United States Patent [19]

Bosch

[11] **3,875,852**

[45] **Apr. 8, 1975**

[54] **RADIAL PISTON MACHINE**

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[22] Filed: **Oct. 4, 1973**

[21] Appl. No.: **403,714**

[30] **Foreign Application Priority Data**

Oct. 10, 1972 Germany 2249527

[52] **U.S. Cl.** **91/498**

[51] **Int. Cl.** **F01b 13/06**

[58] **Field of Search** 91/6.5, 487, 491, 492

[56] **References Cited**

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Primary Examiner—William L. Freeh

Attorney, Agent, or Firm—Michael S. Striker

[57] **ABSTRACT**

A radial piston machine wherein the peripheral surface of the pintle has a high-pressure chamber and a low-pressure chamber located diametrically opposite the high-pressure chamber. The chambers are flanked by pairs of axially aligned recesses machined into the peripheral surface of the pintle and forming two groups each of which includes a pair of recesses adjacent to the high-pressure chamber and a pair of recesses adjacent to the low-pressure chamber. A regulating valve in the pintle can connect the high-pressure chamber with the recesses of at least one group during each revolution of the cylinder block so as to center the cylinder block on the pintle if the width of the gap between the pintle and cylinder block at a first point differs from the width of the gap at a second point located diametrically opposite the first point. The spool of the regulating valve is shiftable from a neutral position against the opposition of one or more springs when the fluid pressure at one of the two points of the gap exceeds the pressure at the other point. This increases the fluid pressure in the one group of recesses so that the fluid changes the radial position of the cylinder block as long as the pressure at the first point of the gap differs from the pressure at the second point of the gap.

