The invention relates to a piston pump, in particular for brake pressure regulation in a hydraulic vehicle brake system. To control the pressure medium flow, piston pumps of the known type have an outlet valve which is accommodated in a valve lid. An outflow duct of the piston pump opens out into a pressure fluid conduit of a pump housing. As viewed in the direction of the longitudinal axis of the piston pump, the pressure fluid conduit is arranged above an end, which is situated in the interior of the pump housing, of the valve lid. The pressure fluid conduit is therefore at a relatively great distance from an outer side of the pump housing. The invention is directed to a special embodiment of the outflow fluid conduit of the piston pump, which makes it possible for the distance between the pressure fluid conduit and the outer side of the pump housing to be reduced. The pump housing may thereby be optimized in terms of installation space.
PISTON PUMP OF A HYDRAULIC VEHICLE BRAKE SYSTEM

PRIOR ART

[0001] The invention is based on a piston pump, in particular for generating brake pressure in a hydraulic vehicle brake system, as generically defined by the characteristics of the preamble to claim 1.

[0002] Various designs of such piston pumps are known, for instance from German Patent Disclosure DE 101 12 618 A1. These known piston pumps have a pump housing with a receiving bore embodied on it. A bushing of the piston pump is inserted into this receiving bore. The bushing guides a piston, which can be driven into a reciprocating stroke motion by an eccentric element and which defines a pressure chamber of variable volume. A flow of pressure fluid through the piston pump is controlled by valves. The pressure fluid delivered flows to a pressure fluid conduit in the pump housing via an outflow conduit of the pump.

[0003] The versions in FIGS. 5, 8 and 9 have piston pumps in which one of the valves, for controlling the flow of pressure fluid through the piston pump, is disposed separately from the piston in an installation chamber of a valve cap. The valve cap closes off the receiving bore of the pump housing in pressure fluid-tight fashion from the environment. This embodiment has the advantage over the other variants shown that the valve does not follow the piston motion, and as a result, the accelerations and decelerations that occur at the piston do not affect the opening and closing behavior of the valve.

[0004] A pressure fluid conduit of the pump housing, in the versions of FIGS. 5, 8 and 9, discharges into the receiving bore on the far side of the inner end of the valve cap. However, this produces a relatively great axial spacing of this pressure fluid conduit from the outside of the pump housing. This great spacing has an adverse effect on the structural volume of the pump housing.

DISCLOSURE OF THE INVENTION

Advantages of the Invention

[0005] A piston pump as defined by the characteristics of claim 1 has the advantage over the prior art that the spacing of a pressure fluid conduit toward the pump housing from an outside of this pump housing is reduced. Thus the pressure fluid conduit is located closer to one of the outsides of the pump housing and as a result makes better utilization of the structural space of the pump housing possible, for instance for the disposition of further pressure fluid conduits, not shown, or the like. Overfill, a more compactly designed pump housing can be attained as a result. Particularly in automotive construction, because of the limited installation space, the structural volume, material requirements, and weight are a major competitive criterion.

[0006] Further advantages or advantageous refinements of the invention will become apparent from the dependent claims or the ensuing description.

[0007] By means of the characteristics of claim 2, first and second conduit portions of the outflow conduit can be advantageously disposed in view of maximizing the available cross-sectional area. The goal is the largest possible cross-sectional areas, so that no throttling action originates at the outflow conduit. Advantages in this respect are also offered by the annular grooves claimed in claim 5.

DRAWINGS

[0008] One exemplary embodiment of the invention is shown in the drawings and will be described in detail in the ensuing description.

[0009] FIG. 1 for that purpose shows a piston pump, embodied according to the invention, in longitudinal section;

[0010] FIG. 2 shows a valve cap of the piston pump in plan view; and

[0011] FIG. 3 shows this valve cap again in a three-dimensional view, for the sake of clarity.

