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(54) **AXIAL PISTON MACHINE**

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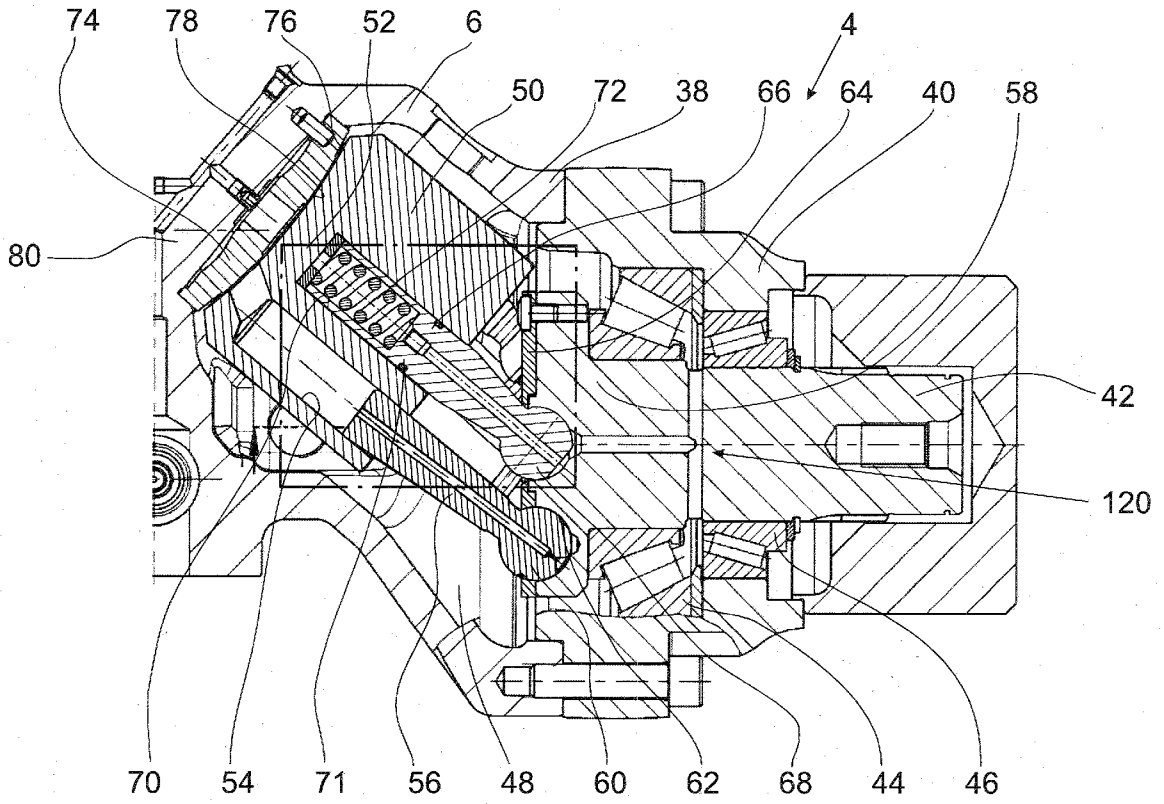
(57) **ABSTRACT**

An axial piston machine of an inclined axis design includes a housing in which a cylinder drum is disposed. The cylinder drum is rotatably supported on a central journal which is hingedly connected to a drive shaft. The central journal is inserted, in an axially displaceable manner, in a central journal bore formed in the cylinder drum which extends approximately coaxially to the longitudinal axis of the cylinder drum. A compression spring is disposed in central journal bore which bears against an end face facing away from the drive shaft, and loads the cylinder drum against a control disk. A radial groove is formed in central journal, in which an O-ring is accommodated, by way of which the central journal is held in a non-positive manner in the central journal bore when the axial piston machine is assembled and disassembled.