12 Claims, 7 Drawing Figures

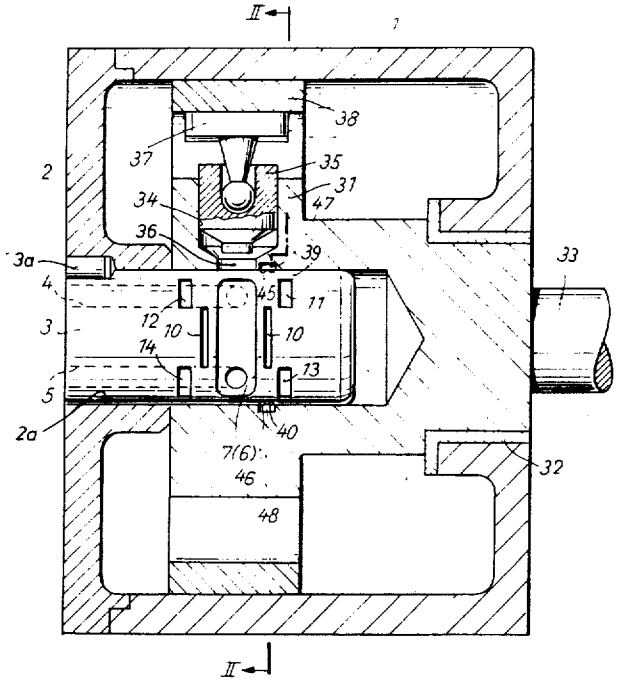

Fig. 1

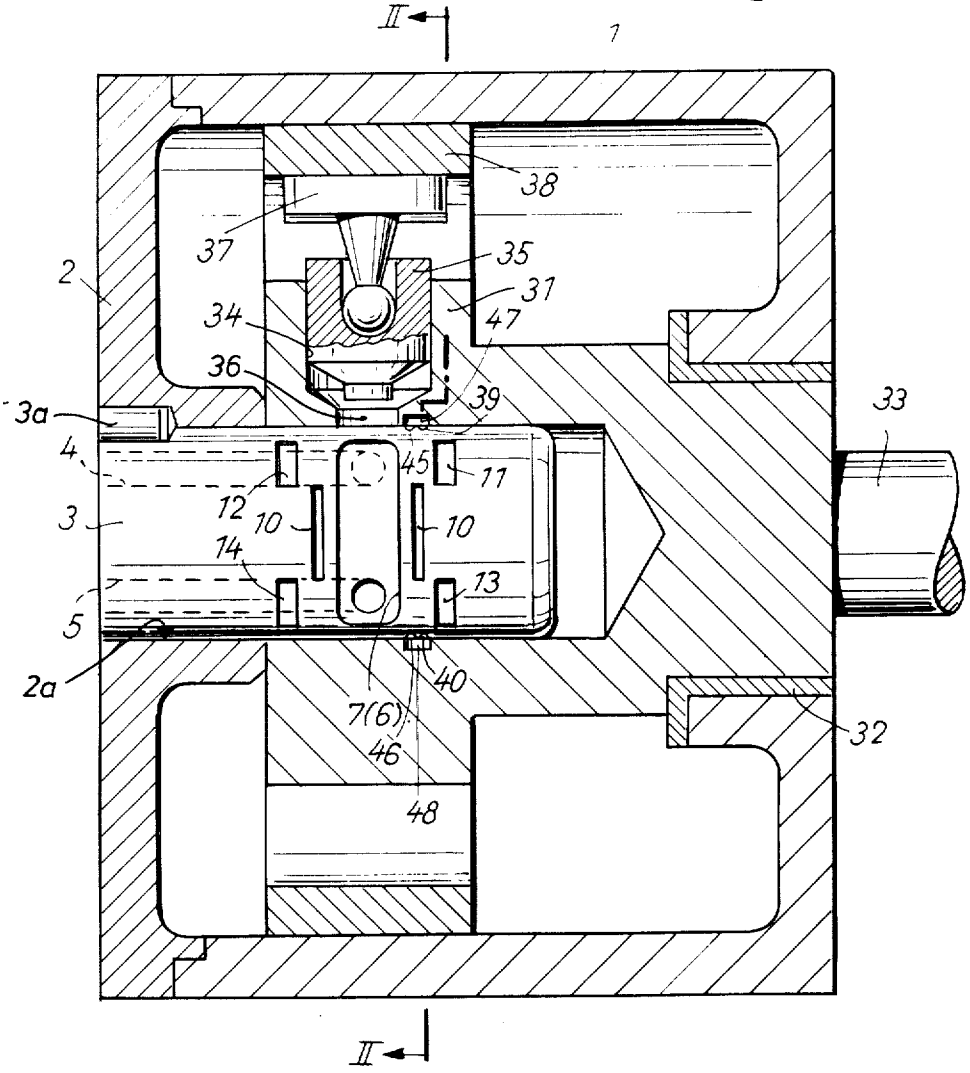
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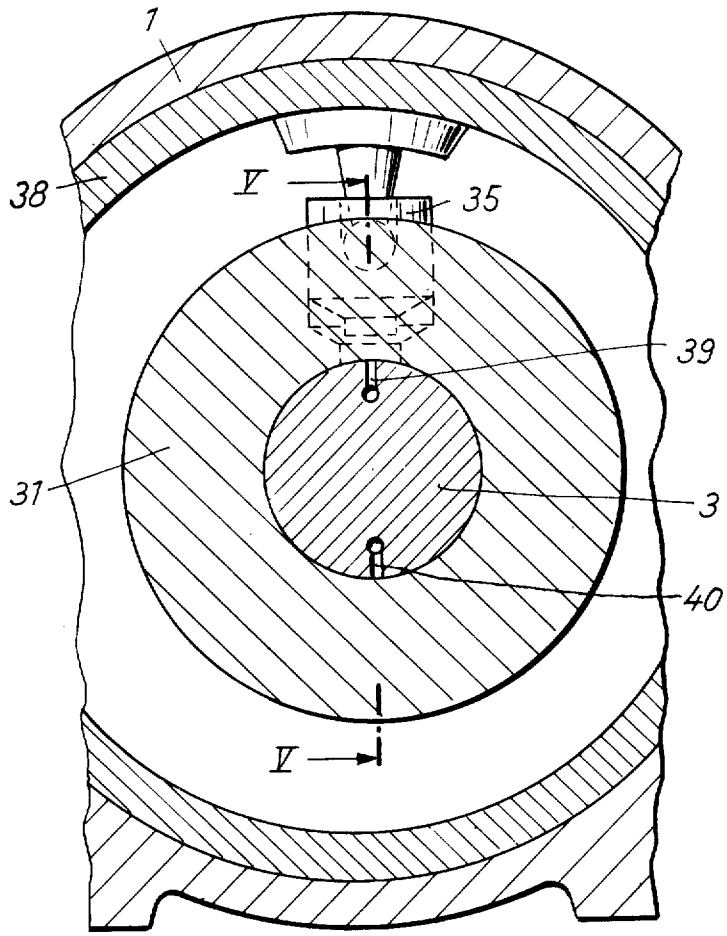
Fig. 2