DESCRIPTION OF THE EXEMPLARY EMBODIMENT

[0012] The piston pump 10 shown in FIG. 1 is disposed in a hydraulic unit of an electronically traction-controllable vehicle brake system and serves to regulate the brake pressure in at least one wheel brake, which is connected to this hydraulic unit via brake lines. The hydraulic unit includes a pump housing 12 and an electronic control unit, not shown, secured to it. The pump housing 12 is provided, among other things, with a receiving bore 14 with a piston pump built into it. This receiving bore 14 is reduced multiple times from the outside inward in its inside diameter and discharges toward an outside 16 of the pump housing 12. Transversely extending pressure fluid conduits 18, 20 discharge into the receiving bore 14. A first pressure fluid conduit 18, facing away from the outside 16, forms an inlet and carries pressure fluid to the piston pump 10, while a second pressure fluid conduit 20, oriented toward the outside 16 of the hydraulic unit, functions as an outlet and carries pressure fluid, which is at elevated pressure, away from the piston pump 10.

[0013] A bushing 22 of the piston pump 10 is inserted into the receiving bore 14. This bushing 22 is embodied in cup form and has a flat bushing bottom 24, provided with a through bore, and a hollow-cylindrical bushing shaft 26 joined to the bushing bottom in one piece. The bushing bottom 24 is oriented toward the outside 16 of the pump housing 12. On its end opposite the bushing bottom 24, a sleeve-like filter element 28 is mounted on the bushing shaft 26. The filter element extends past the end of the bushing 22, and the portion of the filter element 28 protruding past the bushing 22 is constricted in its outer and inner diameters and as a result partly covers an opening cross section of the bushing shaft 26. As a result, the filter element 28 simultaneously acts as an axial stop for a piston 30 received movably in the bushing 22.

[0014] The piston 30 is constructed of two piston parts 32, 34. The first piston part 32 protrudes past the filter element 28 and forms the drive end of the piston 30. It is embodied cylindrically, and on its end toward the bushing it is provided with a centrally disposed, blind-borelike recess. The second, sleevelike piston part 34 protrudes in some portions into this recess. An encompassing sealing and guide region 36 is integrally formed onto the outer circumference of the second piston part 34 and rests on the inside of the bushing 22. This sealing and guide region 36 guides the piston 30 and simultaneously seals off a pressure chamber 38 of the piston pump 10 that is located between the piston 30 and the bushing bottom 24. By means of the pressure prevailing in the pressure chamber 38, the sealing and guide region 36 is pressed to an increased extent against the inside of the bushing 22.
A restoring spring 40 is accommodated in the pressure chamber 38; it is braced by one end on the bushing bottom 24, and by the other end it urges the piston 30 in the direction of a drive element (not shown) that brings about the piston motion. The end toward the piston of the restoring spring 40 is braced indirectly on the piston 30, via a cup-shaped inlet valve housing 42 of an inlet valve 44. The inlet valve housing 42 is provided with perforations on its circumference, and in its interior it receives an inlet valve spring 46. This spring presses an inlet valve member 48, which in the exemplary embodiment is embodied in the form of a valve plate, against an inlet valve seat 50. The latter is embodied on the open end of the second piston part 34.

A valve cap 52 seals off the receiving bore 14 from the surroundings. To that end, the valve cap 52 is pressed into the receiving bore 14 and is retained in it in form-locking fashion by means of a wedging of material of the pump housing. The valve cap 52, on its inner face end, has an encompassing annular shoulder 54 and a collar 56 of narrow cross section protruding axially past the annular shoulder 54. The bushing 22 and the annular shoulder 54 are adapted in their diameters to one another, and as a result the collar 56 of the valve cap 52 surrounds the bushing 22 on the outer circumference. With its bushing bottom 24, the bushing 22 is braced on the annular shoulder 54 of the valve cap 52. A shallow countersunk feature 58 embodied centrally on the valve cap 52 defines the inside diameter of the annular shoulder 54 and forms a hollow space between the bushing 22 and the valve cap 52. This shallow countersunk feature 58 merges with a blind-borelike central recess 60 in the valve cap 52. An outlet valve spring 62 is built into this central recess 60 and acts on an outlet valve body 64. A ball serves as the outlet valve body 64 and cooperates with an outlet valve seat 66 embodied on the bushing bottom 24.

FIG. 2, in a plan view, shows the face end of the valve cap 52 located in the interior of the receiving bore. The central recess 60, which as explained later receives the outlet valve spring 62, is located in this center. The central recess 60 merges with the shallow countersunk feature 58. The annular shoulder 54 adjoining it toward the outside is provided with a radially extending groove 70, which hydraulically contacts a first recess 72 embodied on the inside of the collar 56. This first recess 72 extends parallel to the longitudinal axis of the valve cap 52 over the entire length of the collar 56 and forms a first conduit portion 74 of an outflow conduit of the piston pump 10. A plurality of such first recesses 72 are embodied along the inner circumference of the collar 56.