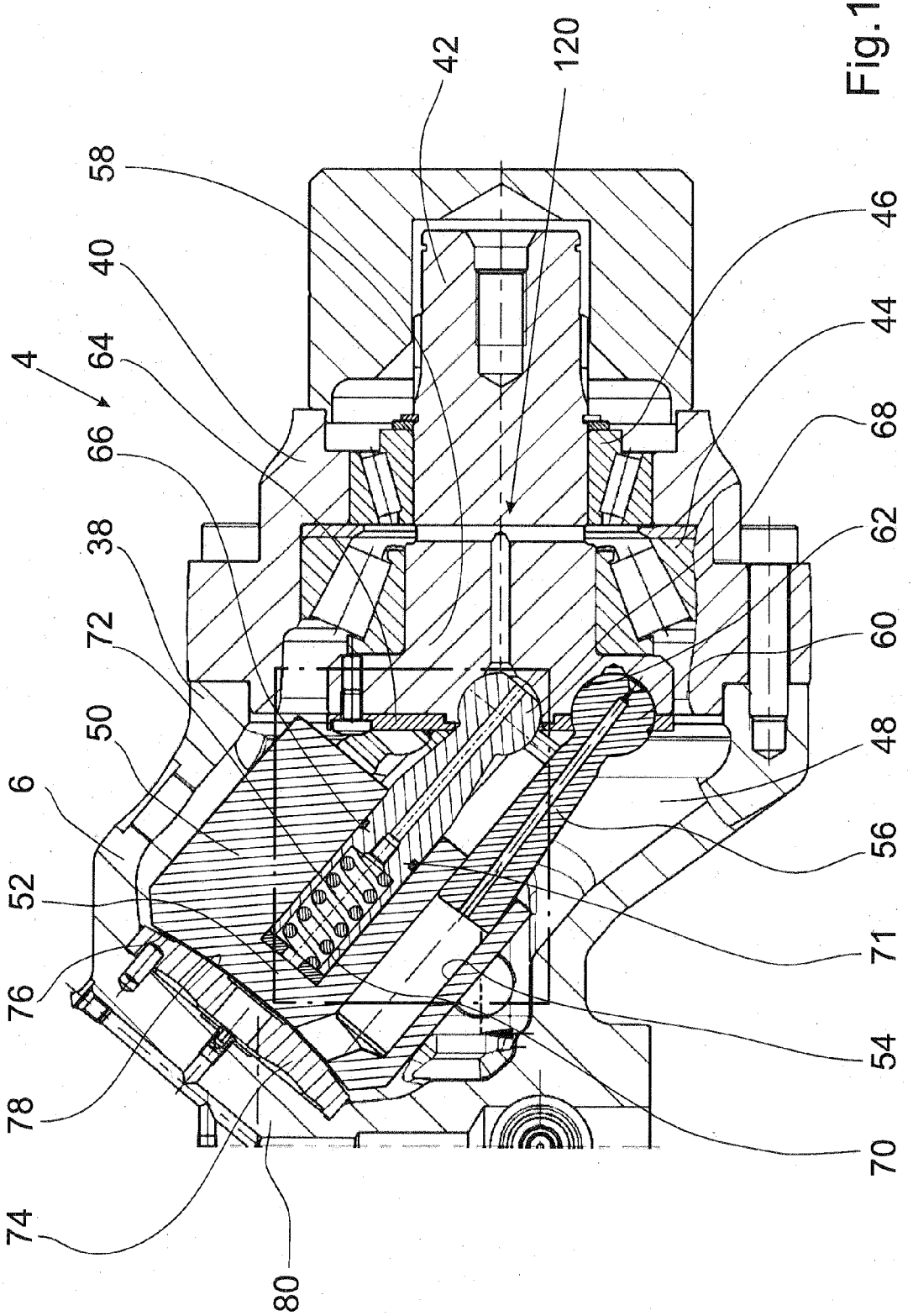

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Fig.1

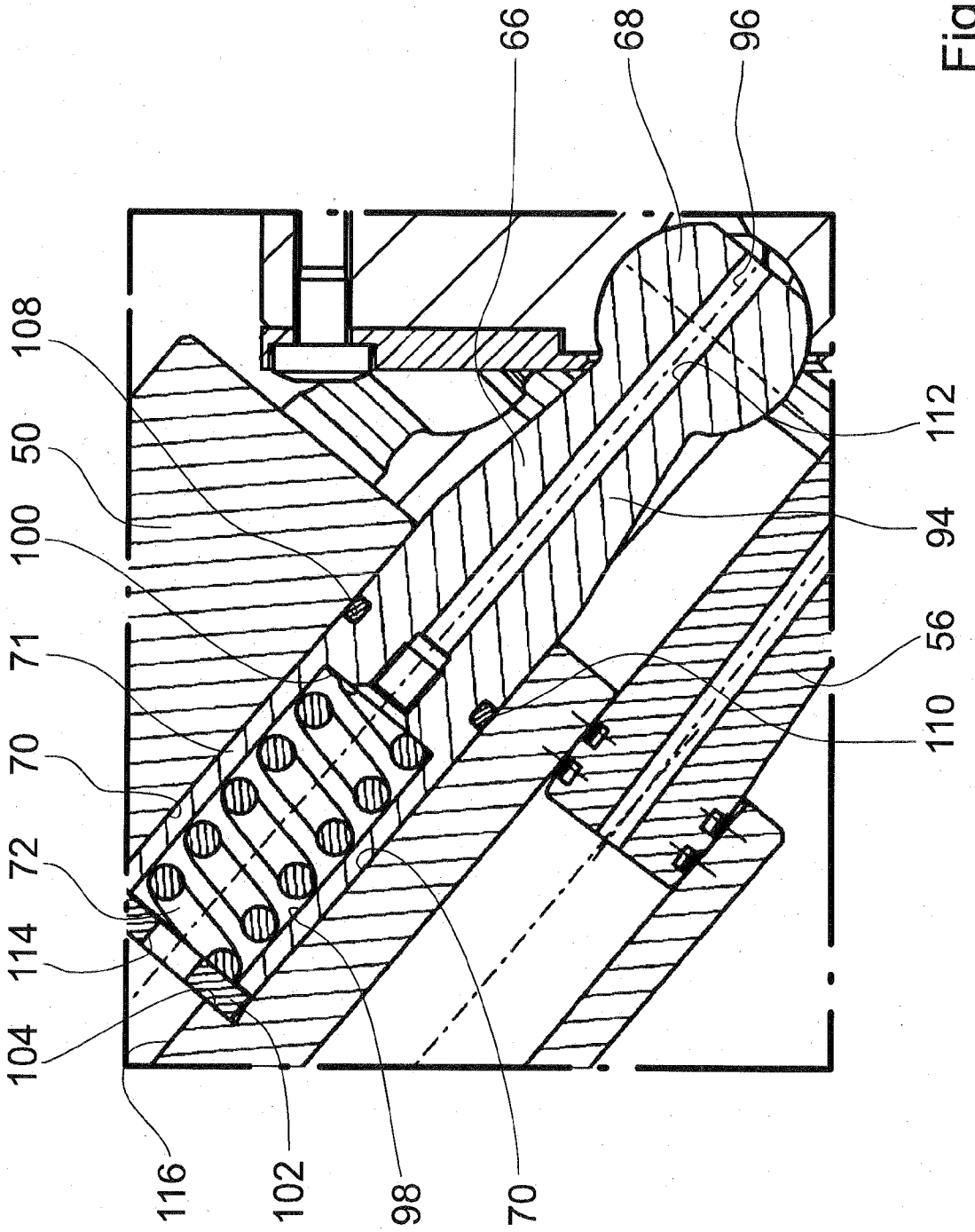

Fig.2

AXIAL PISTON MACHINE

CROSS-REFERENCE

[0001] The invention described and claimed hereinbelow is also described in DE 102009058332.7, filed Dec. 15, 2009. This German Patent Application, whose subject matter is incorporated here by reference, provides the basis for a claim of priority of invention under 35 U.S.C. 119 (a)-(d).

BACKGROUND OF THE INVENTION

[0002] The invention relates to an axial piston machine.

[0003] An axial piston machine of that type is disclosed in DE 101 19 36 C1, in which a plurality of pistons are guided in an axially displaceable manner in cylinder bores of a cylinder drum. The cylinder drum is supported in a housing of the axial piston machine in a manner that allows it to swivel about a pivot axis that extends transversely to the rotational axis thereof. The pistons are supported on a drive shaft that is rotatably supported in the housing. A central journal that is used to support the cylinder drum and, similar to the pistons, is supported on the drive shaft is inserted in a gliding manner in a stepped bore of the cylinder drum, approximately coaxially to the longitudinal axis of the cylinder drum. The central journal includes, on its side facing away from the drive shaft, a blind hole into which a compression spring is inserted, the compression spring bearing against a hole base of the blind hole and loading the cylinder drum against a control disk.

[0004] The disadvantage of this solution is the extremely complex installation and deinstallation of the cylinder drum together with the central journal and the compression spring of the axial piston machine since it must be ensured that the cylinder drum and the central journal are not driven apart by the spring forces of the compression spring.

