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PUMP, MORE PARTICULARLY AN AXIAL PISTON PUMP WITH ADJUSTABLE STROKE

Filed Aug. 10, 1940

Serial No. 352,147

2 Sheets-Sheet 1

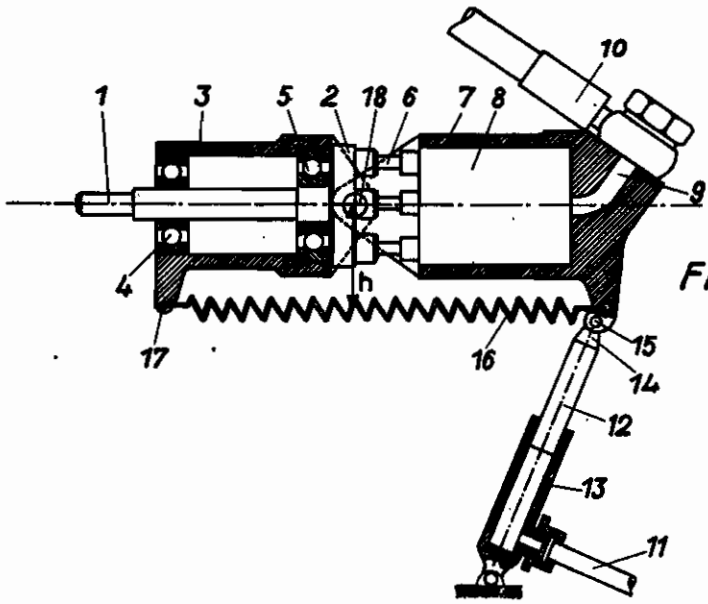

Fig. 1

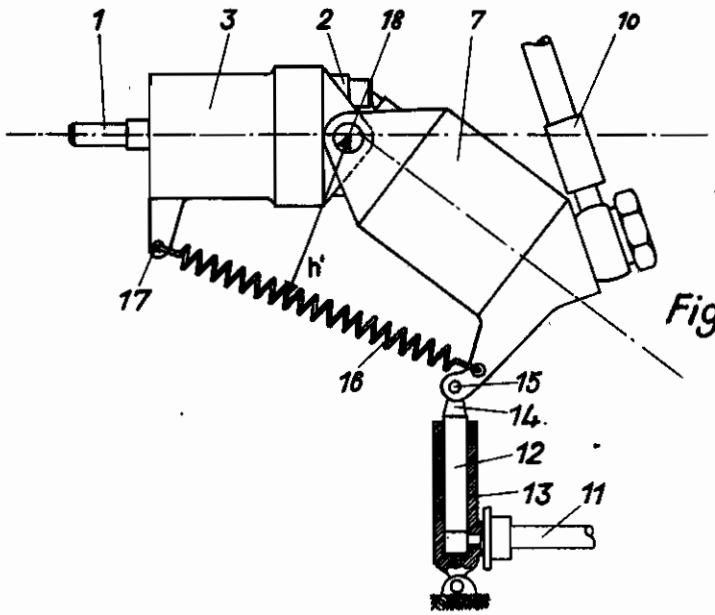

Fig. 1a

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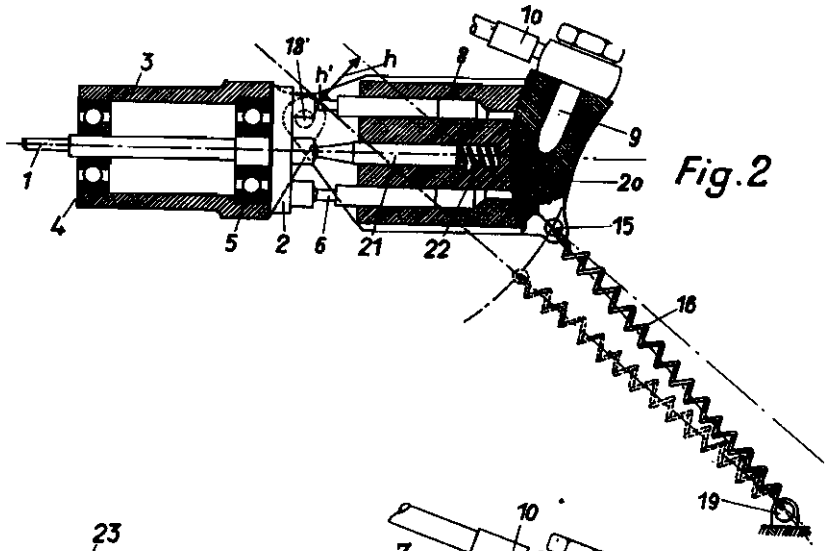

