

Dec. 7, 1965

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3,221,564

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Filed Jan. 18, 1962

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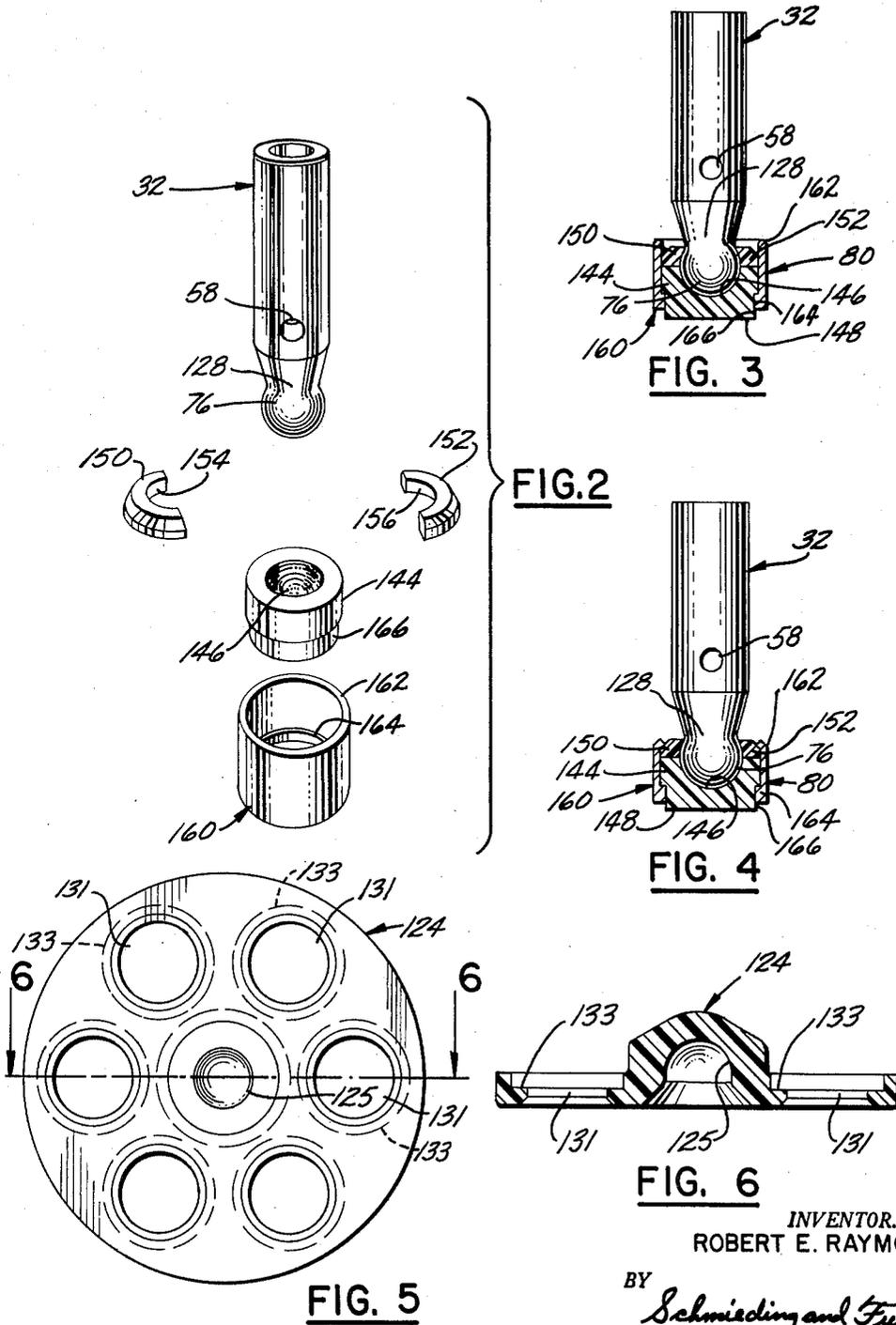


FIG. 3

FIG. 2

FIG. 4

FIG. 6

FIG. 5

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PISTON SHOE CONSTRUCTION FOR AXIAL PISTON PUMP

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Filed Jan. 18, 1962, Ser. No. 167,030
16 Claims. (Cl. 74-569)

This invention relates to hydraulic machines and particularly to pumps and motors.