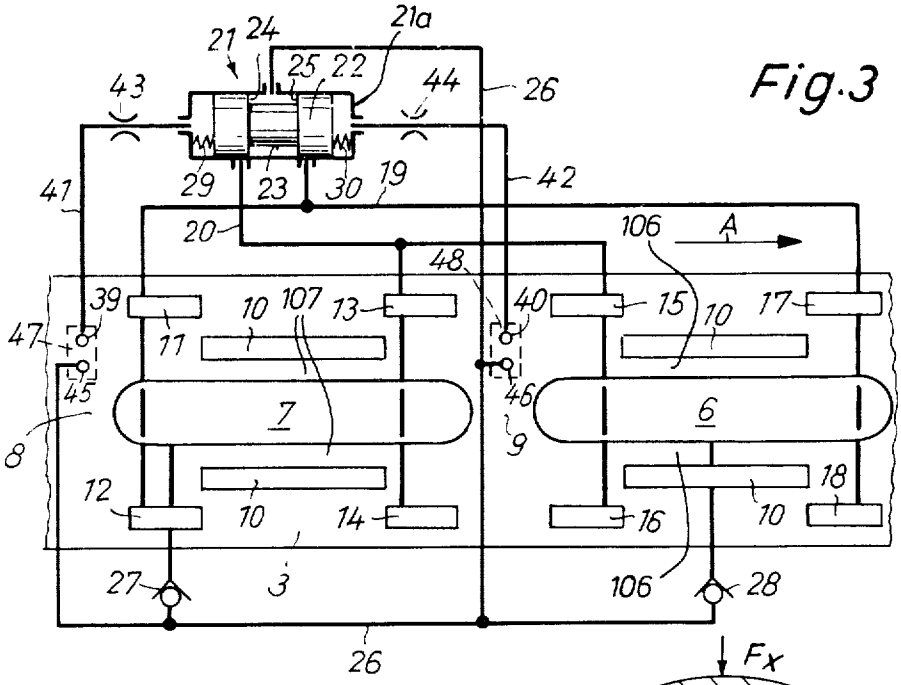


Fig.3

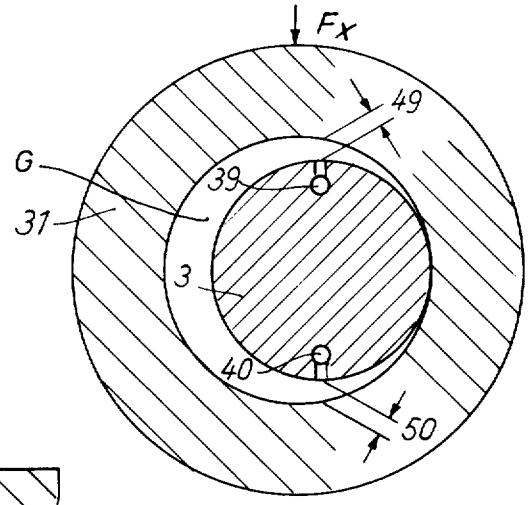


Fig.4

Fig.5

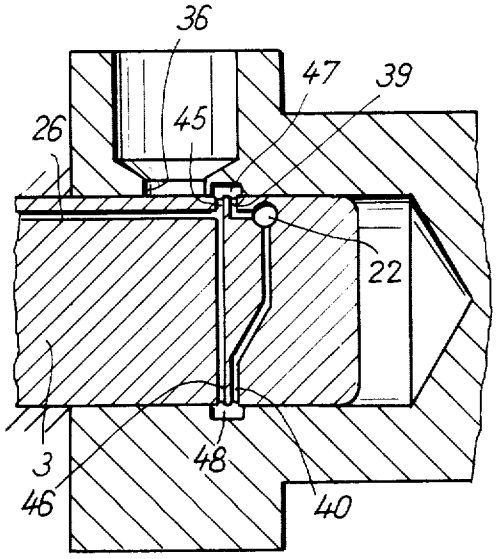


Fig.6

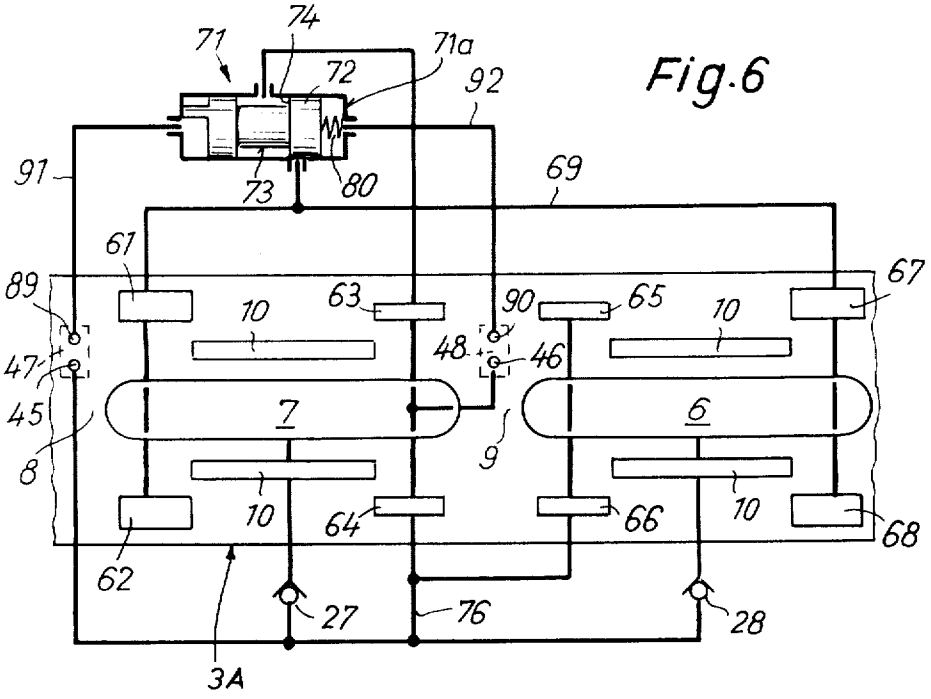

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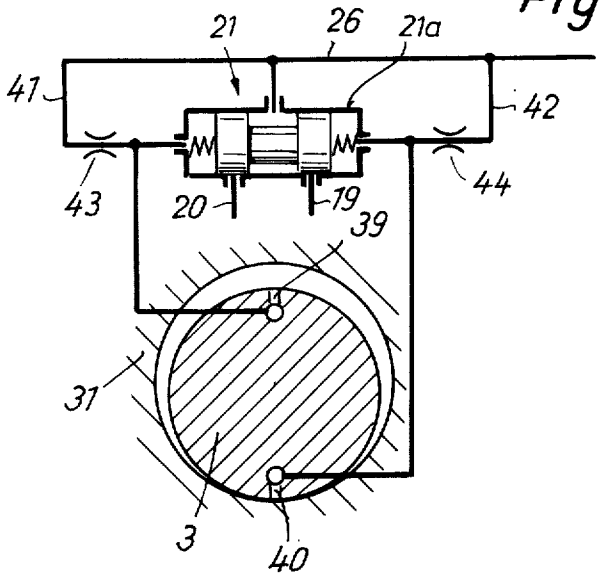
Fig.7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RADIAL PISTON MACHINE

BACKGROUND OF THE INVENTION

The present invention relates to radial piston machines in general, and more particularly to improvements in radial piston machines of the type wherein the pintle around which the cylinder block rotates is provided with a high-pressure control chamber and a low-pressure control chamber located diametrically opposite the high-pressure control chamber. Still more particularly, the invention relates to radial piston machines of the type wherein the peripheral surface of the pintle is formed with recesses which can be connected with the high-pressure side of the machine so that the pressurized fluid therein opposes the movement of the adjacent portion of the cylinder block toward the pintle.

German Offenlegungsschrift No. 1,453,628 discloses a radial piston machine wherein the outer ends of the pistons in radial cylinders of the cylinder block engage rollers which in turn engage the cylindrical internal surface of a rotary slide block serving to effect reciprocatory movements of pistons in response to rotation of the cylinder block about the pintle. The slide block rotates the cylinder block when the machine is used as a pump and the cylinder block rotates the slide block when the machine is used as a motor.

