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PISTON PUMP IMPROVEMENT

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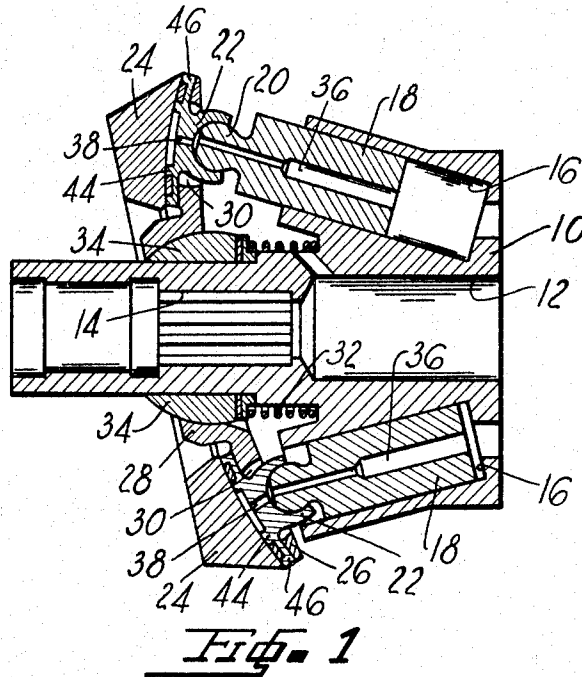


Fig. 1

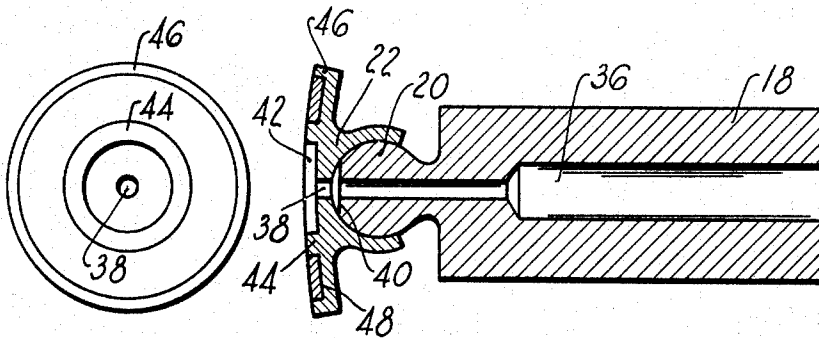


Fig. 2

Fig. 3

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PISTON PUMP IMPROVEMENT

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The present invention relates to fluid pumps and more particularly to an improvement in piston pumps of the wobble or swash plate type operating in extreme temperature, speed, or pressure conditions.

In prior art pumps of the wobble or swash plate type it is the normal practice to provide relative rotation between a member containing reciprocating pistons and a tiltable wobble plate member. Intermediate the pistons and wobble plate, bearing shoes or slippers are interposed to permit changing angularity between piston and swash plate and to provide a bearing surface with the swash plate. These bearing or shoe members must accept the piston back pressure reaction force, frictionally slide at high pumping speeds against the swash plate, and be exposed to whatever pump or fluid temperatures that are applied. As a result the shoes or slippers deteriorate rapidly in service.

It is an object of the present invention therefore to provide a piston pump construction designed to materially increase the life of shoe or slipper member from that obtained heretofore—particularly under extreme operating conditions.

Other objects and advantages of the present invention will become apparent from the following detailed description taken in connection with the appended drawings in which:

FIGURE 1 is a cross section view of a piston pump and wobble plate member illustrating a preferred embodiment of our invention;

FIGURE 2 is an enlarged cross sectional view of the pump piston and slipper member of FIGURE 1; and,

FIGURE 3 is a plane view of the shoe or slipper bearing surface of the type illustrated in either of the prior figures.

