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H. MOLLY
AXIAL PISTON PUMP
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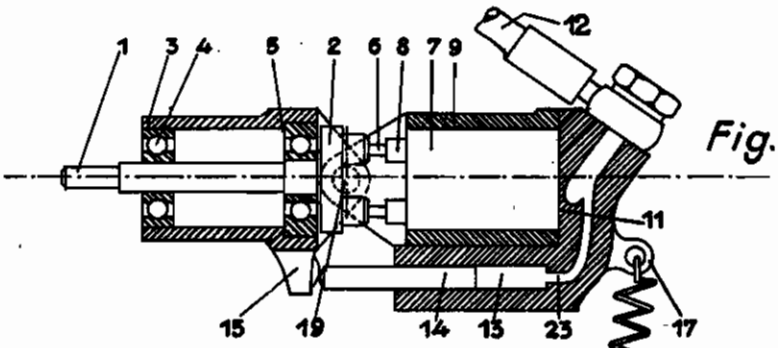


Fig. 1

Fig. 2

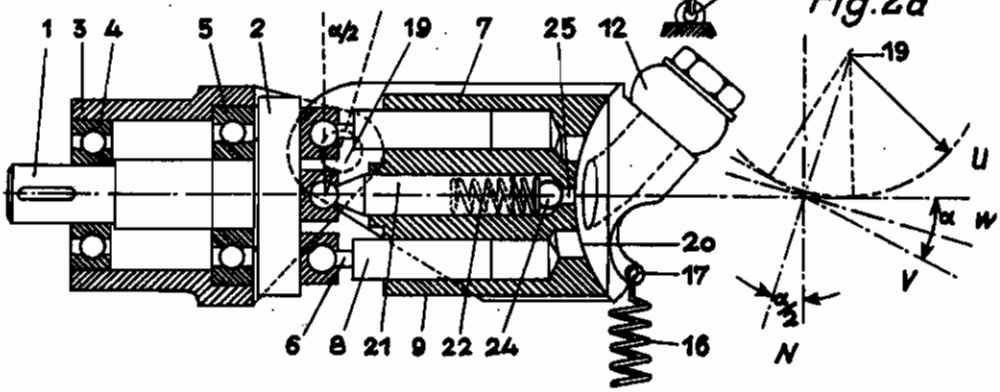


Fig. 2a




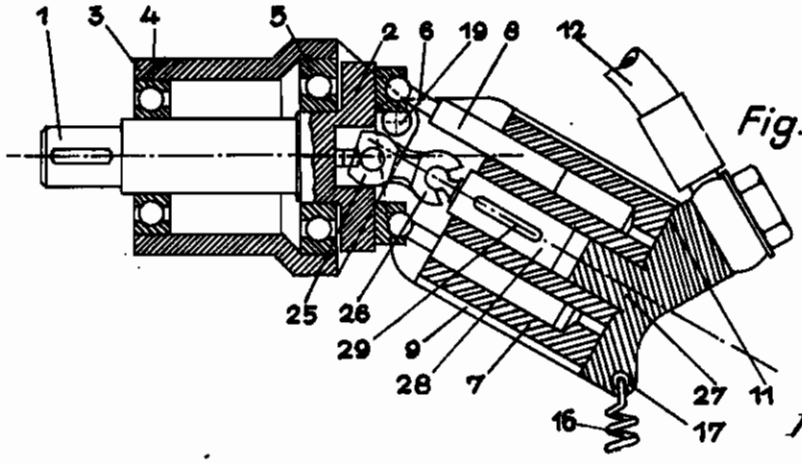


Fig. 3

Inventor
Hans Molly

By A. D. Adams

Attorney

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# ALIEN PROPERTY CUSTODIAN

## AXIAL PISTON PUMP

Hans Molly, Berlin-Tempelhof, Germany; vested in the Alien Property Custodian

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The invention relates to axial piston pumps with adjustable stroke. A known form of pressure regulation and pressure restriction in such pumps consists in a pump pressure responsive element, for instance a piston automatically adjusting the stroke adjusting member in the sense of a stroke reduction as soon as a certain pressure is being exceeded. In such axial piston pumps two forces balancing one another are as a rule brought to bear upon the stroke adjusting member, namely an external force urging the stroke adjusting member towards its maximal stroke position and a force exerted by the pressure control element tending to return said member to the zero position. Thus a certain pump pressure will always be automatically produced corresponding to the respective amount of the external force. Such devices are used for instance for driving hydraulic machine tools, retracting devices for landing gear or the like, i. e. in all cases where a stop is provided for the part to be moved by the hydraulic motor at the completed motion and where the pressure is prevented from increasing in an undesired manner at continued operation of the pump. Besides these instances calling for pressure restriction there are, however, quite a number of cases in which it may be desirable for the pump to possess a predetermined pressure characteristic.

The invention is based on the perception that it is possible to introduce an essential simplification in the construction of pressure regulating devices in axial piston pumps in which the cylinder block carrier is swingably mounted with a view to stroke adjustment. Instead of as hitherto providing in the pressure conduit of the pump a special element (cylinder with piston) acting on the stroke adjusting member, the requisite regulating forces may according to the invention be produced in the cylinder block carrier itself.

This may be done in such a way that a special pressure cylinder with piston is arranged in the cylinder block carrier, said piston being held in a fixed support. In such an arrangement the pressure responsive regulating element moves with the cylinder block, and special conduits and lever systems may be dispensed with. It is merely necessary to provide the regulating cylinder with a short channel leading to the contacting part of the control surface. This direct connection of the regulating cylinder and the pressure duct of the control surface, beside its obvious advantages, possesses the additional advantage that the pump pressure is produced in the regulating cylinder without retardation and the regulation thus operates free from any pendulous tendency.