An annular groove 76 also present on the annular shoulder 54 establishes a hydraulic communication between the radially extending groove 70 and a second first recess 72 on the inside of the collar 56. Preferably, this further recess 72 is located facing the first recess 72.

Further second recesses 78, extending in the direction of the longitudinal axis of the valve cap 52, are embodied on the outside and create second conduit portions 80 of the outflow conduit of the piston pump 10. The outer, second recesses 78 have a greater axial length than the inner, first recesses 72. Moreover, the outer and inner recesses 78, 72 are offset from one another in the circumferential direction of the collar 56, so that the collar 56, viewed from above, has an undulating contour. Such a contour can be made for instance by metal-cutting machining of the valve cap 52 or more economically by non-cutting shaping techniques. The outer and inner recesses 72, 78 discharge from the end of the valve cap 52 to the receiving bore 14 of the pump housing 12 and as a result communicate hydraulically with one another toward the outflow conduit of the piston pump.

As can be seen from FIG. 1, in the pump housing 12 there is a pressure fluid conduit 20, which carries the pressure fluid delivered by the piston pump 10 away. This pressure fluid conduit 20 extends transversely to the receiving bore 14 and discharges into it. The discharge point of the pressure fluid conduit 20 is disposed at the level of the valve cap 52, because of the outer recesses 76. Compared to known embodiments, the axial spacing A of this outflow conduit 20 from the outside 16 of the pump housing 12 can thus be reduced. Because of this reduction in spacing, space is gained for disposing other necessary recesses in the interior of the pump housing 12, as a result of which the pump housing 12 can be made overall more compactly.

FIG. 3 shows the valve cap 52, already described above, in a perspective view and therefore requires no additional explanation. The reference numerals used are kept for FIG. 3.

The function of the piston pump 10 is known per se to one skilled in the art and will therefore be described only briefly below, merely for the sake of completeness:

The piston 30 of the piston pump 10 is driven into a reciprocating stroke motion by a drive element, not shown, such as an eccentric element or a cam. Because of this reciprocating motion, the volume of the pressure chamber 38 defined by the bushing 22 and the piston 30 varies. If the piston 30 is moved by the drive element to the left in FIG. 1, counter to the force of the restoring spring 40, the volume of the pressure chamber 38 decreases, and in the pressure fluid contained in it a pressure increase takes place. Together with the force of the inlet valve spring 46, this pressure increase means that the inlet valve member 48 is pressed against the inlet valve seat 50 and seals it off.

If the pressure in the pressure chamber 38 exceeds a value determined by the design of the outlet valve spring 62, the outlet valve member 64 lifts from the outlet valve seat 66, and the outlet valve opens. The pressure fluid of the pressure chamber 38 then flows into the interstice, formed by the shallow countersunk feature 58 in the valve cap 52, between the bushing 22 and the valve cap 52, and from there, via the radially extending groove 60 of the annular shoulder 54, it reaches the first conduit portions 72 on the inside of the collar 56 on the valve cap 52. Via these first conduit portions 72, the pressure fluid flows into the receiving bore 14 of the conduit portion 10 and is diverted there by 180° and flows via the second conduit portions 78 of the outflow conduit, which are embodied on the outside of the valve cap 52, to the pressure fluid conduit 20 in the pump housing 12. The 180° deflection of the pressure fluid flow in the receiving bores 14 has a damping effect on pressure pulsations that can occur because of the cyclical drive of a piston pump.

If the piston 30 acted on by the drive element reaches its bottom dead center, its direction of motion reverses, and the volume of the pressure chamber 38 gradually increases again. Accordingly, an underpressure is now established in the pressure chamber 38. Together with the outlet valve spring 62, this underpressure has the effect that the outlet valve member 64 is pressed against the outlet valve seat 66, and the outlet valve closes. Simultaneously, the inlet valve member 48 lifts from the inlet valve seat 50 counter to the force of the inlet valve spring 46, and new pressure fluid flows into the pressure chamber 38 of the piston pump 10 via
the sleevelike second piston part 34. Both processes are repeated cyclically as a function of the actuation of the piston 30 by the drive element.