Referring now to the drawings the portion of the piston pump illustrated in FIGURE 1 is comprised of a rotor 10 which contains a tubular bore 12 having a spline connection 14 adapted to be connected to a suitable rotary drive shaft, not shown. The rotor 10 is provided with a plurality of angularly disposed cylinders 16 in which are reciprocally mounted plungers or piston members 18. The pistons or plunger members 18 have a generally spherical or rounded end 20 over which is received a shoe or slipper member 22 which in turn bear against in sliding contact with rotatively fixed but tiltable wobble plate member 24, pivot trunnions for wobble plate not illustrated. Shoe member 22 is fabricated from a dense metal material having high structural strength such as steel, bronze or alloys thereof. A cam plate 26 having a central depending flange 28 disposed within the central opening of wobble plate 24 is provided with a plurality of openings 30 each of which is adapted to receive a piston shoe 22. Cam plate 26 is urged into engagement with wobble plate 24 by means of spring 32 acting through a thrust member 34 which is slidably mounted on an extension of rotor 10. Cam plate 26 is provided to insure retraction of pistons 18.

In operation, drive means connected to spline connection 14 of rotor 10 rotationally drives the rotor which carries with it pistons 18 and shoes 22. As the shoes 22 rotate in a circular path they are urged against the face of wobble plate 24 by spring 32, thrust member 34 and cam plate 26. Thus the shoes follow the inclined surface of wobble plate 24 reciprocating pistons 18 in cylinders 16 to create pumping action.

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As pistons 18 move to the right on the pumping compression stroke fluid is raised in pressure and delivered to a receiving device. The fluid pressure additionally reacts on piston 18 producing a reaction force on shoes 22 creating a high wear condition between the contacting surfaces of shoe 22 and wobble plate 24.

It is known in the prior art to alleviate this fluid pressure reaction force to a high degree by supplying fluid from the pumping chamber to the bearing face of the shoe to aid in neutralizing or balancing this reaction force. Such pump arrangements may be referred to as fluid balanced piston pumps and it is our object to advance still further the extreme temperature, speed, and pressure conditions in which pumps of the fluid balanced piston type may be used while providing the maximum service life.

Referring to FIGURES 2 and 3 the piston 18 is provided with an axial fluid passage 36 extending fully through the piston and spherical end 20. A similar fluid passage 38 is provided in the center of shoe 22 so that fluid may pass from the pumping cylinder to bearing face of shoe. The extreme left end of spherical end 20 is ground flat at 40 to insure fluid connection between passages 36 and 38 when piston 18 and shoe 22 are moved angularly relative to each other. A balancing recess 42 is provided in the center of shoe 22 extending inwardly from the bearing face to form a pocket or reservoir for pump fluid and thus define an area on which high pressure fluid reacts back on the combined shoe and piston assembly to balance the fluid pressure forces. Immediately radially outwardly of recess 42 there is formed an inner circular rim or projection 44. At the outermost radial extremity of shoe 22 an outer circular rim or projection 46 is formed such that rims 44 and 46 in combination form an annular recess 48. Each of the projections 44 and 46 are of a dense metal having high strength. In the recess 48 there is deposited an annular ring of soft bearing metal material having good resistance to seizure or scoring such as silver, tin, cadmium or the like.

While the bearing properties of silver, tin and cadmium are generally known in the art, what has not been previously recognized to our knowledge is that these materials when applied to a balanced type shoe such as that disclosed as by plating or the like and the pump is subjected to very sudden changes in pressure these metals will quickly deteriorate at the edges.

We have found that providing a thin rim of dense metal around the inner and outer edges of the soft bearing metal that under the same severe pressure changes the bearing metal does not tend to chip away or spall.

We believe that the bearing metals, which have a greater porosity, cannot withstand the very rapid changes from high to low pressures which are experienced under severe operating conditions. The high pressure is trapped in the pores of the material and when the pressure is suddenly released, particles of bearing metal are torn from the surface by the escape of the high internal pressure in the pores of the material. By providing rims 44 and 46 of dense metal such as steel or the like, which are more homogeneous without the attendant porosity, in the critical areas at the edge of shoe and balancing recess, this effect is eliminated. A further advantage is that the rim of dense metal captivates the bearing material and resists tearing from the shoe surface.

Although a particular embodiment of our invention has been described, it will be understood by those skilled in the art that objects of the invention may be attained by the use of constructions different in certain respects from that disclosed without departing from the underlying principles of the invention. It is well known in the art to which the present invention relates that piston pumps

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may be run in the reverse direction to act as fluid motors without the exercise of invention.