The means for centering the cylinder block on the pintle comprises two recesses which are machined into the peripheral surface of the pintle diametrically opposite each other and each of which extends along an arc of approximately 160°. Both recesses are connected with the high-pressure control chamber by way of bores machined into the pintle and containing one-way check valves which permit fluid to flow from the high-pressure chamber but not in the opposite direction. The fluid pressure in the recesses must be high enough to insure that the cylinder block cannot move away from the pintle in the region of the high-pressure control chamber.

A drawback of the just described radial piston machine is that the high-pressure control chamber is directly connected with the recesses in the peripheral surface of the pintle. This causes excessive leakage of fluid, especially if the gap or clearance between the peripheral surface of the pintle and the internal surface of the cylinder block is relatively wide. On the other hand, the just described machine must be formed with a relatively wide gap between the pintle and the cylinder block because the temperature of the pintle often exceeds the temperature of the cylinder block so that the dimensions of the pintle increase radially and the pintle is likely to frictionally engage the cylinder block except if the gap between these parts is sufficiently wide to allow for maximum contemplated radial expansion of the pintle.

SUMMARY OF THE INVENTION

An object of the invention is to provide a radial piston machine which can be used as a pump or motor and wherein the width of the gap between the peripheral surface of the pintle and the internal surface of the cylinder block can be reduced without risking excessive wear on these parts and with automatic centering of the cylinder block on the pintle.

Another object of the invention is to provide novel and improved means for connecting the high-pressure side of the radial piston machine with selected recesses in the peripheral surface of the pintle to thereby counteract the tendency of the cylinder block to move away from the pintle in the region of the high-pressure control chamber and/or in the region where the pistons in the cylinder block approach the peripheral surface of the pintle.

A further object of the invention is to provide a novel and improved regulating valve for controlling the flow of pressurized fluid between the high-pressure control chamber of the pintle and selected recesses in the peripheral surface of the pintle.

An additional object of the invention is to provide a radial piston machine wherein the regulating valve is installed in the pintle in a novel and improved way and wherein the leakage of fluid between the pintle and the cylinder block is less pronounced than in heretofore known radial piston machines.

Another object of the invention is to provide a radial piston machine wherein the cylinder block is closely adjacent to the high-pressure chamber of the pintle without excessive leakage of fluid between the pintle and the cylinder block.

A further object of the invention is to provide a radial piston machine wherein the width of the gap between the cylinder block and the pintle in the region of the high-pressure control chamber is small during each stage of operation of the machine and such gap is disposed symmetrically with respect to the center of the high-pressure chamber.

The invention is embodied in a radial piston machine which comprises a pintle having a peripheral surface formed with high-pressure and low-pressure control chambers which are located diametrically opposite each other and with first and second groups of communicating recesses whereby each such group includes at least one recess (but preferably two recesses which are aligned with each other as considered in the axial direction of the pintle) adjacent to the high-pressure chamber and at least one recess adjacent to the low-pressure chamber, a rotary cylinder block having a cylindrical internal surface surrounding the pintle and defining with the peripheral surface of the pintle a gap wherein the fluid leaks from the high-pressure control chamber, a plurality of radially extending cylinders machined into the cylinder block and arranged to communicate alternately with the high- and low-pressure chambers in response to rotation of the cylinder block about the pintle, fluid displacing pistons movably mounted in the cylinders, means for reciprocating the pistons in the respective cylinders in response to rotation of the cylinder block, regulating valve means having an inlet connected with the high-pressure control chamber, at least one outlet connected with one group of recesses in the peripheral surface of the pintle, and a spool or an analogous valve member normally assuming in the body of the regulating valve means a neutral position in which the inlet is sealed from the outlet, and means for moving the valve member from its neutral position in response to development of a pressure differential between two predetermined portions of the gap which are located diametrically opposite each other whereby the valve member permits pressurized fluid to flow from the inlet to the one group of recesses wherein the fluid effects a change in the radial position of the cylinder block relative to the pintle so as to equalize the fluid pressure in the two predetermined portions of the gap, i.e., to insure that the width of one predetermined por-

tion equals the width of the other predetermined portion.

The recesses in the peripheral surface of the pintle are preferably disposed at both sides of each control chamber, as considered in the axial direction of the pintle.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved radial piston machine itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific embodiments with reference to the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a sectional view of a radial piston machine which embodies one form of the invention;

FIG. **2** is a fragmentary sectional view as seen in the direction of arrows from the line II—II of FIG. **1**;

FIG. **3** is a fragmentary developed view of the pintle in the machine of FIG. **1**, further showing a regulating valve which controls the flow of pressurized fluid to recesses in the peripheral surface of the pintle;

FIG. **4** illustrates a portion of the structure shown in FIG. **2**, the width of the gap between the pintle and the cylinder block being greatly exaggerated for the sake of clarity;

FIG. **5** is a fragmentary sectional view as seen in the direction of arrows from the line V—V of FIG. **2**;

FIG. **6** is a view similar to that of FIG. **3** but showing a modified pintle and a modified regulating valve; and