[0026] It is understood that changes or refinements of the exemplary embodiment described are conceivable without departing from the fundamental concept of the invention.

10. A piston pump, in particular for generating brake pressure in a hydraulic vehicle brake system, comprising:
   a pump housing,
   a receiving bore disposed in the pump housing and receiving the piston pump; and
   a valve cap closing the receiving bore from outside the pump housing, the valve cap having first conduit portions and second conduit portions of an outflow conduit of the piston pump which are embodied on the valve cap, the first conduit portions being disposed on an inner circumference of the valve cap and the second conduit portions being disposed on an outer circumference of the valve cap, wherein the conduit portions each discharge into the receiving bore on an end of the valve cap located in an interior of the receiving bore.

11. The piston pump as defined by claim 10, wherein a second conduit portion of the outflow conduit of the piston pump communicates hydraulically with a pressure fluid conduit of the pump housing, and the pressure fluid conduit discharges into the receiving bore of the piston pump at a radial level of the valve cap which corresponds to the second conduit portions.

12. The piston pump as defined by claim 10, wherein the first conduit portions and the second conduit portions are offset from one another in a circumferential direction of the valve cap, on the end of the valve cap located in the interior of the receiving bore.

13. The piston pump as defined by claim 11, wherein the first conduit portions and the second conduit portions are offset from one another in a circumferential direction of the valve cap, on the end of the valve cap located in the interior of the receiving bore.

14. The piston pump as defined by claim 10, wherein the valve cap, on the end located in the interior of the receiving bore, has an annular shoulder and an axially protruding collar that surrounds the annular shoulder on an outer circumference thereof.

15. The piston pump as defined by claim 11, wherein the valve cap, on the end located in the interior of the receiving bore, has an annular shoulder and an axially protruding collar that surrounds the annular shoulder on an outer circumference thereof.

16. The piston pump as defined by claim 12, wherein the valve cap, on the end located in the interior of the receiving bore, has an annular shoulder and an axially protruding collar that surrounds the annular shoulder on an outer circumference thereof.

17. The piston pump as defined by claim 14, wherein a length of the first conduit portions in a direction of the longitudinal axis of the valve cap is equal to at least a length of the collar, and a length of the second conduit portions is equal to at least the length of the first conduit portions.

18. The piston pump as defined by claim 15, wherein a length of the first conduit portions in a direction of the longitudinal axis of the valve cap is equal to at least a length of the collar, and a length of the second conduit portions is equal to at least the length of the first conduit portions.

19. The piston pump as defined by claim 16, wherein a length of the first conduit portions in a direction of the longitudinal axis of the valve cap is equal to at least a length of the collar, and a length of the second conduit portions is equal to at least the length of the first conduit portions.

20. The piston pump as defined by claim 14, wherein the annular shoulder of the valve cap is provided with a radially extending groove, which discharges into a first conduit portion of the outflow conduit of the piston pump.

21. The piston pump as defined by claim 17, wherein the annular shoulder of the valve cap is provided with a radially extending groove, which discharges into a first conduit portion of the outflow conduit of the piston pump.

22. The piston pump as defined by claim 20, wherein an annular groove is embodied on the annular shoulder and puts a plurality of first conduit portions hydraulically into contact with one another.

23. The piston pump as defined by claim 21, wherein an annular groove is embodied on the annular shoulder and puts a plurality of first conduit portions hydraulically into contact with one another.

24. The piston pump as defined by claim 14, wherein a bushing of the piston pump is braced on the annular shoulder and surrounded by the collar of the valve cap.

25. The piston pump as defined by claim 17, wherein a bushing of the piston pump is braced on the annular shoulder and surrounded by the collar of the valve cap.

26. The piston pump as defined by claim 20, wherein a bushing of the piston pump is braced on the annular shoulder and surrounded by the collar of the valve cap.

27. The piston pump as defined by claim 22, wherein a bushing of the piston pump is braced on the annular shoulder and surrounded by the collar of the valve cap.

28. The piston pump as defined by claim 10, wherein the first conduit portions and the second conduit portions of the valve cap are embodied such they can be made in non-metal-cutting fashion, by a non-cutting shaping work process.

29. The piston pump as defined by claim 19, wherein the first conduit portions and the second conduit portions of the valve cap are embodied such they can be made in non-metal-cutting fashion, by a non-cutting shaping work process.

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