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Schlanzky

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[54] **HYDRAULIC PUMP**

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[52] **U.S. Cl.** **417/269,** 417/533

[51] **Int. Cl.** **F04b 21/02**

[58] **Field of Search** 417/269, 569, 567, 417/533, 539, 273

[56] **References Cited**

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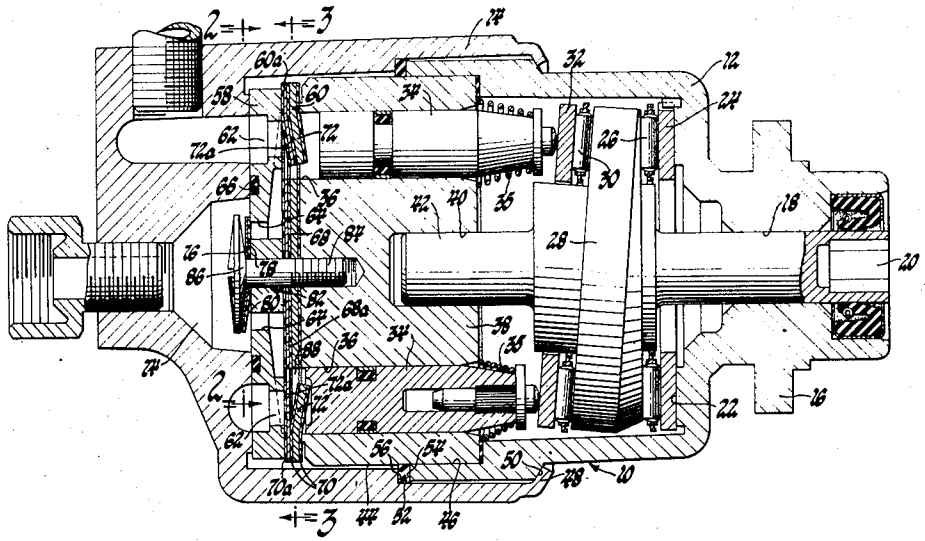
[57] **ABSTRACT**

An axial piston pump having flapper valves on the inlet ports and a continuous flexible ring member providing valving for the outlet ports. The ring member has an elastic sealing surface adjacent to the outlet ports to prevent reverse flow from the pump outlet to the cylinder bores. The ring member is deflected away from the outlet ports when the cylinder bores are pressurized. The deflection of the ring member varies with the amount of fluid flow from the cylinder. Since the amount of fluid flow from a single cylinder in this type of pump is sinusoidal, the outer edge deflection of the ring member is in the form of a sine wave. The ring member also seals the outlet ports to prevent back-flow through the pump when the input shaft is not being driven.

