smallness of the diameter of the pistons permits a more favorable length to diameter ratio while the largeness of the diameter of the tappets provides a large bearing surface and therefore tends to lessen wear in the presence of the above mentioned lengthwise pressure component.

Another advantage of the particular piston and tappet arrangement is that the cylinder bores which receive the pistons need not be accurately aligned with the tappet-guide bores which receive the tappets. Furthermore, as compared with a single piston, where the piston and tappet might be combined in one piece and therefore connected together, or where the piston itself acts as the tappet as in my co-pending application above referred to, a distinct advantage exists in the respect that each piston may be formed with a good hydraulic fit in the cylinder bore while each tappet has a good free-running mechanical fit in its tappet-guide bore. A piston, in order to provide a good hydraulic seal for extremely high pressures must fit the cylinder bore within a few ten-thousandths of an inch. Under such conditions the hydraulic drag becomes extremely high so that if the piston and tappet were of one piece or connected together this hydraulic drag would tend to oppose rotation of the tappet and therefore would produce friction between the tappet and the reaction member. With a tappet such as here contemplated, wherein the point of contact of the head with the reaction member is offset a sufficient distance from the axis to cause the tappet to rotate at high speeds and pressures without excessive friction, the tappet is subject to severe stresses at the juncture of the shank portion with the head portion. By using a small diameter piston with a relatively larger diameter tappet the tappets become large enough and strong enough to provide long useful life.

With the above and other ends in view the invention is more fully disclosed with reference to the accompanying drawings in which

Fig. 1 is a fragmental longitudinal cross section, and

Fig. 2 is a fragmental transverse cross section.

More specifically, 1 designates a pump housing

in which a stationary pintle 2 is mounted. Rotatably supported by the pintle 2 is a rotor 3 which is connected to a drive shaft 13, journalled in the housing 1, and having means 14 for connection to a motor drive. The rotor 3 is formed with two banks of cylinder bores 4 each having an axially aligned tappet-guide bore 5. The tappet-guide bores are of larger diameter than their respective cylinder bores and are separated therefrom by an enlarged run-out or undercut 15. Each run-out 15 has a vent port 16 opening through the side of the rotor to prevent a dashpot action by the tappets (hereinafter described) which reciprocate in the tappet-guide bores. The two banks of cylinder and tappet-guide bores are arranged at equal and opposite angles, as viewed in longitudinal cross section, in what might loosely be termed a V relationship.

Slidably disposed in each cylinder bore 4 is a piston 6, the outer end of which extends into the associated tappet-guide bore 5. Each piston has a close hydraulic fit with its respective cylinder bore. In each tappet-guide bore 5 is a tappet 7 the shank portion of which is larger than the piston and which has an enlarged head 8 disposed exteriorly of the rotor. Each tappet head has the shape of a zone of a sphere, and the inner end of each tappet is crowned and contacts the outer end of the adjacent piston. The crowned end acts as anti-friction means which enables each tappet to rotate freely with respect to the piston it actuates. The center of the spherical zone falls on the axis of the tappet at a point within the tappet-guide bore.

The pintle 2 is formed with fluid intake ports 9 and with fluid outlet ports 10 with which the inner ends of the cylinder bores 4 successively communicate as the rotor 3 revolves about the pintle. An elliptical reaction ring 11, supported by the housing 1, surrounds the rotor 3, and is so disposed that it permits the pistons and tappets to move outwardly under the influence of centrifugal force while the cylinder bores 4 are in communication with the fluid inlet ports 9, and so that it forces the tappets and consequently the pistons inwardly when the cylinder bores are in communication with the fluid outlet ports 10.

It will be noticed, upon reference to Fig. 1, that the angularity of the tappet-guide bores is such that the point of contact between each tappet and the reaction ring is offset from the axis of the tappet, so that the tappets rotate and roll freely, rather than slide over the surface of the reaction ring. This combined rotary and reciprocatory movement, along with the comparatively large bearing surface which each tappet has in its tappet-guide bore, contributes to long useful life in the presence of extremely high pressures.

The reaction ring 11 is retained against rotary movement by a pin 12, pressed into the wall of the housing 1, and engaging in a hole in the ring.

Although a specific embodiment of the invention has been illustrated and described it will be understood that various structural changes may be made within the scope of the appended claims without departing from the spirit of the invention, and such changes are contemplated.

What I claim is:

1. In a device of the class described, a rotor having a multiplicity of banks of cylinder bores disposed at equal and opposite angles and a tappet-guide bore substantially axially aligned with each cylinder bore and of relatively larger diameter than said cylinder bores, fluid inlet and outlet means for said cylinder bores, a piston in each cylinder bore, a tappet in each tappet-guide bore with one end engaging the associated piston and its other end extending outwardly of said rotor, and a reaction ring surrounding said rotor, the outwardly extending ends of said tappets being rounded and engaging said reaction member, said equal and opposite angularity of said banks being such as to dispose the tappets angularly with respect to the reaction member so that the point of contact of said rounded ends is offset from the axes of the tappets and induces rotation of said tappets through contact therewith.

2. In a device of the class described, a rotor having a multiplicity of banks of cylinder bores disposed at equal and opposite angles and a tappet-guide bore of relatively larger diameter substantially axially aligned with each cylinder bore, said rotor having an enlarged chamber separating each cylinder bore and tappet-guide bore and a vent port opening said enlarged chamber to the exterior of said rotor, fluid inlet and outlet means for said cylinder bores, a piston in each cylinder bore, a tappet in each tappet-guide bore with one end engaging the associated piston and its other end extending outwardly of said rotor, and a reaction ring surrounding said rotor, the outwardly extending ends of said tappets being rounded and engaging said reaction member, said equal and opposite angularity of said banks being such as to dispose the tappets angularly with respect to the reaction member so that the point of contact of said rounded ends is offset from the axes of the tappets and induces rotation of said tappets through contact therewith.

JAMES F. HOFFER.