April 9, 1968 R. LEDUC ET AL 3,376,822

VARIABLE-DELIVERY HYDRAULIC PUMP

Filed Jan. 4, 1967 2 Sheets-Sheet 1

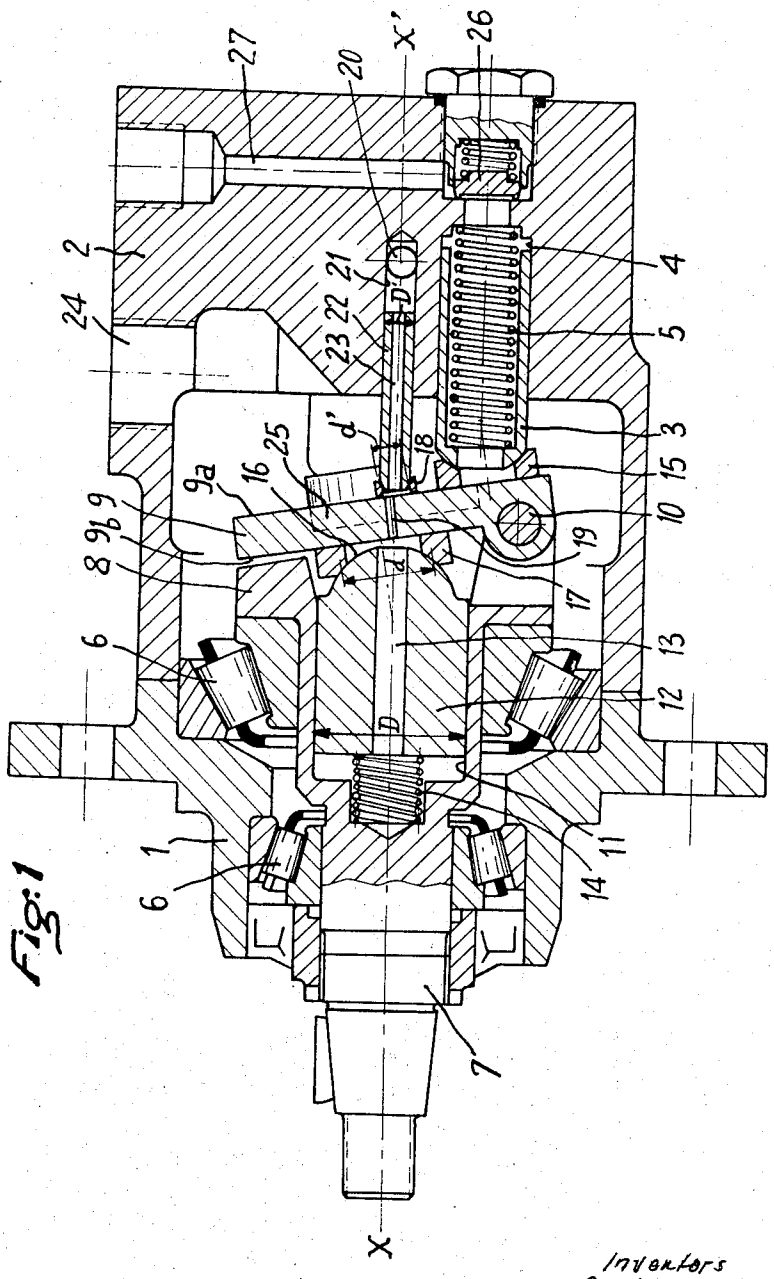

Fig. 1

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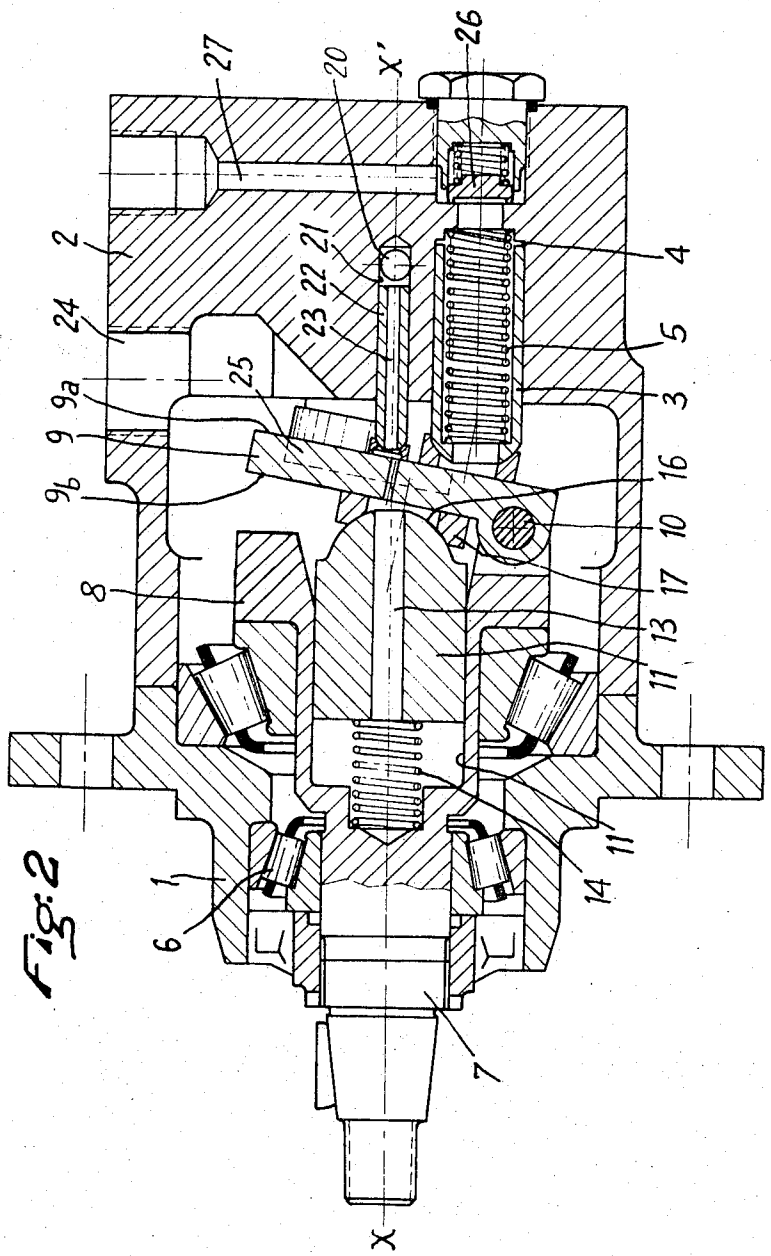

Fig. 2

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VARIABLE-DELIVERY HYDRAULIC PUMP

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3 Claims. (Cl. 103—38)

ABSTRACT OF THE DISCLOSURE

Multi-piston hydraulic pump comprising a plurality of parallel pistons which are given a reciprocating movement of variable amplitude by means of a swash plate pivotally mounted on its support wherein the improvement comprises: a first piston bearing on the rear face of the swash plate and sliding in a cylinder bored in the body of said support; a second piston bearing on the front face of said swash plate and sliding in a cylinder bored in the pump body and communicating with a source of pressure; an axial bore extending through both of the pistons and said piston communication one with the other through a orifice drilled through the swash plate.

It is known to vary the angle of the swash plate of a multi-piston hydraulic pump in order to vary the travel of the said pistons and therefore the delivery of the pump.

Hitherto known devices are complicated so that pumps of this type are generally of a very high prime cost and they are not adequately reliable in operation.

The present invention concerns a pump of this type which is simple and reliable in operation.

The hydraulic pump according to the present invention is a multi-piston swash plate pump wherein the rotation of the said swash plate causes a reciprocating movement of the pistons and wherein the said swash plate is mounted in oscillatory fashion on its support, comprising: a first piston whose head bears on the rear face of the swash plate and which slides in a cylinder formed in the body of the said support of the swash plate coaxially with the driving shaft of the latter; a second piston whose head bears against the front face