1 Claim, 3 Drawing Figures



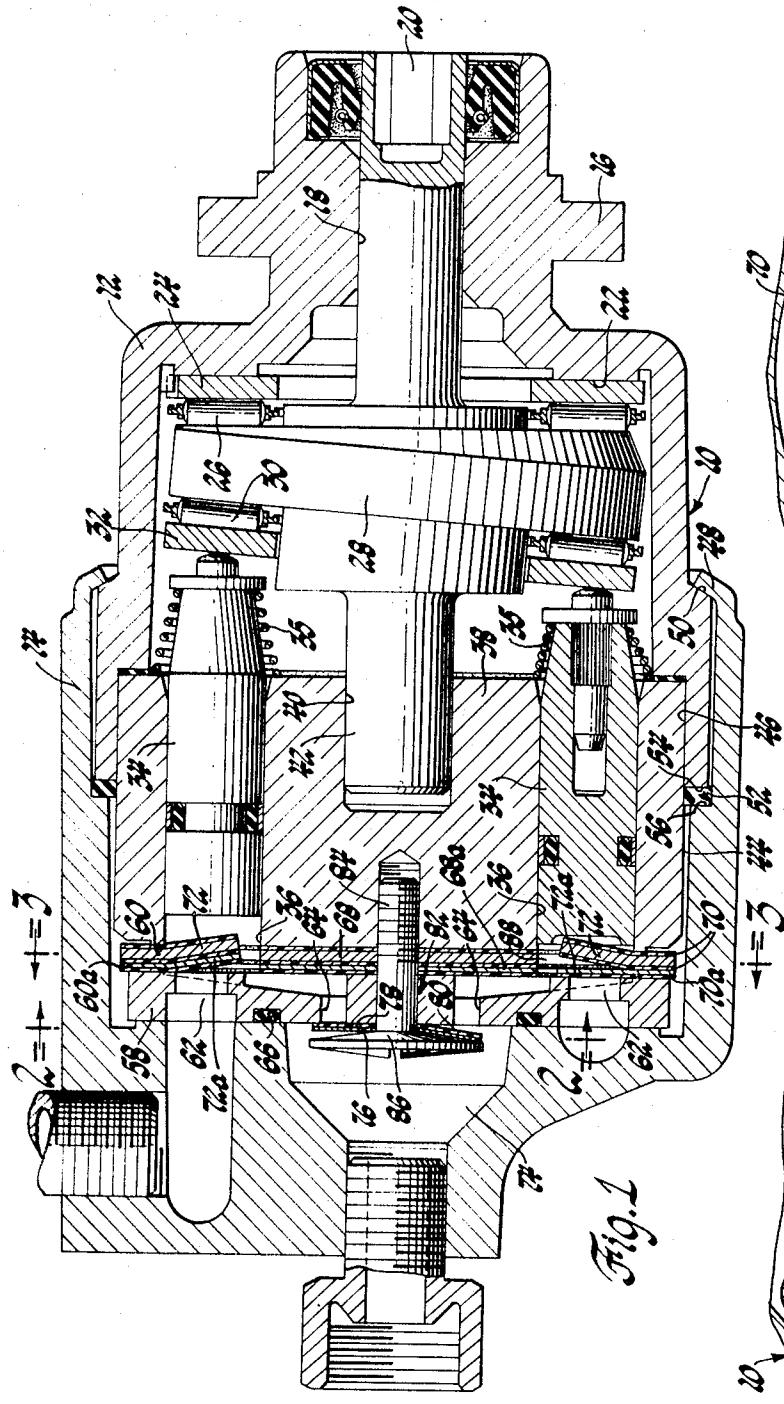


Fig. 1

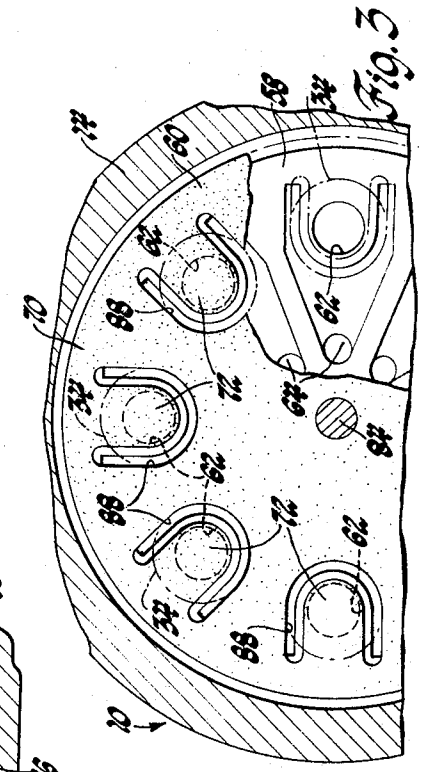


Fig. 3

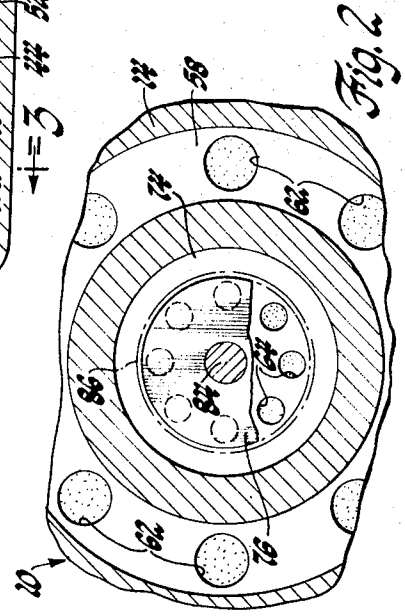


Fig. 2

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HYDRAULIC PUMP

This invention relates to axial piston pumps and more particularly to axial piston pumps having movable valving to control fluid flow.

The present invention is primarily used in axial piston pumps in which the cylinder block is held stationary within the housing and the pistons driven reciprocably in the cylinder block by a wobble plate which is driven by the input shaft. In this type of axial piston pump it is necessary to provide fixed valve members between the inlet and outlet ports of each bore in the cylinder block. Prior art devices have used flapper type valves, sliding valves or poppet type valves to control fluid flow at the inlet and outlet ports of the pump. While the operation of these type valves is satisfactory, they do have associated therewith pressure peaks which are undesirable.