Fig.2

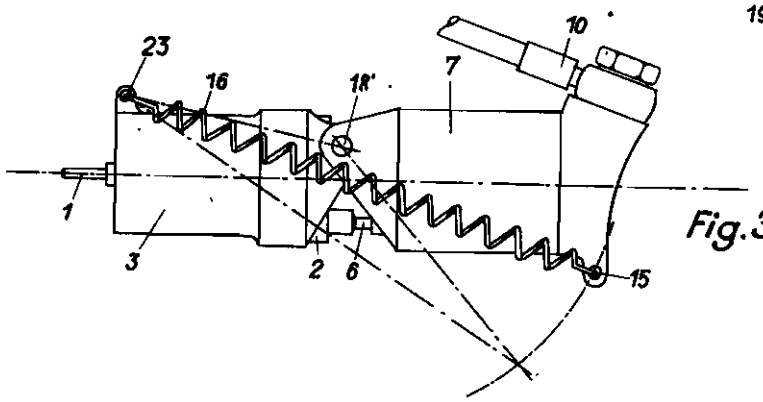

Fig.3

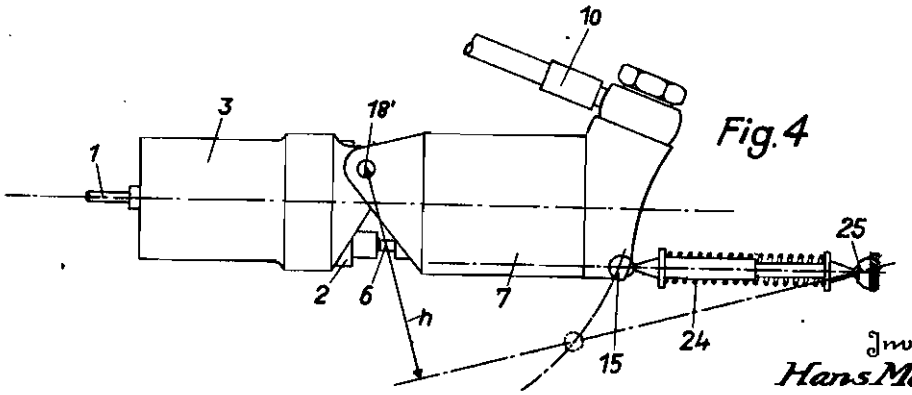

Fig.4

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ALIEN PROPERTY CUSTODIAN

PUMP, MORE PARTICULARLY AN AXIAL PISTON PUMP WITH ADJUSTABLE STROKE

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

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The invention relates to pumps with adjustable stroke in which according to a known arrangement a stroke adjusting pressure control device is provided acting on the stroke adjusting member in opposition to a spring determining the desired pressure. As is known, pumps of this kind operate in such manner that a spring acts on the stroke adjusting member so as to urge it toward its maximal stroke position. This spring is counteracted by a pressure responsive regulating member tending to return the stroke adjusting member to its zero position. Thus, the spring force and the adjusting force balance one another at a certain pressure determined by the spring force. If the pressure decreases on account of increased pressure fluid consumption, the spring force will preponderate and shift the stroke adjusting member until the pump due to the increased pressure fluid amount is again capable of maintaining a pressure equalling the force of the spring. The object of the present invention consists in obtaining a desired characteristic of the predetermined pressure course in dependence on the adjustment of the stroke adjusting member. It may for instance be desirable for certain purposes to maintain constant the predetermined pressure independent of the position of the stroke adjusting member. As however the tension of the spring decreases at increasing spring displacement and increasing displacement of the stroke adjusting member, respectively, this object may not be attained simply by means of a spring per se. The inventive principle consists in the feature that the points of suspension of the spring are so chosen as to vary the effective lever arm of the spring in response to the varying displacement of the stroke adjusting member in such manner that the predetermined pressure course may be chosen according to a curve which is independent of the spring characteristic. If the suspension points of the spring are for instance chosen in such manner that the effective lever arm of the spring increases in proportion to the increasing displacement of the stroke adjusting member and the increasing displacement of the spring, respectively, a constant rocking moment is obtained at all deflection angles of the stroke adjusting member and hence regulation onto a constant pressure value may be effected. The points of application of the spring force may, however, also be chosen in such a way that the effective lever arm of the spring decreases at increasing deflecting angles. In such an arrangement the pump is rendered capable of automatically maintaining a high pressure even at small pressure fluid amounts and a lesser pressure decreasing according to a predetermined characteristic at small pressure fluid amounts. Such a characteristic is for instance desirable in cases where a pressure fluid motor is fed from the pump, said motor being required to produce great force at a small number of revolutions and a lesser force at a great number of revolutions.