FIG. **7** is a fragmentary partly diagrammatic and partly sectional view of a radial piston machine which constitutes a further modification of the machine shown in FIGS. **1** to **5**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to FIGS. **1** to **5**, there is shown a radial piston machine which can be used as a pump or motor. The machine comprises a housing **1** having a cover **2** which is provided with a centrally located bore **2***a* for a stationary pintle or valve **3**. The means for holding the pintle **3** against rotation in the housing **1** comprises a pin **3***a* which is inserted into recesses provided therefor in the cover **2** and pintle **3**. The pintle **3** is formed with a pair of axially extending bores **4, 5** which respectively communicate with elongated control chambers **6, 7** machined into the peripheral surface of the pintle. It is assumed that the machine is operated as a pump and that the control chambers **6** and **7** respectively constitute a low-pressure control chamber and a high-pressure control chamber. As shown in FIG. **3**, each of the control chambers **6, 7** extends circumferentially of the pintle **3** along an arc of a little less than 180°. The means for separating the control chambers from each other comprises two platforms or lands **8, 9** shown in FIG. **3**. The control chambers **6, 7** and the lands **8, 9** have a common symmetry plane which is normal to the axis of the pintle **3** and extends horizontally, as viewed in FIG. **3**. The width of the lands **8** and **9**, as considered in the circumferential direction of the pintle **3**, is selected in such a way that the control chamber **6** is never in direct communication with the control chamber **7** irrespective of the momentary condition of the radial piston machine, i.e., irrespective of the angular position of a cylinder block **31** which rotates in the housing **1** about the pintle.

Each of the control chambers **6, 7** is flanked by a pair of elongated grooves **10** (FIG. **3**) which define with the respective control chambers pairs of elongated sealing projections or ribs **106, 107**. The pressurized fluid which leaks from the high-pressure control chamber **7** toward the respective grooves **10** flows between the internal surface of the cylinder block **31** and the sealing projections **107** to establish pressure fields which oppose a movement of the internal surface of the cylinder block toward the control chamber **7** and the sealing projections **107**. Weaker pressure fields develop between the internal surface of the cylinder block **31** and the sealing projections **106** which flank the control chamber **6**.

The peripheral surface of the pintle **3** is further provided with eight substantially rectangular recesses or depressions **11, 12, 13, 14, 15, 16, 17** and **18**. The recesses **11, 13, 15** and **17** are disposed at one side and the recesses **12, 14, 16, 18** are disposed at the other side of the control chambers **6** and **7**, as considered in the axial direction of the pintle **3**. Also, the recesses **11, 13, 15, 17** are respectively aligned with the recesses **12, 14, 16, 18**, as considered in the axial direction of the pintle **3**, and all of the recesses are assumed to have the same size, shape and depth. The recesses **11, 12** and **13, 14** are respectively adjacent to the lands **8** and **9**, and the recesses **15, 16** and **17, 18** are respectively adjacent to the lands **9** and **8**. As shown in FIG. **3**, the combined length of a groove **10** and two recesses equals or approximates the length of a control chamber, as considered in the circumferential direction of the pintle **3**. Each recess is relatively shallow and the common central symmetry plane of the recesses **11, 13, 15, 17** is parallel to the common central symmetry plane of the recesses **12, 14, 16, 18**; each of these symmetry planes is normal to the axis of the pintle **3**.

The recesses **11, 12** and **17, 18** form a first group or set of four recesses which communicate with a common channel or conduit **19** machined into the pintle **3**. A second channel or conduit **20** connects the recesses **13-16** which form a second group or set of four recesses. It will be noted that each such group comprises two recesses which are adjacent to the control chamber **6** and two recesses which are adjacent to the control chamber **7**. The inlets of the conduits **19, 20** are connected with the two outlets of a regulating valve **21** here shown as a three-position two-way directional control valve having a body **21***a* and a reciprocable valve member or spool **22**. The smaller-diameter median portion of the spool **22** defines with the internal surface of the body **21***a* an annular compartment **23** communicating with the outlet of a pressure line **26** which is connected to the high-pressure side of the radial piston machine. The annular compartment **23** is disposed between two plungers **24, 25** of the spool **22**; these plungers can respectively seal the pressure line **26** from the conduits **20** and **19**, depending on the axial position of the spool.

As shown in FIg. **3**, the pressure line **26** is connected with the control chambers **6** and **7** by branches respectively containing one-way check valves **28, 27**. In the embodiment of FIGS. **1** to **5**, the pressure line **26** is communication with the high-pressure control cham-

ber 7 but is sealed from the low-pressure control chamber 6.

The compartments at the ends of the valve body 21*a* receive helical springs 29, 30 tending to maintain the spool 22 in a neutral position in which the plungers 24, 25 respectively seal the pressure line 26 from the conduits 20 and 19. The spool 22 automatically assumes such neutral position when the pressure in the line 26 drops to a predetermined minimum value.

The cylinder block 31 is installed in a friction bearing 32 of the housing 1 and is provided with a shaft 33 which is driven by a suitable prime mover (not shown) when the radial piston machine is operated as a pump. When the machine is operated as a motor, the shaft 33 is driven by the cylinder block 31. The latter is formed with a number of equidistant radially extending cylinders 34 for pistons 35. Each cylinder 34 has a conical inner end portion whose diameter decreases toward the periphery of the pintle 3 and which communicates with a port 36 of the cylinder block 31. Successive ports 36 travel along the control chamber 6, land 8, control chamber 7 and land 9 when the cylinder block 31 is rotated in the direction indicated by arrow A in FIG. 3 of the drawing. Each piston 35 is a tight sliding fit in the respective cylinder 34 and each thereof comprises an arcuate head or shoe 37 engaging the internal surface of a ring-shaped slide block 38. In the embodiment shown in FIGS. 1 and 2 the slide-block 38 is installed excentrically relative to the axis of the pintle 3. In other embodiments the slide-block 38 can be movable radially of the pintle 3 in a manner not forming part of the invention to thereby change the stroke of the pistons 35. The stroke of each piston 35 is zero when the axis of the slide block 38 coincides with the axis of the pintle 3.