[0005] To solve this problem, an annular recess can be formed in the outer circumference of the central journal and in an inner jacket surface of the central journal bore, into which a common snap ring is placed. The snap ring would prevent the compression spring from driving the central journal and the cylinder drum apart. This solution has the disadvantage, however, that it requires a great deal of device complexity. Furthermore, it prevents the central journal from being removed from the cylinder drum.

SUMMARY OF THE INVENTION

[0006] In contrast, the object of the invention is to create an axial piston machine that is easily assembled and disassembled, and that can be manufactured cost-effectively.

[0007] According to the invention, an axial piston machine of an inclined axis design includes a housing in which a cylinder drum is disposed. A plurality of cylinder bores, which are open toward a drive shaft which is rotatably supported in the housing, is formed in the aforementioned cylinder drum; a piston which is hingedly connected to the drive shaft is axially displaceably guided in each of the cylinder bores. The cylinder drum also includes a central journal bore that extends approximately coaxially to its longitudinal axis. Inserted therein is a central journal which is hingedly connected to the drive shaft and is used to rotatably support the cylinder drum using a section of the central journal. Furthermore, a spring is disposed in the bore of the central journal. The spring bears against the central journal and loads the cylinder journal against a control disk which bears against the housing; the control disk can be used to connect the cylinder bores to a high-pressure channel or a low-pressure channel. Advantageously, a recess having a retaining element is formed in the central journal section of the central journal in a manner such that the central journal is connected via the retaining element in a non-positive manner to the central journal bore.

[0008] This solution has the advantage that the cylinder drum can be installed and removed together with the spring and the central journal as one unit. Without this recess with the retaining element, the central journal could be accelerated via the spring in the axial direction and separated from the cylinder drum upon removal. To prevent this, a strong counterforce would have to be applied if this recess and the retaining element were not present. The retaining element therefore facilitates safe installation and removal with a minimum of device complexity.

[0009] Advantageously, the recess in the central journal is a simple annular groove, and the retaining element is an O-ring that is inserted into this annular groove. An annular groove of that type is cost-effective to manufacture, and the O-ring is likewise a cost-effective, conventional component.

[0010] The annular retaining element is disposed on the central journal in a manner such that, and the spring is designed in a manner such that the retaining element remains in the central journal bore of the cylinder drum when the spring is in the substantially unloaded state.

[0011] The axial piston machine is designed e.g. as a constant unit having a fixed pivot angle, or as an adjusting unit having an adjustable pivot angle.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] A preferred embodiment of the invention is explained in the following in greater detail with reference to schematic drawings. They show:

[0013] FIG. **1** a longitudinal sectional view of an axial piston machine according to one embodiment; and

[0014] FIG. **2** an enlarged section of the axial piston machine depicted in FIG. **1**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0015] FIG. **1** shows, in a longitudinal sectional view, an axial piston machine **4** according to one embodiment. It is a displacement machine of an inclined axis design, which can be used as a hydraulic motor and a hydraulic pump.

[0016] Axial piston machine **4** is accommodated in a pot-shaped housing section **38** of a housing **6**, which is closed by a housing cover **40**. A drive shaft **42** is rotatably supported using at least one journal bearing in housing cover **40**, and drive shaft **42** extends outwardly through housing cover **40**. The journal bearing is composed of two roller bearings **44**, **46** disposed in the shape of an "o" in housing cover **40**.

[0017] In a cavity **48** of housing section **38**, a cylinder drum **50** that is axially opposite drive shaft **42** is supported such that it can rotate about drum axis **52** thereof. Cylinder drum **50** comprises a plurality of cylinder bores **54**, which are distributed on a partial circle, are open toward drive shaft **42**, and in which pistons **56** are supported in an axially displaceable manner. Pistons **56** are axially supported on a drive shaft flange **58** of drive shaft **42**. Pistons **56** are hingedly supported, each with a spherical piston head **60**, in a spherical cap **62** of drive shaft flange **58**. Piston heads **60** are axially held by a retaining device **64** which extends behind piston heads **60** and

is fastened to drive shaft flange **58**, and which is formed e.g. by a screwed-on perforated plate.