The present invention incorporates a flat ring or disc type valve which covers the outlet ports of the pump. This flat valve member is made from a resilient material such as beryllium copper or spring steel and has bonded thereto an elastic material such as Buna-N rubber. The Buna-N rubber is adjacent to the outlet ports of the pump to provide a positive sealing surface for the outlet ports. The flat valve member is positioned adjacent to the outlet ports by a deflection limiter having a cone-shaped portion which prevents excessive stress in the flat ring valve. The flat ring valve is responsive to the fluid flow from the cylinder bores of the pump and will open according to the amount of flow which is being delivered. In a wobble plate type axial piston pump the fluid flow from a single cylinder bore is sinusoidal. That is, fluid flow develops from a minute amount at the beginning of a pumping stroke to a maximum amount at approximately one-half way through the pumping stroke and then recedes to a minute amount at the end of a pumping stroke. If the fluid flow were plotted for one full revolution a sine wave would be generated. The flat valve member compensates for this flow variation by deflecting in the form of a sinusoidal-shaped curve at the discharge ports of the pump. Due to the ability of the plate valve to assume the sinusoidal shape, pressure peaks which accompany typical flapper type valves are not present in a pump employing this invention.

It is, therefore, an object of this invention to provide in an axial piston pump an improved valving member which substantially lessens the pressure peaks at the discharge port.

It is another object of this invention to provide in an improved axial piston pump an outlet valve controlling fluid flow from the pump comprised of a flexible disc member and an elastic material.

It is another object of this invention to provide in an improved axial piston pump a flexible type valve controlling inlet flow to the pump and a continuous flexible ring valve having elastic sealing surface adjacent to the outlet ports to control fluid flow from the pump.

Still another of this invention is to provide in an improved axial piston pump a flexible ring outlet valve having a metal ring portion and an elastic ring portion bonded thereto and a deflection limiter for controlling the maximum opening of said outlet valve.

These and other objects and advantages of the present invention will be more apparent from the following description and drawings in which:

FIG. 1 is a cross-sectional plan view of an axial piston pump;

FIG. 2 is a cross-sectional view taken along line 2—2 of FIG. 1; and,

FIG. 3 is a cross-sectional view taken along line 3—3 of FIG. 1.

Referring to the drawings wherein like characters represent like or corresponding parts, there is seen an axial piston pump **10** having a two piece housing consisting of portions **12** and **14**. Housing portion **12** is a cup-shaped member having a mounting flange **16** and a bore **18** for rotatably journaling an input shaft **20**. The housing portion **12** also has a flat surface **22** supporting a race **24** of a roller bearing **26** which rotatably supports a wobble plate or wedge shaped portion **28** secured to the input or drive shaft **20**. A second roller bearing **30** is rotatably mounted on the wobble plate **28** adjacent a bearing race **32** against which abuts a plurality of pistons **34** reciprocably disposed in a plurality of cylinder bores **36** formed in a stationary cylinder block **38**. The pistons are urged toward the bearing race **32** by return springs **35**. The cylinder block **38** also has a central bore **40** in which is rotatably journaled one end **42** of the drive shaft **20**. The outer diameter **44** of the cylinder block **38** is positioned in an annular recess **46** on the housing portion **12**.

The housing portion **14** is also a cup-shaped member having swaged portion **48** which abuts a surface **50** of the housing portion **12** to secure the two portions **12** and **14** together. A seal member **52** is compressed between shoulders **54** and **56** on the housing portions **12** and **14** respectively to prevent fluid leakage from within the housing past the swaged portion **48**. An inlet valve member **60***a* is sandwiched between a valve plate **58** and a gasket plate **60** which together are positioned between the housing portion **14** and the cylinder block **38**. The valve plate **58** has a plurality of inlet ports **62** and a plurality of radially inwardly and axially extending outlet ports **64**, one inlet and outlet port for each cylinder, formed therein and carries a round **0**-ring type seal **66** between the inlet and outlet ports **62** and **64** to prevent the interchange of fluid therebetween. The inlet valve member **60***a* is comprised of a sheet metal member **68***a* made of a flexible material such as spring steel or beryllium copper and has an elastic member **70***a* from an elastic material such as Buna-N or a fluoroelastomeric bonded to that side of the sheet metal member **68***a* which faces the valve plate **58**. The gasket plate member **60** is comprised of a sheet metal member **68** made of suitable types steel and has an elastic member **70** from an elastic material such as Buna-N or a fluoroelastomeric bonded to both sides of the sheet metal member **68**. The elastic member **70** abuts the inlet valve **60***a* at the uncoated side of said inlet valve and the cylinder block **38** near their outer diameters to prevent fluid flow outwardly from the cylinder bores **36**. The inlet valve member **60***a* is flat in its normal position and has a plurality of flapper portions **72***a* having one flapper portion **72***a* abutting to each of the inlet ports **62**. The flapper portions **72***a* deflect toward the cylinder bores **36** and away from the valve plate **60** during the suction stroke of the pistons **34**. This deflection of the flapper portions **72***a* is limited by a corresponding number of formed gasket plate portions **72**, which prevent excessive stress in the flapper portions **72***a* of the inlet valve **60***a*. However, when the pistons **34** are reciprocated in the bores **36** and pressure develops