of the swash plate and which slides in a cylinder formed in the pump body coaxially with the driving shaft of the swash plate, the said cylinder communicating with a source of liquid under pressure, the two pistons being both traversed by an axial bore and communicating with one another through an aperture formed through the swash plate, so that the liquid arriving under pressure in the cylinder of the second piston passes successively through the second piston, the swash plate and the first piston to act on the rear face of the latter in order to vary the inclination of the swash plate.

The present invention also comprises all or part of the following features taken separately or in combination:

(a) The head of the first piston bears on the rear face of the swash plate by means of a stud whose internal diameter is substantially smaller than the diameter of the piston.

(b) The head of the second piston bears on the front face of the swash plate by means of a stud whose internal diameter is slightly less than the diameter of the said piston.

(c) The first piston is of a diameter considerably greater than that of the second piston.

(d) The admission of the liquid under pressure into the cylinder of the second piston can be caused by a regulating valve controlling the variations of the pump delivery.

By way of example and in order to facilitate the understanding of the invention, in the accompanying drawings:

FIGURE 1 shows a first example of embodiment of the pump according to the present invention.

FIGURE 2 shows a second example of embodiment of a pump according to the invention.

Referring now to FIGURE 1, it will be seen that the multi-piston pump comprises a pump body in two parts **1** and **2**. The pistons **3** slide in cylinders **4** constituted by bores formed in the part **2** of the pump casing, and are counter-held by springs **5**. A shaft **7** fast with a member **8** serving as a support for a swash plate **9** is journalled in the other part **1** of the pump body, by means of rolling contact bearings **6**.