A particularly advantageous arrangement consists in the cylinder block carrier being made swingable about an eccentric axis in such manner that the pressure produced in the pump cylinders acts upon the cylinder block carrier in the sense of a stroke reduction. In such cases the pressure in the working cylinder itself is thus used for regulation with the result that special regulation devices are not required. Hence the pressure regulation is achieved without any special constructional elements being necessary.

The invention is defined in greater detail in the following with reference to certain embodiments.

Fig. 1 of the drawings shows the embodiment of an axial piston pump in which the regulating force is produced by a special cylinder with piston, and

Fig. 2 another such pump in which the regulating force is obtained by means of the cylinder block carrier being swingable about an eccentric axis;

In Fig. 2*a* this eccentric support is additionally illustrated;

Fig. 3 is distinct from Fig. 2 in that the cylinder block is differently connected to the driving flange. In all figures the same reference characters designate identical parts.

In Fig. 1 the character 1 denotes the axis of the driving flange 2 which is supported in the housing 3 in ball bearings 4 and 5. Piston rods 6 are articulately connected with the driving flange 2, said piston rods 6 imparting to pistons 8 slidably arranged in a cylinder block 7 a reciprocating motion provided the axis of the cylinder block 7 is deflected relative to that of the driving flange 2. In the embodiment shown the pistons 6 via the pistons 8 serve to impart a follow-up movement to the cylinder block 7 which is not however an essential feature of the invention. The cylinder block 7 is rotably supported in a cylinder block carrier 9, the latter being swingable about an axis 10. The plane control surface 11 of the cylinder block 7 is connected on the one hand to the flexible pipe conduit 12 via respective control orifices, said conduit 12 leading to a consumption apparatus (not shown)—as for instance a pressure fluid motor—and is on the other hand connected via a channel 23 with a cylinder 13 arranged in the cylinder block carrier 9. In this cylinder 13 slides a piston 14 which is in turn supported against

a fixed support 15. Thus a force acts upon the cylinder block carrier 9 which in dependence on the pump pressure produced acts on said carrier in the sense of a stroke execution. The external stroke increasing force is produced by a spring 16 acting upon the cylinder block carrier 9 at the point 17 and at a fixed point 18.

The arrangement operates as follows: The pressure occurring in the conduit 12 at a certain pressure medium consumption via the piston 14 sliding in the cylinder 13 produces a force which tends to deflect the cylinder block carrier into its zero position, as of course this piston is supported against a fixed point. This force is counteracted by an external force produced by the spring 16 tending to deflect the cylinder block carrier 9 towards its maximum stroke position. The two forces balance one another so that a pressure may occur in the conduit 12 in dependence on the spring tension. The special piston 14 of Fig. 1 may be dispensed with if—as shown in Fig. 2—the cylinder block carrier 9 is not arranged centrically about an axis 10 but is swingable about an eccentric axis 19. In the latter case the pressure produced in the pump cylinder acts on the cylinder block carrier 9 in the sense of a stroke reduction. This embodiment further differs from that of Fig. 1 in that the control surface is not plane but—as previously proposed elsewhere—has the form of a sphere 20, in which case the support axially guiding the cylinder block is dispensed with. Naturally, however, it is equally possible to provide for a plane control surface. In any case it is, nevertheless, necessary that the cylinder block carrier 9 be articulately connected with the driving flange 2 via a special centering member 21 in a ball on said driving flange. In this way the support of the cylinder block is free from overdetermination. This kind of support allows the compensation for displacements due to kinematic conditions.

In the case now under consideration, in which the cylinder block carrier 9 is swinable around an eccentric axis 19, this kind of support is particularly important in so far as the position of the point of intersection of the cylinder block axis and the driving flange axis is always precisely determined by the centric gulding member 21, and the slight motions caused by the excentric position of the cylinder block carrier 9 relative to the cylinder block 7 due to the stroke adjustment are received by the control surface without disturbing effects.

The centering member 21 is acted upon by the tension of a spring 22 ensuring constant contacting of the cylinder block 7 with the control surface 20. In this connection it is advantageous to have the spring 22 simultaneously act on a check valve 24 connected with the high pressure side of a pump via a duct 25 and exert a dampening effect on the reversing motion of the cylinder block 7.

As shown in Fig. 2*a*, the eccentric pivot point 19 of the cylinder block carrier 9 lies in the normal N to the bisectrix W of the largest angle $\alpha$ possible between the axis of rotation U and the cylinder block carrier axis V, because this normal N is the geometrical point for all circle centers touching the axis of rotation U and the cylinder block carrier axis V and because in this position the smallest possible deviation of the axial intersection point from the desired intersection point is afforded with the result that the above described sliding motion of the cylinder block 9 on the control surface 20 at stroke adjustments is reduced to the smallest possible amounts.

The embodiment according to Fig. 3 similar to that shown in Fig. 2 possesses an excentric support 18 of the cylinder block carrier 9 and a plane control surface 11. In distinction from the embodiments before mentioned the cylinder block 7 does not however follow the movement of the piston rods 6 via the pistons 8, a double cardan joint 25, 26 being provided for causing the follow-up movement via a member 28, which is non-rotatably mounted in the cylinder block by means of a piston 29. A double cardan joint is required because, as mentioned above, the cylinder block 7 at a stroke adjustment undergoes slight displacements due to the eccentric support at 19. As in contrast to Fig. 2 the cylinder block is not supported between two spherical surfaces, it is necessary to guide the plane control surface by means of a special centering member 27.

The invention is not restricted to the embodiments described, there being further possibilities of construction by suitable combination of the details described above with other known features.

HANS MOLLY.