therein the fluid pressure and the spring tension of the deflected flapper portions **72***a* will cause the flapper portions **72***a* to move against the inlet ports **62** to prevent the discharge of fluid through the inlet ports **62.**

The outlet ports **64** are adjacent an outlet chamber **74** formed in the housing portion **14.** The fluid communication between the outlet port **64** and the outlet chamber **74,** however, is controlled by an outlet valve **76** comprised of a flexible annular disc or ring member **78** made from a flexible material such as spring steel or beryllium copper and an elastic material **80** such as Buna-N rubber bonded to the disc **78** so as to be adjacent the outlet port **64.** The disc valve **76** is positioned adjacent the outlet ports **64** by a deflection limiter **82** which has a threaded portion **84** threaded into the cylinder block **38** and a conically shaped portion **86** adjacent the outlet valve **76.** As fluid pressure is developed in the cylinder bores **36** by the pistons **34** the fluid will flow through horseshoe-shaped passages **88** in the inlet valve **60** and through the outlet ports **64** to the outlet chamber **74.** The disc valve **76** will be deflected away from the outlet port **64** by the pressure therein against the deflection limiter **82.** The amount of deflection of the outlet valve **76** is dependent on the fluid flow from the cylinder at any particular time. The fluid flow from the cylinder bore is sinusoidal in character and therefore the deflection of the outlet valve **76** will be sinusoidal in nature. The peak deflection of the valve will occur at the outlet port when the piston is at approximately 50 percent of the stroke. Thus, the maximum deflection point will travel around the deflection limiter as the wobble plate **28** is rotated. At any instant in time the valve, adjacent the ports under pressure, will form a standing sine wave. When the pistons in the cylinder bores are on the intake stroke, the flapper **72***a* of the inlet valve **60***a* opens to admit fluid to the cylinder; while the outlet valve **76** will close due to the fluid pressure in outlet chamber **74** and the spring of the flexible member **78** so that the elastic material **80** will seal against the outlet port **64** to prevent back flow through the pump.

Obviously, many modifications and variations of the present invention are possible in light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. An axial piston pump comprising, valve plate means having a plurality of axial inlet ports, and a plurality of axial outlet ports; an outlet flow chamber in fluid communication with said outlet ports; cylinder block means having a plurality of axially extending cylinder bores each in fluid communication with each of one of said inlet and outlet ports; piston means slidably disposed in said cylinder bores and being reciprocal therein to establish fluid flow into and out of said cylinder bores; inlet valve means disposed between said cylinder block and said valve plate means having flapper means adjacent each said inlet ports for opening in response to the suction stroke of pistons when fluid is flowing into said cylinder bores and being closed by spring tension of said flapper means and pressure in said cylinder bores when fluid is being expelled therefrom and a plurality of flapper deflection limiting means inclined to the cylinder bores and the flapper means for limiting the opening of said flapper means; outlet valve means comprising a continuous flexible ring having a sealing surface adjacent said outlet ports for preventing flow from said outlet flow chamber to said cylinder bores when said flapper means are open, and said continuous flexible ring being displaced from said outlet ports proportional to the amount of fluid flowing from the cylinder bore when said flapper means is closed to permit fluid flow selectively from said cylinder bores to said outlet flow chamber when said pistons are expelling fluid from said cylinder bores; and deflection limiter means including a threaded portion extending centrally through said valve plate means, said inlet valve means and said outlet valve means and being threadably secured centrally in said cylinder block means for securing together said valve plate means, said inlet valve means, said outlet valve means and said cylinder block means, and a conical section adjacent said flexible ring for limiting the maximum deflection of said flexible ring.

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