HYDRAULIC PUMP VALVE SPACER

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This invention relates generally to hydraulic pumps
and finds particular utility in such pumps of the multiple
piston type.

In a pump of this type, the frequency of cyclic opera-
tion between the inlet and outlet check valves of the
pistons is very critical and any axial shifting of the pump-
ing cylinder relative to the piston destroys this desired
frequency.

An object of this invention is to provide an inlet check
cylinder valve spacer of such construction and shape so
that the inlet flow pattern through the piston is greatly improved
and turbulence therein substantially reduced. The result is a
particularly efficient pumping unit. The invention also
provides a novel means for assembling the spacer in a
fixed and predetermined correct axial position.

These and other objects and advantages will appear
hereinafter as this disclosure progresses, reference being
had to the accompanying drawings, in which:

FIGURE 1 is an axial cross-sectional view through a
hydraulic pump embodying the features of this invention;
FIGURE 2 is a transverse cross-sectional view taken
on line 2—2 of FIGURE 1, through the discharge mani-
fold;

FIGURE 3 is a transverse cross-sectional view taken
on line 3—3 of FIGURE 1, and showing the inlet valve
spaces in the discharge end of the pumping pistons;

FIGURE 4 is an axial cross-sectional view, on an
enlarged scale, through an inlet check valve spacer shown
in FIGURES 1—3 made in accordance with this inven-
tion and showing the flow pattern there through;

FIGURE 5 is another view, similarly enlarged, of the
space shown in FIGURE 4;

FIGURE 6 is a still further enlarged view of the
spacer shown in FIGURES 4 and 5, and taken generally
from line 6—6 of FIGURE 5.

Referring more particularly to the drawings, the pump
housing comprises a cylinder barrel section 10 secured
by circumferentially spaced caps 11 to a drive section
12 and having an O-ring seal 13 there betwen. A cham-
ber 14 is defined within the housing into which a supply of
fluid is introduced through the inlet port 15.

A drive shaft 16 extends through the housing and is
suitably journalled in anti-friction bearings 17 in section
12 and its end is piloted in the anti-friction bearings 18
located in the barrel section 10. A shaft seal 19 pre-
vents leakage of fluid from the housing.

A wobble plate 20 is secured to the drive shaft by a
key 21 and has an eccentric surface 22. An axial thrust
bearing plate 23 is located in chamber 14 and a thrust
ring 24 having a plurality of anti-friction bearings 25
therein is located between the bearing plate and the
wobble plate.

An anti-friction ring member 27 is mounted on an
eccentric portion 28 of the drive shaft 16 and is adapted
to rotate freely against the eccentric surface 22. A
hardened steel plate 29 is also mounted on eccentric port-
ion 28 for rotation in respect thereto.

The cylinder barrel section 10 of the pump housing
has a plurality of circumferentially spaced bores 30 extending
there through which are arranged in parallelism and in an
axial direction. These bores are all connected together by
a common manifold 31 which places them in com-
munication with the common discharge port 32 (FIG-
URE 2).

A replaceable cartridge assembly 35 is inserted in each
bore 30 and accurately secured therein against either
axial or rotational displacement as follows. The sleeve
36 of the cartridge has a recess 37 in its periphery which
is adapted to snugly receive the dowel portion 38 of the
cap screw 39. A seal 40 prevents any fluid leakage
to the outside of the pump. The screw 39 accurately
positions the sleeve in an axial correct predetermined
position and also prevents any rotational movement
of the sleeve. A plug 41 has a portion 42 which thread-
ably engages the end of sleeve 36. When the plug is
tightened, its collar portion 43 bears against the outside of
the pump housing and because of the clearance between
the collar 43 and the sleeve, draws the sleeve to the right,
as viewed in FIGURE 1. As a result, the sleeve is drawn
up tight against the locking dowel 38, thus securing
the sleeve in position. A O-ring seal 44 is seated on
portion 46 of the plug acts to seal against fluid leakage.
Another O-ring seal 45 is located between the sleeve 36
and its bore 30 to prevent fluid leakage therebetween.
To remove the entire cartridge assembly it is only neces-
sary to withdraw the dowel portion 38.