We claim:

1. A piston pump comprising: a member having a plurality of annularly arranged piston cylinders, a plurality of pistons mounted in each of said piston cylinders, each of said pistons having a cylindrical portion extending slidably within said piston cylinders and a generally spherical end extending externally of said cylinders, a tiltable wobble plate member, a plurality of steel shoe members one for each of said pistons having a bearing surface in slidable contact with said wobble plate and a socket end fitted over said spherical end of said pistons, said shoes each having an axially centered recess extending inwardly from said bearing surface, each of said plurality of pistons having a first axial fluid passage, each of said shoes having a second fluid passage fluidly connecting said recess and said first fluid passage to transmit fluid from said piston cylinders to said recess, each of said shoes having an inner circular and outer circular projection of dense metal on said bearing surface formed adjacent said axially-centered recess and outer radial edge of said shoes respectively to form an annular recess therebetween; an annular ring of relatively porous bearing metal disposed in said annular recess having an upper surface flush with said inner and outer circular projections to provide a smooth bearing surface.

2. A piston pump comprising: a member having at least one off-center generally axially disposed piston cylinder, a cylindrical piston member slidably mounted in said piston cylinder having one end projecting externally of said cylinder, a tiltable wobble plate member spaced from said one end of said piston member, a shoe member intermediate said wobble plate and said piston having an articulated connection with said one end of said piston member and a bearing surface in slidable contact with said wobble plate member, said shoe having an axially-centered recess extending inwardly from said bearing surface, passage means extending through said piston member and said shoe member and through said articulated connection to fluidly interconnect said axially-centered recess and said piston cylinder, said shoe having an inner circular projection of dense metal extending axially outwardly on said bearing surface adjacent the radial outermost edge of said axially-centered recess, said shoe having an outer circular projection of dense metal extending axially outwardly on said bearing surface at the radial outermost edge of said shoe, said inner and outer circular projections cooperatively forming an annular recess therebetween, an annular ring of relatively porous bearing metal disposed in said annular recess having a surface flush with said inner and outer projections to provide a smooth bearing surface.

3. A piston and shoe assembly for use in a wobble plate piston pump having a wobble plate and a member having cylindrical piston cylinders, said piston and shoe assembly comprising: a piston member having a cylindrical body portion and a generally spherical end, an axial through passage formed in said piston member extending through said generally spherical end, a dense metal shoe member having a bearing surface on one side and a socket connection on another side, said socket con-

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nection fitted over said spherical end to provide an articulated connection between said shoes and said piston, said spherical end having flat surface section providing a fluid chamber within said articulated connection fluidly connected to said axial through passage, said shoe member having an axially-centered recess extending inwardly from said bearing surface, a fluid passage formed in said shoe member interconnecting said axially-centered recess and said fluid chamber with said articulated connection, said shoe having an inner circular projection of dense metal extending axially outwardly on said bearing surface adjacent the edge of said axially-centered recess, said shoe having an outer circular projection of dense metal extending axially outwardly on said bearing surface at the radial outermost edge of said shoe, said inner and outer circular projections cooperatively forming an annular recess therebetween, an annular ring of relatively soft bearing metal disposed in said annular recess having a surface flush with said inner and outer projections to provide a smooth bearing surface.

4. A piston and shoe assembly for use in a wobble plate piston pump having a wobble plate and a member with piston cylinders, said piston and shoe assembly comprising: a piston member having an axially disposed through passage formed therein, a dense metal shoe member having an annular bearing surface and an axially-centered recess formed in said bearing surface, an articulated connection interconnecting said shoe member with one end of said piston member, passage means formed in said shoe member fluidly interconnecting said axially-centered recess and said axially disposed through passage, said annular bearing surface comprised primarily of bearing metal, said annular bearing surface having dense metal retaining projections extending to said bearing surface at the edges of said bearing metal.

5. A piston and shoe assembly comprising: a piston member of generally cylindrical shape having an axially disposed through passage formed therein, a dense metal shoe member connected to one end of said piston member and having a bearing surface formed thereon, a recess formed in said bearing surface having passage means interconnecting said recess and said through passage, said bearing surface comprised primarily of bearing metal deposited on said dense metal shoe member, dense metal projections extending from said shoe member to said bearing surface at the edges of said bearing metal to entrap said bearing metal.

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