[0018] Cylinder drum **50** is supported on a central journal **66** which is disposed coaxially to cylinder drum **50** and which—similar to piston **56**—is hingedly held using a spherical central journal head **68** in one of the spherical caps **62** by retaining device **64**. Central journal **66** is inserted via a central journal section **71** in a central journal bore or stepped bore **70** of cylinder drum **50**, which extends approximately coaxially to drum axis **52**. A spring or compression spring **72** is disposed in stepped bore **70**, bears against a side of central journal **66** facing away from drive shaft **42**, and loads cylinder drum **50** against a control disk **74**. The end faces of cylinder drum **50** and control disk **74**, which face one another, bear against one another via guide surfaces **76** and **78**. Guide surface **76** of cylinder drum **50** is concave, while guide surface **78** of control disk **74** is convex. Cylinder bores **54** are connected by channel sections, which extend through cylinder drum **50** and control disk **74**, to pressure-medium supply lines or pressure-medium discharge lines which extend approximately in a left—as shown in FIG. **1**—housing section **80** of housing **6**. The design of the channel sections is known per se and will therefore not be described in greater detail. Control disk **74** is securely connected to housing section **38** and is oriented using a centering bolt.

[0019] FIG. **2** mainly shows, in an enlarged sectional view and in sections, cylinder drum **50** together with central journal **66**, one of the pistons **56**, and compression spring **72** depicted in FIG. **1**. Central journal section **71** of central journal **66**, which is inserted into stepped bore **70** of cylinder drum **50**, is designed substantially in the shape of a circular cylinder. Adjacent thereto is a centrally-located central journal section **94** which extends conically toward central journal head **68**, and on the end of which central journal head **68** is formed. A blind hole **98** is formed in central journal **66** approximately coaxially to longitudinal axis **96** thereof, on the side facing away from central journal head **68**. Compression spring **72** is disposed in blind hole **98**, compression spring **72** being loaded between a base surface **100** of the blind hole and an annular disk **102**. Annular disk **102** bears against a contact shoulder **104** of stepped bore **70** of cylinder drum **50**. Compression spring **72** therefore does not have direct contact with cylinder drum **50**.

[0020] Blind hole **98** extends through central journal section **71** along approximately ⅔ the length of central journal section **71**; central journal section **71** is inserted substantially entirely into stepped bore **70**. An annular groove **108**, into which a retaining element or O-ring **110** is inserted, is formed on the remaining section of central journal section **71** of central journal **66**. O-ring **110** bears against an inner wall of stepped bore **70**, at least in sections, in a non-positive manner.

[0021] In the installed state of axial piston machine **4**, cylinder drum **50**, together with central journal **66** and compression spring **72**, is supported between drive shaft **42**, which is supported on housing cover **40**, and control disk **74**. When axial piston machine **4** is assembled or disassembled, housing cover **40** is released, thereby eliminating the supporting effect for drive shaft **42**. In this state, cylinder drum **50** and central journal **66** are prevented from being driven apart by the spring forces of compression spring **72** via the non-positive connection between stepped bore **70** and central journal **66** by O-ring **110**. Cylinder drum **50** and central journal **66** therefore form a unit that can be easily installed in and removed from the axial piston machine. Furthermore, central journal **66** can also be removed from cylinder drum **50**, e.g. to perform maintenance work, simply by overcoming the retaining forces of the non-positive connection between O-ring **110** and stepped bore **70**.

[0022] The spring force and the spring travel of compression spring **72** are designed such that compression spring **72** is released during installation and removal of cylinder drum **50** only to the extent that O-ring **110** is still disposed in stepped bore **70**. Compared to the related art, compression spring **70** is preferably designed with high spring stiffness, thereby resulting in strong spring forces with minimal spring travel.

[0023] A continuous channel **112** is formed approximately coaxially in central journal **66** next to blind hole **98**, and has a pressure-medium connection with leakage channels, which are not depicted, and are formed in left—as shown in FIG. **1**—housing section **80** of housing **6**, the pressure-medium connection being established via blind hole **98**, a continuous port **114** in annular disk **102**, a step **116** of stepped bore **70**, and control disk **74**. Furthermore, channel **112** is connected, on sides of drive shaft **42**, to cavity **48** of housing **6** via connecting channels **120** formed in drive shaft **42**, see FIG. **1**.

[0024] It is feasible for annular groove **108** to not be formed in central journal **66**, but rather in stepped bore **70**, and for O-ring **110** to then be disposed in stepped bore **70**.