The pistons **3** bear in known manner on the front face **9***a* of the swash plate by means of mobile studs **15**.

The swash plate **9** is mounted in oscillatory manner on its support **8** by means of a shaft contained in a plane perpendicular to the axis XX′ of the shaft **7**.

Within the support **8** there is formed a cylinder **11** in which slides a piston **12** through which a bore **13** extends from one side to the other.

The axis of the cylinder **11** and the axis of the bore **13** coincide substantially with the axis XX′.

The head **16** of the piston **12** is spherically rounded and bears against the rear face **9***b* of the swash plate by means of a mobile stud **17**. The head **16** of the piston rests on the stud **17** by means of a sphero-conical annular seat whose mean diameter *d* is substantially smaller than the diameter D of the piston **12**. A spring **14** of weak calibration holds the piston **12** bearing against the stud **17**.

A second piston **22** slides in a bore **21** formed in the part **2** of the pump body, the axis of the bore **21** coinciding substantially with the axis XX′. An axial bore **23** extends right through the piston **22**.

The spherically rounded head of the piston **22** bears on the front face **9***a* of the swash plate by way of a mobile stud **18** on which it rests by means of a spherical or conical annular seat whose mean diameter *d′* is slightly less than the diameter D′ of the piston **22**.

An aperture **19** extends right through the swash plate **9**, being arranged in such a manner that its front end debouches within the mobile stud **18** and its rear end within the mobile stud **17**.

The bore **21** communicates by way of an orifice **20** with a pressure source not shown here.

The pump thus described operates as follows: when the swash plate is in the position illustrated in FIGURE 2 the liquid, coming from the reservoir, arrives by way of the orifice **24** and then, passing by way of the half-moon **25** formed on the face **9***a* of the swash plate **9**, enters the pistons **3** and is delivered through the non-return valves **26** and the outlet ducts **27**.

When pressure liquid arrives from any regulating device, not shown since it does not form part of the invention, by way of the orifice **20**, this liquid under pressure passes through the bore **23**, the aperture **19**, the bore **13** and acts on the rear face of the piston D.

The liquid also acts on the piston **22** but with a very slight force, and this pressure serves only to apply the piston **22** against its stud **18** with sufficient force to ensure sealing-tightness.

Under the influence of the pressure acting on its rear face the piston **12** is displaced towards the right, causing the swash plate **9** to swing about the shaft **10**, which has the result of reducing the inclination of the said swash plate **9** and therefore the travel of the pistons **3** and consequently the delivery of the pump.

In proportion as the piston **12** is displaced towards the right, the inclination of the swash plate is diminished until it becomes nil, the delivery of the pump being reduced until it becomes nil.

Thus the delivery of the pump decreases constantly until it becomes nil and it cannot increase again when the swash plate **9** is inclined in the opposite sense because owing to the arrangement of the half-moon **25** on the face **9***a* of the said swash plate, the admission of the liquid into the pistons **3** would not take place.

FIGURE 1 shows a form of embodiment according to which the delivery of the pump diminishes when the pressure arriving at the orifice **20** increases.

It may be found necessary for the response law to be arranged conversely, the delivery of the pump increasing when the control signal pressure increases. FIGURE 2 represents such a pump.

The pump shown in FIGURE 2 is substantially similar to that shown in FIGURE 1 except for the difference that the inclination of the swash plate is in the inverse sense.

Consequently, in proportion as the pressure arriving through the orifice **20** increases, the inclination of the swash plate and the delivery of the pump increase.

We claim:

1. Multi-piston hydraulic pump comprising a plurality of parallel pistons which are given a reciprocating movement of variable amplitude by means of a swash plate mounted in oscillatory fashion on its support, characterised in that it comprises a first piston whose head bears by means of a mobile stud on the rear face of the swash plate and slides in a cylinder formed in the body of the support of the swash plate, substantially coaxially with the driving shaft of the latter; a second piston whose head bears by means of a mobile stud on the front face of the swash plate and which slides in a cylinder formed in the pump body substantially coaxially with the driving shaft of the swash plate, the said last-named cylinder communicating with a source of liquid under pressure; an axial bore extending through both of the pistons and the said pistons communicating with one another through an orifice formed through the swash plate, in such a manner that the liquid arriving under pressure in the cylinder of the second piston passes successively through this second piston, the swash plate and the first piston to act on the rear face of the latter in order to vary the inclination of the swash plate.

2. Multi-piston hydraulic pump according to claim **1**, characterised in that the first piston is of a diameter which is considerably greater than that of the second piston.

3. Multi-piston hydraulic pump according to claim **1**, characterised in that the liquid under pressure causing modifications of the swash plate angle come from a regulating device which is outside the pump.

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