The axial position of the spool 22 in the body 21*a* of the regulating valve 21 can be adjusted by pressurized fluid which is admitted via conduit 41 or 42. The conduit 41 communicates with that compartment of the body 21*a* which receives the spring 29, and the conduit 42 can admit pressurized fluid to the compartment for the spring 30. The inlet 39 of the conduit 41 communicates with a first portion of the gap G (see FIG. 4) between the cylindrical internal surface of the cylinder block 31 and the peripheral surface of the pintle 3, and the inlet 40 of the conduit 42 communicates with a second portion of this gap which is located diametrically opposite the first portion.

The inlets 39 and 40 are radial bores machined into the pintle 3, and the pressure line 26 communicates with two similar radial bores 45, 46 which are respectively adjacent to the bores 39, 40. The flow of fluid in the conduits 41, 42 is respectively throttled by preferably adjustable flow restrictors 43, 44.

The internal surface of the cylinder block 31 is provided with two shallow cutouts or cavities 47, 48 which sweep past the grooves 10 between the control chambers 6, 7 and recesses 11, 13, 15, 17 when the cylinder block 31 rotates. The cutouts 47, 48 are located diametrically opposite each other and are dimensioned in such a way that they can establish short-lasting communication between the radial bores 39, 45 and 40, 46 when the cylinder block 31 rotates.

The manner in which the fluid is pressurized when the radial piston machine operates as a pump or in which the pressurized fluid rotates the shaft 33 when the machine is used as a motor is well known in the art and need not be described here. The purpose of the recesses 11 to 18 will be explained with reference to FIG. 4 which shows the gap G between the peripheral surface of the pintle 3 and the internal surface of the cylinder block 31. The width of the gap is greatly exaggerated for the sake of clarity. In FIG. 4, the position of the cylinder block 31 with respect to the pintle 3 corresponds to that shown in FIG. 1 or 2. When the cylinder block 31 rotates, fluid in the conduits 41, 42 transmits simultaneous pressure impulses to the corresponding end faces of the spool 22 (whenever the cutout 47 or 48 respectively establishes communication between the bores 39, 45 or 40, 46). The magnitude of such pressure impulses depends on the fluid pressure at the pressure side of the machine, on the number and duration of impulses, and on the width of the gap portions 49, 50 shown in FIG. 4, i.e., the width of those portions of the gap G between the pintle 3 and cylinder block 31 which are respectively adjacent to the bores 39 and 40 in the pintle. If the width of the gap portion 49 is less than the width of the gap portion 50, the pressure in the compartment for the spring 29 of the regulating valve 21 will exceed the pressure in the compartment for the spring 30. Consequently, the spool 22 moves in a direction to the right, as viewed in FIG. 3, and the plunger 25 allows pressurized fluid to flow from the pressure line 26, via compartment 23, and into the conduit 19 which allows such fluid to flow into the recesses 11, 12, 17 and 18. The fluid pressure in these recesses rises accordingly and causes the cylinder block 31 to move upwardly, as viewed in FIG. 4, so that the width of the gap portion 50 increases while the width of the gap portion 49 decreases. This brings about an equalization of the widths of gap portions 49, 50 with the result that the fluid pressure in the compartment for the spring 30 equals the fluid pressure in the compartment for the spring 29. Consequently, the spool 22 reassumes its neutral position and seals the pressure line 26 from the conduit 19. Such position of the cylinder block 31 (in which the width of the gap portion 49 equals the width of the gap portion 50) is shown in FIG. 4.

The adjustment in the position of cylinder block 31 with respect to the pintle 3 is analogous when the width of the gap portion 50 exceeds the width of the gap portion 49. The pressure in the compartment for the spring 30 then exceeds the pressure in the compartment for the spring 29 so that the plunger 24 of the spool 22 allows pressurized fluid to flow from the line 26 into the recesses 13-16 whereby the cylinder block 31 moves downwardly, as viewed in FIG. 4, i.e., the width of the gap portion 49 increases while the width of the gap portion 50 decreases. The just mentioned adjustment of the cylinder block 31 with respect to the pintle 3 is independent of the direction of rotation of the cylinder block and/or of the pressure in the control chambers 6, 7, i.e., the control chamber 6 or 7 may constitute the high-pressure control chamber.

The number of cutouts in the internal surface of the cylinder block 31 and the throttling action of the flow restrictors 43, 44 can be readily selected in such a way that the cylinder block 31 is properly centered within short intervals of time and without appreciable vibration. This reduces the leakage of pressurized fluid and the wear upon the parts 3 and 31.

FIG. 5 shows that the regulating valve 21 may be installed directly in the pintle 3, i.e., the body 21*a* may constitute an integral part of the pintle. The spool 22

is reciprocable in a direction which is normal to the axis of the pintle and this spool is installed in a bore which is adjacent to the inner end portion of the pintle, i.e., that end portion which is nearest to the shaft **33** of FIG. **1.** Such mounting of the regulating valve allows for a reduction of the length of conduits **19, 20, 26, 41** and **42.**