In general, the present invention in one of its aspects relates to a novel through-bored cylinder construction wherein the cylinders are intersected by an annular discharge manifold. The open ends of the through-bored cylinders are provided with removable plugs that extend through the discharge manifold and, in addition form self-contained outlet valve cartridges. This outlet valve cartridge construction provides a high compression apparatus that is inexpensive to assemble and service.

As another aspect of the present invention, the pump includes a novel high compression combined piston means and inlet valve cartridge construction that cooperates with the above described outlet valve cartridge to provide an efficient high compression machine.

Another aspect of the present invention relates to a novel piston return means for a pump or motor that incorporates piston shoe means provided with spherical piston foot bearing sockets and a yoke means provided with a central spherical socket for receiving a yoke actuating member. The yoke means and piston shoe means are so designed that all of the centers of these spherical sockets lie in the same plane with the advantageous result that lateral movement of the shoe means on the drive shaft cam means is eliminated. This permits the most efficient use of novel metal encased piston shoes which also comprise a novel structural feature of the machine of the present invention.

Another aspect of the present invention relates to a novel piston and shoe assembly for a pump or motor wherein each piston incorporates a spherical foot portion provided with a composite shoe means including socket forming components, formed of low friction resinous material such as nylon, and a metal casing that not only reinforces the nylon socket forming components against laterally directed tinsel stresses, but also serves to retain the components in assembled relationship on the spherical piston foot.

Another aspect of the present invention relates to a modified composite piston return yoke means for a pump or motor that includes a metal body portion forming piston shoe mounting recesses and a central insert that forms a spherical socket for a yoke driving member. In this modification each piston shoe is preferably provided with a cup-shaped yoke bearing member, formed of a low friction resinous material such as nylon, which surrounds the upper portion of the previously mentioned casing means in underlying relationship with the metal body portion of the yoke.

As another aspect of the present invention, the novel piston construction is used in combination with a novel yoke formed of low friction resinous material such as nylon or the like.

It is, therefore, an object of the present invention to provide an improved axial piston type pump that includes a novel through-bored cylinder, manifold, and valve cartridge construction that results in a high compression machine that is economical to fabricate, service and assemble.

It is, therefore, an object of the present invention to provide an improved axial piston type hydraulic machine that includes a novel piston return means that includes a coplanar arrangement of spherical bearing sockets that eliminates lateral movement of the piston shoes on the

cam means that drives them and thereby permits the most efficient use of a novel composite piston shoe construction that incorporates socket forming components fabricated of low friction resinous material.

5 It is another object of the present invention to provide a novel piston shoe and return yoke assembly wherein all bearing portions are disposed in coplanar spherical sockets formed of low friction resinous material.

10 It is another object of the present invention to provide a novel piston shoe and return yoke assembly that comprises a metal yoke body portion adapted for the coplanar mounting of spherical bearing sockets formed of low friction resinous material.

15 It is another object of the present invention to provide a novel composite piston shoe construction that includes components formed of low friction resinous material and retained in assembled relationship by a metal casing that also serves to prevent deformation and fracturing of the components under laterally directed tinsel stresses.

20 It is another object of the present invention to provide a novel composite piston shoe construction of the type described that will not gall when abrasive substances are encountered between the shoe and the eccentric that drives it.

25 It is another object of the present invention to provide a novel composite piston shoe construction of the type described that eliminates the need for high pressure lubrication in a hydraulic machine.

30 It is still another object of the present invention to provide a novel composite piston shoe construction of the type described that eliminates the need for holding close tolerances in the fitting of drive components of a hydraulic machine.

35 Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein preferred forms of embodiments of the invention are clearly shown.