[0025] For completeness, it is noted that axial piston machine **4** can also be formed in a separate housing, of course, without axial piston machine **2** shown in FIG. **1**.

[0026] Disclosed herein is an axial piston machine of an inclined axis design comprising a housing in which a cylinder drum is disposed. The cylinder drum is rotatably supported on a central journal which is hingedly connected to a drive shaft. The central journal is inserted, in an axially displaceable manner, in a central journal bore formed in the cylinder drum which extends approximately coaxially to the longitudinal axis of the cylinder drum. A compression spring is disposed in central journal bore which bears against an end face facing away from the drive shaft, and loads the cylinder drum against a control disk. A radial groove is formed in central journal, in which an O-ring is accommodated, by way of which the central journal is held in a non-positive manner in the central journal bore when the axial piston machine is assembled and disassembled.

[0027] It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

[0028] While the invention has been illustrated and described as embodied in an axial piston machine, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

[0029] Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention.

LIST OF REFERENCE CHARACTERS

[0030] **1** Engine
[0031] **2** Axial piston machine
[0032] **4** Axial piston machine
[0033] **6** Housing

[0034] **38** Housing section
[0035] **40** Housing cover
[0036] **42** Drive shaft
[0037] **44** Roller bearing
[0038] **46** Roller bearing
[0039] **48** Cavity
[0040] **50** Cylinder drum
[0041] **52** Drum axis
[0042] **54** Cylinder bore
[0043] **56** Piston
[0044] **58** Drive shaft flange
[0045] **60** Piston head
[0046] **62** Spherical cap
[0047] **64** Retaining device
[0048] **66** Central journal
[0049] **68** Central journal head
[0050] **70** Stepped bore
[0051] **71** Central journal section
[0052] **72** Compression spring
[0053] **74** Control disk
[0054] **76** Guide surface
[0055] **78** Guide surface
[0056] **80** Housing section
[0057] **92** Central journal section
[0058] **94** Central journal section
[0059] **96** Longitudinal axis
[0060] **98** Blind hole
[0061] **100** Base surface
[0062] **102** Annular disk
[0063] **104** Contact shoulder
[0064] **106** Annular end face
[0065] **108** Annular groove
[0066] **110** O-ring
[0067] **112** Lubricating oil bore
[0068] **114** Port
[0069] **116** Step
[0070] **120** Connecting channels

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. An axial piston machine of an inclined axis design, comprising:

a housing (**6**);

a cylinder drum (**50**) disposed in said housing (**6**), said cylinder drum including a plurality of cylinder bores (**54**) open toward a drive shaft (**42**), said drive shaft (**42**) being rotatably supported in the housing (**6**);

a piston (**56**) hingedly connected to the drive shaft (**42**), wherein said piston (**56**) is adapted to be axially displaceably guided in each of the cylinder bores (**54**) and includes a central journal bore (**70**) that extends approximately coaxially to a longitudinal axis thereof;

a central journal (**66**) hingedly connected to the drive shaft (**42**), wherein said central journal (**66**) is inserted in said central journal bore (**70**) and rotatably supports the cylinder drum (**50**) using a central journal section (**71**);

a spring (**72**) disposed in the central journal bore (**70**);

a control disk (**74**) operatively connected to the cylinder bores (**54**) and bearing against the housing, wherein said spring (**72**) is adapted to bear against the central journal (**66**) and load the cylinder drum (**50**) against the control disk (**74**); and

a recess (**108**) having a retaining element (**110**), said recess being formed in the central journal section (**71**) of the central journal (**66**) in such a manner that the retaining element (**110**) is connected in a non-positive manner to the central journal bore (**70**).

2. The axial piston machine according to claim **1**, wherein the recess in the central journal (**66**) is an annular groove (**108**), and the retaining element is an O-ring (**110**).

3. The axial piston machine according to claim **1**, wherein the retaining element (**110**) is disposed on the central journal (**66**) and the spring (**72**) has a spring stiffness, such that the retaining element (**110**), together with the central journal (**66**), cannot be moved out of the central journal bore (**70**) by a spring force of the spring (**72**) in an uninstalled state of the cylinder drum (**50**).

4. The axial piston machine according to claim **1**, wherein the axial piston machine is a constant unit having a fixed pivot angle.

5. The axial piston machine according to claim **1**, wherein the axial piston machine is an adjusting unit having an adjustable pivot angle.

* * * * *