FIG. **6** illustrates a portion of a simplified radial piston machine. All such parts which are identical with or clearly analogous to the corresponding parts of the radial piston machine of FIGS. **1** to **5** are denoted by similar reference characters. The main difference is that the peripheral surface of the pintle **3A** is formed with recesses having different areas. The smaller recesses **63-66** (which correspond to the recesses **13-16**) are directly connected with the pressure line **76** (which corresponds to the pressure line **26**), and the larger recesses **61, 62, 67, 68** (which correspond to the recesses **11**, 12, 17, 18) are connected with a channel or conduit **69** corresponding to the conduit **19.** The area of each larger recess is assumed to equal twice the area of a smaller recess. The regulating valve **71** has a body **71***a*, a spool **72**, a compartment **73** which communicates with the pressure line **76**, a single spring **80**, and an outlet which communicates with the inlet of the conduit **69** and can be sealed by the right-hand plunger **74** of the spool **72.** The radial bores **89, 90** of the pintle **3A** respectively correspond to the radial bores **39, 40** of the pintle **3**, and the conduits **91, 92** respectively correspond to the conduits **41, 42** of FIG. **3.** When the pressure in the line **76** drops to a predetermined value, the spring **80** is free to expand and maintains the spool **72** in the neutral position of FIG. **6** in which the plunger **74** seals the line **76** from the conduit **69.** The construction of the cylinder block (see the cutouts **47, 48**) is the same as that of the cylinder block **31.**

The operation is as follows:

The machine which embodies the structure of FIG. **6** regulates the fluid pressure in the recesses **61, 62, 67,** 68 but not in the recesses **63-66** (which are in permanent communication with the high-pressure side of the machine). If the width of the gap between the cylinder block and the pintle **3A** in the region of the bore **90** exceeds the width of the gap in the region of the bore **89,** the spool **72** is shifted in a direction to the right, as viewed in FIG. **6,** whereby the plunger **74** allows pressurized fluid to flow from the line **76** to the conduit **69** and recesses **61, 62, 67, 68** as long as the pressure in the bore **90** exceeds the pressure in the bore **89.** When the pressure in the bore **90** matches the pressure in the bore **89,** the spool **72** reassumes the neutral position of FIG. **6.**

The hydrostatically effective area of the smaller recesses **63-66** should be selected in such a way that the component Fx (see FIG. **4**) of the force furnished by the pistons **35** in the cylinder block is fully balanced by the pressure of fluid in the recesses **63-66** even when the slide block **38** assumes a position of maximum eccentricity with respect to the pintle. The pressure in the larger recesses **61, 62, 67, 68** is relatively small, e.g., in the range of 1 bar.

In certain instances, the bores **39, 40** or **89, 90** can receive a continuous supply of pressurized fluid, i.e., not in the form of discrete impulses. To this end, and referring to FIG. **7** which shows a modification of the machine illustrated in FIGS. **1** to **5,** the conduits **41, 42** are in permanent communication with the pressure line **26** and the bores **39, 40** communicate with the conduits **41, 42** between the respective flow restrictors **43, 44** and the corresponding compartments of the valve body **21***a*. The arrangement of FIG. **7** thus dispenses with the cutouts in the internal surface of the cylinder block as well as with the bores **45, 46** of the pintle.

The features of the machine shown in FIGS. **1–5, 6** and **7** can be resorted to irrespective of whether the machine is used as a pump or motor.

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 which fairly constitute essential characteristics of the generic and specific aspects of my contribution to the art and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the claims.

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

1. In a radial piston machine, a combination comprising a pintle having a peripheral surface provided with a high-pressure chamber, a low-pressure chamber located diametrically opposite said high-pressure chamber, and first and second groups of communicating recesses, each of said groups including at least one recess adjacent to said high-pressure chamber and at least one recess adjacent to said low-pressure chamber; a rotary cylinder block having a cylindrical internal surface surrounding said peripheral surface and defining therewith a gap wherein the fluid leaks from said high-pressure chamber, said cylinder block having a plurality of radially extending cylinders arranged to communicate alternately with said chambers in response to rotation of said cylinder block; fluid displacing pistons mounted in said cylinders; means for reciprocating said pistons in response to rotation of said cylinder block; regulating valve means having an inlet connected with said high-pressure chamber, at least one outlet connected with one of said groups of recesses, and a valve member normally assuming a neutral position in which said inlet is sealed from said outlet; and means for moving said valve member from said neutral position in response to development of a pressure differential between two predetermined portions of said gap which are located diametrically opposite each other whereby said valve member permits fluid to flow from said inlet to said one group of recesses wherein the fluid effects a change in the radial position of said cylinder block relative to said pintle so as to equalize the pressure in said predetermined portions of said gap, comprising first and second conduits each communicating with a different predetermined portion of said gap and flow restrictor means provided in each of said conduits, said conduits being connected with said regulating valve means at the opposite sides of said valve member and comprising inlets constituting radial bores provided in said pintle, said bores being disposed between said recesses and said chambers, as considered in the axial direction of said pintle.

2. In a radial piston machine, a combination comprising a pintle having a peripheral surface provided with a high-pressure chamber, a low-pressure chamber located diametrically opposite said high-pressure chamber, and first and second groups of communicating recesses, each of said groups including at least one recess adjacent to said high-pressure chamber and at least one

recess adjacent to said low-pressure chamber, the area of each recess of one of said groups being substantially twice the area of a recess of the other of said groups and said high-pressure chamber being in permanent communication with the recesses of said other group; a rotary cylinder block having a cylindrical internal surface surrounding said peripheral surface and defining therewith a gap wherein the fluid leaks from said high-pressure chamber, said cylinder block having a plurality of radially extending cylinders arranged to communicate alternately with said chambers in response to rotation of said cylinder block; fluid displacing pistons mounted in said cylinders; means for reciprocating said pistons in response to rotation of said cylinder block; regulating valve means having an inlet connected with said high-pressure chamber, at least one outlet connected with said one group of recesses, and a valve member normally assuming a neutral position in which said inlet is sealed from said outlet; and means for moving said valve member from said neutral position in response to development of a pressure differential between two predetermined portions of said gap which are located diametrically opposite each other whereby said valve member permits fluid to flow from said inlet to said one group of recesses wherein the fluid effects a change in the radial position of said cylinder block relative to said pintle so as to equalize the pressure in said predetermined portions of said gap.