In the drawings:

40 FIG. 1 is a side elevational view of an axial piston type pump constructed in accordance with the present invention, the section being taken along a vertical plan through the center line of the pump;

45 FIG. 2 is an exploded view of a piston and shoe construction comprising a portion of the apparatus of FIG. 1;

FIG. 3 is a side elevational view, partially in section, of the piston and shoe construction prior to a crimping operation;

50 FIG. 4 is a second side elevational view, partially in section, of the piston and shoe construction subsequent to the crimping operation;

FIG. 5 is a plan view of a piston return yoke used in combination with the piston and shoe construction of FIGS. 2-4; and

55 FIG. 6 is a side sectional view of the piston return yoke of FIG. 5, the section being taken along the line 6-6 of FIG. 5.

Referring in detail to the drawings, FIG. 1 illustrates an axial piston type pump constructed in accordance with the present invention that comprises a housing means indicated generally at 20 which includes front and rear casing portions 22 and 24 joined together at confronting surfaces 26 and 28.

65 Rear casing portion 24 includes a plurality of open ended circumferentially spaced bores that form cylinders 30 that slideably receive a plurality of piston means indicated generally at 32.

70 The end of each cylinder is closed by a threaded plug indicated generally at 34 that forms an outlet valve cartridge and includes a recess 36 containing an outlet ball check valve 38, the end of passage 36 being closed by a threaded plug 40 that is screwed into a threaded

bore 44. Plug 40 is provided with an axial outlet passage 42.

Threaded plug 34 further includes a plurality of radially extending outlet passages 46 that connect valve chamber 36 with an annular groove 48 in the plug that in turn communicates with an annular manifold passage 50, the latter being core molded in rear casing portion 24.

Outlet check 38 is biased against an outlet valve seat 52 on the end of plug 40 by a compression spring 54, the latter being provided with a guide pin 56.

Reference is next made to a combined piston means and inlet valve cartridge indicated generally at 32. An intake passage 58 is drilled transversely through the lower portion of the piston means and oil is supplied to each cylinder 30 via an axial passage 60, valve chamber 62, and a passage 64 formed longitudinally through a threaded plug 66, the latter being screwed into a threaded bore 68 in the upper end of the valve chamber.

An inlet ball check valve 70 is biased against a seat 72 by a compression spring 74.

With continued reference to FIG. 1, each of the piston means 32 includes a spherical foot portion 76 on which is mounted a piston shoe means indicated generally at 80. The shoe means ride on an inclined drive surface 82 of a cam means 84 that is keyed to a drive shaft 86 at a key 88, the cam means being retained on the shaft by a nut 90.

Shaft 86 is rotatably mounted in front casing portion 92 by conventional tapered roller bearings 94 and 96 that are pressed into recesses 98 and 100 said bearings being disposed in back to back relationship.

The front end of the shaft is provided with a wiper type seal assembly 102 and includes a key 104 for mounting a drive pulley.

As seen in FIG. 1, the front casing portion 22 of the pump forms a low pressure chamber 106 that receives a supply of oil from a reservoir, not illustrated, via an intake passage 108 that has its outlet at a lower surface 110 of the casing means which is provided with annular seals 112 and 114 that adapt the pump for convenient subplate mounting. This arrangement, in many installations, eliminates the need for fittings and lines.

Pressurized oil from annular manifold 50 is delivered to the load, not illustrated, via outlet passage 116 that communicates with the previously mentioned subplate mounting surface 110. Since one of the outlet passage portions 118 is formed by drilling through the rear casing portion and into annular manifold 50, a plug 120 is provided to close the open end of the drilled hole.

With reference to FIGS. 1, 5 and 6, the piston means 32 are returned to the bottom of their strokes by a yoke indicated generally at 124, said yoke being moulded from low friction resinous material such as nylon or the like. Yoke 124 includes an integrally molded spherical central socket 125 for receiving a spherical bearing portion 127 on the end of an axially shiftable yoke driving member 136, the latter being mounted in a bore 129 in rear casing portion 124. Driving member 136 is constantly urged against yoke 124 by a compression spring 138 the ends of which are centered by spring positioners 140 and 142.

As is best seen in FIGS. 5 and 6, the periphery of yoke 124 is provided with a plurality of circumferentially spaced holes 131 that are large enough to permit free oscillation of neck portions 128, FIG. 1, of piston means 32.