An essentially different characteristic of the pressure development is obtained if in further modification of the embodiment of the invention the points of application of the spring force are so chosen that the effective lever arm of the spring, and hence the rocking moment, increases in proportion to the deflecting angle of the stroke adjusting member. In such cases the pump normally operates with maximum stroke volumes. As soon, however, as the pressure in the pressure conduit exceeds the maximum rocking moment, the stroke adjusting member due to this preponderant pressure suddenly returns to the zero position and the pump maintains at a minimal pressure fluid amount a lesser pressure corresponding to the reduced rocking moment. Now as soon as this pressure drops still further the rocking moment will preponderate, immediately returning the stroke adjusting member to its maximal stroke position until the process described repeats itself. Such a pump characteristic is for instance required for retracting gear for undercarriages, in which the undercarriage in the first instance has to be retracted at a high pressure and subsequently after adjustment has to be maintained in the retracted position at lesser pressure. In all arrangements, in which the effective lever arm of the spring increases with increasing deflection angles, it is advantageous with respect to space to produce the rocking moment by means of a compression spring.

In the following the invention is explained in detail with reference to the embodiments shown in the drawings, in which

Fig. 1 shows an embodiment of a spring suspension in which a constant rocking moment is attainable at all deflection angles of the stroke adjusting member,

Fig. 1*a* shows the same arrangement in the zero position at a deflected position of the stroke adjusting member, and

Fig. 2 discloses a mode of spring suspension in which the effective lever arm of the spring is reduced at increasing deflection angles of the stroke adjusting member.

Fig. 3 shows an embodiment, in which the ef-

fective lever arm of the spring increases as the deflection angle increases.

Fig. 4 illustrates an embodiment in which the tension spring of the embodiment in Fig. 3 is replaced by a correspondingly connected compression spring. In all figures the reference characters stand for identical parts.

In the Figs. 1 and 1*a* the numeral 1 denotes a driving shaft of a driving flange 2 supported in a casing 3 by means of ball bearings 4 and 5. Piston rods 6 are articulately connected to the driving flange 2; the respective piston, provided that the axis of the driving flange 2 inclines relative to the cylinder block 6, reciprocate in said cylinder block 8 which is arranged in a carrier 7. The follow-up movement of the cylinder block 8 is advantageously effected in a manner already known, namely by means of piston rods 6 articulately connected to the driving flange 2. Through the piston stroke a certain amount of pressure fluid is pumped from a pressure fluid container (not shown) into a conduit 10 via a bore 9 in a control surface of the cylinder block 6, the amount being dependent of the angle of deflection of the cylinder block carrier relative to the driving flange, and said conduit leading to a consumption apparatus, for instance a pressure fluid motor (not shown). The pressure in the conduit 10 further acts via a conduit 11 on a piston 12 arranged in a cylinder 13. The free end 14 of the piston 12 is developed as a piston rod and articulately connected at 15 to the carrier 7 of the cylinder block 8. A spring 16 is secured at the same point, the other end being fixed on the casing 3 at the point 17. The tension of the spring 16 tends to deflect the cylinder block 8 together with its carrier 7 about the pivot point 18 and is counteracted by a counterpressure acting on the piston 12.