The cartridge assembly includes a cylinder 47 in
the sleeve 36 which forms a pumping chamber for the
piston assembly 48 reciprocatingly mounted therein.
The cylinder 47, of the cartridge assembly shown in FIG-
URES 1 and 2, is placed in fluid communication with the
manifold passage 51 by means of the cross bore 50 in
the sleeve 36.

An outlet check valve is provided for each pumping
unit and includes a check ball 52 which is adapted to
seat against the ring seat 53 located in the counterbore
54 of the sleeve. The seat 53 is held against axial dis-
placement by the locking ring 55 which is threadably
engaged in the sleeve. A spring 56 bears against the
ball 52 to yieldingly hold it against its seat and also
bears against the inner end of plug 41. A projection
57 is formed integrally on the inner end of the plug and
acts as a locating guide for the spring 56 surrounding it.

The piston assembly 48 may also be considered as part
of the cartridge assembly and includes the piston 58 which
has a hemispherical end 59, on which is held captive
by snap ring 60, and universally tiltable slipper 61.
The slipper are urged firmly against the wobble plate
assembly by the spring 62 which acts between the shoulder
63 of the sleeve and the collar 64, which is secured to
the piston by snap ring 65.

As viewed in FIGURE 1, the piston 58 has a series of
bores 67, 68, 69 and 70 which progressively decrease
in diameter in that order and which are all connected

A pair of cross ports 71 place the pump inlet
chamber 14 in fluid communication with bore 70.

An inlet check valve is provided within each piston
which serves to admit fluid to the pumping chamber 47
when the piston is moved to the left (FIGURE 1) dur-
ing its suction stroke. When the piston delivers its pump-
ing stroke the inlet valve is closed. This inlet valve com-
mprises a check ball 72 which positively seats against
the shoulders 73 formed by the juncture of bores 68 and
69. A spring 74 urges the ball to this seated position.
The spring also bears against the inlet valve spacer 75
which is fixedly and accurately positioned in bore 67
within the limits predetermined by the snap ring 76 and
the shoulder formed by the juncture of bores 68 and
69. The exact axial location of the snap ring 76 relative to
the ball 72 is predetermined and it is an easy matter
to assemble this piston without error. In other words,
it is unnecessary to first screw the spacer into contact
with the ball and then back it off a predetermined num-
ber of revolutions where it would be locked in place.
The spacer 75 thus accurately locates the maximum travel of the check ball in the opening direction. The extent of this ball movement is important as the frequency of cyclic operation between the inlet ball 72 and the outlet ball 52 is critical to the proper high speed operation of these pistons and the smooth flow of fluid therethrough.

The spacer made in accordance with this invention is of such shape and construction that a highly improved flow pattern of fluid therethrough has been achieved. The flow through this particular location must be without turbulence if maximum efficiency of the pumping unit is to be obtained.

Referring to FIGURES 4, 5 and 6, the spacer 75 includes a tubular portion 77 which has integrally formed at its leading edge of the flat, centrally located, ball contacting stem 78. The stem is of smaller diameter and width than the internal bore 79 of the tubular portion 78. The stem 78 is cut away at its central part adjacent the tubular portion, to form an opening 80 which contributes to the smooth flow of fluid through the spacer. As shown in FIGURE 6, a substantially semi-circular opening 81 is provided at either side of the spacer through which the fluid flows. By splitting the flow with the openings of this shape, a diametrically opposed flow has been obtained which has no turbulence. The result has been a marked increase in the efficiency of these pumping units.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

What is claimed and desired to be secured by Letters Patent is:

1. A piston assembly for a hydraulic pump comprising, a piston having a passageway extending axially therethrough, said passage defined by bores of different diameters so as to form first and second shoulders, an inlet check ball in said passage and adapted to seat against said first shoulder, a spacer for said ball comprising a tubular portion mounted in one of said bores and sealed at one end against said second shoulder, a snap ring mounted in said one bore and securely holding said spacer against said second shoulder, the wall of said one bore being imperforate, a stem extending from said tubular portion and having a free end against which said ball is adapted to bear when in a fluid admitting position, said stem being of generally flat cross section and forming at its junction with said tubular portion on each of two diametrically opposed sides a fluid passageway of substantially semi-circular shape when viewed axially along said spacer.

2. An assembly as defined in claim 1 including a spring mounted around said stem and contacting said check ball to urge the latter toward said first shoulder.

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