The periphery of yoke 124 further includes a plurality of piston shoe mounting recesses 133 that are shaped to form snugly fitting sockets for the tops of the piston shoe means indicated generally at 80 in FIGS. 1-4.

Reference is next made to FIGS. 2 through 4, which illustrate in detail the previously mentioned shoe means 80. The shoe means is of composite construction and includes a lower bearing portion 144 that forms an

upper spherical surface 146 for receiving spherical piston foot 76 and a lower bearing surface 148 that engages the upper surface 32 of the eccentric.

With continued reference to FIGS. 2 through 4, a pair of upper bearing segments 150 and 152 include spherical surfaces 154 and 156 that conform with the upper portion of ballshaped piston foot 76 and a metal casing indicated generally at 160 includes an upper edge 162 that is crimped over upper bearing segments 150 and 152.

The lower edge of metal casing 160 is provided with an inner shoulder 164 that surrounds a recess 166 of reduced diameter provided on the lower end of lower bearing portion 144.

Lower bearing portion 144, upper bearing segments 150 and 152 are formed of low friction resinous material such as nylon, whereby galling is eliminated between the pivotal bearing portions in metal spherical piston foot 76 and also between lower bearing portion 144 and metal cam means drive surface 82.

It will be understood that the above mentioned nylon to metal bearing surfaces although under relatively heavy axial loads, will not gall or cause failure when metal chips or other foreign particles are encountered.

In operation, when shaft 86, FIG. 1, is driven by a prime mover, not illustrated, rotation of cam means 84 exerts axial forces on piston means 32 and causes the reciprocation in cylinders 30. On each downstroke of a piston means an intake check valve 72 opens whereby hydraulic fluid from low pressure chamber 106 is drawn into a cylinder 30 via passages 58 and 60, valve chamber 62, and plug passage 64, it being understood that the outlet check of the particular cylinder will remain on its seat.

On the upstroke of each piston the intake check 70 is closed and piston means 32 delivers oil to main outlet passage 116 via plug passage 42, valve chamber 36, radial passages 46, and annular manifold 50.

When the high axial stresses are imposed on the shoe means 80, the resinous lower bearing members 144 have the advantageous characteristic of possessing high strength under compression. These lower bearing portions 144 have the undesirable characteristic of being relatively weak when subjected to tensile stresses. Since the spherical piston foot 76 is axially forced into the hemispherical socket 146 of the lower bearing portion, the lower bearing portion is subjected to radially directed tensile forces and since the low friction resinous materials such as nylon are relatively weak under tension, the metal casing 160 confines bearing portion 144 against radial deformation and rupture.

While the form of embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow:

I claim:

1. In a piston construction for engagement with the cam means of a hydraulic machine, the combination of a metal casing surrounding a piston shoe means formed of low friction material and mounted on a ball-shaped piston foot, said shoe means including a side wall provided with a recess, the lower portion of said metal casing including an inner shoulder disposed in said recess said shoe means including a bearing surface extending outwardly of said metal casing for engagement with said cam means.

2. In a piston construction for engagement with the cam means of a hydraulic machine, the combination of a metal casing surrounding a piston shoe means formed of low friction material and mounted on a ball-shaped piston foot, said shoe means including a side wall provided with a recess, the lower portion of said metal casing including an inner shoulder disposed in said recess, and the upper portion of said metal casing including an intumed flange overlying said shoe means said shoe means includ-

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ing a bearing surface extending outwardly of said metal casing for engagement with said cam means.

3. In a piston construction for engagement with the cam means of a hydraulic machine, the combination of a metal casing surrounding a piston shoe means formed of low friction material and mounted on a ball-shaped piston foot, said shoe means including a lower bearing portion outwardly of said casing for engaging said cam means and an upper multiple segment ring bearing overlying the upper portion of said piston foot, the lower portion of said metal casing including means for retaining said lower bearing portion in said metal casing.

4. In a piston construction for engagement with the cam means of a hydraulic machine, the combination of a metal casing surrounding a piston shoe means formed of low friction material and mounted on a ball-shaped piston foot, said shoe means including a lower bearing portion outwardly of said casing for engaging said cam means and an upper multiple segment ring bearing overlying the upper portion of said piston foot, the upper portion of said metal casing including an inturned flange overlying said upper ring bearing portion, the lower portion of said metal casing including means for retaining said lower bearing portion in said metal casing.