3. A combination as defined in claim **2,** wherein said regulating valve means further comprises a body for said valve member and a resilient element arranged to bias said valve member to said neutral position.

4. In a radial piston machine, a combination comprising a pintle having a peripheral surface provided with a high-pressure chamber, a low-pressure chamber located diametrically opposite said high-pressure chamber, and first and second groups of communicating recesses, each of said groups including at least one recess adjacent to said high-pressure chamber and at least one recess adjacent to said low-pressure chamber; a rotary cylinder block having a cylindrical internal surface surrounding said peripheral surface and defining therewith a gap wherein the fluid leaks from said high-pressure chamber, said cylinder block having a plurality of radially extending cylinders arranged to communicate alternately with said chambers in response to rotation of said cylinder block; fluid displacing pistons mounted in said cylinders; means for reciprocating said pistons in response to rotation of said cylinder block; regulating valve means comprising a body having an inlet connected with said high-pressure chamber and at two outlets each connected with a different group of said recesses, a valve member defining with said body a compartment in communication with said inlet and normally assuming in said body a neutral position in which said inlet is sealed from said outlets; and means for moving said valve member from said neutral position to a first position in response to development of a pressure differential between two predetermined portions of said gap which are located diametrically opposite each other whereby said valve member establishes communication between said compartment and said one group of recesses and permits fluid to flow from said inlet to said one group of recesses wherein the fluid effects a change in the radial position of said cylinder block relative to said pintle so as to equalize the pressure in said predetermined portions of said gap, said valve member being further movable from said neutral position to a second position in which said compartment communicates with the other group of said recesses.

5. A combination as defined in claim **4,** wherein said valve member is reciprocable between said positions thereof and said regulating valve means further comprises springs installed in said body and arranged to bias said valve member to said neutral position.

6. In a radial piston machine, a combination comprising a pintle having a peripheral surface provided with a high-pressure chamber, a low-pressure chamber, located diametrically opposite said high-pressure chamber and first and second groups of communicating recesses, each of said groups including at least one recess adjacent to said high-pressure chamber and at least one recess adjacent to said low-pressure chamber; a rotary cylinder block having a cylindrical internal surface surrounding said peripheral surface and defining therewith a gap wherein the fluid leaks from said high-pressure chamber, said cylinder block having a plurality of radially extending cylinders arranged to communicate alternately with said chambers in response to rotation of said cylinder block; fluid displacing pistons mounted in said cylinders; means for reciprocating said pistons in response to rotation of said cylinder block; regulating valve means having an inlet connected with said high-pressure chamber, at least one outlet connected with one of said groups of recesses, and a valve member normally assuming a neutral position in which said inlet is sealed from said outlet; means for moving said valve member from said neutral position in response to development of a pressure differential between two predetermined portions of said gap which are located diametrically opposite each other whereby said valve member permits fluid to flow from said inlet to said one group of recesses wherein the fluid effects a change in the radial position of said cylinder block relative to said pintle so as to equalize the pressure in said predetermined portions of said gap, comprising first and second conduits each communicating with a different predetermined portion of said gap and flow restrictor means provided in each of said conduits, said conduits being connected with said regulating valve means at the opposite sides of said valve member and comprising inlets constituting radial bores provided in said pintle; and a pressure line connecting said high-pressure chamber with the inlet of said regulating valve means, said pintle having two additional radial bores each adjacent to one of said first mentioned radial bores and each communicating with said pressure line.

7. A combination as defined in claim **6,** wherein said internal surface of said cylinder block is provided with cutouts each arranged to temporarily connect said additional bores with the adjacent first mentioned bores during each revolution of said cylinder block.

8. In a radial piston machine, a combination comprising a pintle having a peripheral surface provided with a high-pressure chamber, a low-pressure chamber located diametrically opposite said high-pressure chamber, and first and second groups of communicating recesses, each of said groups comprising a pair of recesses adjacent to said high-pressure chamber and a pair of recesses adjacent to said low-pressure chamber, the recesses of each of said pairs being disposed at the opposite sides of the respective chamber, as considered in the axial direction of said pintle; a rotary cylinder block having a cylindrical internal surface surrounding said

peripheral surface and defining therewith a gap wherein the fluid leaks from said high-pressure chamber, said cylinder block having a plurality of radially extending cylinders arranged to communicate alternately with said chambers in response to rotation of said cylinder block; fluid displacing pistons mounted in said cylinders; means for reciprocating said pistons in response to rotation of said cylinder block; regulating valve means having an inlet connected with said high-pressure chamber, at least one outlet connected with one of said groups of recesses, and a valve member normally assuming a neutral position in which said inlet is sealed from said outlet; and means for moving said valve member from said neutral position in response to development of a pressure differential between two predetermined portions of said gap which are located diametrically opposite each other whereby said valve member permits fluid to flow from said inlet to said one group of recesses wherein the fluid effects a change in the radial position of said cylinder block relative to said pintle so as to equalize the pressure in said predetermined portions of said gap.

9. A combination as defined in claim **8,** further comprising a pressure line connecting said inlet with said chambers and check valves provided in said line to prevent the flow of fluid from said inlet to said chambers.

10. A combination as defined in claim **1,** wherein said means for moving said valve member comprises first and second conduits each communicating with a different predetermined portion of said gap, said conduits being connected with said regulating valve means at the opposite sides of said valve member and said means for moving said valve member further comprising flow restrictor means provided in each of said conduits.

11. A combination as defined in claim **8,** wherein said regulating valve means is installed in said pintle.

12. A combination as defined in claim **11,** wherein said valve member is reciprocable in a direction at right angles to the axis of said pintle.

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