Be it assumed that the cylinder block carrier 7 is deflected by a certain angle for producing a certain predetermined pressure as shown in Fig. 1*a*. This position of the cylinder block carrier corresponds to a certain pressure value in the conduit 10 as well as to a certain rocking moment exerted by the piston 12 via the conduit 11 on the cylinder block carrier 7 and a certain countermoment produced by a spring 16, the force of which is applied below the lever arm h'. In the position shown these two moments balance one another i. e. the consumption apparatus is regulated onto a certain predetermined pressure. If the pressure increases in the conduit 10, the piston 12 tends to reestablish the predetermined in the conduit 10 by adjusting the cylinder block carrier 7 at a reduced angle corresponding to the increased fluid pressure. To this position corresponds a reduced lever arm h' of the spring but an increased spring tension, and therefore the rocking moment of the spring remains constant so that the stroke adjusting member upon the reattainment of the predetermined pressure resumes the illustrated position. Contrary to this the cylinder block carrier at diminishing pressure in the conduit 10, in order to restore the predetermined pressure, tends to assume a more deflected position. In this instance also the rocking moment of the spring 18 remains constant as the lever arm h' increases in length while the spring force decreases. Thus in every position of the cylinder block carrier the spring 18 exerts a constant rocking moment thereon requisite for regulating onto a constant pressure.

Fig. 2 shows a mode of spring suspension according to which the rocking moment exerted by the spring increases as the angle of deflection decreases. In the initial position of zero the lever arm h is operative. In the deflected position (dotted spring) the reduced lever arm h' is operative. This is due to the fact that the spring is not—as shown in Figs. 1 and 1*a*—articulately secured on the casing 3 but at a point 19 outside the casing. A characteristic obtained in this way is desirable, as already mentioned at the beginning, where a pressure fluid motor has to be fed, said motor having to exert great force at a small number of revolutions and inconsiderable force at a large number of revolutions. The pump illustrated is further distinct from those shown in Figs. 1 and 1*a* in that the moment counteracting the spring 16 is not produced by a special piston but by means of the pivot point 18' of the stroke adjusting member being eccentric relative to the axes of the driving flange and of the cylinder block. Furthermore the control surface 20 contrary to that of the above mentioned embodiment is of spherical form while the cylinder block 8 is articulately connected with the driving flange 2 by means of a special centering member 21 supported by means of a spring 22.

An embodiment in which the effective lever arm of the spring and consequently the rocking moment thereof increases at increasing angles of deflection is shown in Fig. 3. Here also the force tending to shift the stroke adjusting member into its zero position is produced by supporting the cylinder block 7 eccentrically at 18'. The spring force 16 is on the one hand applied to the cylinder block carrier 7 at 15 and on the other hand on the casing 3 at 23.

As mentioned above in describing the mode of operation of this kind of pumps, this pump is operative in but two positions, namely at the maximal stroke and at a small set predetermined stroke, while it is inoperative in any other position.

The effect obtained according to Fig. 3 by means of a tension spring 18 may be obtained, as shown in Fig. 4, by using a compression spring 24, said compression spring acting on the one hand on the stroke adjusting member at point 15 and on the other hand resting against a fixed point 25. The operation of such a compression spring will be apparent from above description. The use of such a compression spring offers advantages in so far as it can be easily mounted in the pump casing. As moreover the compression spring can act centrically on the cylinder block carrier, one drawback connected with the use of tension springs is eliminated, namely that two springs must be provided in order to avoid one-sided application, said springs having to be arranged alongside the cylinder block (cfr. Fig. 3).

As already mentioned, the figures merely represent embodiments of the invention. It is of course possible to use the spherical control surface according to Figs. 2–4 in the embodiments according to Figs. 1 and 1*a*. Furthermore the countermoment according to Figs. 1 and 1*a* produced by a special piston may be obtained by excentric support of the stroke adjusting member as shown in Figs. 2–4.

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