5. In a piston construction for engagement with the cam means of a hydraulic machine, the combination of a metal casing surrounding a piston shoe means formed of low friction material and mounted on a ball-shaped piston foot, said shoe means including a lower bearing portion outwardly of said casing for engaging said cam means and an upper ring bearing portion overlying the upper portion of said piston foot, the lower portion of said metal casing including means for retaining said lower bearing portion in said metal casing.

6. In a piston construction for engagement with the cam means of a hydraulic machine, the combination of a metal casing surrounding a piston shoe means formed of low friction material and mounted on a ball-shaped piston foot, said shoe means including a lower bearing portion outwardly of said casing for engaging said cam means and an upper ring bearing portion overlying the upper portion of said piston foot, the lower portion of said metal casing including means for retaining said lower bearing portion in said metal casing and the upper portion of said metal casing including an inturned flange overlying said upper ring bearing portion.

7. In a piston and return yoke assembly for engagement with the cam means of a hydraulic machine, the combination of a metal casing surrounding a piston shoe means formed of low friction material and mounted on a ball-shaped piston foot said shoe means including a bearing surface extending outwardly of said metal casing for engagement with said cam means; a yoke bearing member formed of low friction material and surrounding said piston foot in overlying relationship with said metal casing; and a multiple segment ring shaped bearing engaging the upper portion of said casing means including an inwardly extending flange overlying said ring shaped bearing, the lower portion of said metal casing including means for retaining said lower bearing portion in said metal casing.

8. In an axial piston type hydraulic machine for engagement with the cam means of a hydraulic machine, the combination of casing means including a plurality of axially disposed cylinders; a cam means rotatably mounted in said casing means; a plurality of piston means in said cylinder means, each of said piston means including a ball-shaped piston foot; a piston shoe means formed of low friction material and mounted on one of said piston feet, said shoe means including a bearing surface extending outwardly of said metal casing for engagement with said cam means; a metal casing surrounding said piston shoe means; a piston return yoke formed of low friction material and including a peripheral portion overlying said piston shoe means; a resilient means constantly

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urging said yoke towards said cam means; and a multiple segment ring shaped bearing engaging the upper portion of said piston foot, the upper portion of said casing means including an inwardly extending flange overlying said ring shaped bearing, the lower portion of said metal casing including means for retaining said lower bearing portion in said metal casing.

9. The apparatus defined in claim 8 wherein, the upper portion of said metal casing includes an inturned flange overlying said shoe means.

10. The apparatus defined in claim 8 wherein said shoe means including a side wall provided with a recess and wherein the lower portion of said metal casing includes an inner shoulder disposed in said recess.

11. The apparatus defined in claim 8 wherein the upper portion of said metal casing includes an inturned flange overlying said shoe means, wherein the lower portion of said metal casing includes an inner shoulder disposed in said recess.

12. The apparatus defined in claim 8 wherein the upper portion of said metal casing includes an inturned flange overlying said piston shoe means, wherein said shoe means includes a lower bearing portion provided with a recess, and wherein the lower portion of said metal casing includes an inner shoulder disposed in said recess.

13. The apparatus defined in claim 8 that includes a yoke bearing member disposed between said piston return yoke and said casing means.

14. The apparatus defined in claim 8 that includes a yoke bearing member including a spherical end, said piston return yoke including a central socket for receiving said spherical end.

15. In a piston and return yoke assembly, the combination of yoke means including circumferentially spaced piston shoe mounting recesses; a plurality of piston shoe means mounted in said recesses, each of said shoe means including a spherical piston foot socket formed of low friction material, said shoe means including a multiple segment ring shaped bearing overlying each of said piston foot sockets; and a metal casing surrounding each of said ring-shaped bearings and piston shoe means, the lower portion of said metal casing including means for retaining said lower bearing portion in said metal casing, the centers of said central socket and piston shoe sockets being substantially coplanar.

16. The piston and return yoke assembly of claim 15 wherein said yoke means is formed of low friction resinous material.

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